APPENDIX

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR THE

HANA RANCH COUNTRY CLUB

HANA, MAUI, HAWAII

NOVEMBER 1992

KEOLA HANA MAUI, INC.

APPENDIX

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR THE

HANA RANCH COUNTRY CLUB

HANA, MAUI, HAWAII

NOVEMBER 1992

Prepared For:

Keola Hana Maui, Inc.
P.O. Box 519
Hana, Maui, Hawaii 96713

Prepared By:

Pacific Planning and Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

APPENDICES

The following reports are included in this Appendix to the November Final Environmental Impact Statement for the Hana Ranch Country Club.

Appendix A	EIS Preparation Notice Comments Received From Agencies, Organizations and Individuals & Draft EIS Comments Received From Agencies, Organizations and Individuals
Appendix B	Market Feasibility and Economic Impact Study of the Proposed Hana Ranch County Club at the Hotel Hana Maui Prepared by PKF Hawaii, June 1992
Appendix C	Agricultural Feasibility of Hana Ranch Country Club Lands and Effects of Conversion on Agriculture Prepared by Frank S. Scott, Jr., Agricultural Economist, May 1992
Appendix D	Water Resources and Supply for Proposed Hana Ranch Country Club Prepared by Water Resource Associates, July 1992
Appendix E	Environmental Risk Assessment and Integrated Golf Course Management Plan for the Proposed Golf Course at Hana, Maui Prepared by Environmental & Turf Services, Inc., July 1992
Appendix F	Biological and Water Quality Surveys of Fresh Water and Marine Environments for the Hana Ranch Golf Course Prepared by AECOS, July 1992

APPENDICES (continued)

APPENDIX A

EIS PREPARATION NOTICE COMMENTS RECEIVED FROM AGENCIES, ORGANIZATIONS AND INDIVIDUALS
AND
DRAFT EIS COMMENTS RECEIVED FROM AGENCIES, ORGANIZATIONS AND INDIVIDUALS

EIS Preparation Notice Comments Received From Agencies, Organizations and Individuals

JOHN WAIHEE
GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

ILIMA A. PIIANAIA
DEPUTY TO THE CHAIRPERSON

FAX:

Mailing Address:
P. O Box 22159
Honolulu, Hawaii 95823-2159

March 24, 1992

COPY

TO: Brian J. J. Choy, Director
Office of Environmental Quality

FROM: Yukio Kitagawa, Chairperson
Board of Agriculture

Subject: EIS Preparation Notice Hana Ranch Golf Course
Keola Hana Maui, Inc.

THK: 1-4-02: pors. 4, 7, 8, 10; 1-4-02: 9
1-4-03: pors. 5, 6, 7, 9; 1-4-07: pors. 4, 6
Area: 243 acres

The Department of Agriculture has received and reviewed the subject EIS Preparation Notice and has the following comments.

As stated in our previous reviews associated with this project (letters dated November 20, 1990 and November 29, 1991), the Department's concerns focus on the loss of pasture lands where the golf course will be located and on the potential impacts resulting from the use of herbicides and pesticides to maintain the course. Although the Environmental Assessment included reference to these considerations, we would like to see these concerns addressed in detail in the EIS.

Thank you for the opportunity to comment.

c: Alvin K. U. Chong
Pacific Planning and Engineering

GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

ILIMA A. PIIANAIA
DEPUTY TO THE CHAIRPERSON

FAX: 548-6100

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96823-2159

'91 DEC -4 P5:37

November 29, 1991

TO: Brian Miskae, Director
Planning Department
County of Maui

FROM: Yukio Kitagawa, Director
Board of Agriculture

Subject: Hana Ranch Golf Course
Keola Hana Maui, Inc.
91/EA-003 Environmental Assessment Determination
91/CPA-002, 91/CIZ-021 Plan Amendment and Zoning Change
THK: 1-4-02: pors. 4, 7, 8, 10
1-4-02: 9
1-4-03: pors. 5, 6, 7, 9
1-4-07: pors. 4, 6
Area: 243 acres

The Department of Agriculture has reviewed the subject application and environmental assessment and has the following comments to offer.

Impact of the Golf Course on Agricultural Lands and Resources

In reviewing the January 1991 Environmental Assessment (EA) for the golf course, we note that our comments on the original EA document (see attached letter to Jonathan K. Shimada, dated November 20, 1990) have been addressed. In particular, we note that the 243 acres of pasture lands to be removed from use will be offset by the reclamation of approximately 600 acres of brush-infested lands. Furthermore, regarding the siting of alternative golf course sites, we note that avoidance of "A" and "B" rated lands was a criterion. We note that there are no plans to develop or sell any land for resort/residential use in the vicinity of the proposed golf course.

Impact of Pesticide Use

Regarding the use of pesticides, we offer the following recommendations.

- In an effort to minimize the use of pesticides, the golf course superintendent should implement Best Management

EXHIBIT 13

Practices (BHP) such as flora selection, pest population monitoring, establishing pest threshold levels, and the selection of suitable pesticides.

- Application of pesticides through the golf course's irrigation system (chemigation) should be prohibited, even if specifically permitted by the pesticide's label directions, to minimize the likelihood of drift to nontarget areas such as the adjacent residential area and wetland areas.
- Pesticide applications should be prohibited when wind speeds exceed ten miles per hour (10 mph).
- Pesticide application equipment should be designed to minimize drift to nontarget areas and maximize application efficiency. In addition to being properly calibrated, pesticide application equipment should be equipped with low pressure nozzles, use low application pressures, and utilize shrouds for spray booms.
- To minimize exposure, golfers and other unprotected individuals entering areas where pesticides were applied should be notified. Such notification may be superseded by individual pesticide labels, if a label is more stringent, such as requiring a 24-hour re-entry interval.
- Water features to be built as part of the proposed golf course should be designed to minimize the use and impact of pesticides in adjacent areas. Additional precautions should be exercised when applying pesticides near the developed wetlands to prevent adverse effects to waterbirds attracted to these water features. Applications should be prohibited in areas and conditions likely to result in drift and runoff. Pesticides to be used in the wetland areas should be carefully selected to prevent adverse impact on the flora and fauna, and applications should be prohibited when threatened and/or endangered birds are present.

Should you have any questions, please call me at 973-9551, or my staff at the Planning and Development Office (973-9470) and the Pesticide's Program (973-9401).

Thank you for the opportunity to comment.

Attachment

c: Maui County Planning Department
Planning and Development Office
Pesticide Branch, Plant Industry Division

PACIFIC PLANNING
E N G I N E E R I N G , I N C

March 30, 1992

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
P.O. Box 22159
Honolulu, HI 96823

Dear Mr. Kitagawa:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 24, 1992 (and your previous letters of November 20, 1990 and November 29, 1991), regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letters will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
SEVEN WATERFRONT PLAZA, SUITE 300
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
92:PPE/1239 jt

March 23, 1992

Mr. Alvin K. U. Chong
Pacific Planning & Engineering
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

Re: EISPN for the Proposed Hana Golf Course

We have reviewed the subject EISPN and offer the following comment.

Policy B(3) of the State Housing Functional Plan seeks to ensure that projects which impact housing need provide an adequate amount of affordable housing opportunities to satisfy that need. The EIS should fully address this issue.

Thank you for the opportunity to comment.

Sincerely,

Joseph K. Conant
Executive Director

c: Office of Environmental Quality Control

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Joseph Conant, Executive Director
Housing Finance and Development Corporation
State of Hawaii
7 Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, HI 96813

Dear Mr. Conant:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 23, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

February 28, 1992

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

Subject: Hana Golf Course Project-Preparation of Draft EIS

Our review of the subject project indicates that it will have no impact on the public schools in the area.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga
L. Lindsey

RECEIVED
MAR 0 7 1992

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Charles T. Toguchi, Superintendent
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, HI 96804

Dear Mr Toguchi:

Subject: Hana Golf Course Draft Environmental Impact Statement

Thank you very much for your letter of February 28, 1992 regarding the Hana Ranch Golf Course Environmental Impact Statement.

Your letter noting that there will be no impact on the public schools in the area will be included in the Draft Environmental Impact Statement.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

RECEIVED
APR 02 1992

March 24, 1992

92-080/epo

TO: The Honorable John Waihee
Governor, State of Hawaii

c/o Office of Environmental Quality Control

FROM: John C. Lewin, M.D.
Director of Health

SUBJECT: Environmental Impact Statement (EIS) Preparation Notice for Hana Golf Course, Keola Hana, Maui, Inc.
Hana, Maui

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

We have previously commented on the Environmental Assessment (EA) for this project. Please refer to the letter of November 26, 1991 from Mr. David Nakagawa, Chief Sanitarian, Maui District Health Office, addressed to Mr. Brian Miskae, Director of the Maui County Planning Department (copy enclosed).

We have the following additional comments to make for this preparation notice.

We have no objections to the golf course development on Maui, provided that adequate wastewater treatment and disposal is provided for facilities generating wastewater. This may be achieved either by municipal or packaged aerobic treatment plants and leaching field system and septic tanks for comfort stations along the golf course. At present, the Department supports the reclamation of wastewater effluent on golf courses provided that both health and environmental concerns are met.

For your information, the Department has implemented a policy of requiring proposed golf course developers to address twelve (12) major concerns of the Department (updated from the eight (8) conditions, revised January 1992). These concerns range from hazardous material handling to wastewater effluent irrigation.

Please find enclosed copy of the State of Hawaii Twelve (12) Conditions Applicable To All New Golf Course Development, version 4. Furthermore, the Wastewater Branch is drafting guidelines on wastewater effluent reuse. We would like to see the developer's commitment to these conditions stated in the Draft EIS.

If you should have any questions, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290, or Mr. David Nakagawa of the Maui District Health Office at 243-5255.

Enc.

c: Wastewater Branch
Maui District Health Office

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE

'91 NOV 29 P4:47

November 26, 1991

Mr. Brian Miskae
Director
Department of Planning
County of Maui
200 S. High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

Subject: Hana Ranch Golf Course, Keola Hana Maui, Inc.
Environmental Assessment Determination Plan Amendment and Zoning Change, I.D. No. EA-003, 91/CPA-002, 91/CIZ-021
TMK: 1-4-02: por of 4, 7, 8 & 10; 1-4-02: 09; 1-4-03: por of 5, 6, 7, & 9;
1-4-07: por of 4 & 6

We have completed the review of the subject matter and have the following comments:

1. As there is no existing public wastewater treatment plant in Hana, we concur with the concept of a private wastewater treatment works utilizing a leaching field system to handle the wastewater from the clubhouse and septic tank systems for the comfort stations along the golf course. We especially support the concept of land reclamation and irrigation utilizing the treated effluent.

   Domestic wastewater disposal by means of an on-site system is acceptable provided that the system meets all of the applicable requirements of the Department of Health's Administrative Rules, Chapter 11-62, "Wastewater Systems." However, we are concerned with any non-domestic wastewater generated. Conventional treatment works and individual wastewater systems may not be appropriate for such wastes. Detailed plans for both domestic and

EXHIBIT

non-domestic wastewater must be submitted to and approved by the Department of Health.

2. For development activities involving clearing, grading and excavation of more than five (5) acres of total land area, a storm water NPDES permit application should be submitted to the Director of Health at least 90 days before the date on which construction is to commence.

3. The golf course is located above the UIC line.

   The eight golf course conditions (EGCC) (attached) is applicable to the proposed project but is not mentioned in the Environmental Assessment; however, the workshop meeting conducted on Maui on Wednesday, October 30, 1991, by Keola Hana Ranch, indicated that the development was committed to implementing appropriate monitoring and management plans per the EGCC. This commitment needs to be formally expressed.

   During the aforementioned workshop, the developer indicated a commitment to reuse all vegetative wastes from the golf course for purposes of weed control and supplemental fertilization through the processes of composting and mulching. This commitment needs to be better described and formally expressed.

4. Also, the Department of Health's EGCC is being amended and upon its completion, the amended version will be forwarded to you as soon as possible for your consideration.

Should you have any questions, please call me at 243-5255.

Sincerely,

David H. Nakagawa
DAVID H. NAKAGAWA
Chief Sanitarian

attachment (EGCC)

STATE OF HAWAII
DEPARTMENT OF HEALTH

January, 1992 (Version 4)

TWELVE (12) CONDITIONS APPLICABLE TO ALL NEW GOLF COURSE DEVELOPMENT

The following conditions are recommended for all new golf course development in Hawaii to assure that environmental quality is preserved and enhanced as it relates to human health and the protection of sensitive ecosystems. Additional conditions may be imposed based on site-specific considerations.

1. Baseline groundwater/vadose zone and/or, if appropriate, coastal water quality shall be established. Once the sampling plan has been determined and approved by the State Department of Health, the owner/developer shall establish the baseline groundwater/vadose zone water quality, and, if appropriate, nearshore water quality, and report the findings to the State Department of Health. Analyses shall be done by a laboratory approved by the Department of Health.

2. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A monitoring system tailored to fit site conditions and circumstances. The system shall include, and not be limited to, the use of monitoring wells, lysimeters, and vadose zone monitoring technologies. If monitoring wells are used, the monitoring wells shall generally extend 10 to 15 feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months, or more frequently, if required by the State Department of Health in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list shall include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; and other compounds associated with fertilizers, biocides, or effluent irrigation.

3. If the data from the monitoring system indicate increased levels of a contaminate that poses, or may pose, a threat to public health and the environment, the State Department of Health shall require the owner to take immediate action to stop the source of contamination. Subsequently, the owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal for the clubhouse and other facilities by connecting to the public sewer system or by means of a treatment individual wastewater system approved by the Department of Health in conformance with Administrative Rules, Title 11, Chapter 62, Wastewater Treatment Systems. The use of wastewater for irrigation will be generally encouraged, with appropriate controls (see Condition 5).

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer, and all subsequent owners, shall develop and adhere to a Wastewater Reuse Plan which shall incorporate the provisions of the Department of Health's Guidelines for the Use of Reclaimed Water which includes:

   a. An Irrigation Plan encompassing buffer distances, pipe and appurtenance placement, and labeling.

   b. An Engineering Report encompassing treatment options and treatment levels.

   c. Hydro-geologic and hydrologic surveys to determine application rates, sizing and storage needs.

   d. A monitoring plan.

   e. A management plan.

   f. Public and employee education plans.

6. Underground storage tanks (USTs) used to store petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators that pose potential risk to groundwater shall be discouraged. Use of electric golf carts and above-ground storage tanks for emergency power generators shall be encouraged.

   Should the owner/developer/operator plan to install USTs that contain petroleum or other regulated substances, the owner/developer/operator must comply with the federal UST technical and financial responsibility requirements setforth in Title 40 of the Code of Federal Regulations Part 280. These federal rules require, among other things, owners and operators of USTs to meet specific requirements in release detection and response, and subsequent corrective action. Also, the owner/developer/operator must comply with all State UST rules and regulations pursuant to the Hawaii Revised Statutes, Chapter 342-L, Underground Storage Tanks.

7. Buildings designed to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be reviewed by the State Department of Health prior to implementation.

9. Every effort shall be made to minimize the amount of noise from golf course maintenance activities. Essential maintenance activities (e.g., mowing of greens and fairways) shall be conducted at times that do not disturb nearby residents.

10. Solid waste shall be managed in a manner that does not create a nuisance. Whenever possible, composting of green wastes for subsequent use as a soil conditioner or mulching material is encouraged. The composting and reuse should be confined to the golf course property to eliminate the necessity for offsite transport of the raw or processed material. In addition, during construction, the developer should utilize locally-produced compost and soil amendments whenever available.

11. Fugitive dust shall be controlled during construction in accordance with Hawaii Administrative Rules, Title 11, Chapter 60, Air Pollution Control. Pesticides and other agricultural chemicals should be applied in a manner that precludes the offsite drift of spray material. The State Department of Agriculture should be consulted in this regard.

12. To avoid soil runoff during construction, the developer should consult with the U.S. Department of Agriculture, Soil Conservation Service to assure that best management practices are utilized. If the total project area is five (5) acres or more and the development activities include clearing, grading, and excavation, a National Pollutant Discharge Elimination System (NPDES) stormwater permit application shall be submitted to the Department of Health in accordance with the Federal Clean Water Act requirements.

If there are any questions regarding the twelve (12) conditions mentioned here, please contact the Environmental Planning Office at 586-4337. We appreciate your cooperation in preserving and protecting environmental quality in Hawaii.

PACIFIC PLANNING
ENGINEERING, INC

April 3, 1992

Mr. John C. Lewin, M.D.
Director of Health
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801

Dear Dr. Lewin:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 24 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HUMAN SERVICES
Planning Office
P.O. Box 339
Honolulu, Hawaii 96809

WINONA E. RUBIN
DIRECTOR
LYNN H. FALLIN
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR

March 17, 1992

Mr. Brian Choy
Director
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: EISPN Hana Maui Golf Course, Hana, Maui, Keola Hana Maui, Inc., Portions of TMK: 01-04-02, 01-04-03, 01-04-07.

We have reviewed the Maui Planning Commission's Environmental Assessment (EA) Report on the subject project, and comments from various agencies on the EA. We request that the Draft EIS discuss potential impacts upon employment and housing. In particular, the DEIS should discuss:

- Number and Types of Jobs Created
  - Estimated Number of Area Residents Hired
  - Estimated Number of In-Migrants Hired
- Anticipated Wages/Salaries
- Number of Available Affordable Housing Units
  - Fee/Leasehold
  - Rentals
- Number of Affordable Housing Units Required by In-migrants
  - Fee/Leasehold
  - Rentals
- Impacts upon price of existing housing units
  - Fee/Leasehold
  - Rentals

We are concerned that the economically vulnerable may be threatened with homelessness if housing costs rise significantly and an adequate number of

affordable units is not available. Further, once homeless they may require increased support from public income maintenance and social services.

If there are any questions regarding this matter, please contact Kim Kadooka, Planner, in our Planning Office, at 586-5114.

Sincerely,

Winona E. Rubin
Winona E. Rubin
Director

cc: Pacific Planning & Engineering, Inc.
Homeless Program
HHA
FASDA
MBA

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Ms. Winona Rubin, Director
Department of Human Services
State of Hawaii
P.O. Box 339
Honolulu, Hawaii 96809

Dear Ms. Rubin:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 17, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

John P. Keppeler, II
Dona L. Hanaike

REF:OCEA:SKK

MAR 30 1992

FILE NO.: 92-537
DOC. ID.: 429

Mr. Alvin K. U. Chong, Associate
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

SUBJECT: Hana Golf Course Environmental Impact Statement Preparation Notice, Maui, Hawaii

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Brief Description:

The project involves the development of a golf course and clubhouse on lands used for cattle ranching and pasture for the past 25 years.

Division of Aquatic Resources Comments:

Two intermittent streams, Haneoo and Hoomoonui, pass through the project area. The lower reaches are normally dry. A reconnaissance survey by a DAR biologist in 1991 found no native aquatic organisms in the gulches within the project area. The highest reaches that could be accessed by foot (660 feet in Haneoo and 750 feet in Hoomoonui) contained standing pools but no aquatic organisms. It appeared in the fall of 1991 that the higher reaches of these streams might be capable of supporting native aquatic species, but there was no confirmation of this possibility. A recent helicopter overflight by our Maui aquatic biologist found that the upper reaches of these streams were completely dry as a result of the serious drought conditions in the area.

Properly managed, the proposed project should have no effect on the available stream habitats. Use of construction equipment in the gulch bottoms should be avoided. The gulches should not be used as disposal areas for waste construction materials, used oil, toxins, or any other materials. Measures should be taken to prevent sediment runoff and erosion both before and after construction. Golf course maintenance activities should minimize use of herbicides, pesticides, and fertilizers, which will inevitably enter both stream and near shore marine environments if used in excess.

Historic Preservation Division Concerns:

Based on our previous review of this project, the Environmental Impact Statement should include the following: 1) identification of significant historic sites within the project area; 2) assessment of the effects of the proposed golf course on these sites; and 3) proposed mitigation measures. The final report on the archaeological inventory survey, including the results from the subsurface testing and additional sites that were recorded since the initial survey was conducted, should also be appended to the EIS document.

Division of Water Resource Management Comments:

The EIS should address irrigation demands and sources of water supply. Stream or ground water source developments will require permits from the Commission on Water Resource Management. Construction within streams or gulches would also require permits.

Office of Conservation and Environmental Affairs Comments:

We hope to comment on the upcoming draft Environmental Impact Statement.

Also, our Department's Division of Land Management recommends the following measures:

- kamaaina rates should be further defined as current municipal fee rates;
- local residents should be residents of the State;
- playing time should be not less than 50% play during weekend or weekday at current municipal green fees;
- also, there is adjoining state land through which access should be maintained via the golf course at no cost to the State.

Thank you for your cooperation in this matter. Please feel free to call Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

WILLIAM W. PATY

PACIFIC PLANNING

& ENGINEERING, INC

April 3, 1992

Mr. William W. Paty, Director
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Paty:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 30 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526 9748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

ESTHER UEDA
EXECUTIVE OFFICER

February 27, 1992

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

Subject: Environmental Impact Statement Preparation Notice for Hana Golf Course Project

We have reviewed the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Hana Golf Course transmitted by your letter dated February 21, 1992 and confirm that the project site as identified in Exhibit 1, is located in the State Land Use Agricultural District.

We suggest that the project site be represented on a reproduction of an official State Land Use District Boundary Map and also on tax maps as listed on page 4 of the EISPN.

Additionally, we suggest that the project site be represented on a reproduction of the Land Study Bureau's Detailed Land Classification map for the area.

We have no further comments at this time. We thank you for the opportunity to comment on this matter. If you should have any questions, please call me or Leo Asuncion of my staff at 587-3825.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

cc: OEQC
DBED

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Ms. Esther Ueda, Executive Officer
Land Use Commission
Department of Business, Economic Devleopment and Tourism
State of Hawaii
Room 104, Old Federal Building
335 Merchant Street
Honolulu, HI 96813

Dear Ms. Ueda:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of February 27, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

RECEIVED

(P)1276.2

APR 3 1992

Office of Environmental
Quality Control
Central Pacific Plaza
220 South King Street, 4th Floor
Honolulu, Hawaii

Gentlemen:

Subject: Hana Golf Course
Hana, Maui
EIS Preparation Notice

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

RY:jk
cc: ✓Pacific Planning and Engineering, Inc.

PACIFIC PLANNING
& ENGINEERING, INC

April 10, 1992

Mr. Teuane Tominaga
Public Works Engineer
Department of Accounting and General Services
Division of Public Works
State of Hawaii
1151 Punchbowl Street, Room 430
Honolulu, HI 96813

Dear Mr. Tominaga :

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of April 3, 1992 regarding the Hana Golf Course Environmental Impact Statement Preparation Notice.

Although you did not have any comments, your letter will be included in the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Associate

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
LAND USE AND CODES ADMINISTRATION
250 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

RECEIVED
MAR 12 1992

March 9, 1992

Alvin K. U. Chong, Associate
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

Re: Draft Environmental Impact Statement for the Proposed Hana Golf Course at Hana, Maui, TMK:1-4-02:Portion of 4, 7, 8, 9, 10; 1-4-03:Portion of 5, 6, 7, 9; 1-4-07:Portion of 4 & 6

In response to your February 21, 1992 request, we have no additional comments to the Draft Environmental Impact Statement.

If you have any questions, please contact the Land Use and Codes Administration at 243-7373.

Very truly yours,

George N. Kaya

GEORGE N. KAYA
Director of Public Works

AS/mt

cc: Office of Environmental Quality Control
Maui County Planning Dept.

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Mr. George N. Kaya, Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, HI 96793

Dear Mr. Kaya:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 9, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO
HWY-PS
2.1146

MAR 16 1992

RECEIVED
MAR 19 1992

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

Hana Golf Course Environmental Impact Statement

Thank you for your letter of February 21, 1992, requesting our comment on the subject project.

Our attached comments (HWY-PS 2.9762, dated November 14, 1991) to the Maui County Planning Department are still valid and applicable.

Sincerely,

For Rex D. Johnson
Director of Transportation

Enclosure

NOV 14 1991

HWY-PS
2.9762

Mr. Brian Miskae
Director
Planning Department
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

Environmental Assessment 91/EA-003; Community Plan Amendment 91/CPA-002; Zoning Change 91/CIZ-021; Hana Ranch Golf Course (Keola Hana Maui, Inc.), Hana, Maui, TMK: 1-4-02; 1-4-03; 1-4-07

Thank you for your transmittal of September 18, 1991, requesting our review of the referenced project.

The developer should implement the recommendations of its traffic consultant to improve the intersection of Hana Highway and Haneoo Road/Project Access Road.

Very truly yours,

Edward Y. Hirata
Director of Transportation

RI:gm

c: HWY-M, -PS

7

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Rex D. Johnson, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813

Dear Mr. Johnson:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 18, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

March 16, 1992

RECEIVED

Planning Division

Mr. Brian J. J. Choy, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Mr. Choy:

We have reviewed the Environmental Impact Statement Preparation Notice for the proposed Hana Golf Course, Hana, Maui. The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. Any discharge of fill material into Haneoo, Hoomoonui, or Hoomooiki Gulches for fairways, crossings, drainage structures, etc., will require a DA permit.

b. According to the Federal Emergency Management Agency's Flood Insurance Rate Map, Panel 150003-0320-B, dated June 1, 1981 (copy enclosed), the project site is located in Zone C (areas of minimal flooding).

Sincerely,

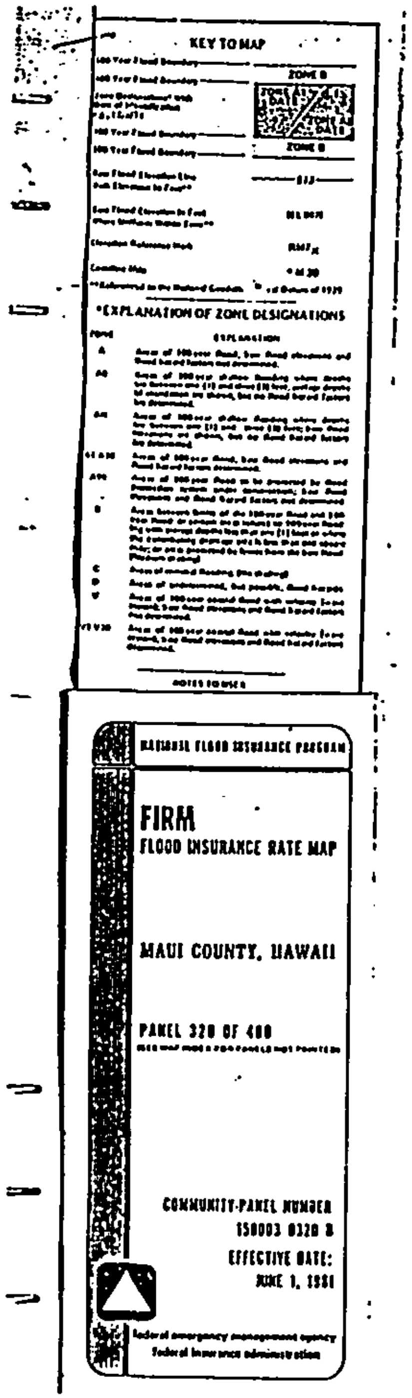
C. Fuji

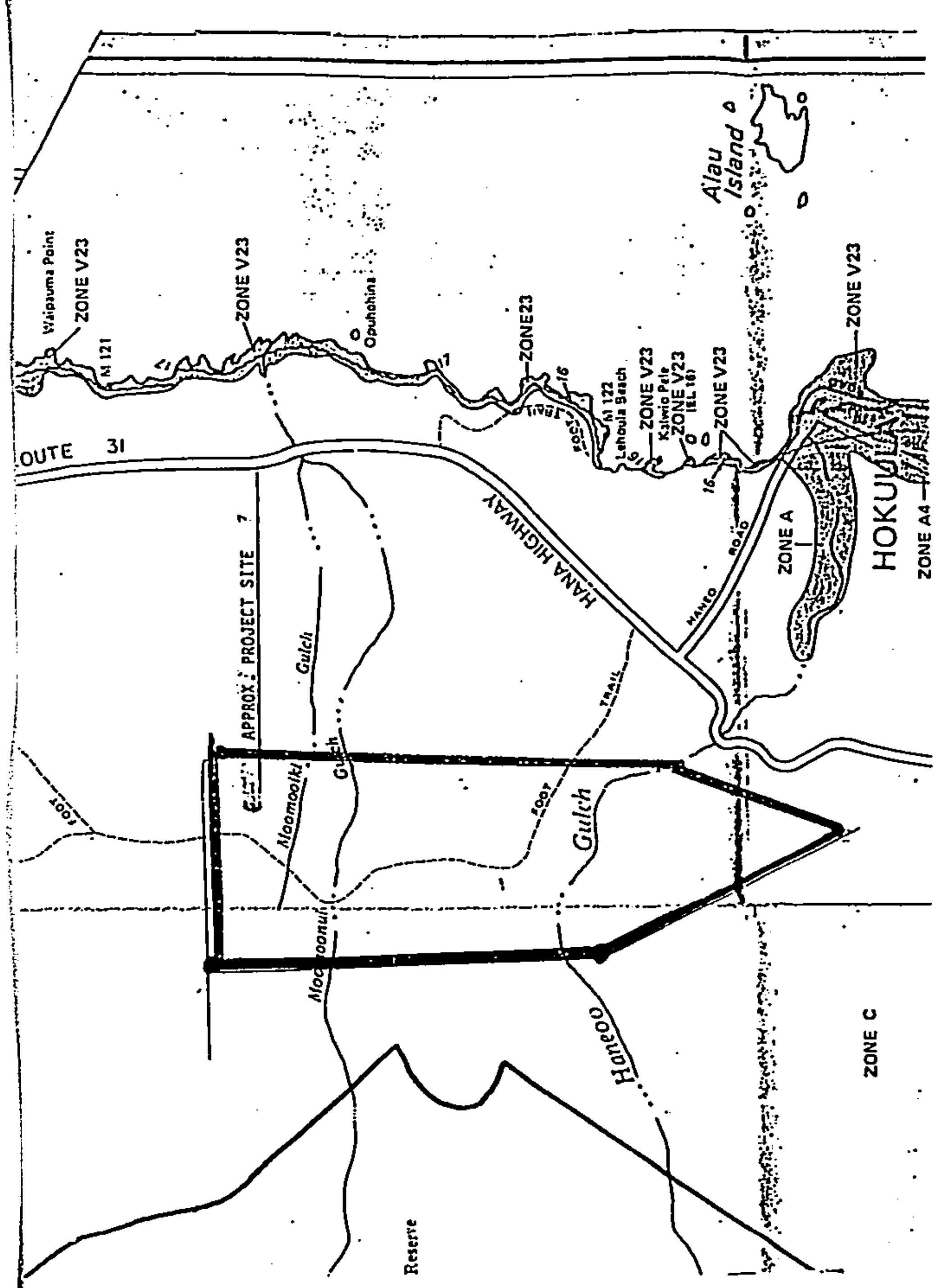
Kisuk Cheung, P.E.
Director of Engineering

Enclosure

Copy Furnished:

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814





PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Mr. Kisuk Cheung
Planning Division
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter HI 96858-5440

Dear Mr. Cheung:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 16, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. BOX 50004
HONOLULU, HAWAII
96850

March 12, 1992

Mr. Brian J.J. Choy, Director
Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

RECEIVED
MAR 14 1992

Dear Mr. Choy:

Subject: Environmental Impact Statement Preparation Notice (EISPN)-
Hana Golf Course, Hana, Maui, Hawaii

We have reviewed the EISPN for the Hana Golf Course and would like to offer the following comments:

We support the concerns expressed by Maui County's Department of Water in comments made for the Environmental Assessment. Because the golf course is to be located above critical groundwater resources, we believe that the golf course operations should be concerned with its potential to adversely effect the aquifer. We would like to recommend that the operation follow approved nutrient and pesticide management plans. These plans should reflect the careful management of the fertilizers and pesticides to be used.

We support the Hawaii Department of Agriculture's recommendations concerning pesticide use in comments made for the Environmental Assessment. We believe that department's concerns would be addressed if the proposed golf course would be required to follow an approved pesticide management plan. In addition, we would like to recommend that plants selected for golf course landscaping be naturalized or native plants. This will hopefully reduce the pesticide requirements and make the project blend more closely into the surrounding area.

We support Maui County's Department of Public Works request for a detailed drainage and erosion control plan as stated in comments submitted for the Environmental Assessment. We agree that this plan should address any potential for adverse effects due to runoff and/or sedimentation on any adjacent and downstream properties. However, we believe that this plan should be expanded to specifically address the total nonpoint source pollution issues this project would present. We would like to suggest that the erosion control plan name specific erosion prevention measures to be used with a schedule for application. We would also like to suggest that, to the maximum extent possible, sediment should be required to be retained on site. In addition, we support the requirement for nutrient and pesticide management plans that would outline methods to reduce the effects of nutrient and pesticide runoff on the surrounding surface waters and reduce the probability of nutrients and pesticides leaching into the underlying ground water.

Thank you for the opportunity to comment on this document. We are interested in commenting on the Draft EIS when it become available.

Sincerely,

Warren M. Lee

WARREN M. LEE
State Conservationist

cc:
Mr. Alvin K.U. Chong, Pacific Planning & Engineering, Inc.,
1221 Kapiolani Boulevard, Suite 740, Honolulu, Hawaii 96814

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Warren M. Lee, State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, HI 96850

Dear Mr. Lee:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 12, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I (we) wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

Name: Hawai'i Audubon Society, Attention: David Hill

Address: 212 Merchant Street, Honolulu, 96813

Thank you.

Copy: Office of Environmental Quality Control
220 South King Street, Honolulu 96813

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. David Hill
Hawaii Audubon Society
212 Merchant Street
Honolulu, HI 96813

Dear Mr. Hill:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

The Hawai'i — Lā'ieikawai Association, Inc.
P.O. Box 720, Ka'a'awa, Hawai'i 96730 · Phone (808) 237-7015

March 30, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.
1221 Kapi'olani Blvd.
Honolulu, Hawai'i 96814

Re: Consulted party, Hana Ranch Golf Course EIS

Dear Mr. Shimada:

We wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Fianl EIS for this project to:

Dr. Jim Anthony, Executive Director
Hawai'i- La'ieikawai Association
P.O. Box 720
Ka'a'awa, Hawai'i 96730

Thank you.

Sincerely

Jim Anthony, Ph.D.

copy: Office of Environmental Quality Control
220 South King Street, Honolulu 96813

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Dr. Jim Anthony, Executive Director
Hawaii-Laieikawai Association
P. O. Box 720
Kaaawa, HI 96730

Dear Dr. Anthony:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 30, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

HANA COMMUNITY ASSOCIATION

March 20, 1992

RECEIVED
MAR 23 1992

Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793

Attention: Brian Miskae

Pursuant to publication of EIS Preparation Notice on the Hana Ranch Golf Course in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Association wishes to be considered as a consulted party and offers the following concerns to be addressed:

1. Will the golf course provide financial stability to the Hotel Hana-Maui?

2. Is the proposed 'golfer' target market a market that the Hotel Hana-Maui can be competitive in since many other golf resorts are located on Maui in places where the weather conditions are much more stable and conducive to playing and where there are other activities for family members who may not want to play golf.

3. If the golf course fails to provide the financial stability necessary to sustain the Hotel Hana-Maui, will Keola or a subsequent owner use this to justify further development?

4. Since the Hotel Hana-Maui is currently financially unstable, have the following items been taken into consideration?

   a. Is the recently developed 'cottage industry' of vacation rental homes a factor in the declining occupancy of the Hotel Hana-Maui.

   b. Is the current management by Sheraton and their target market the best market for Hotel Hana-Maui.

5. Does Hana have enough employment resources available to serve the Hotel, the golf course, and other amenities?

6. If the golf course operation requires an influx of employees, is there adequate housing available to handle such an influx?

7. Will an influx of new residents and the increased demand for rental housing cause a rise in rent values thereby displacing residents who can not afford higher rents or making the rent values too high for people to pay?

8. How will a possible influx of new residents affect the current infrastructure of the community. i.e. schools, parks, beaches, medical and police facilities, etc.

9. Will the golf course development cause land values to escalate and therefore taxes to rise?

10. The ownership of the land currently proposed to be used for the golf course is in dispute. The ownership must be settled prior to development or approvals for development.

11. The current site of the golf course includes possible State of Hawaii ceded lands. These lands must be identified and appropriate State agencies notified and questioned regarding the affects of this type of use on these lands.

12. Will the run off from the golf course affect the waters along the shoreline?

13. Will the intensified use of pesticides and herbicides affect the coastal waters?

14. The areas along the shoreline are critical to the local residents who use the area for fishing and gathering of edible substances to supplement their families food needs as well as to perform native cultural activities. Will intensified uses of pesticides, herbicides, and fertilizers affect these waters thereby affecting these activities.

15. Will the golf course and the maintenance practices necessary to sustain it, such as the use of pesticides, herbicides and fertilizers, affect the aquifer and/or ground water in the area?

16. A thorough study of the proposed site must be done to identify significant archaeological sites.

17. How will the current infrastructure of the community be affected by this development and the increased tourist activity that it will bring?

18. What would be the social affects caused by the sale of memberships to foreign nationals upon a community that has had limited exposure to foreign national tourism?

19. What would be the impacts on the Hana airport facilities, which is currently serviced by only Aloha Island Air, when substantial freight increase occurs due to the transport of golf club bags.

Founded and incorporated in 1953 as a tax-exempt non-profit organization to develop and maintain a unified community spirit amongst the people of Hana
POST OFFICE BOX 202, HANA, MAUI, HAWAII 96713

These represent some of the most critical concerns brought to the attention of the Association by the community.

We look forward to receiving the draft Environmental Impact Statement.

Sincerely,

Dawn Lono, Chair
on behalf of the Board of Directors

Tony Pu, Vice Chair
Haunani Collins, Co-Secretary
Laureen Tanaka-Sanders, Co-Secretary
Annie Rahl, Treasurer
Robert Carroll
Kalani English
Robert Vogele
John Blumer Buell

cc: Keola Hana-Maui, Inc., Liebert Landgraf
Pacific Planning & Engineering, Inc., Jonathon Shimada
Office of Environmental Quality Control, Brian J.J. Choy

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Ms. Dawn Lono, Chairperson
Hana Community Association
Post Office Box 202
Hana, HI 96713

Dear Ms. Lono:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 20, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

08 March 1992.

Brian J.J. Choy
Director
Office of Environmental Quality Control
220 South King Street
Central Pacific Plaza, Fourth Floor
Honolulu, Hawaii 96813

SUBJECT: Notice of the Requests of a Consulted Party

Dear Mr. Choy;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee filed Requests to be a Consulted Party and concurrently submitted its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana to:

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793 as the Accepting Authority

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713 as the Applicant

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814 as the Consultant

Enclosed with this letter is the submission of the Hana Community Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc..

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

cc: Keola Hana Maui, Inc.
Maui Planning Commission
Pacific Planning & Engineering, Inc.
Negotiations Committee

08 March 1992.

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

SUBJECT: Request to be a Consulted Party

Dear Jonathan;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

Accepting Authority: Maui Planning Commission
Applicant: Keola Hana Maui, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

RECEIVED
MAR 10 1992

COMMENTS OFFERED

by the

Hana Community

Negotiations Committee

as a

Consulted Party

Submitted March 08, 1992.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

Prefacing Comments

This submittal of Comments Offered by the Hana Community Negotiations Committee is provided pursuant to publication of the EIS Preparation Notice on the Hana Ranch Golf Course as was published in the OEQC Bulletin, Volume IX, No.3, dated February 8, 1992.

This submittal of Comments Offered by the Hana Community Negotiations Committee is sequenced as follows:

Any questions or comments regarding this submittal and the contents contained within should be directed to:

Bill Fuhrmann
Community Negotiator and
Chair of the Hana Negotiations Committee
Post Office Box 183
Hana, Maui, Hawaii 96713

Telephone: 248-8345 (Office)
248-8300 (Home)

Section "A"

BACKGROUND

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

==

BACKGROUND

The residents of Hana, at a community meeting scheduled by the Hana Community Association who provided via a community wide mailout notice to all residents of the Hana District, decided to engage in contructive, good faith dialogue with representatives of Keola Hana Maui, Inc. regarding Keola's proposed development of a golf course in Hana. On February 20, 1991, the residents of Hana decided the following:

WHY NEGOTIATIONS ??

"to let Hana's people, with Hana's sensitivities, solve Hana's problems, with Hana type solutions"

conditioned upon:

(1) the residents of Hana would select their representatives, which they did:

REPRESENTING the Sensitivites of Hana: these Residents of Hana as members of the Negotiations Committee:

Bill Fuhrmann-Community Negotiator & Chair of the Negotiations Committee

Joe Ahuna II-Agricultural Concerns

Harry Hasegawa-Business Concerns

John Hanchett Sr.-Property Owners Concerns

Henry Kahula Sr.-Lifetime Hana Residents' Concerns

Bob Getzen-Recent Hana Residents' Concerns

Randy Medeiros Jr., Tau'a Pahukoa, & Anela Lind-Hana Student Residents' Concerns

Bruce Lind, Joseph Kaina & Bennett Medeiros-Current Lifestyle Concerns

Geraldine Carroll-Cultural & Archeological Preservation Concerns

Bob Bradley-Environmental & Ecological Concerns

Terry Lee Poaipuni & Bob Casey-Other Concerns

Roland Torres-Keola(non-union) Employees' Concerns

Sharol Nani Smith-Keola(unionized) Employees' Concerns

John Blumer-Buell & Mike Minn-Hana Community Association's Concerns

BACKGROUND (continued)

and conditioned upon:

(2) That all terms and conditions of settlement be presented to the residents of Hana, who will, by secret ballot majority vote, determine their decision on having a golf course in Hana.

The Hana Community Association has commited to engage in implementation of this "ratification" process.

As of yet, no terms and conditions of settlement have been framed in the negotiations between the Negotiations Committee and representatives of Keola Hana Maui, Inc..

In order for the Negotiations Committee to have a clear focus on the issues and concerns regarding the proposed golf course project, the following question was framed as the:

QUESTION IN NEGOTIATIONS:

"Will Keola Hana Maui's proposed golf course fulfill its(KHM's) financial objectives WHILE the residents of the Hana District are able to retain the balance and the harmony of the community's lifestyle, cultural and social qualities, and rural and environmental qualities ?"

A complex question when simplified means:

"Will the golf course help Keola, and if it does, will Hana be the Hana the residents of Hana want Hana to be ?"

This Question identifies: Hana's problems

Keola needs to be financially sound and operationally profitable;
Residents of Hana who are employees of Keola need stabilized employment with sufficient income to support themselves and their families;
The community of Hana needs to have the major economic entity within the community stabilized and operationally viable.

This Question defines: Hana Type Solutions

:: Hana's solutions must retain the essence of Hana:
the community's lifestyle;
the community's cultural and social qualities;
the community's rural and environmental qualities.
Hana's solutions must be acceptable to all residents of Hana.

Essentially, the negotiations process is simply:

"to let Hana's people, with Hana's sensitivities, solve Hana's problems, with Hana type solutions"

Nothing more; nothing less.

Section "B"

COMMENTS OFFERED

BY THE

HANA COMMUNITY

NEGOTIATIONS COMMITTEE

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

The Comments offered by the Hana Community Negotiations Committee are contained within this report and are sequenced as follows:

SECTION I

Comments offered

by the

Hana Community

Negotiations Committee

on

Economic Issues and Concerns

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

==

General Comments to Economic Issues:

The major deterrent to progressing through the discussions necessary to find resolution of the community's concerns regarding the proposed golf course development has been the ambiquities of the evidence provided on Economic Issues.

While there is little dispute that the economic viability of Keola Hana Maui, Inc., as the major employer and provider of income for the residents of Hana, is essential to the community's economic well-being, no evidence has been presented, by the Environmental Assessment or during the course of negotiations, which would allow for analysis and examination of factors relevant to the decline in the hotel's occupancy performance. The residents of Hana, through the Negotiations Committee, need opportunity to examine these factors. The residents of Hana, through the Negotiations Committee, need assurances that Keola has taken as much remedial action as possible to cure the problems affecting the occupancy performance of the hotel. While it can be credibly argued that certain factors, such as the current recession and the effects of the Gulf War, are beyond the remedial ability of Keola, similarly the ability of the hotel's occupancy performance would have to be analyzed without consideration of these factors. The analysis of the hotel's ability to attract guests should only be measured in terms of the factors within the control of the owners and the management of Hotel Hana Maui.

The development of a golf course, a stand alone golf course without surrounding and/or complementary development, is a "big ticket" item. While it is Keola's financial ability that will allow for the development of this "big ticket" item, it is the residents of Hana, current and future, who will be paying for this development. Accordingly, the effects and impacts over the long term retirement of this purchase requires full and complete analysis and discussion.

Based on this question: "Will the golf course project be the economic salvation for Keola and this community or will the golf course project place primarily this community and secondarily Keola in economic jeopardy ?", the Comments offered by the Hana Negotiations Committee in this section are the primary concerns which need full and complete analysis and discussion, prior to examination of the social, cultural, and environmental effects and impacts of the proposed project.

General Comments to Economic Issues (continued):

Of noteworthy clarification, the Negotiations Committee, in its discussions, on and off the record, with representatives of Keola Hana Maui, Inc., has not indicated its doubts of Keola's desire to be a long term partner in the economic future of Hana. The Negotiations Committee has made Keola's representatives aware that while Keola has the viable option to leave Hana, most of the residents of Hana, with roots imbedded by generations of ancestral tenancy, do not have such an option. Both, the Negotiations Committee and Keola's representatives, do not want to be parties to (a) cause dislocation of Hana's residents; or, (b) cause displacement of Hana's heritage; or, (c) cause devaluation of the lifestyle, traditions, cultural and social values of Hana's people.

The Negotiations Committee proposes that the sequence for assessing the Economic Issues be as follows:

(a) Determining and the assessing the factors which have been influential in the declining occupancy performance of the hotel.

(b) Determining and assessing the remedial actions which can be undertaken to address the influence of these factors.

(c) Determining and assessing the remedial options then necessary to improve the occupancy performance of the hotel.

(d) Subsequent the determinations, assessments, and analysises of the remedial options which may be necessary, a full and complete assessment of the proposed action to develop a golf course should be presented. Such assessment should focus on the economic benefits and the economic risks to Keola as well as to the community.

The Negotiations Committee believes this sequence of assessing the Economic Issues will help to determine the validity of the justification for the proposed golf course.

The next step, assuming valid economic justification has been established for the proposed golf course, is to analyze and discuss the effects and impacts, immediate and long-term, of the golf course project on the economic well-being and economic future of both Keola and the community.

The Comments offered by the Hana Community Negotiations Committee on Economic Issues and Concerns are being offered in the context of these General Comments on Economic Issues.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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Issue: Credible and Complete Justification for project

A critical examination and discussion of the factors which have contributed to the decline of the hotel occupancy performance needs to be provided.

The examination conducted by the Negotiations Committee of Environmental Assessment indicates that such notable factors as

(a) the effects of changes in ownership over the last ten years;
(b) the effects of the renovations and build-out of the hotel complex;
(c) the effects of changes of management;
(d) the effects of changes of market orientation;
(e) the effects of escalated room rates;
(f) the effects of community's relationship with the hotel's guests;
(g) the effects of the changes within the workforce from a pre-dominant local Hawaiian employee complement to a more visible less local Hawaiian employee complement;
(h) the effects of the considerable changes within the supervisory ranks on the morale and effectiveness of the rank and file employees;
(i) the effects of the limited employment resources within the community; and,
(j) the effects of shortfall of infrastructure within the hotel;

were never identified or discussed. Without a full and complete examination of these and other factors, the effects and cumulative impacts of these factors upon the occupancy performance of the hotel, and proposed remedial actions to address these factors, the Environmental Impact Statement will similarly fail to offer credible and complete justification for the proposed development of the golf course.

The Negotiations Committee has previously expressed its concern that the precedent two owners of Hotel Hana-Maui have justified their needs for their additional development with claims of improving the hotel's occupancy perfórmance and their companys' economic viabilities. As Keola Hana Maui is the third owner within the last ten years to iterate such claims, the community, through the Negotiations Committee, seeks a more thorough examination of these claims.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: Alternative Remedies

A critical examination and discussion of alternative remedies to cure the hotel's occupancy shortfall needs to be provided.

The Negotiations Committee and the residents of the Hana community must be able to discern whether the proposed golf course when compared with other alternatives is the best of the remedies offered to cure the hotel's occupancy shortfall.

ISSUE: Hotel Hana Maui's capability to compete

A critical examination and discussion of Hotel Hana Maui's capability to compete with the other luxury resort properties needs to be provided.

The Negotiations Committee needs to be able to analyze the capability of Hotel Hana Maui to compete with the other luxury resort properties, especially if the singular element to be competitive is the development of the proposed golf course. If other elements are necessary to be considered in Hotel Hana Maui's desire to be at a competitive level with the other resort properties, such elements should be identified, examined, and analyzed as well.

ISSUE: Attainability of Objective

A critical examination and analysis of the golf course being able to sufficiently attract the numbers of guests and/or prolong the stays of the guests in order to validate the attainability and/or sustainability of the level of occupancy desired needs to be provided.

The Negotiations Committee needs to be able to analyze if the proposed golf course will be able to attain and then sustain the projected level of occupancy necessary for the hotel to be operationally viable.

ISSUE: Community's Economic Dependency

A critical examination of the effect the proposed golf course will have on the community's economic dependency upon tourism as its essential source of income needs to be provided, particularly with the experiences of the effects of the recession and the Gulf War crisis upon tourism.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Examination of Environmental Assessment

As the Environmental Assessment failed to:

(a) analyze and discuss the effects and impacts of the proposed golf course upon the community's economic viability;

(b) analyze and discuss the effects and impacts of the proposed golf course upon the community's limited employment resources;

(c) analyze and discuss the effects and impacts of Hana's weather upon the viability of the golf course and the resulting effects and impacts upon the hotel's occupancy;

(d) analyze and discuss the correlation of weather playable periods with peak occupancy periods;

(e) analyze and discuss the effects and impacts upon the hotel's workforce caused by sustained high levels of occupancy;

(f) analyze and discuss the effects and impacts of the sale of "membership fees" upon the capitalization of the golf course project and upon the continued operational viability of the golf course;

(g) analyze and discuss the economic feasibility of the golf course project and its effects and impacts upon the viability of Keola Hana Maui, Inc.;

(h) analyze and discuss the effects and impacts of the proposed golf course upon Keola's proposed Town Center project; and,

(i) analyze and discuss the effects and impacts of the proposed golf course upon the long term financial capabilities of those employees of the hotel who desire to purchase homes for themselves and their families;

the Environmental Impact Statement should provide such critical analysises, and substantial and credible discussions of these issues.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: The Evidence of the Environmental Assessment

As the evidence provided in the Environmental Assessment, based on some incredible assumptions, predicted about $ 1.5 million in operational losses for the hotel and golf course combined annually, the Environmental Impact Statement needs to provide, through credible analysis and thorough discussion, sufficient evidence to overcome the evidence of the Environmental Assessment.

If the Environmental Impact Statement is unable to credibly overcome the evidence of the Environmental Assessment, then this question:

"Is the proposed golf course project really going to help Keola financially, or will the proposed golf course hurt Keola financially, and then jeopardize the residents of Hana who depend on Keola for their economic well-being?"

will still remain on the minds of the members of the Negotiations Committee as well as on the minds of the residents of Hana.

ISSUE: The Golf Course: the "Cure-all" or "Part of the Cure"

If the Environmental Impact Statement is only able to present credible evidence that shows the golf course project will offer partial cure to the economic viability question, then the Environmental Impact Statement will need to offer, with credible analysis and thorough discussions, the other parts of the cure.

Given the development proposals of the past owners, the specter of "what else is necessary" will be the primary haunting factor in the acceptability of the golf course proposal by the residents of Hana. The Negotiations Committee feels the community will not accept the golf course proposal if it is only a partial cure unless the rest of the cure is also analyzed, discussed and then found to be acceptable.

ISSUE: Community Economic Concerns

The Negotiations Committee, during the course of its negotiations with representatives of Keola Hana Maui, Inc., did present and discuss several of the community's economic concerns relative to potential adverse impacts resulting from the development of the golf course.

These community economic concerns are being re-submitted as part of the Negotiations Committee's comments offering. This submittal consists of three(3) pages and are attached hereto.

COMMUNITY'S CONCERN

Viability of district's economic interests;

business, tourisim, agriculture, ranching

Common Concerns

There are two(2) major concerns common to the businesses of the district:

1) the sustainability of the district's employment resources

and

2) the effect of escalated land values

Employment Resources:

The ability of the community to supply added workers to fulfill the employment needs created by the proposed golf course is a major concern for the following reasons:

1) Without a definitive base-line study to discern the number of employable persons within the district to fulfill the jobs being created by the project, leads to the concern that Keola, as the major employer of the area, with unionized operations and contractual benefits, will be at a severe competitive advantage in attracting employable residents to work its operations. Of concern then is the ability of the smaller employers to compete for workers. The smaller employers do not have the financial ability to import and house workers from the outside. In most cases, the smaller employers are unable to offer wages and benefits comparable to Keola's offerings. The smaller employers are able to offer different work conditions, different work environment, and certain other social and cultural advantages as enticement for their employees.

Many Hana residents do not desire to be employed in the more regimented operations of a hotel. Some desire the "flexibility" of strictly daytime hours, some enjoy the more social benefit of weekends off, some feel more comfortable in a setting of "less social interaction with customers". The "hospitality" aspect, the "production regimentation", the "inflexibility" of scheduling, more the "time off" vs. the "time on" scheduling, the requisite "grooming", the ability to converse, the supervisory organization of a hotel operations, the "promotional and seniority" requirements, and the "regimentation" inherent of a large employer, are some of the more notable factors deterring Hana residents from seeking employment at the hotel.

Further, many Hana residents prefer "outdoor" type of work. While the golf course may well add to the number of "outdoor" type jobs, with the promotional and seniority requirements of the hotel, many of the golf course jobs will be filled by "in-house transfers".

Continued to next page.

COMMUNITY'S CONCERN

Viability of district's economic interests:
business, tourism, agriculture, ranching

Employment Resources (continued)

Resulting from the "in-house transfers" will be vacancies of "entry level positions" such as bushelp, dishwashers, etc. These jobs, by their nature, go begging currently within the resident employment pool, primarily due to the jobs being "low totem pole" jobs with inflexible work schedules and back of the house production required jobs. With a workforce that is quite young, promotional opportunities will be limited. These entry level positions may be viewed as more permanent positions.

From the community's perspective, seeking to have a more diversified economic base, the golf course promotes to the contrary with its appetitie for employees, on the golf course and within the hotel. The employment population will be more concentrated with a single employer than current.

The need for employees does not only affect businesses, for if the supply cannot meet the demand, secondary employment opportunities will be created. However, with secondary employment comes the continued problem of determining which employer is the primary employer with the expectation of its employees to first fulfill that employer's primary needs. The social and cultural impact of parents being employed in more than one job needs to be assessed.

In summary, the need to have the smaller employers operationally viable with an adquate supply of employees remains a concern, a concern that can only be best addressed after a definitive base-line study regarding the district's employment resources has been conducted.

Escalated Land Values

The concern that the development of agricultural lands will cause escalation of land prices is a major concern to businesses that require a land base for viability.

1) Agricultural interests are concerned that escalated land prices will effect their profitability, especially with higher tax assessments.

2) Agricultural lands, it is feared, will be further subjected to pressures to sell or develop.

3) Ranching lands will face similar pressures.

4) Additionally, ranching lands will be diminished, on Hana Ranch lands, by at least 250 acres. While the replacement of these lands is projected, the factors concerning productivity of these lands has not been addressed as well as the added costs to replace these lands.

Continued to next page.

COMMUNITY'S CONCERN

Viability of district's economic interests:
business, tourism, agriculture, ranching

Additional Concerns

These two major reasons remain concerns by their own volition, yet become more severe with the evidence currently on record that the golf course project will not be economically viable and that the hotel will still sustain losses, though if the current reports are accurate, the losses will be less.

With the unanswered question as to what else is neccessary for Keola to achieve viability, the additional severity of these two concerns cannot be measured.

Of noteworthy concern is What if the Golf Course project does not achieve its financial objectives. Will these businesses be able to operate without the hotel as a major employer ? In most cases the retail businesses are complementary, provide support services for the guests at the hotel and for the employees of the hotel. The agricultural operations and ranching operations while not necessarily dependent upon the hotel, many of their employees have an indirect dependency upon the hotel. The extent of that indirect dependency varies yet in total is quite substantial to the overall economic well being of those employees.

Overall, the economic well-being of the community is affected by the economic well-being of the district's major employer. Likewise, the economic well-being of the major employer has to be analyzed for the impacts to the economic well-being of the community. Shifting of the employment resources to help one without concern for the effect upon the other will upset the well-being of both. Without consideration for the impacts of escalated land values and the sustainability of the district's employment resources, puts both, the community and Keola in jeopardy.

Further, development required to achieve economic viability beyond what is being proposed will likewise have tremendous effect on the well-being of the community and of Keola.

Other Economic Concerns

The following concerns, hopefully, will be addressed by the Employment Resources Study.

1) Employability of residents, noting constraints and desires
2) Stability and viability of employment opportunities.
3) Sufficiency of future employment opportunities.
4) Types of future employment opportunities.

SECTION II

Comments offered

by the

Hana Community

Negotiations Committee

on

Community's Concerns

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

General Comments to Community's Concerns:

The Comments offered by the Hana Community Negotiations Committee as the Community's Concerns in this section are conditioned on the following Economic Assumptions:

(a) The applicant has credibly proven the economic necessity of having the golf course developed.

(b) The golf course proposal will attain the financial objectives of the applicant.

(c) The golf course proposal will be credibly able to maintain the financial objectives of the applicant.

(d) The community's economic well-being will not be adversely effected by the proposed golf course project; or if adversely effected, then such effects will be credibly and sufficiently mitigated.

(e) The applicant is able to prove through credible and acceptable evidence that no further development will be necessary to support and/or complement the hotel and/or the golf course.

In the event any of the foregoing Economic Assumptions are invalidated, in whole or in part, due to the determinations, the examinations, the analysises, and/or the discussions of the Economic Issues and Concerns presented in the preceding section and/or due to the determinations, the examinations, the analysises, and/or discussions of the Concerns Arising Out of Negotiations, as presented in the succeeding section, the Negotiations Committee should be allowed opportunity to respond to the effects and/or impacts caused by such invalidations.

Accordingly, the Comments offered by the Hana Community Negotiations Committee in this section as Community's Concerns are being presented subject to the foregoing conditions.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Community's Concerns regarding the Proposed Golf Course Development

Assuming the applicants, through the presentation of credible evidence and substantive discussions within the Environmental Impact Statement, is able to cross the threshold issue, that the proposed golf course project, of and by itself, will fulfill the applicant's financial objectives, then the Negotiations Committee offers the following comments:

(a) Impact on property owners;

(b) Impact on traditional cultural and social values;

(c) Impact on social interaction of residents; impact on social interactions between residents and guests/patrons;

(d) Sustainability of subsistence lifestyles, farming, fishing, hunting;

(e) Impacts on burdened infrastructure;

(f) Impacts on recreational resources;

(g) Impacts on historical evidence of culture and perpetuation of existing culture;

(h) Impacts on sustainability of natural, environmental, and ecological resources; and,

(i) Impacts on long range planning; impacts on existing community plan.

These comments are substantially the concerns presented to Keola Hana Maui, Inc., without opportunity for discussion, on October 17, 1991. These concerns were framed within the premise of the golf course project being the exclusive development necessary to cure the economic viability issue. Accordingly, the Environmental Impact Statement should examine, analyze, and discuss these concerns within the same governing premise. In the event, the current characteristics of the proposed project are altered, the Negotiations Committee should be given opportunity to respond to such alterations and/or the effects of such alterations.

These comments are offered by the Negotiations Committee as an attachment of ten(10) pages hereto.

COMMUNITY'S CONCERN

Impact on property owners

Major Concerns

This issue covered two major areas: (1) land ownership disputes on parcels within the project site and (2) the effect upon property owners caused by the proposed development.

Land Ownership Disputes

Several parcels of land within the project site are encumbered by litigation over ownership based on Keola's filing of Actions to Quiet Title (AQT). While none of the parcels are lands of residential habitation, there are several current Hana residents who have rights of ownership to these parcels. Some parcels are owned by descendents of former Hana residents. As best as can be determined, all parcels for which AQT's were filed are owned partially by Keola and partially by current and/or former residents.

Resolution of these disputes are not within the domain of the golf course negotiations. However, due to the relationships between the members of the Negotiations Committee and the defendants, the Committee did not want to negotiate issues of the golf course which indicated support of the project site upon lands within dispute. Accordingly, the parties in negotiations came to an understanding that these disputes needed to be settled before negotiations on the physical location of the golf course became an issue on the table. Keola agreed to notice the Committee as disputes were resolved but not of the terms and conditions of resolution of those disputes.

Aside from the parcels of the AQT type dispute, the question was raised by a representative of the John Medeiros Sr. Estate that lands to which the Medeiros Estate has title was also part of the proposed development. At the Committee's request, Keola has agreed to show that the Medeiros Estate land is not part of the proposed development.

Further, the State of Hawaii claims title to a parcel within the proposed project site, however, the State has granted Keola permission to proceed with its applications. Further, information subsequently furnished, indicates that the State parcel contains "ceded lands", currently a very politically sensitive issue.

Keola has subsequently presented to the Committee that it is "re-designing" the golf course to exclude the parcels of dispute and the State's parcel. Upon provision of evidence to the Committee that all lands for the proposed development are wholly and entirely owned by Keola and evidence that the Medeiros Estate parcel is not part of the project, this area of concern should be mitigated if not eliminated.

Continued to next page.

COMMUNITY'S CONCERN

Impact on property owners

Effect upon property owners

The second major concern deals with primarily the effect upon property owners caused by the development.

The effect is of two parts: (1) the escalated property taxes which follow escalated land values and (2) the pressures caused by the escalation of land values.

The concern of property owners is the perception that golf course development, of its own volition, escalates land values. While this is a problem (or benefit) to lands surrounding the golf course, the concern escalates with the understanding that Keola, as the owner of the surrounding properties, desires not to develop these lands. Such a desire, it is believed, does not eliminate property values from escalation; such a desire causes the shift of pressures of escalated property values to other properties. Keola, as a major land owner, may be able to withstand these pressures. Yet if the shifting pressures reach areas such as Kaeleku, Hakaalae, Puuiki, Hamoa, on out to Wailua, then the property owners of lands within those areas will be effected. As many of those property owners are long-time kamaaina families, the fear is that this pressure would further cause dislocation and displacement of Hawaiian families from family lands.

The other part of this concern is the impact of property taxes caused by escalated land values. Again the focus of the concern is on the long-time kamaaina families being adversely effected by higher taxation, either by the indirect effect of the shifting of escalated land values or by the direct effect of neighboring property owners yielding to the pressures to develop their properties or to sell their properties at the higher value.

This concern remains active as no long term enduring mitigative measures have been discussued.

COMMUNITY CONCERNS

Impact on traditional cultural and social values

The Concern

A fundamental element of the question of Negotiations:

> Will Keola Hana Maui's proposed golf course development fulfill its (KHM's) financial objectives WHILE the residents of the Hana District are able to retain the balance and harmony of the community's lifestyle, cultural and social qualities, and rural and environmental qualities ?

is the delicate nature of "the balance and harmony" and the effect of the proposed development upon that "balance and harmony". While the Committee is concerned about the delicate balance and the fragility of the harmony for all residents of the Hana District as a whole, special consideration is tendered to those residents with deeply rooted ancestral ties to the district. These particular residents, if the "balance and harmony" is upset or altered adversely, have, in reality, two choices to consider:

1) to adjust to living an altered lifestyle, within a a changed cultural environment with different social values, caused by artificially stimulated development;

or

2) to react with the militancy currently exhibited by other Hawaiian communities to protect their rights of birth.

Given the current unrest and uneasiness among many of the residents, the latter scenario is most probable.

However, neither scenario is desirable. The residents' ability to retain the "balance and harmony" of the community's lifestyle, cultural and social values is essential. Loss of such diminishes the perception of Hana as the "last Hawaiian place".

FURTHER, DEFINING "HANA'S LIFESTYLE" is essential to determine the viable options to consider for retaining the "balance and harmony".

COMMUNITY CONCERN

Impact on the social interactions of residents

By and large the social interactions of the Hana residents have been harmonious. Perhaps the term "Hana accepts those who accept Hana" best depicts the essence of this harmony.

The concern is that the golf course, once developed, would be a magnet, not only, as Keola claims, attracting guests to the hotel, attracting residents to Hana who have a specific desire to reside in a golf course environment, not necessarily a desire to reside in Hana. The fear that these residents will be more "socially class conscious" and not accept "Hana as Hana", then causing a distinction among residents. This distinction will have a disconcerting influence on the social interaction among residents.

The gravity of this concern can be more adequately analyzed once the viability of the project is discerned.

COMMUNITY CONCERN

Social interactions between residents and guests/patrons

The concern regarding the social interactions between residents and guests of the hotel and patrons of the golf course is predicated on the proposed international marketing of memberships in the golf course.

While Hana residents are tolerant of tourists, exposure to tourists from international markets has been very limited. How well the Hana residents interact with tourists from international ports with the anticipated increase of such tourists into Hana due to marketing of membership fees remains a concern.

Further analysis of this concern is contemplated once the marketing of membership fees becomes more definitive.

COMMUNITY CONCERNS

Sustainability of subsistence lifest les
farming, fishing, hunting

For Clarification

A vast majority of the kamaaina ana residents depend on subsistence lifestyle activities, such as farming, fishing and hunting to supplement the furnishmets necessary for their families and themselves. Added to this kamaaina element are some non-kamaaina residents. Of no , by mahele of large catches, primarily akule, other res. lents benefit from these subsistence activities.

Major Concerns

The major concern is sustainab ty and continuance of these activities. The influencing ctors of this concern are evident with the community's co erns on:

a) the economic viability and ability within the community as a whole and wi in Keola as an entity, primarily as economic viabi. ty is the moving force causing changes and such ch ges have to be analyzed as to impacts then being ge rated.

b) the sustainability of the n ural resources based on the potentiality of environ ntal changes caused by development.

c) the social changes evolving rom the proposed development, such as increas d residential population, the cultural differences whi h may come with the influx of new residents and the pot ntial competition for certain resources, competiti n which directly affects the sustainability of these esources.

d) the adverse impacts such as scalated land values which tag along with certain types of development.

As these influencing factors have b n or are being presented as Community Concerns under different h adings, the foregoing identification is designed to show t e inter-relationship of those concerns with this concern.

Of further significance, the En ronmental Assessment addresses the potentiality of conta nation of Coastal Waters yet does not with any degree address the significance of the Coastal Waters, the predominant natu al element essential to sustainability of subsistence lifest les.

COMMUNITY CONCERNS

Impacts on burdened infrastructure

1) Water Supply and Resources

a) current shortfall of County ater supply evident by continuance of Wailua Surfac Water Catchment as source; potential remedy to supplant this source is to install another well on the Kawaipap Aquifer.

b) further compounding the shor.fall of the County's supply is evidenced by the Report within the Environmental Assessment not ng the County's system being adequate until 2010.

2) Solid Waste Disposal

Additional burden to disposal o solid waste will be generated by the clubhouse operations and he landscaping requirements of the golf course.

Potential mitigation: prohibit u e of disposable containers made of non-biodegradable substa ces or of materials with limited re-cyclable value.

3) Medical Facilities

Additional burden to medical fa lities from golf course patrons, additional guests at ho el, additional employees and families being brought into r attracted into area due to additional employment opp rtunites generated or caused by golf course.

4) Educational Facilities

Additional burden to educational facilities from additional employees with families being br ught into or attracted into area due to employment oppo tunities generated or caused by golf course.

5) Police and Fire Services

Additional burden to police serv ces from golf course patrons, additional guests at hotel, resi ent population increase due to additional employment opport ites, the escalation of social problems due to addition impacts on housing, the change of working conditions an pressures caused by inadequate sufficiency of employable resid ts, other social problems which may generate due to socia interactions with new residents to area.

Additional burden to fire servi s caused by increase in resident population and increas in housing inventory.

6) Housing

Additional burden to acute short all of affordable residential housing due to increased residen population to satisfy the additional employment requiremen s generated or caused by the golf course.

COMMUNITY CONCERNS

Impacts on recreational resources

1) Beach areas

Additional burden to limited bea·h areas due to additional guests at hotel; due to increase: resident population to satisfy additional employment re uirements generated or caused by the golf course.

Hamoa Beach is already overburde ed during periods of peak hotel occupancy. The next alter ative beach area is Hana Bay, currently used primarily by residents. Fairly crowded conditions exist at Hana Bay dui ng holidays and weekends of good weather and sea conditi s.

2) Outdoor recreational activities ureas

Limited areas for picnicing and similar outdoor recreational activities exist within Hana are . Such areas are normally extensively utilized by overland day visitors. Additional burden due to increased resident population to satisfy additional employment requiremen:s generated or caused by the golf course will become evi ent.

3) Sport activities areas

Hana Ball Park is the primary, ith Hana School area being the only other site, area for or anized sports activites. Court sports such as tennis, vo leyball and basketball utilize this area with the Hana school gym also available for volleyhall and basketball. ield sports such as soccer, baseball and softball u· primarily the Hana Ball Park. With resident popul ion increased to satisfy employment requirements generat or caused by the golf course, the Hana Ball Park will become burdened to satisfy the community's needs for organ zed sports activities, both field and court sports.

COMMUNITY CONCERNS

Impacts on historical evidence of culture and perpetuation of existing culture

Historical Evidence

Concern still remains over the completeness of the survey of archeological inventory on the proposed golf course site. This concern can be mitigated to a substantial degree with additional field trips involving former residents and/or descendants of former residents who may have some personal knowledge of any other evidences. Similarly, field trips involving former employees of Hana Ranch may help to discern the completeness of the inventory.

However, such filed trips should be scheduled at such time as the project site becomes finalized.

Existing Culture

Concern remains regarding the continuance of the existing local culture, not in a museum like setting, but perpetuation of a living culture.

As previously covered, the essence of the living local culture evolves around the natural resources, the land, the water, and the sea. Adverse impacts to these natural resources will manifest as adverse impacts to the living local culture.

Another essential element of the living local culture is the subsistence lifestyle activity, evidenced by farming, fishing and hunting. These activities are influenced by economic viability and stability within the community and within Keola as an entity, with actions to vitalize economic viability being generators of potential adverse impacts to local living culture. However, at this point in time, not being able to analyze these "actions to vitalize economic viability", any analysis of potential adverse impacts would be primarily conjecture and speculation.

COMMUNITY CONCERNS

Impacts on sustainability of natural, environmental, and ecological resources

Major Source of Concern

The major source of concern of sustainability of these resources centers on the potentiality of contamination due from use of chemicals on the golf course.

The potentiality of contamination of:

a) the ground water with the golf course situated on the major aquifer which supplies the seven(7) wells providing potable water to the residents of the area.

b) the coastal waters which provides the flora and fauna caught and gathered by a majority of the local kamaaina residents and shared with many other local residents as well as non-resident friends and families.

The other area of concern, with an anticipated increase in resident population, is the adequacy of the resources to furnish the needs of the residents.

Impact on Culture

The fundamental tenets of the local culture, primarily Hawaiian, not only in blood but in heart, are wai (water), kai (ocean) and aina (land), the principle elements of the natural resources. Adverse impacts to these principle elements will adversely effect the local culture.

Effect of Environmental Assessment

The Environmental Assessment addresses the potentiality of contamination and offers as the mitigative measure "proper management and application by trained personnel". Failing to offer any other remedy and based on the acute sensitivity of the community on sustainability of these natural resources, the Committee remains discomforted with chemical usage upon the golf course. Without sufficient protection of these natural resources, essential not only to the health and safety of the residents, the cornerstones of local lifestyle and local culture, the well-being of Hana as a community remains jeopardized.

COMMUNITY CONCERNS

Impacts on long range planning

The major concern is that the golf course development by its purpose and by its creation will become a hub of major concern on many of the elements for consideration in long range planning.

At this time, lacking adequate and sufficient insight on the viability of the proposed project and the viability of Keola Hana Maui, Inc. and the resultant impact on the viability of Hana as a whole, clarity and definitiveness of these impacts to long range planning cannot be determined.

Of acute concern is the fact that this proposed development is being advanced by Keola without an opportunity for discussions on the needs of the community, the concerns of the community, the desires of the community, being held in a long range planning forum. The opportunity for expression of the community's needs, concerns, and desires is limited to the parameters of the forum concerning the proposed golf course exclusively. While other forums, such as discussions on Access, are being held, these forums are again confined to the issue of discussion.

Another major concern relating to long range planning is the inability to date of having a socio-economic baseline study for the Hana region engaged and conducted. Such data would be essential in determining residents attitudes and concerns and then framing the issues germane to planning the future of the Hana area.

COMMUNITY CONCERNS

Impacts on existing Community Plan

The most evident impact is that the current Hana Community Plan must be amended to allow for the proposed golf course development. Given the timing and delay of having the current Community Plan going through a revision process, it appears the amendment may receive approval prior to the revision of the current Plan being approved.

Of legal interest is the scenario of having the revised Plan negate the amendment.

This concern dovetails with the concern on long range planning, although the life of the revised Plan is to be only ten (10) years and long range planning, by the perception of the community, should encompass a far longer period, certain prohibitions or restrictions placed into the revised Plan will have long range impact.

The Community Plan Review/Revision process is a compatible forum for discussions on long range planning, although the processing of the Plan Amendment and subsequent approval may negate some of the discussions or cause a refocus of the discussions on certain issues inherent in long range planning dialogue.

SECTION III

Comments offered by the Hana Community Negotiations Committee on Community Concerns Arising from Negotiations

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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General Comments to Community Concerns Arising from Negotiations

The Comments offered by the Hana Community Negotiations Committee within this section as Community Concerns Arising from Negotiations need to assessed from the focus of (a) the context of negotiations; (b) the dynamics of negotiations; and (c) the interactions between the parties in the negotiations forum. Accordingly, the Negotiations Committee offers this subjective description:

The negotiations process was entered into voluntarily by both parties with some external influence by political and government forces being exerted upon the parties to engage in the process as a method of resolving their differences within Hana. Elements essential to the negotiations process, such as trust between the parties and "good faith" representations being conveyed between the parties, though not visibly evident at the onset of the process, did become evident as the relationship of the parties evolved.

The Community Concerns Arising from Negotiations are the by-products of the negotiations process.

Of these concerns, the following:

(a) Sales Agreement with Rosewood;

(b) Understanding the Impact of Economics;

(c) Prohibitions on further development-protective remedies;

(d) Golf Course Project-linkage to Town Center and to Affordable Housing Project;

are influenced, in whole or in part, to the validity of the Economic Assumptions delineated in the General Comments to the Community's Concerns (See page II-2). Accordingly, if any effects and/or impacts caused by any invalidations, in whole or in part, to these Economic Assumptions become evident relative to the foregoing concerns, the Negotiations Committee should be allowed opportunity to respond to the effects and/or impacts caused by such invalidations.

Accordingly, the Comments offered by the Hana Community Negotiations Committee in this section as Community Concerns Arising from Negotiations are being presented subject to the application of such conditions.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: Community Concerns arising from Negotiations

Certain community concerns became evident during the course of negotiations between representatives of Keola Hana Maui, Inc. and the Negotiations Committee.

While these community concerns surfaced during the course of negotiations, they do have substantive influence on the proposed golf course project. The Environmental Impact Statement should discuss these concerns. Accordingly, the Negotiations Committee offers these concerns as its comments.

These comments, provided as attachments hereto, are identified as follows:

(a) Sales Agreement with Rosewood; Understanding the Impact of Economics (2 pages);

(b) Prohibitions on further development-protective remedies (2 pages);

(c) Golf Course Project-linkage to Town Center and to Affordable Housing Projects (1 page); and,

(d) Philosophical Compatibility: Defining "Hana's Lifestyle" (1 page).

COMMUNITY'S CONCERN

Sales Agreement with Rosewood

Qualifications

While this issue is a community concern, it is a non-negotiable matter. Keola entered into a contractual agreement with Rosewood, the precedent owner, which impacts the tone and tenor of the negotiations between Keola and the community.

Effect of Sales Agreement

An issue of primary focus and extensive dialogue during our earlier negotiations session was the provision of the Sales Agreement with Rosewood which requires the Purchaser (Keola Hana Maui, Inc.) to pursue with all due diligence and best efforts all actions necessary to gain approval to develop a championship , eighteen (18) hole golf course with other related amenities.

Keola representatives have disclosed that upon Keola gaining approval to develop such golf course, Keola is required to pay an additional $ 25 million to Rosewood. Further, if Keola does not pursue the necessary actions with all due diligence and best efforts, Keola would be in default and owe the same sum to Rosewood.

The Sales Agreement set the initial filing dates as well as governs other timeline matters.

Effect on Economic Viability

This additional debt burden further impacts the economic viability of the proposed project.

Keola has been provided the attached diagram entitled:

UNDERSTANDING THE IMPACT OF ECONOMICS

Provision of this diagram was necessary for Keola to understand why so much of the Committee's initial focus was aimed at the Economic Viability issues and concerns.

UNDERSTANDING THE IMPACT OF ECONOMICS

Understanding the rationale for requests for information regarding economics and other financial considerations.

SIMPLE ECONOMIC EQUATION

REVENUES/INCOME		EXPENSES/COSTS		ECONOMIC VIABILITY
Sale of membership fees 20% retention Income from Operations Golf Course Hotel Ranch Other Enterprises	less	Cost of assets purchased from Rosewood (??) Cost of fulfillment of Sales Agreement (??) Cost of Development of Golf Course (E.A.) Cost of Development of portion of Town Center (??) Cost of Financing Loans (??) Membership Fees @ 80% (??) Cost of Impact Fees (??) Cost of Operations Golf Course (E.A.) Hotel (E.A.) Ranch (??) Other Enterprises (??) Cost of Community Benefits (??)	yields	Keola Hana Maui Hotel Golf Course Ranch Other enterprises Employment Stability Affordability of Housing Community Viability Economic Social Agricultural Cultural Environmental Lifestyles Residential
SUM OF ALL REVENUES and ALL INCOME	less	SUM OF ALL EXPENSES and ALL COSTS	yields	DECISION OF THE RESIDENTS OF HANA

COMMUNITY'S CONCERN

Prohibitions on further development (protective remedies)

Commitment to future development

Based on the evidences of the current Economic Impact Section of the Environmental Assessment, the concern is whether the community is setting itself up for a claim for future development being necessary to remedy the shortfalls of the proposed development.

The community, by and large, is concerned about the economic well-being of Keola. The need to have a stable economic operations by the area's largest single employer is recognized. The economic stability then creates stable employment for the employees of this employer. Many of these employees currently reside in over-crowded homes, therefore they need and desire their own homes. While this is not an argument that the proposed project must provide housing, the nature of the hotel operations is a business that is labor intensive and requires a high number of residents to staff its operations. Accordingly, the hotel and the other entities supplementing or complementing the hotel operations should be required to provide housing for its employees, with or without a golf course. Without provision of housing, the workforce remains destabilized, subjected to employees needs for suitable housing. While Hana does not provide unlimited economic opportunities, many residents will endure the economic limitations offset by their culturel and social attractions to the area if provided suitable housing. However, such suitable housing can only be provided in an economically stable environment.

Therefore, the proposed project, lacking the assurances of being economically viable, further destabilizes the economic environment. The fear that the community, by adopting the proposed project, must later adopt further development to (1) stabilize the economic viability of the major employer as well as its own economic vitality and (2) stabilize the economic viability of the employee residents who are then encumbered by purchases of suitable housing, remains a haunting element in the mindset of the residents.

The proposed project must be able to realisically achieve its financial objectives and the community must then be able to have prohibitive measures put into place against further development. For the community to support this development, without realistic assurances of it achieving its financial objectives, and, then to also require prohibitions on future development, is economic suicide.

Noteworthy of this point, even those residents who have indicated a willingness to support the golf course project do so with severe reservations about further development.

Continued to next page.

COMMUNITY'S CONCERN

Prohibitions on further development (protective remedies)

Viability of the Project

While the evidences currently available indicates the proposed project will still sustain operational losses, there is a major concern about the overall viability of the project.

As the evidence indicates the current operations do not sustain operational expenses, this evidence fails to assess the current debt service of Keola. What the evidence does indicate, that with an appreciably higher occupancy, operational losses will be diminished though the degree of diminishment is still debatable. Accordingly, if this evidence is valid, then the way to reduce losses is to increase occupancy without the increase of losses.

To date, the evidence does not show how occupancy will be adequately and sufficiently increased by the proposed project. The record merely reflects an assumption without adequate evidence to validate such an assumption. The assumption being that the proposed golf course will, by its creation, attract sufficient occupancy to reduce operational losses. This assumption, without further evidence, is purely speculative. The resultant economic formula does not factor in the additional debt service incurred by the development of the proposed golf course. If the purchase price established by the media is $ 63 million, then the new debt service burden will be easily doubled by Keola's own evidence. Further, while the evidence refers to sale of membership fees, the marketability of such fees has not been established. Of note, Keola has indicated that membership fees are really interest free loans, repayable at 80% to 90% of principle within 10 years.

The viability of the proposed project remains questionable based on the speculative assumption that a golf course in Hana will attract a sufficient degree of occupancy for the hotel to diminish operational losses, an assumption that lacks evidence of a formal market study, and the speculative assumption which references, again without a market study, the inclusion of membership fees without discounting 80% to 90% of such fees as loans repayable within 10 years. Further, without adequate consideration of current debt service and then the doubling of such debt service by the development of the proposed project, this community and its representatives on the Negotiations Committee find the project as non-viable and of further jeopardy to Keola's and well as the community's economic well-being.

COMMUNITY'S CONCERN

Golf Course Project-linkage to Town Center and to Affordable Housing Projects

Background

The initial representations by Keola Hana Maui were that Keola was planning three (3) projects; the Golf Course Project, the Hana Town Center Project, and the Affordable Housing Project. During presentations of these projects, Keola representatives emphasized that each project "stood alone", independent of the other projects.

During negotiations regarding the Golf Course project, Keola maintained this posture.

May 11th Meeting

During the meeting of may 11, 1991, between representatives of Keola Hana Maui and employees of Keola Hana Maui, the following statement was made by Masamichi (Ted) Kato, who is a Director, a Vice-President and Treasurer, and is also the son of Masami Kato, the Chairman of the Board and Chief Executive Officer of Keola Hana Maui, Inc., to the employees, "No Golf Course, No Housing."

Current Status

Discussions subsequent the May 11th meeting have revealed that both the Hana Town Center project and the Affordable Housing project are linked to the Golf Course project realizing its financial objectives, Keola as a corporate entity achieving economic viability and Keola's employees attaining the resultant employment stability. With particular emphasis to the affordable housing project, the prospective home purchaser-employee must be able to have a comforting measure of employment stability and a realistic expectation of continued employment to repay a mortgage. Without this realistic expectation of continued employment for prospective home purchaser-employees, the financing of the affordable housing project is jeopardized.

With the Town Center project, much of the proposed development will focus on improving the infrastructural shortfalls of the hotel facilities. If improved occupancy at the hotel, the primary purpose for development of the golf course project, is not attained, then many of the infrastructural improvements may not be necessary.

COMMUNITY'S CONCERN

Philosophical Compatibility

Developing a mindset during negotiations is critical for productive and fruitful dialogue. The earlier discussions and meetings were conducted in an atmosphere of skepticism with some degree of distrust.

Current Status

Agreement of the minds has been reached that the community of Hana and Keola Hana Maui have a partnership relationship. Both parties are concerned about the economic vitality of the other; both have the same objectives although differences regarding the proposed solutions to achieve these objectives still need to be worked out. The community's economic viability is Keola's concern and Keola's economic viability is the community's concern.

Both, Keola and the Negotiations Committee, have expressed "on the record" commitments to continue to negotiate their differences.

COMMUNITY'S CONCERN

Defining "Hana's Lifestyle"

The parties have agreed that in order to analyze and critique the non-economic impacts, both beneficial and adverse, the term "Hana's Lifestyle" needs to have a mutually acceptable definition.

Several sessions have been held in a "brain-storming" mode between the parties without success to define this term. Accordingly, a facilitator to help the parties find a mutually acceptable definition has been contacted and by agreement between the parties will be engaged to provide such assistance.

SECTION IV

Comments offered

by the

Hana Community

Negotiations Committee

on

the Environmental Assessment

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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<u>General Comments to the Reports contained within the Environmental Assessment for the Hana Ranch Golf Course</u>

Within this section the Hana Community Negotiations Committee offers its comments to the contents of the Environmental Assessment prepared for the Hana Ranch Golf Course.

Further, the Negotiations Committee concurs with the comments offered by the various agencies as their respective reviewing comments on the contents of the Environmental Assessment. These comments are incorporated within the Department Report from the Department of Planning, County of Maui, submitted to the Maui Planning Commission for its consideration and action on January 14, 1992.

For clarification of certain reports contained within this section, references are made to revised studys and/or revised reports. The Negotiations Committee did not, and has not received any revised studys and/or revised reports. However, in its analysis of the reports germane to issues concerning the physical location and/or design of the proposed project site, the Negotiations Committee was and still is under the impression the project site may be re-designed and/or perhaps relocated due to the ownership of lands being disputed (see discussion contained within Section II Community's Concerns).

The Negotiations Committee requests opportunity to respond on any issues related to the project site and/or project design once the exactness of the project site and/or project design is finally established.

With that proviso, the Negotiations Committee offers as its comments in this section its reports on the contents of the Environmental Assessment for the Hana Ranch Golf Course.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: <u>Environmental Assessment Report</u>

ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE

The Negotiations Committee offers as its comments on this report contained within the Environmental Assessment a copy of a memorandum from Bill Fuhrmann, Community Negotiator and Chair of the Negotiations Committee to the Negotiations Advisory Committee and the Research and Support Committee, subject matter being: General Concerns regarding the Environmental Assessment ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE.

This memorandum, consisting of three(3) pages, was previously provided to representatives of Keola Hana Maui, Inc. on October 17, 1991.

The provision of this memorandum is for informational notice specifically. A more extensive and comprehensive presentation of the comments offered by the Negotiations Committee regarding the community's concerns on the economic effects and impacts of the proposed golf course project are contained within the scope of Section I. Economic Issues and Concerns; within parts of Section II. Community's Concerns; and within parts of Section III. Concerns Arising from Negotiations.

To: The Negotiations Advisory Committee and the Research and Support Committee

From: Bill Fuhrmann, Community Negotiator and Chair of the Negotiations Committee

Subject: General Concerns regarding the Environmental Assessment
ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE

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Basically this is a recital of an excerpt from the Record of Negotiations, Session of 25 July 1991.

RECORD OF NEGOTIATIONS Page # 4 of 4.

Session of 25 July 1991.

D) Community's Exceptions to Economic Impact section of Environmental Assessment

Community's Positions: Basically the Economic Impact section is substantially flawed, based on many incredible assumptions and many unrealistic factors.

Keola's Response: Agreed, need to have the consultants made aware of this. Suggest that the consultants hear directly from the community on these problems. Need to work out a schedule for this meeting with the consultants.

Community's Response: Understand that this is not the feasibility study but the Economic Impact section. The assumptions such as no formal market study, just analysis of comparable resorts without comparisons of all elements of these resorts. The assumption that the study assumes a fully operational and mature operations means six to seven years away with late 1992 for approvals, 18 to 24 months for construction, and another two years for stabilization of operations. Unrealistic factors such as 365 days of playability, given Hana's weather. Use of 1989 expenses when Keola was not owner until late 1989 and did not have operations manager until 1990. The whole Economic Impact Section is flawed.

Keola's Response: Again, agreement. Let's meet with consultants, it better they hear from you on these problems directly.

Community's Response: Let's get this meeting scheduled, here in Hana, in Honolulu, wherever is most convenient.

By MEMORANDUM

TO: BILL FUHRMANN
FROM: LIBERT LANDGRAF
DATE: AUGUST 1, 1991.
SUBJECT: RECORD OF NEGOTIATIONS - JULY 25, 1991

Accepted.

Based on the foregoing excerpts of the records of the parties in negotiations, the parties agreed that the Economic Impact Section of the Environmental Assessment is flawed.

Continued to next page.

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The following is taken from the personal notes of Bill Fuhrmann:

Monday 19 August 1991.

10:35 Meeting at offices of Pannel, Kerr, Forster with Ernest A. Watari along with Jerry D. Fitzgerald of Ronald M. Knoll Consulting Group and Libert Landgraf

Libert explained to Watari the purpose for the meeting
(a) based on the negotiations between the community and Keola, the parties agreed that major flaws existed with the Economic Impact Section; and
(b) Keola felt it was best that Pannel Kerr Forster hear directly of these flaws from the community.

Watari explained that given the time constraints and the specifications of the contracted study, Pannel, Kerr, Forster prepared its report. Keola did not want a formal market study. Keola wanted a comparison of Hotel Hana Maui with comparable resort hotels and analysis of the performance of Hotel Hana Maui.

I identified for Watari some of the flaws of the Economic Impact Study as seen by the Negotiations Committee.

a) lack of a formal market study

b) citing quotes from studies; studies not identified nor provided.

Watari responded that studies are from other projects done by Pannel, Kerr, Forster or from studies done by the State. Not able to release studies done for other clients; studies by State are public records.

I further identified the failure to show that the "rest and relaxation" segment of the luxury market, formerly Hotel Hana Maui's orientation, is no longer a viable market.

Watari responded that the "rest and relaxation" segment is a very limited segment of the luxury market, less of a target than the "activity oriented" segment.

I further inquired about the viability of the "eco-tourist" market.

Watari responded that the "eco-tourist" market probably could not afford Hotel Hana Maui room rates.

(PERSONAL OBSERVATION: As Watari continued to be defensive in responding to the flaws identified, it appeared that to continue to point out flaws would be counter-productive. I decided to withhold presentation of additional flaws and concerns until such time as Keola decided to do another study and then advance these concerns for comment within the new study.)

Continued to next page.

The following is taken from the personal notes of Bill Fuhrmann:

22 August 1991.

Met with Landgraf 10:00 to 11:30 at HCA office:
Discussed briefly need to screen the revised feasibility study before being commissioned; to check if the issues and concerns are going to be answered by new study, otherwise certain issues may remain unanswered. Landgraf agreed, will let me know when specifications of new study are being drawn up.

19 September 1991.

Met with Landgraf 10:00 to 11:30 at Keola's office:
Was informed that Keola met with Pannel Kerr Forster on 18 September 1991; PKF reworked their proposal, PKF commissioned to do revised Economic Impact Study; will factor in membership fees. Landgraf indicates with the membership fees factored into economic viability, project will work. Ted Kato explained how the membership fees would work, 10% to 20% retained, 90% to 80% refundable after 10 years, however, will earn interest off of this portion during the interim. PKF was eager to do new study; should have preliminary work done within 10 days. Will advise me when draft is in.

09 October 1991.

Met with Landgraf 15:00 to 17:30 at Keola's office.
Has not yet received draft of revised Economic Impact study. Left call with PKF regarding study.

17 October 1991.

Met with Landgraf 09:00 to 11:00 at Keola's office.
Still has not received draft of revised Economic Impact Study.

Other flaws with current Economic Impact Study.

a) Lack of credible insight and evaluation of hotel's occupancy performance, especially with the decline as compared to other resorts.

b) failure to show how golf course will enhance hotel's occupancy.

c) failure to analyze impact of golf course on community's economic viability; employment shortage

d) failure to analyze correlation of weather to peak occupancy to playable days on golf course, (late summer in Hana-low occupancy, wet winter in Hana-high occupancy).

e) failure to analyze impacts on work force with sustained 75% occupancy.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Reports

NOISE STUDY FOR THE HANA RANCH GOLF COURSE PROJECT
and
AIR QUALITY STUDY FOR THE PROPOSED HANA RANCH GOLF COURSE PROJECT

Analysis of both of these sections of the Environmental Assessment indicate both studys reference two(2) distinctive time frames for consideration.

The first time frame analyzes the issues during the period of construction. As the impacts deriving from construction may deviate due to relocation of the golf course, analysis of such impacts will be more productive once the location of the project site becomes final and absolute.

The second time frame analyzes the issues during the period of operations and often references the impacts in relations to neighboring properties. Until such time as the project site is firm, analysis of impacts in relations to neighboring properties, at this point in time, appears more speculative than substantive.

CONCERNS FROM THE COMMUNITY REGARDING these two(2) sections has yet to become evident. However, further analysis which, once location of project site is finalized, will be undertaken may disclose evidence of such concerns.

CONCERNS REGARDING NOISE IMPACTS caused by aircraft traffic due to Keola's proposed mode of accommodating the construction personnel shall be analyzed once such mode is determined to be final.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

CHEMICAL USAGE FOR THE PROPOSED KEOLA HANA MAUI GOLF COURSE

The general concern is the growing sensitivity of the district's residents of the potentiality of contamination due to the use of chemicals as fertilizers and pesticides for the golf course.

Based on the current location of the golf course upon the major aquifer and that efforts to relocate the golf course would still result in its location being on this aquifer, the potential for contamination of the ground water remains a haunting element.

Further, the potential contamination of coastal waters due to runoff likewise remains a haunting element.

The report does not refute the potential for contamination; the report only offers mitigative measures. The most discomforting element of the mitigative measures is that the essence of mitigation is vested with "proper management and application by trained personnel". The discomforting element is aptly depicted in the saying "..to err is human".

If this be the only potential practicable remedy offered, then it is incumbent upon this community to insure against human error. How such insurance is manifested remains the trick.

HOWEVER, THE REPORT FAILS TO OFFER any other remedy to the potentiality of contamination. Until such time as all other possible remedies are explored, the major concern, a concern of severe gravity, still remains as an essential problem to development of the golf course.

CONCERN: BASED ON THE INFORMATION PROVIDED, the lack of consideration for alternative methods to enhance the landscaping of the golf course without use of chemicals causes grave concerns regarding the golf course development. In order to mitigate these concerns other alternatives should at least be considered and analyzed.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

WATER RESOURCES AND SUPPLY FOR PROPOSED HANA GOLF COURSE

Of general concerns based on this layman's analysis of this section of the Environmental Assessment are the following:

1) This report indicates a high degree of permeability within the soil of the area due to the composition of the soil and the underlain subsoil.

   CONCERN: BASED ON THIS INFORMATION, the concern is the effect of chemicals sifted down within the soil to the water table.

2) The Kavaipapa Aquifer extends from Kaeleku to Waiohonu, the source of potable water for seven(7) wells. Three(3) of the wells are owned by the County of Maui-Wakiu A, Wakiu B, and Hamoa; three(3) of the wells are owned by Keola-Kaeleku, Helani, and Wananalua; and the seventh(7th) well is owned by Keaka-Wai and is located in Mokae.

   The County is currently capable of providing 500,000 gallons per day of potable water and relys on a surface water source at the Wailua intake for an additional 100,000 gallons per day.

   Keola is currently capable of providing 960,000 gallons per day of potable water from its three(3) wells.

   Provision capability figures for the Keaka-Wai well are not available.

   The estimated provision capability of these seven(7) wells located on the Kavaipapa aquifer is 1.5 million gallons per day of potable water.

   The proposed golf course project site is situated on the Kavaipapa aquifer. The proposed location situates the golf course between the Wananalua Well and the Hamoa Well.

   CONCERN: BASED ON THIS INFORMATION, the concern is the potential contamination of the primary potable water source for the Hana area.

3) The report indicates that the County Water System's wells are expected to meet the water needs of the Hana area to the year 2010.

   CONCERN: BASED ON THIS INFORMATION, the potential shortfall of the County's system has been identified. Potential remedy of this shortfall needs immediate consideration. Of possible remedy is provision of potable water from Keola's Wananalua Well or consideration by the County of installing another well upon this aquifer with the location of this well being important.

Continued to next page.

4) The report indicates the need to have a viable source for irrigation of the golf course with specific references to two(2) golf courses located in areas of similar magnitude of annual rainfall.

These two(2) golf courses, per the report, used between 47,000 gallons per day to 65,000 gallons per day with higher usage of 81,400 gallons per day to 97,200 gallons per day to irrigate the greens only during mid-August to mid-September.

Further, for fire protection, is the requirement of a reserve storage capacity of 240,000 gallons.

The clubhouse facilities are estimated to use between 20,000 gallons to 30,000 gallons per day, based on typical usage.

The clubhouse, which requires potable water, will draw from the Wananalua Well.

Irrigation water, estimated at 100,000 gallons per day, will, by the reports explicit expressions, be met by utilizing the Wananalua Well source, on-site reservoir storage and possibly off-site reservoir storage with rain catchment.

The on-site reservoir storage appears by the composition and inferences of the report to be three(3) on-site ponds. The three(3) ponds will be supplied by the irrigation system. The storage capacity of these ponds are not indicated within the report. Further, these ponds are to provide the required reserve storage capacity for fire protection.

The off-site reservoirs, for possible use, by indication from the report, are two(2) small open reservoirs in need of restoration work and connection work to the on-site ponds. A third off-site reservoir with rain catchment capability provides stock water supply for cattle operations. The capacities of these off-site reservoirs were not disclosed.

The fire protection requirement will be met by the irrigation system.

CONCERN: BASED ON THIS INFORMATION, the report indicates the necessity of having irrigation capabilities for the golf course. The only identified currently viable source of water is Keola's Wananalua Well, a major source of potable water. Although other possibilities are referenced, which also includes the Helani Well, another source of potable water, the report identifies potable water sources as the viable source for irrigation and fire protection with possible development of "non-potable" water sources.

Continued to next page.

5) The report does reference Fertilizers and Pesticides Contamination, recognizing the potential for contamination and offering mitigative measures.

The conclusionary remarks are indicative of this facet of the report: "In general, with proper management and application by trained personnel, the proposed golf course is not expected to present a threat to the existing quality of runoff and ground water."

CONCERN: BASED ON THE INFORMATION provided within the report and the tenor of the expressions of the report, the concern is to prohibit the contamination of the water source in total and not to only decrease the probability of contamination.

6) The report does address Waste Water Disposal by offering what "should be" done as an appropriate method of disposal. Yet the report does not show with a degree of comfort that the wastewater disposal will not contaminate the groundwater resources.

CONCERN: BASED ON THE INFORMATION provided in the report, prohibiting the contamination of the ground water source remains a concern.

7) The report does address, minimally, Storm Runoff and Drainage, and Coastal Waters. Basically the report analyzes the relation of Storm Runoff and Drainage, and the impact to Coastal Waters compared to current conditions, with the following excerpt being indicative; "...surface runoff from the project site will not be increased above existing conditions." The report indicates there is no data currently available on the quality of the coastal waters and that no long-term impact on the coastal waters is expected. The report also states "...the potential for fertilizer and pesticide contamination from intermittent runoff and subsurface percolation which may reach coastal waters is expected to be minimal and insignificant."

CONCERN: BASED ON THE INFORMATION provided within the report and the tenor of the expressions of the report, the concern remains to prohibit the contamination of the Coastal Waters in total.

GENERAL CONCLUSION

The report on the WATER RESOURCES AND SUPPLY FOR PROPOSED HANA GOLF COURSE lacks sufficient substance to relieve the Negotiations Committee of its concerns regarding the potential contamination of the ground water source, the potential contamination of the coastal waters. Further, this report indicates that the identified viable sources for irrigating the golf course and supply of water for fire protection are from potable water sources, the Wananalua Well and possibly the Helani Well. The use of such potable water sources contradicts representations previously and

Continued to next page.

continuously made assertions by Keola Hana Maui, Inc. that non-potable water will be used to irrigate the golf course.

In the event that Keola Hana Maui, Inc. does develop non-potable water sources for irrigation, the costs of such development needs to be factored into the costs of the project and the overall viability equation.

THIS ANALYSIS DOES NOT INCLUDE the impacts, especially relating to runoff, drainage, and coastal waters, caused by the construction of the golf course. This matter can only be addressed once the design and/or location of the golf course is finalized. Of note, the actual location of the site will probably remain on the Kawaipapa aquifer, therefore the concerns relating to the aquifer should by and large remain constant. Similarly, use of potable water, given the location of the sources, would probably remain constant. The other issues of Fertilizer and Pesticide Contamination, Waste Water Disposal, Storm Runoff, Drainage, and Coastal Waters may need some alteration based on design and location, however, the concerns of this report are relevant to the disclosures of the Environmental Assessment and the inadequate expressions of such disclosures.

THIS REPORT ADDRESSES THE GENERAL CONCERNS, specifics which need further, more expert, analysis should be done at a later time. Such specific, more expert examination can best be productive only when design and location are final, grading and erosion control reports are then amended, if necessary, and the inadequacies of the disclosures of the current Environmental Assessment are remedied.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

TRAFFIC IMPACT ASSESSMENT REPORT FOR THE HOTEL HANA-MAUI GOLF COURSE

Analysis of this section of the Environmental Assessment is deterred by the following:

1) The access to the project site is identified as a road directly mauka of the current Haneo'o Road junction off of Hana Highway.

   This identified access contradicts other depictions of the access to the project site as located away from this junction.

   Analysis of traffic will differ dependent upon the access to the project being a turn off going mauka or an intersection where traffic may move in any of three directions.

2) The specifics of patronage of the golf course is still, at the time of the development of this report, being researched and studied by consultants retained by Keola Hana Maui, Inc..

   If definitive data becomes available through this current study, such needs to be factored into the traffic impact.

3) At the time of the development of this report, Keola Hana Maui, Inc. was seriously considering redesign and/or relocation of the project site. Based on that disclosure, analysis of the traffic impact should be held in abeyance pending finalization of the project site.

Based on the foregoing, analysis of this section of the Environmental Assessment was not undertaken.

CONCERNS DUE EXIST, that impact from traffic generated by the golf course be minimal at worst or non-existant at best.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

ARCHEOLOGICAL INVENTORY SURVEY OF THE PROPOSED HANA RANCH GOLF COURSE

Initial analysis of this section was undertaken by the Research and Support Committee, who prepared overlays of the depiction showing the identified Archeological Sites imposed upon the Project Site. Further, a brief field trip, which included members of the Island Burial Council and a state archeologist, was undertaken.

Further analysis was deterred by the disclosure that Keola Hana Maui, Inc. was considering a possible redesign or a possible relocation of the golf course site.

CONCERNS STILL REMAIN regarding the completeness of the survey, specifically in relation to sites of evidences not yet identified. Continued efforts to involve former residents and/or descendants of former residents of the area to help discern the completeness of the survey remains a primary objective of the Committee. Further, consideration to have former employees of Hana Ranch involved in this discernment is another primary goal of the of the Committee.

FURTHER ANALYSIS AND ADDITIONAL CONCERNS may become evident upon finalization of the golf course site location.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

SOCIAL IMPACT ASSESSMENT FOR HANA RANCH COUNTRY CLUB

Full analysis of this section of the Environmental Assessment is deterred in large measure by the yet unanswered economic viability question. Upon full disclosure of all essential ingredients of the economic viability recipe, comments to the adequacy of the assessment of Social Impacts will be more meaningful and less speculative.

However, the following flaws are, and unless remedied, remain evident:

1) The demographical information, by and large, is antiquated, being at least ten (10) years old. More recent data is available via the SMS Research Study on Housing in Hana and possibly the 1990 Census Reports.

2) The mitigation measures proposed, after lengthy discussion of the social impacts, are inappropriate responses to the impacts identified. In essence, the mitigative measure was a "No Action" alternative.

3) The list of recommendations dealt primarily with encouraging Keola "to improve its relationship with the community" and recommendations of how hotel management should deal with guest relations and with employee relations.

ADDITIONAL CONCERNS may become more evident upon disclosure of the essence of the economic viability information.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: <u>Environmental Assessment Reports</u>

BOTANICAL SURVEY HANA GOLF COURSE
and
SURVEY OF AVIFAUNA AND FERAL MAMMALS FOR A HANA GOLF COURSE E.A.

Analysis of both of these sections of the Environmental Assessment is at best a superficial reading of the contents contained within each report.

CONCERNS FROM THE COMMUNITY REGARDING each of these sections has yet to become evident.

Based on the lack of evidences as to any concerns of the community regarding these two(2) sections, as Chair of the Negotiations Committee, it is my recommendation that positions on these sections be held in abeyance pending the requisite critiques, which will evolve as part of the processing of the review of the Environmental Assessment, becoming part of the record on these elements.

FURTHER ANALYSIS MAY BECOME necessary if the project site is relocated.

SECTION V

CLOSING COMMENTS

offered by the

Hana Community

Negotiations Committee

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

<u>General Comments to Closing Comments</u>

The comments offered in this section by the Hana Community Negotiations Committee are specific to the desire of the Negotiations Committee to be involved as a "hands-on" consulted party during the preparation and development of the Environmental Impact Statement for the Hana Ranch Golf Course.

A "partnership" relationship was created during the course of negotiations between the Negotiations Committee and the representatives of Keola Hana Maui, Inc.. This relationship was the most tangible and beneficial result of the negotiations process. Accordingly, the Negotiations Committee desires to maintain its partnership role by being a "hands-on" active partner in this relationship.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: <u>The Role of the Hana Community Negotiations Committee as a "consulted party".</u>

The Hana Community Negotiations Committee seeks to be a "hands on" consulted party during the development of the Environmental Impact Statement.

As the fundamental purpose for the residents of Hana to engage in negotiations with Keola Hana Maui, Inc. is to:

"LET HANA'S PEOPLE, WITH HANA'S SENSITIVITES, SOLVE HANA'S PROBLEMS, WITH HANA TYPE SOLUTIONS"

the participation by the Negotiations Committee as a "hands-on" consulted party enhances the fulfillment of this purpose.

This purpose is negated to a substantive degree if the Draft Environmental Impact Statement is prepared exclusively by the applicant's consultants. If such be the desired course of action, then the Negotiations Committee is forced to become a "reactionary" party rather than a "consulted" party.

For historical information purposes, attached is a two paged letter, dated 23 October 1991, from the Community Negotiator and Chair of the Negotiations Committee to the Chief Operating Officer and Spokesperson for Keola Hana Maui, Inc. on the subject of the POSITION OF NEGOTIATIONS COMMITTEE. The position of the Negotiations Committee remains as was described in that letter.

While the Negotiations Committee may lack the expert insight on some of the technical issues presented in an Environmental Impact Statement, the members of the Negotiations Committee do have the expert insight on the sensitivities and concerns of the residents of Hana. The Negotiations Committee feels that type of insight is of essential importance in the development and preparation of the Environmental Impact Statement. As the problems the proposed project is attempting to solve are Hana's problems and effects Hana's people, the Negotiations Committee requests, as the selected representatives for Hana's people, to be a "hands-on" consulted party in the development and the preparation of the Environmental Impact Statement.

23 October 1991.

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
P.O. Box 519
Hana, Maui, Hawaii 96713

Subject: POSITION OF NEGOTIATIONS COMMITTEE

Dear Libert,

The purpose of this letter is to clarify the position of the Negotiations Committee regarding the desire, as expressed during our Negotiations Session of 17 October 1991, of Keola Hana Maui to refer to its consultants the following:

a) The Community's Concerns regarding the Proposed Golf Course; and,

b) The General Concerns regarding the Environmental Assessment.

The concern of the Negotiations Committee is not referral. The General Concerns regarding the Environmental Assessment should, as a matter of course, be referred to Keola's consultants. Those concerns are expressed criticisms of their work product. The Community's Concerns regarding the Proposed Golf Course, as I explained, represent the community's views as conveyed to the Negotiations Committee from the community's viewing perspective. Referral of these concerns to the consultants retained by Keola is discretionary and of no concern to the Negotiations Committee. Similarly is referral of both of these concerns to the agencies critiquing the Environmental Assessment.

The concern of the Negotiations Committee is remedy. The General Concerns of the Environmental Assessment by nature will find remedy through the discernment of the adequacy of the Environmental Assessment. On the other hand, the Community's Concerns regarding the Proposed Golf Course should find remedy through the negotiations process. As the fundamental purpose for our negotiations is to " LET HANA'S PEOPLE, WITH HANA'S SENSITIVITIES, SOLVE HANA'S PROBLEMS ", the Negotiations Committee is concerned that this purpose will be negated if by referral of the Community's Concerns regarding the Proposed Golf Course to its consultants Keola is seeking to have these consultants rebut, through refinement of their reports and proposed mitigative measures, the sensitivities of the community. Then the process designed to achieve resolution is lost and then supplanted by a process designed to achieve dissolution.

Continued on next page.

For the integrity and continuance of negotiations, the parties, the committee representing the community and the spokespersons representing Keola, should not be constrained to debating the merits and demerits of the consultants' rebuttals nor constrained to adoption or rejection of the mitigative measures they propose. The parties in negotiations should be allowed to debate the merits and demerits of their concerns, to create their own solutions, and to determine their own mutually satisfactory resolution.

The community must feel comforted that its points of view have been explored, its issues and concerns discussed and debated, and its problems resolved in a mutually satisfactory mode. Arbitrary imposition of solutions by outside parties does not meet this test. Further, from my experiences, if such arbitrary imposition is unilateral, the reaction to this kind of act will negate any possible merits of the solutions being imposed.

Accordingly, it is and shall continue to be the position of the Negotiations Committee:

" LET HANA'S PEOPLE, WITH HANA'S SENSITIVITIES, SOLVE HANA'S PROBLEMS ! "

Nothing more, nothing less.

As to having Keola's consultants available as resources to the parties in negotiations, an offer tendered by the Negotiations Committee during our last session, the issue remains on the table for further consideration. Once it has been determined that Keola desires continuance of negotiations and that the concerns of the Negotiations Committee, as expressed in this letter, have been satisfactorily addressed, then I suggest that dialogue between the parties' negotiators commence on this proposal.

If you desire clarification of the foregoing, please contact me directly.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

cc: Negotiations Committee

Section "C"

CORRESPONDENCE

08 March 1992.

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793

SUBJECT: Request to be a Consulted Party

Dear Brian;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:
Applicant: Keola Hana Maui, Inc.
Consultant: Pacific Planning & Engineering, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

08 March 1992.

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713

SUBJECT: Request to be a Consulted Party

Dear Libert;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

<u>Accepting Authority</u>

Maui Planning Commission

<u>Consultant</u>

Pacific Planning & Engineering, Inc.

<u>Office of Environmental Quality Control</u>

cc: Negotiations Committee

08 March 1992.

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

SUBJECT: Request to be a Consulted Party

Dear Jonathan;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

Accepting Authority: Maui Planning Commission

Applicant: Keola Hana Maui, Inc.

Office of Environmental Quality Control

cc: Negotiations Committee

08 March 1992.

Brian J.J. Choy
Director
Office of Environmental Quality Control
220 South King Street
Central Pacific Plaza, Fourth Floor
Honolulu, Hawaii 96813

SUBJECT: Notice of the Requests of a Consulted Party

Dear Mr. Choy;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee filed Requests to be a Consulted Party and concurrently submitted its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana to:

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793 as the Accepting Authority

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713 as the Applicant

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814 as the Consultant

Enclosed with this letter is the submission of the Hana Community Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc..

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

cc: Keola Hana Maui, Inc.
Maui Planning Commission
Pacific Planning & Engineering, Inc.
Negotiations Committee

PACIFIC PLANNING
ENGINEERING INC

AC -ac
ES -
AM

March 10, 1992

Mr. Bill Fuhrmann, Chairman
Hana Negotiations Committee
P. O. Box 183
Hana, HI 96713

Dear Mr. Fuhrmann:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 8, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Please send any additional comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

08 March 1992.

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793

SUBJECT: Request to be a Consulted Party

Dear Brian;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann
Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

Applicant: Keola Hana Maui, Inc.
Consultant: Pacific Planning & Engineering, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

RECEIVED
MAR 25 1992

23 March 1992.

Alvin K.U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Subject: Additional Comments regarding the Hana Golf Course

Dear Al;

Pursuant to your letter of March 10, 1992, the Hana Community Negotiations Committee submits its offering of additional comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

Enclosed you will find this submittal.

If you have any questions regarding this matter, please contact me directly.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Hana Negotiations Committee

Copies to:

Maui Planning Commission
Keola Hana Maui, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

ADDITIONAL
COMMENTS OFFERED BY
the Hana Community Negotiations Committee

==

Issue: Effect of the international economic situation upon the hotel's capability to achieve its occupancy objective.

A credible examination and discussion regarding the effect of the international economic situation upon the hotel's capability to achieve its occupancy objective.

Issue: Effect of the national economic situation upon the hotel's capability to achieve its occupancy objective.

A credible examination and discussion regarding the effect of the national economic situation upon the hotel's capability to achieve its occupancy objective.

Issue: Effect of national politics upon the sale of golf course memberships in Japan.

A credible examination and discussion regarding the effect of national politics upon the marketing and sale of golf course memberships in Japan by Keola Hana Maui, Inc..

08 March 1992.

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713

SUBJECT: Request to be a Consulted Party

Dear Libert;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

<u>Accepting Authority</u>
Maui Planning Commission
<u>Consultant</u>
Pacific Planning & Engineering, Inc.
<u>Office of Environmental Quality Control</u>

cc: Negotiations Committee

---

23 March 1992.

Brian J.J. Choy
Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street
Central Pacific Plaza, Fourth Floor
Honolulu, Hawaii 96813

Subject: Additional Comments regarding the Hana Golf Course

Dear Mr. Choy;

Pursuant to the letter of March 10, 1992 from Pacific Planning and Engineering, Inc. (a copy is attached for reference), the Hana Community Negotiations Committee submits its offering of additional comments on the proposed action by Keola Hana Maui to develop a golf course in Hana.

Enclosed you will find this submittal.

If you have any questions regarding this matter, please contact me directly.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Hana Negotiations Committee

Copies to:

Maui Planning Commission
Keola Hana Maui, Inc.
Pacific Planning & Engineering, Inc.

cc: Negotiations Committee

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Bill Fuhrman, Chairman
Hana Negotiations Committee
P.O. Box 183
Hana, HI 96713

Dear Mr. Fuhrman :

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letters of March 8 and 23, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letters will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

b/file Hana Road Golf Course Please send copies to appropriate parties.

KALEPA FARM - Botanical Preserve

'92 MAR 23 P2:35

OFC. OF ENV. QUALITY C...

STAR ROUTE, BOX 181
HANA, MAUI
HAWAII 96713

March 18, 1992

RECEIVED
MAR 24 1992

O.E.Q.C.
720 South King St.
Honolulu, Hi. 96813

Dear Sirs.

As a citizen of the Hana area I am writing to you to express my views ana concerns regarding the proposed developement of a golf course in Hana. During my 14 years on Maui I have witnessed a tremendous ammount of growth, virtually all of it centered around tourism. Hana itself has become a "company town" balancing precariously on the success or failure of the Hotel Hana Maui, and now this golf course is being pushed in the supposed interest of insuring a strong steady business for the hotel, and hense economic security for Hana. Thanks to a handful of alert, aware residents resistance to this developement has come about.

Nationwide and worldwide tourism is declining, and here on Maui this is already being felt. Hotels that already have golf courses are at half capacity or less. A golf course is no insurance against the economic trends of the nation.

The economic environment of Hana would be benefitted much more by developement along the lines of agricultural diversity. Considering the soil fertility and climate, Hana could potentially produce abundant food crops, lessening our dependance on food shipped from the mainland & reducing the ammount of fossil fuel presently burned for its transport. The mowing maintanence on a golf course requires the burning of more fossil fuels, which is a major consideration regarding ozone depletion planet-wide and must not be down-played.

Sincerely,
Susan Richardson

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Ms. Susan Richardson
Kalepa Farm Botanical Preserve
Star Route Box 181
Hana, HI 96713

Dear Ms. Richardson:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 18, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

KA PILINA O HANA
P.O. BOX 267
HANA, MAUI 96713

RECEIVED
MAR 11 1992

March 9, 1992

Brian Miskae, Director
Maui Planning Commission
250 South High Street
Wailuku, Maui 96793

RE: CONSULTED PARTY STATUS

DEAR BRIAN:

In reference to the EIS Preparation Notice published in the OEQC Bulletin, Vol IX, No. 3 on Feb 8, 1992, Ka Pilina O Hana request to be recognized as a Consulted Party to Keola Hana Maui Inc. proposed "Hana Ranch golf course" in Hana.

If there are any questions, please contact me.

Very Truly Yours,

J. Kalani English, Spokesman
Ka Pilina O Hana

CC:

Applicant: Keola Hana Maui, Inc.
P.O Box 519
Hana, Maui 96713

Consultant: Pacific Planning & Engineering, Inc.
1221 Kapi'olani Blvd, Suite 740
Honolulu, O'ahu 96814

OEQC: OEQC
220 S. King Street
Central Pacific Plaza
Fourth Floor
Honolulu, O'ahu 96813

PACIFIC PLANNING
ENGINEERING, INC

March 11, 1992

Ka Pilina O Hana
P. O. Box 267
Hana, Maui, HI 96713

Dear Sir:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 9, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Please send any comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

NATIVE HAWAIIAN ADVISORY COUNCIL
A Nonprofit Corporation
1088 Bishop Street, Suite 1204, Honolulu, Hawaii 96813
Telephone (808) 523-1445
Facsimile (808) 599-4300

RECEIVED
MAR 24 1992

1992 March 23

Maui Planning Commission
250 S. High Street
Wailuku, HI 96793

Attention: Brian Miskae

RE: HANA RANCH GOLF COURSE EIS PREPARATION NOTICE

Native Hawaiian Advisory Council, Inc. (NHAC) assisted many Hana residents in declaring water uses and registering water sources withe the State Commission on Water Resource Management. We believe that the EIS for the proposed project must include reference to these declarations and registrations and assessments of the proposed project's potential impacts upon the water rights and water uses of Hawaiians in the Hana area.

This can best be accomplished by opening all phases and aspects of the EIS preparation process to public involvement. While state law does not require any public contact between this scoping exercise and the publication of the DEIS, we maintain that the fairest and most thorough assessment will occur when local residents are involved in choosing the assumptions, methodologies, and contractors used in compiling the EIS.

Unfortunately, our concerns about Hawaiian water rights and water uses are not being addressed at the regional level. Parties such as Keola Hana Maui, Inc., EMI, Nature Conservancy, and representatives of the Department of Land & Natural Resources are entering into cooperative management agreements for East Maui watersheds, but representatives of Hawaiian concerns are being shut out of the proceedings. The EIS must also address this lack of representation and seek means of resolving it so that Hawaiian water rights-holders and water users are involved in watershed management policy and decision making.

Mahalo,

David L. Martin

David L. Martin, Vice-President

pc: OEQC
Keola Hana Maui, Inc. (L. Landgraf)
Pacific Planning & Engineering, Inc. (J. Shimada)

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. David L. Martin, Vice-President
Native Hawaiian Advisory Council
1088 Bishop Street, Suite 1204
Honolulu, HI 96813

Dear Mr Martin:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 23, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

NATIVE HAWAIIAN LEGAL CORPORATION

1270 Queen Emma Street • Suite 1004 • Honolulu Hawaii 96813 • Telephone (808) 521-2302 • Fax (808) 537-4268

March 12, 1992

Libert Landgraf
Keola Hana Maui, Inc.
P.O. Box 519
Hana, Hawaii 96713

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Brian Miskae
Maui Planning Commission
250 S. High Street
Wailuku, Hawaii 96793

Re: Hana Ranch Golf Course

Gentlemen:

We hereby request to be a consulted party with respect to the Hana Ranch Golf Course project as described in the February 23, 1992, OEQC Bulletinn and ask that we be sent a copy of the Draft EIS for this project when it is circulated for public review. Thank you for your attention to this matter.

Very truly yours,

Carl C. Christensen

Carl C. Christensen
Staff Attorney

RECEIVED
MAR 19 1992

PACIFIC PLANNING
ENGINEERING, INC

March 16, 1992

Mr. Carl C. Christensen
Native Hawaiian Legal Corporation
1270 Queen Emma Street, Suite 1004
Honolulu, HI 96813

Dear Mr. Christensen:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 12, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Please send any comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: LILLIAN & CHARLES J. BOERNER

My address: S.R. 149 Hana, Maui Hi 96713

Telephone: 248-7179

Sincerely,

Lillian Boerner

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
ENGINEERING, INC

April 3, 1992

Mr. and Mrs. Charles J. Boerner
S.R. 149
Hana, HI 96713

Dear Mr. and Mrs. Boerner:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27 (received on April 3), you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

P. O. Box 622
Haiku, HI 96708
February 14, 1992

Mr. Jonathan Shimada
Pacific Planning and Engineering, Inc.
1221 Kapiolani Blvd., #740
Honolulu, HI 96810

Dear Mr. Shimada:

The Environmental Impact Statement for a golf course and related facilities in Hana should address the following:

1. Traffic impacts, not only within Hana but for the entire Hana Highway from Kahului to the golf course site. This must realistically predict the increase in the number of automobiles both coming and going, including the added number of cars attempting to pull off at the already overcrowded lookouts and waterfalls. Portions of the only paved road to Hana would not even meet the roadway standards required of a rural subdivision.

2. The social and cultural impacts of such an overpowering addition to this tiny rural community. A dining room that seats 200 and a parking lot for 150 cars might be fairly insignificant in a large urban setting, but will completely transform the prized sleepy village character of Hana.

3. Impacts on the community water supply. Hana already experiences severe water restrictions during drought periods. At times public camping is prohibited at Waianapanapa State Park due to water shortages. The proposed dining facility can only exacerbate such problems.

4. Both the local and island-wide impacts on the electrical power supply. Maui is already facing rolling blackouts as new hotels go on line. The Hana loop has a limited capacity and experiences frequent outages.

Please list me as a consulted party in the preparation of this EIS. Your attention to the above concerns in the Draft EIS will be appreciated.

Sincerely yours,

John Bose, II

cc: Maui Planning Dept.
OEQC
Keola Hana Maui, Inc.
Sierra Club (Maui Group)

RECEIVED
FEB 18 1992

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Mr. John Bose, II
P. O. Box 622
Haiku, HI 96708

Dear Mr. Bose:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of February 14, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Associate

B/file: Hana Ranch Golf Course. Please send copies to appropriate parties.

Alastair Couper
181 Star Route
Hana, Hi. 96713

Office of Environmental Quality Control
220 S. King St.
Honolulu Hi. 96813

'92 MAR 23 P2:34

OFC. OF ENVIR. QUALITY

Dear Friends.

The following comments concern the proposed golf course development by Keola Hana Maui. Now that the truth about ozone depletion is known more completely and the problem continues to worsen, all assessments of environmental affects must take this global crisis into account. As the process of global warming continues and the atmosphere becomes more unstable, focusing on mere economic and local concerns only amounts to harmful ignorance.

This proposed tourist amusement requires, like all tourism at present, huge exenditures of fossil fuels in order to operate. All the patrons will arrive and depart and cause air pollution in so doing. All the golf carts will either run on gasoline, or have their batteries charged by Maui Electric, who is being forced by rampant tourist over-development to consider coal fired power plants. The food which will be served at the facility will be grown, shipped, and prepared through the use of fossil fuels. The maintanence of the grounds will require fossil fuel powered tractors and power tools, and all the pesticides, herbicides, and fertilizers used are likely oil derived. These latter chemicals will leave their own residue in the soil. There is no segment of this development which does not contribute to global air pollution and obviously this is felt on the local level as a decrease in all the possibilities for living under the sky.

This development is entirely negative in impact. It represents rapacious and suicidal tendancies of those who stand to make large profit at the expense of the Earth. Reforestation and diversified agriculture are the best uses this land could be put to.

Thank you for considering these comments.

Sincerely,

Alastair Couper

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Mr. Alistair Couper
Star Route Box 181
Hana, HI 967813

Dear Mr Couper:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 18, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

FRIENDS OF THE HANA COAST
STAR ROUTE 96
HANA, HAWAII 96713

(808) 248-7769

RECEIVED
FEB 21 1992

February 19, 1992

The Maui Planning Commission
250 S. High Street
Wailuku, HI 96793

Dear Commission,

Please consider this letter our formal request to become a consulting party for the Environmental Impact Statement currently being prepared for the proposed Hana Ranch Golf Course. Preparation notice for this proposal was published February 8, 1992 in the OEQC Bulletin. Friends of the Hana Coast, Inc. wishes to receive all pertinent information about this proposal during the draft period.

Thank you for your considerations.

Sincerely,
Evelyn S. Dana
Evelyn S. Dana
President

CC: OEQC
Keola Hana Maui, Inc.
Pacific Planning & Engineering, Inc.

PACIFIC PLANNING
& ENGINEERING, INC

April 3, 1992

Friends of the Hana Coast
Ms. Evelyn S. Dana, President
Star Route 96
Hana, HI 96713

Dear Ms. Dana:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of February 19, 1992 regarding the Hana Golf Course Environmental Impact Statement (EIS). We have been and will continue to send all transmittals regarding the EIS to the Friends of the Hana Coast in care of Isaac Davis Hall, Attorney at Law.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

SENT BY:1505 E14th St;357-3721; 3-30-92 ; 15:45 ;CopyMatX765anLeandro→ 808 528 9748;# 1

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 1 of 1
To Jonathan Shimada	From Cheryl Duke
Co.	Co.
Dept.	Phone # 510-895-9046
Fax # 1-808-526-9748	Fax #

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: Cheryl Duke

My address: 15907 Mauhert Avenue
San Leandro, CA 94578

Telephone: 510-895-9046

Sincerely,

Cheryl Duke

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Ms. Cheryl Duke
15907 Mauhert Avenue
San Leandro, CA 94578

Dear Ms. Duke:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

ISAAC DAVIS HALL
ATTORNEY AT LAW
2087 WELLS STREET
WAILUKU, MAUI, HAWAII 96793
(808) 244-9017
FAX (808) 244-6775

OF COUNSEL:
G. RICHARD OESCH

RECEIVED
MAR 25 '92

March 23, 1992

Office of Environmental
Quality Control
State of Hawaii
220 S. King St., 4th floor
Honolulu, HI 96813

Mr. Alvin K.U. Chong
Pacific Planning &
Engineering, Inc.
122 Kapiolani Blvd. #740
Honolulu, HI 96814

Re: Comments on the preparation of the Draft EIS for the Hana Golf Course

Dear Office of Environmental Quality Control
and Alvin K.U. Chong:

This letter is written on behalf of the Friends of the Hana Coast, a group dedicated to assuring that sound environmental planning -- which is absolutely necessary to ensure the survival of the Hana community and Native Hawaiian culture in the area -- takes place. The Friends of the Hana Coast, as an entity, is now a consulting party. We trust that you will actively consult with concerned individuals and entities in Hana during the course of your work to make sure that a fully adequate Environmental Impact Statement ("EIS") is prepared.

We are particularly concerned about the adequate analysis and disclosure of the social impacts which will directly result from further resort development, such as the golf course, in Hana. It is our view that this will lead to irreparable cultural and ecological damage which will cause chronic social problems and human suffering. This is particularly so with respect to Native Hawaiians. Their cultural traditions are dependent upon the same natural resources that serve as the basis for development.

Particular attention should be paid to the wage scales which will be paid through the jobs created by the golf course. A cost/benefit analysis should be included which honestly discloses the extent of any economic benefits claimed to result from this project.

Pacific Planning was responsible for the contents of the inadequate Draft EIS for the Kahului Airport. Even though your company is being paid by the developer, you must make every effort to prepare a document in accordance with the applicable regulations and not a self-serving, heavily biased document the purpose of which is to convince decision-makers of the virtues of development.

Thank you for the opportunity to comment on your Draft EIS. Please feel free to consult the Friends of the Hana Coast throughout the preparation of this document.

Sincerely yours,

Isaac Hall

IH/jp
cc: Friends of the Hana Coast

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Friends of the Hana Coast
c/o Mr. Isaac Davis Hall
Attorney at Law
2087 Wells Street
Wailuku, HI 96793

Dear Mr. Hall:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 23, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

XEROX COPY

PAGE 01
204 Consulted P.

AC-RW
ES-ES
All other

02/28/92

RECEIVED
FEB 28 1992

Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

To the attention of ALyssa Miller
Via fax number 526-9748

Dear Madam:

I would like to be a consulted party in connection with EIS preparation for the Hana Ranch Golf Course. Please let me receive all documents relative to this request including the preparation notice and draft EIS.

My mailing address is : SR Box 190, Hana, HI 96713.
Telephone and fax number: 248-8001.

Thank you.

Sincerely,

Lisa Hamilton

Lisa Hamilton

P.S. Kindly verify that March 23rd is the deadline for receipt of comment.

February 28, 1992

Ms. Lisa Hamilton
S.R. Box 190
Hana, HI 96713

Dear Ms. Hamilton:

Subject: Hana Golf Course Environmental Impact Statement

In response to your request of February 28, you will be included as a consulted party during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control, which includes the agency comments you requested.

Please send any comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

RECEIVED
MAR 3 1 1992

03/29/92

Mr. Jonathan Shimada
Pacific Planning and Engineering, Inc.
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Keola Hana Maui EIS

Dear Mr. Shimada:

The EIS of the golf course and related facilities in Hana should fully disclose and address the following matters:

1) FINANCIAL IMPACTS: Reportely, Keola Hana Maui is in debt and the hotel is not making money.
a) Please incorporate Keola's financial statements, balance sheets and financial projections since the corporation aquired Hana Ranch.
b) show how the construction of the golf course and relative facilities will effect Keola's financial picture.

2) TOURIST DEPENDENCY: Many commentators have noted the adverse effect of over-dependency on the tourist industry. Please show how golf development in Hana will effect tourist dependency: increase, decrease or have no effect on dependency.

3) OZONE DEPLETION. Medical experts are warning that ozone depletion will have serious adverse health effects. Golf tends to be played at mid-day, the most dangerous period. Please show how Keola would be impacted if there were a serious down turn in golf tourism for this or other reasons.

4) A FOUR-LANE HIGHWAY TO HANA? The Maui Long-Range Highway Planning Study of May 1991 shows the plan to extend the Piilani Highway from Wailea to Hana at an estimated cost of \$83.5 million. Please show how Keola Hana Maui's investment in Hana would be impacted by opening up Hana to traffic coming directly from the Wailea resort area. Please evaluate how Hana would be impacted by direct access with such a highway.

Sincerely,

Lisa Hamilton

Lisa Hamilton
Hana, Hawai'i 96713

PACIFIC PLANNING
& ENGINEERING, INC

April 3, 1992

Ms. Lisa Hamilton
Star Route Box 190
Hana, HI 96713

Dear Ms. Hamilton:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 29, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

Ack copies to appropriate parties   FILE

February 13, 1992

'92 FEB 14 P4:39

OEQC
220 South King St.
Honolulu HI 96813

Sirs,

This is a request to be listed as Consulted Party in response to the EIS preparation notice in the 2/8/92 OEQC Bulletin for Hana Ranch Golf Course.

A request for the EIS preparation notice and EA has been mailed today to the the applicant's consultant.

Sincerely,

Carl R. Honig

Carl R. Honig, M.D.
Professor of Physiology
University of Hawaii
University of Rochester
45-200 Kokokahi Place
Kaneohe, HI 96744
(808) 247-2343

RECEIVED
FEB 19 1992

PROJECT NO. 204

February 13, 1992

Pacific Planning and Engineering, Inc.
1221 Kapiolani Blvd.
Honolulu, HI 96814

'92 FEB 14 P4:39

Dear Mr. Chong,

In accord with our 'phone conversation today, this is a formal request to be listed as Consulted Party for the DEIS for the Hana Ranch Golf Course.

I would appreciate receiving both the EA and the Preparation Notice.

Thank you for your attention to this matter.

Sincerely,

Carl R. Honig, M.D.
Professor of Physiology
45-200 Kokokahi Place
Unviersity of Hawaii
University of Rochester
Kaneohe, HI 96744
(808) 247-2343

xc OEQC

PACIFIC PLANNING
& ENGINEERING, INC

mailed to OEQC
2/24
AC-cc
CS
AM

February 24, 1992

Carl R. Honig, M. D.
45-200 Kokokahi Place
Kaneohe, HI 96744

Dear Dr. Honig:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of February 13, you will be included as a consulted party during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control, and the Environmental Assessment report.

Please send any comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,
Alvin K.U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

UNIVERSITY OF
ROCHESTER
MEDICAL CENTER

STRONG MEMORIAL HOSPITAL
SCHOOL OF MEDICINE AND DENTISTRY
SCHOOL OF NURSING

DEPARTMENT OF PHYSIOLOGY

March 2, 1992
Mr. Alvin K.U. Chong
Pacific Planning and Engineering Inc.
1221 Kapiolani Blvd. Suite 740
Honolulu HI 96814

Dear Mr. Chong,

The following comments should be considered in preparing the DEIS for the Hana Ranch Golf Course.

1. Please furnish legible topos showing location of golf holes and water features in relation to: a. potable water wells (County and Keola), b. gulches, and c. location of drainage ditches or culverts that receive surface flow from Ka Iwi o Pele cinder cone makai of the property.
Map 129 SCS Soil Survey of Islands ... shows a cinder cone just south of the property. Does this cone affect sheet flow on the site?

2. The DOH recommends use of class B wastewater for disposal of effluent on golf courses. Packaged plants generally do not meet that standard. Therefore a plan for the facility showing how class B wastewater will be achieved should be provided. Packaged IWS also may not be satisfactory for restaurant application, which generates wastewater somewhat different in composition from domestic wastewater. The plan should include redundancy, and at least 20 day storage capacity to permit repair without release of incompletely treated effluent. Operation, oversight, and contingency plans should be specified. Location of the lined storage facility should be indicated. The EA calls for a leach field system. How will this system be compatible with use of effluent for irrigation? The design of the leach field systems should be clarified.

3. Please furnish chemical name as well as product name for selected pesticides. Toxicity for aquatic species should be added to Tables. Your reference to Kleveno cannot be verified. If this data is unpublished a summary will help. Parameter values used in the modelling and an evaluation of the applicability of assumptions to this site should be provided. Please note that Rao's model is intended as rough screening procedure to rank possible choices; it is not appropriate to use it to infer extent of vertical or lateral transport. The design and operation of the pesticide storage and mixing facility should be specified. A monitoring plan for pesticides and nutrients should be provided. The monitoring plan should be directed to the underlying aquifer, and to nearshore water, biota and sediment.

4. A soil erosion control plan should be provided. This plan should be as specific and quantitative as possible. Though the layout of the golf course is not final, the plan will identify your approach to the problem: What mitigation measures will be used, where (assuming tentative plan) would containment devices be deployed, what would be their approximate capacity relative to expected run-off, how would the work be scheduled etc. If a soil transport model is used, give its structure, evaluate its assumptions, and provide parameter values.

5. Please do not respond to requests for specifics by stating that they will be dealt with in permitting applications. The purpose of the EIS process is informed permitting.

I look forward to reviewing the DEIS.

Sincerely,

Carl R. Honig

Carl R. Honig, M.D.
Professor of Physiology
University of Rochester
University of Hawaii
45-200 Kokokahi Place
Kaneohe, HI 96744
(808) 247-2343

Please address correspondence to my Kaeohe office.

601 Elmwood Avenue, Box 642
Rochester, New York 14642-8642
(716) 275-2591
Fax: (716) 461-1250

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Carl R. Honig, M. D.
45-200 Kokokahi Place
Kaneohe, HI 96744

Dear Dr. Honig:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 2, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

March 27, 1992

RECEIVED
MAR 26 [illegible]

Jonathan Shimoda
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimoda:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: Samuel Ka'eo

My address: 331 Noe St
Kihei Maui, HI 96753

Telephone: 879 7532

Sincerely,

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
ENGINEERING, INC

March 27, 1992

Mr. Samuel Ka'eo
331 Noe Street
Kihei, HI 96753

Dear Mr. Ka'eo:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

XEROX COPY

February [illegible], 199[illegible]

Maui Planning Commission
250 S. High Street,
Wailuku, Hawaii 96793
Attn: Brian Miskae

RECEIVED
MAR 0 2 1992

RE EIS preparation notice for Hana Ranch Golf Course "The Hana Ranch Country Club".
Comments and request to be a consulted party to the EIS for the Hana Ranch Golf Course published in the February 8, 1992 OEQC Bulletin.
===

My main concern regarding the development of a golf course in the Hana area is its economic viability in relation to the Hotel operations and the impacts that may occur if it in fact does not produce the results expected by the Economic Impact Study presented by Keola. Analysis of this Economic Study show multiple flaws in data and assumptions. It would suggest the need for a through market study and empirical evidence that this golf course will have a substantial positive impact on Hotel operations and limited negative impact on the Community.

Keolas' Report SectionIII page10-13, show a substantial increase in luxury resorts over the next 10 years yet does not shed any light on the direct impact to Hotel operations except to indicate that most of these resorts will have a golf course and therefore Keola must have a golf course to be competitive in the luxury market.

Keolas' Report SectionIV pg1, Shows a potential occupancy rate based on 365 days per year. Using 365 days, however, for predicting the number of rounds of golf played per year is not appropriate. There could be substantial loses of playable rounds due to the large rainfall in the Hana area. This will impact the bottom line stated in the projected balance sheet.

Using the University of Hawaii study "The Golf Industry in Hawaii 1990" pg 62 shows the best case scenario of 145 rounds per room unit per year at Mauna Kea, which is one of the most popular golf courses, and plugging this data in the 97 rooms at the Hotel Hana Maui, only produces about 14,000 rounds of guest play compared to Keola Report estimates of almost 17,000 rounds of guest play. This will also impact the bottom line projection. Keola Estimate of 17,000 rounds per year guest play equals a 175 per room per year rate of play which is 20% better than any other hotel has ever been able to produce.

Estimates for employment figures are taken directly form the University Report Table A-8. These estimates are used to project 1990 cost figures for golf operations. However the figures in the UH Report are based on [illegible] starting pay levels and should be considered low as stated in pg 13 of the UH Report.

The Impact on County of Maui Tax Revenue [illegible] states over $[illegible] in Revenue created. Are these figures not taxes from new visitors to Maui or [illegible] increase in occupancy that may be taken from other resort destinations in the County of Maui?

Management fees estimates for 199[illegible] are $[illegible], [illegible] this include fees that may be received from golf course operations?

A direct correlation exists between the [illegible] occupancy rates at the Hotel Hana and the dramatic [illegible] room rates especially when compared to the average [illegible] and room rates in the competitive luxury market.

Their entire report is based on assumptions [illegible] comparisons for occupancy, rate of golf play etc., appear to be based on a best case scenario. There Report shows a continuing loss of revenues. If they continue to lose revenues for 5,10,15,20 years what will the continuing impacts be to their viability and the impacts of social, economic and environmental on the community. Keola has stated that if they don't get a golf course they may have to liquidate some or all of their assets, but if they continue to loose revenues they may still have to liquidate assets. What is the difference?

This is not an exhaustive critique of the Economic Study but indicates the need for a more through market analysis.

Please feel free to contact me.

Francis JM Kennedy
P.O. Box 640
Hana, Maui, Hawaii 96713

248-8071

cc
Keola Hana Maui Inc.
Pacific Planning & Engineering Inc.
OEQC

PACIFIC PLANNING
& ENGINEERING, INC

March 30, 1992

Mr. Francis J.M. Kennedy
P.O. Box 640
Hana, HI, 96713

Dear Mr. Kennedy:

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of February 28, 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong
Alvin K.U. Chong
Associate

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

XEROX COPY

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: JUDY KINSER

My address: SR 167 A
HANA, HI 96713

Telephone: 248-8556

Sincerely, J. Kinser

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
& ENGINEERING, INC

April 1, 1992

Ms. Judy Kinser
S.R. 167 A
Hana, HI 96713

Dear Ms. Kinser:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27 (received on April 1), you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

RECEIVED

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: Pat O'Connell

My address: S.R. 148A
Hana, Hi 96713

Telephone: 248-7086

Sincerely,

Pat O'Connell

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Mr. Pat O' Connell
S.R. 148A
Hana, HI 96713

Dear Mr. O' Connell:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

Mickael Om Mast
3 Haneo'o Road
Hana, Maui 96713

RECEIVED
MAR 1 3 1992

March 9, 1992

Brian Miskae, Director
Maui Planning Commission
250 South High Street
Wailuku, Maui 96793

Dear Brian:

As noticed in the OEQC Bulletin, Vol. IX, No. 3 on Feb. 8, 1992, I request to be a Consulted Party to Keola Hana Maui Inc. proposed "Hana Ranch golf course" in Hana.

Thank you for your attention in this matter

Mahalo,

Mickael Om Mast

Mickael Om Mast

CC:

Applicant:	Keola Hana Maui,Inc. P.O. Box 519 Hana, Maui 96713
Consultant:	Pacific Planning & Engineering, Inc. 1221 Kapi'olani Blvd., Suite 740 Honolulu, O'ahu 96814
OEQC:	OEQC 220 S. King Street Central Pacific Plaza Fourth Floor Honolulu, O'ahu 96813

PACIFIC PLANNING
ENGINEERING, INC

March 14, 1992

Mr. Mickael Om Mast
3 Haneo'o Road
Hana, HI 96713

Dear Mr. Mast:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 9, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Please send any comments you would like us to consider in the preparation of the Draft EIS by March 23, 1992 to the following:

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

and

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

March 30, 1992

RECEIVED
MAR 31 1992

Jonathan Shimoda,
Pacific Planning and Engineering, Inc.
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Dear Mr. Shimoda:

The Environmental Impact Statement for a golf course and related facilities in Hana should address the following issues.

Instead of maintaining that the reason for a golf course in Hana is to keep up with the recent trend of the activity oriented tourist, there should be a priority placed on keeping Hana as a haven from just such resorts. Hana's allure is that it appeals to the tourist looking for a quiet, relaxing getaway with a touch of old Hawai'iana.

It is my opinion that to "Keep Hana Hawai'ian" and reduce the 'losses' of the Keola Hana Maui Corporation, it is advantageous to the community (as well as the corporation) to turn instead to an "eco-tourism" approach. This approach is not only a growing market at this time, but is also a business with a sustainable future.

Instead of contributing to the destructive development of Hana, there is an opportunity to create a sustainable alternative: A community working together to develope an eco-resort. This resort could consist of gardens for food self-sufficiency, alternative energy production, massage and healing arts programs, hiking trails, etc. All of this would have to be researched by the community to see that the needs of the Hana community are met.

The fate of Hana should be decided by the residents of the community. They should be the people who plan for their future. Not out-of-town big business who is in it to make money. A multinational corporation can not be a citizen of the community. Therefore it is not a desirable business owner in that community. They have not true commitment to the community other than a profit motive.

If the Keola Hana Maui Corp feels they can no longer afford to run the Hotel, they should finance their employees so they can purchase the hotel from them and see how co-operation and true commitment to the community can be profitable. The alternative I wish to have considered is for just such an arrangement.

I am not against the development of Hana. Change is the only constant in our world. Therefore even Hana must change. I do think, however, that any development that occurs should be approached from the aspect of How will this improve the Hana community for the Hana community? Not how will this profit the Keola Hana Maui Corporation. It is the job of local, state and federal government to protect the rights of all people. It's time for government to begin to stand up for the small communities and end it's incestuous relationship with big business.

Sincerely, J.T. Scott

J.T. Scott,
3948 Delphi Rd., S.W.
Olympia WA. 98502

PACIFIC PLANNING
ENGINEERING, INC

April 3, 1992

Mr. J. T. Scott
9981 Delphi Road
Olympia, WA 98502

Dear Mr. Scott :

Subject: Hana Golf Course Environmental Impact Statement

Thank you very much for your letter of March 30 1992 regarding the Hana Golf Course Environmental Impact Statement.

The concerns raised in your letter will be fully considered in the preparation of the Draft Environmental Impact Statement.

Sincerely,

Alvin K.U. Chong

Alvin K.U. Chong
Associate

XEROX COPY

March 27, 1992

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: Caroline Smith

My address: SR Box 166, Kipahulu
Hana, Maui HI 96713

Telephone: 248.8978

Sincerely,

Caroline Smith

Copy: Office of Environmental Quality Control
220 South King Street, Honolulu 96813

PACIFIC PLANNING
ENGINEERING, INC

March 30, 1992

Ms. Caroline Smith
S.R. Box 166, Kipahulu
Hana, HI 96713

Dear Ms. Smith:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

March 27, 1992

RECEIVED

Jonathan Shimada
Pacific Planning and Engineering, Inc.,
1221 Kapiolani Blvd.,
Honolulu, HI 96814

Re.: Consulted party, Hana Ranch Golf Course EIS.

Dear Mr. Shimada:

I wish to be a consulted party regarding the proposed Hana Ranch Golf Course EIS. The deadline for this request has been extended to March 30, 1992, one week, by the Maui Planning Department.

Please send documents, notices and Draft and Final EIS for this project to:

My name is: Rich von Wellsheim

My address: SR 156

Hana Hi 96713

Telephone: 808-248-8411

Sincerely,

Copy: Office of Environmental Quality Control

PACIFIC PLANNING
& ENGINEERING, INC

March 27, 1992

Mr. Rich Von Wellsheim
SR 156
Hana, HI 96713

Dear Mr. Wellsheim:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 27, you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

Sincerely,

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

SR 93
Ha'iku, Hawai'i 96708
March 19, 1992

Pacific Planning & Engineering, Inc.
1221 Kapiolani Blvd., Ste. 740
Honolulu, Hawai'i 96814

RECEIVED
MAR 2 4 1992

Attention: Jonathan Shimada

Dear Mr. Shimada:

I wish to be a consulted party in the EIS process for the Hana Ranch Golf Course. Please send me copies of the Environmental Assessment and EIS Preparation Notice, as well as any other publications and information which become available concerning this proposal, including copies of any engineering reports, Draft EIS and Final EIS.

Thank you.

Sincerely,

Elaine S. Wender

Elaine S. Wender

cc: Keola Hana Maui, Inc.
Maui Planning Commission

PACIFIC PLANNING
ENGINEERING, INC

March 24, 1992

Ms. Elaine S. Wender
SR 93
Haiku, HI 96708

Dear Ms. Wender:

Subject: Hana Golf Course Environmental Impact Statement

In response to your letter of March 19 (received on March 24), you will be consulted during the preparation of the Environmental Impact Statement (EIS) for a proposed Hana Golf Course project. Enclosed is a copy of the EIS Preparation Notice filed by the County of Maui, Planning Department with the Office of Environmental Quality Control.

For your information, the deadline for submitting comments to be considered during the preparation of the Draft EIS ended on March 23, 1992.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Associate

cc: Office of Environmental Quality Control

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

Draft EIS Comments Received From Agencies, Organizations and Individuals

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. BOX 50004
HONOLULU, HAWAII
96850

October 2, 1992

Mr. Keone Fairbanks
Maui Planning Department
County of Maui
250 S. High Street
Wailuku, Hawaii 96793

Dear Mr. Fairbanks:

Subject: Draft Environmental Impact Statement (DEIS) - Hana Ranch Country Club, Hana, Maui, Hawaii

We have reviewed the DEIS and have no additional comments to make at this time. Thank you for the opportunity to comment on this document.

Sincerely,

Warren M. Lee

WARREN M. LEE
State Conservationist

cc:
Mr. Libert Landgraf, Chief Operating Officer, Keola Hana Maui, Inc.,
P.O. Box 5519, Hana, HI 96713
Mr. Alvin K.U. Chong, Pacific Planning & Engineering, Inc.,
1221 Kapiolani Boulevard, Suite 740, Honolulu, Hawaii 96814

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. Warren M. Lee
State Conservationist
U. S. Department of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, HI 96850

Dear Mr. Lee:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of October 2 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K.U. Chong

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 52? ?748

United States Department of the Interior
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

RECEIVED
OCT 1 3 1992

September 25, 1992

Mr. Keone Fairbanks
County of Maui
Department of Planning
200 S. High Street
Maui, Hawaii 96793

Dear Mr. Fairbanks:

Subject: Draft Environmental Impact Statement (DEIS) Hana Ranch Country Club

The staff of the U. S. Geological Survey, Water Resources Division, has reviewed the subject (DEIS) and has no comments at this time.

At your request, we are returning the DEIS to Office of Environmental Quality Control.

Thank you for allowing us to review this petition.

Sincerely,

William Meyer
District Chief

Enclosure

cc: Mr. Libert Landgraf
Keola Hana Maui, Inc.
P. O. Box 519
Hana, Hawaii 96713

Mr. Alvin K. U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

PACIFIC PLANNING
ENGINEERING INC

November 23, 1992

Mr. William Meyer, District Chief
U. S. Department of the Interior
Geological Survey, Water Resources Division
677 Ala Moana Blvd., Suite 415
Honolulu, HI 96813

Dear Mr. Meyer:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 25 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Project Manager

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO
11010
Ser N42/3067
27 AUG 1992

Mr. Keone Fairbanks
County of Maui
Department of Planning
200 S. High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Fairbanks:

HANA RANCH COUNTRY CLUB

We have reviewed the Draft Environmental Impact Statement (DEIS) and have no further comments to offer. Since we have no further use for the DEIS, it is being returned to the Office of Environmental Quality Control (OEQC).

Thank you for the opportunity to review the DEIS.

Sincerely,

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Mr Libert Landgraf
Keola Hana Maui, Inc.

Mr. Alvin K. U. Chong
Pacific Planning and Engineering Inc.

PACIFIC PLANNING
ENGINEERING INC

November 23, 1992

Mr. W. K. Liu
Assistant Base Civil Engineer
Naval Base Pearl Harbor
Department of the Navy
Box 110
Pearl Harbor, HI 96860

Dear Mr. Liu:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of August 27 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 4748

RECEIVED
OCT 0 1 1992

(P)1830.2

SEP 30 1992

County of Maui
Department of Planning
200 South High Street
Wailuku, Maui, Hawaii 96793

Attention: Mr. Keone Fairbanks

Gentlemen:

Subject: Hana Ranch Country Club
Hana, Maui
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

Gordon Matsuoka

GORDON MATSUOKA
State Public Works Engineer

RY:jk
cc: Keola Hana Maui, Inc.
Pacific Planning and Engineering, Inc.
OEQC

PACIFIC PLANNING & ENGINEERING, INC

November 23, 1992

Mr. Gordon Matsuoka
State Public Works Engineer
Department of Accounting and General Services
State of Hawaii
1151 Punchbowl Street
Honolulu, HI 96813

Dear Mr. Matsuoka:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 30 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

ILIMA A. PIIANAIA
DEPUTY TO THE CHAIRPERSON

FAX: 973-9613

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96823-2159

October 5, 1992

RECEIVED
OCT 07 1992

TO: Keone Fairbanks
Department of Planning
County of Maui

FROM: Yukio Kitagawa, Chairperson
Board of Agriculture

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Hana Ranch Country Club
Applicant: Keola Hana Maui, Inc.
Request: Develop 18-Hole Golf Course, Driving Range and Clubhouse
Area: Approximately 201 acres, Hana, Maui
Tax Map Key: 1-4-2:7, 9, and 10; 1-4-2:por 4 and 8; 1-4-3:6; 1-4-3:por 5 and 9; and 1-4-7:por 4

The Department of Agriculture (DOA) has reviewed the subject statement and has determined that the DEIS has adequately addressed our concerns on agricultural lands and resources and the impact of pesticide use. Our Department has no additional comments to offer.

Thank you for the opportunity to comment.

c: Keola Hana Maui, Inc.
Attn: Libert Landgraf
Pacific Planning Engineering, Inc.
Attention: Alvin K.U. Chong
Office of Environmental Quality Control

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, HI 96814

Dear Mr. Kitagawa:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 5 regarding the above project. Your comments that the DEIS has adequately addressed your concerns on agricultural lands and resources and the potential impact of pesticide use will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM
ENERGY DIVISION, 335 MERCHANT ST., RM. 110 HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

RECEIVED
SEP 15 1992

September 10, 1992

Mr. Keone Fairbanks
County of Maui
Department of Planning
Wailuku, Maui 96793

Dear Mr. Fairbanks:

Subject: Hana Ranch Country Club
Island of Maui, District of Hana
Tax Map Key: 1-4-02:7, 9, and 10
1-4-02:portion 4 and 8
1-4-03:6
1-4-03:portion 5 and 9
1-4-07:portion 4

We wish to inform you that we have no comments to offer on the subject Draft Environmental Impact Statement (DEIS). We are returning the DEIS with no comments.

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:hkeis50

cc: Office of Environmental Quality Control
Keola Hana Maui, Inc.
Pacific Planning & Engineering, Inc.

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Maurice H. Kaya
Energy Program Administrator
Department of Business, Economic Development & Tourism
State of Hawaii
335 Merchant St. Room 110
Honolulu, HI 96813

Dear Mr. Kaya:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 10 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9165 ▲ FAX (808) 526-9748

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

RECEIVED
OCT 15 1992

October 13, 1992

TO: Mr. Keone Fairbanks
Department of Planning
County of Maui
200 S. High Street
Wailuku, Hawaii 96793

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: HANA RANCH COUNTRY CLUB DRAFT ENVIRONMENTAL IMPACT STATEMENT

We appreciate the opportunity to comment on the draft Environmental Impact Statement for the Hana Ranch Country Club, Hana, Maui, Hawaii. We do not object to the environmental assessment (EA).

While we do not have negative comments specifically directed at this particular EA, we do wish to offer a proposal for State Civil Defense, Department of Defense, State of Hawaii. Recommend consideration of at least one new siren simulator device and the siren simulator support infrastructure. The location for this simulator is normally in an office that is manned 24 hours. Siren simulators are large, suitcase size, portable sirens, complete with built-in battery backup power. The siren simulators are triggered by the same radio system that triggers the outdoor sirens. The installation of such a device consists of a siren simulator, an antenna cable duct, typically from ground floor level to the rooftop. Additionally, the site may be suitable for a facility(s) to house a Limited Automated Remote Collector (LARC) rain gauge. A LARC provides real-time remote rainfall data collection and information. This addition would enhance the existing LARC system and the National Weather Service and Civil Defense's ability to plan for the safety and well-being of the population at risk.

Our State Civil Defense planners and technicians are available to discuss this further if there is a requirement. Please have your staff contact Mr. Mel Nishihara at 734-2161.

bc: Mr. K. U. Chong
Pacific Planning & Engineering, Inc.

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. Roy C. Price, Sr.
Vice-Director of Civil Defense
Department of Defense
3949 Diamond Head Road
Honolulu, HI 96816

Dear Mr. Price:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of October 13 regarding the above project. The project will include the construction of a weather station which will be made available to you. In response to your request for consideration of a siren simulator device and support infrastructure, Keola Hana Maui, Inc. is open to discussing the matter with you.

Sincerely,

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9165 ▲ FAX (808) 526-4748

FACILITIES' COPY

STATE OF HAWAII
DEPARTMENT OF EDUCATION

September 1, 1992

Mr. Brian Hiskae
Planning Director
Maui Planning Department
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Hiskae:

SUBJECT: Draft Environment Impact Statement (DEIS)
Hana Ranch Country Club
TMK: 1-4-02: 7, 9, and 10; 1-4-02: por. 4 and 8; 1-4-03: 6; 1-4-03: por. 5 and 9; 1-4-07: por. 4

Our review of the subject DEIS indicates that the proposed golf course development will have minimal impact on the student enrollment at Hana High and Elementary School.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga
L. Lindsey

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Charles T. Toguchi, Superintendent
Department of Education
State of Hawaii
P. O. Box 2360
Honolulu, HI 96804

Dear Mr. Toguchi:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 1 regarding the above project. Your comments will be included in the Final EIS.

For your information, enclosed is our response to the Hana High and Elementary School PTSA.

Sincerely,

Alvin K. U. Chong
Project Manager

RECEIVED OCT - 5 1992

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

October 2, 1992

Mr. Libert Landgraf
Chief Operating Officer
Keola Hana Maui Inc.
P. O. Box 519
Hana, Hawaii 96713

Dear Mr. ~~Landgraf~~ Libert,

Subject: Draft EIS for the Hana Ranch Country Club (18-Hole Golf Course)

The proposed project will have no direct impacts upon the programs and projects of the Department of Hawaiian Home Lands (DHHL).

As a state agency concerned for the welfare of native Hawaiians, the DHHL appreciates portions in the assessment which address the likely social impacts of the development on the local Hawaiian community.

Thank you for the opportunity to comment.

Warmest aloha,

Hoaliku L. Drake
Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:BH:JC:asy/2582L

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Ms. Hoaliku L. Drake, Chairman
Hawaiian Homes Commission
State of Hawaii
P.O. Box 1879
Honolulu, HI 96805

Dear Ms. Drake:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of October 2 regarding the above project. Your comments that the project will have no direct impacts upon the programs and projects of the Department of Hawaiian Home Lands will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

RECEIVED
OCT 1992

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

October 7, 1992

92-321/epo

Mr. Brian Miskae, Director
Department of Planning
County of Maui
200 High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Miskae:

Subject: Comments on the Draft Environmental Impact Statements (DEIS)
Hana Ranch Country Club
Hana, Maui

Thank you for allowing us to review and comment on the subject document. We had earlier commented on the Environmental Assessment (EA) by letter, dated November 26, 1991, from our Chief Sanitarian on Maui, Mr. David Nakagawa. The DEIS should include the new "Twelve Golf Course Conditions Applicable to All New Golf Course Development", January 1992 (Version 4), copy enclosed. These "Twelve Conditions" should replace the "Eight Conditions" referred to in the EA.

If you should have any questions on our comments, please contact David Nakagawa at 243-5254.

Very truly yours,

for
JOHN C. LEWIN, M.D.
Director of Health

Enc.

c: Keola Hana Maui (Libert Landgraf)
Pacific Planning & Engineering, Inc. (Alvin Chong)
Maui District Health Office (David Nakagawa)
Office of Environmental Quality Control

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Dr. John C. Lewin, Director
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801

Dear Dr. Lewin:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7 regarding the above project. Section 6.3.3 of the DEIS states that Keola Hana Maui, Inc. "will fully comply with the State Department of Health's 12 conditions applicable to new golf course developments, including the establishment of baseline groundwater data and the implementation of an approved groundwater monitoring plan and system."

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HUMAN SERVICES
Planning Office
P.O. Box 339
Honolulu, Hawaii 96809

WINONA E. RUBIN
DIRECTOR

LYNN N. FALLIN
DEPUTY DIRECTOR

LESLIE S. MATSUBARA
DEPUTY DIRECTOR

RECEIVED
OCT 1 ...

September 28, 1992

Mr. Keone Fairbanks
County of Maui
Department of Planning
200 S. High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Fairbanks:

Subject: DEIS, Hana Ranch Country Club, Hana, Maui
TMK: 1-4-02: 7,9 & 10; 1-4-02: portion of 4 & 8, 1-4-3: 6; 1-4-3: por. 5&9; and 1-4-7: por 4.

Thank you for the opportunity to review this project. We have no comments to offer.

Sincerely,

Winona E. Rubin
Director

cc: Keola Hana Maui, Inc.
Pacific Planning & Engineering, Inc.

AN EQUAL OPPORTUNITY AGENCY

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Ms. Winona E. Rubin, Director
Department of Human Services
State of Hawaii
P. O. Box 339
Honolulu, Hawaii 96809

Dear Ms. Rubin:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 28 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA:KCK

OCT 8 1992

FILE NO.: 93-134
DOC. ID.: 1487

RECEIVED

The Honorable Brian Choy, Director
Office of Environmental Quality Control
Central Pacific Plaza
220 S King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: Draft Environmental Impact Statement for the Hana Ranch Country Club, Hana, Maui, TMK: Various

Thank you for giving our office the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Commission on Water Resource Management

An 18-hole golf course is proposed for the Hotel Hana Maui. The potable water supply requirement of 20,000 to 30,000 gpd would be requested of the Maui Department of Water Supply. However, if this request is not approved, the developer proposes to construct the necessary improvements to obtain potable water from the existing Wananalua well source owned by Hana Ranch.

Also, an estimated average 70,000 gpd of non-potable water required for golf course irrigation would be provided by restoring an existing 5-acre rain catchment and storage system. Here, the use of untreated water from the rain catchment system would be in compliance with Maui County's recently enacted ordinance that prohibits the use of potable-quality water for golf course irrigation. At the same time, it would be consistent with the state Water Commission's regulatory policy that recommends that only water of equal or better quality be applied on lands overlying potable water aquifers.

The developer is informed of the need to secure appropriate stream channel alteration permits if streams in the project site are altered or otherwise modified in connection with the construction of the golf course or its ancillary facilities.

Division of Aquatic Resources Comments:

There apparently will be no activities that will markedly impact the streams in inshore marine waters. Surveys found no populations of native diadromous fishes or invertebrates. The golf course ponds will not be stocked with species that could be harmful to the environment if they escape. Given these conditions, we have no objections to the project from the aquatic resources standpoint.

In addition, our Department's Historic Preservation Division will repond in a separate letter.

Thank you for your cooperation in this matter. Please feel free to call Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

John P. Keppeler

for WILLIAM W. PATY

cc: County of Maui, Dept. of Planning
Pacific Planning and Engineering, Inc.

COPY

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OCT 03 1992

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

October 5, 1992

LOG NO.: 6200
DOC NO.: 2532a

Mr. Brian Miskae, Director
Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

SUBJECT: Historic Preservation Review of the Draft Environmental Impact Statement for the Hana Ranch Country Club (Keola Hana Ranch Maui, Inc.)
Hana, Maui
TMK: 1-4-02:7,9, & 10; 1-4-02: por. 4 & 8; 1-4-03:6, por. of 5 & 9; 1-4-07: por. 4

Thank you for the opportunity to review and comment on this document.

Our comments are limited only to historic preservation concerns, specifically Section 6.9, Historic and Archaeological Resources; and Appendix G, Archaeological Inventory Survey and Subsurface Testing for the Proposed Hana Ranch Country Club.

Section 6.9

This section has adequately presented the results of an archaeological survey conducted on an area approximately 400 acres, half of which covers the project site. Of the total of 51 historic sites identified, 23 are within or partially inside the boundaries of the proposed golf course. Figure 6.9.1 shows the location of the sites within the survey area and the project site. Table 6.9.1 clearly presents a summary of all the sites identified, along with the significance criteria and tentative recommendations for mitigation. Table 6.9.2 is a repetition of Table 6.9.1 except that it includes only those 23 sites within the project site. According to this table, 4 sites are "no longer significant", 18 are significant for their information content (criterion d) only, and 1 site (2742, railroad grade) is assessed significant under multiple criteria. We concur with the significance assessments except for 2742. We believe that not

enough evidence was presented in the report to support significance under criterion b, associated with the lives of persons significant in the past. Nonetheless, this means that we agree that 19 significant historic sites are within the project area.

We agree with the mitigation commitment for these 19 sites -- 10 to undergo archaeological data recovery and 9 sites to be preserved (3 historic period sites only for selective preservation).

The next step in mitigation would be the preparation of detailed archaeological data recovery and preservation plans, to be approved by our Division and your department. This Draft EIS states that a data recovery plan will be developed. There is no mention of a preservation plan. We recommend that the Final EIS include a statement that a detailed preservation plan including provisions for buffer zones, protective measures during construction work, and long-term preservation measures will be developed, and must be approved by our Division and your department.

The Final EIS should also include a final statement saying that our Division and your department will verify that these plans have been successfully concluded.

Appendix G

The report entitled Archaeological Inventory Survey and Subsurface Tesing for the Proposed Hana Ranch Country Club (Borthwick et al. 1992) was reproduced in its entirety as Appendix G of this Draft EIS. It appears that all sites within the project area have been identified and that adequate information has been collected to assess their significance. We have a few comments on this report, and the report needs minor revision, with a revised copy should be submitted to our office. Also, the Final EIS should incorporate the revised report.

1) Some inventory data on 2 sites (2721 and 2727) assessed to be "no longer significant" are lacking. A site plan and a representative profile from the test pit at site 2721 must be included. Site 2727 has no site plan. These data must be included in the descriptions to fully document that sufficient information has been collected from these sites.

2) Page 76: What does Fig. * in the descriptions of 2741 and 2742 represent? There are no site plans for these sites.

3) If indeed site 2742 is also significant because of its association with a person significant in Hana's past, then this information must be included in the site description.

4) Except for the significance criteria for each site presented in Table 1, the report has made no significance assessment of all the sites. There should be a brief section of text at the end of the report evaluating the significance of the sites, with a reference to Table 1.

Should you have any questions about these comments, please contact Ms. Annie Griffin at 587-0013.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

AG:aal

c: Sam Lemmo, OCEA (File No.:93-134)

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. William W. Paty, Chairperson
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, HI 96809

Dear Mr. Paty:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letters of October 5 and 8 regarding the above project. The following are responses to your comments:

Historic and archaeological resources. The Final EIS will provide additional information on Site 2742. Cultural Surveys Hawaii's report, for example, will include references to Mr. August Unna as the person responsible for railroad construction and land consolidation that eventually became Hana Plantation.

The Final EIS will include a statement that a detailed preservation plan including provisions for buffer zones, protective measures during construction work, and long-term preservation measures will be developed, and must be approved by the State Historic Preservation Division (SHPD) and the Maui Planning Department. The Final EIS will also state that the foregoing agencies will verify that these plans have been successfully concluded.

Cultural Surveys Hawaii's report (Appendix G) will be revised to incorporate and address the four comments made. The revised report will be included in the Final EIS and submitted to the SHPD.

Commission on Water Resource Management. The golf course and cart paths will be designed to avoid altering any stream channels.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 5748

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
HWY-PS
2.3948

SEP 30 1992

RECEIVED
OCT 0 1 1992

Mr. Brian Miskae
Director
Planning Department
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Attention: Mr. Keone Fairbanks

Dear Mr. Miskae:

Draft Environmental Impact Statement, Hana Ranch Country Club, Hana, Maui; TMK: 1-4-02: 7, 9, 10, por. 4 & 8; 1-4-03: 6, por. 5 & 9; 1-4-07: por. 4

We are responding to the request from the Office of Environmental Quality Control for our review and comment of the subject document.

The developer should implement the intersection improvements recommended in their Traffic Impact Assessment Report to improve safety and traffic flow. We have no additional comment on the proposed project.

Sincerely,

T. Harano
for Rex D. Johnson
Director of Transportation

RI:gf

c: Libert Landgraf, Keola Hana Maui, Inc.
Alvin K. U. Chong, Pacific Planning & Engineering, Inc.
OEQC

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Rex D. Johnson, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813

Dear Mr. Johnson:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 30 regarding the above project. Keola Hana Maui, Inc., will implement the intersection improvements recommended in the Traffic Impact Assessment report if the project obtains the appropriate approvals.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

RECEIVED

IN REPLY REFER TO:
92:PPE/4998mo

October 7, 1992

County of Maui
Department of Planning
200 S. High Street
Wailuku, Maui, HI 96793
Attn: Mr. Keone Fairbanks

Dear Mr. Fairbanks:

Subject: Hana Ranch Country Club Draft Environmental Impact Statement (DEIS)

We have reviewed the subject document and have the following comments to offer:

1. In section 7.2 Housing, a study was mentioned which is not included in your appendix. We would like to see the study which established the need for 47 additional housing units and how it was derived.

2. Section 7.2.2 states that Keola is providing assistance to the Hana Affordable Housing and Community Development Corporation (HAHCDC). How is this assistance being provided? If through contributions, what type of formula is used to equate the required assistance?

3. The State Housing Functional Plan policy B(3) state that projects which impact housing need provide an adequate amount of affordable housing opportunities. The correlation between the proposed project and affordable housing opportunities has not been fully addressed.

4. Please clarify the statement, "Hana's housing projects are government-assisted efforts which is significant in that there have been no prior public sector housing projects in Hana."

If there are any questions in this matter, please contact Michele Otake at 587-0637.

Sincerely,

JOSEPH K. CONANT
Executive Director

c: Office of Environmental Quality Control - Mr. Keone Fairbanks
Keola Hana Maui, Inc. - Mr. Libert Landgraf
Pacific Planning and Engineering, Inc. - Mr. Alvin K.U. Chong

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. Joseph K. Conant, Executive Director
Housing Finance and Development Corporation
State of Hawaii
677 Queen Street, Suite 300
Honolulu, HI 96813

Dear Mr. Conant:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7 regarding the above project. The following are responses to your comments:

Additional housing. The 47 additional housing units were estimated using historical trends. Based on a regression analysis, Hana's resident population was forecast to increase from 1,895 residents in 1990 to 2,040 residents in 1995 (Section 7.1.2 of the DEIS). The forecast increase in 145 residents was divided by a factor of 3.09 (persons per household, 1990 Census) to derive the estimated 47 additional housing units that would result under the No-Action Alternative based upon historical trends.

Hana Affordable Housing and Community Development Corporation (HAHCDC). Section 7.2 of the DEIS discusses the current housing efforts in Hana and the probable impacts of the golf course project on housing.

The non-profit Hana Affordable Housing and Community Development Corporation (HAHCDC) was created to develop affordable housing for the residents of Hana. Keola has played the key role of sponsor for this organization. It has been instrumental in getting it started. To this end, Keola has provided assistance to the HAHCDC in the form of start-up, training, orientation, studies, surveys, workshops, legal and consultant fees, travel, inspection tours, clerical support, technical resources and funding. They have previously committed a donation of 15 acres of land for a single-family affordable housing project.

State Housing Functional Plan policy B(3). In addition to the above assistance to the HAHCDC, Keola will provide further direct support (i.e., land, funding, or in-kind services) to mitigate the housing needs of the project. However, the HAHCDC is a free standing entity, separate from and independent of Keola. To the extent that Keola resources, financial, staffing or otherwise are accepted, the HAHCDC will retain its independent status.

Accordingly, a memorandum of understanding will be executed to clearly delineate the on-going relationship between Keola and HAHCDC, particularly the types of financial and other types of support which Keola may give to the HAHCDC, as both parties work to increase the supply of affordable housing for the residents of Hana.

It should be noted, that a significant number of Hana residents that currently work outside of Hana have expressed a strong desire to work at the golf course in Hana which would reduce the housing needs of the project.

Public sector housing projects. The Final EIS will state that the government housing agencies have been cooperative and helpful in the past. The recent appropriations totaling $1,000,000 by the State and County are evidence of this support for housing in Hana.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

'92 OCT -5 P4:14
DEPT OF PLANNING
COUNTY OF MAUI
RECEIVED

September 30, 1992

Mr. Brian Miskae, Planning Director
County of Maui Planning Department
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

Subject: Hana Ranch Country Club, Draft Environmental Impact Statement (EIS)

Thank you for submitting the above mentioned document for our review. We have the following comments:

Please discuss the impacts of the proposed Hana Town Center and Housing projects if they are to be developed in conjunction with the golf course and club house.

Provide a list of those who had no comment on the EIS Preparation Notice and the Draft EIS as required by Hawaii Administrative Rules (HAR) §11-200-17(p).

The Summary of Unresolved Issues section of the Draft EIS states that, "It is expected that the large majority of (unresolved) issues will be resolved to the satisfaction of the community, government and Keola." Section 11-200-17(n), HAR, requires that the Draft EIS contain, "a summary of unresolved issues and either a discussion of how such issues will be resolved prior to commencement of the action, or what overriding reasons there are for proceeding without resolving the problems."

Please follow the requirements of HAR §11-200-22(c)(1) and (2), which requires that responses to comments on the Draft EIS include a, "Point-by-point discussion of the validity, significance, and relevance of comments and a discussion as to how each comment was evaluated and considered in planning the proposed action. The response shall endeavor to resolve conflicts, inconsistencies, or concerns." It would also be helpful for your response letters to indicate where information pertinent to the specific comment is located in the EIS.

Letter to Brian Miskae
September 28, 1992
Page 2

If you have any questions, please contact Margaret Wilson or Karen Mau at 586-4185.

Sincerely,

Brian J. J. Choy

Brian J. J. Choy
Director

PACIFIC PLANNING

ENGINEERING INC

November 23, 1992

Mr. Brian J. J. Choy, Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, HI 96813

Dear Mr. Choy:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of September 30 regarding the above project. The following are responses to your comments:

Hana Town Center and housing projects. The Hana Town Center project will not be developed in conjunction with the golf course project. The Town Center project is currently on hold and would be an incremental upgrading or replacement of already existing facilities such as the Hana Store, purchasing, engineering, motorpool and laundry facilities.

Section 4.1 of the DEIS clearly states "There are no plans to increase the number of guestrooms or cottages at the Hotel Hana-Maui, nor to construct luxury homes or condominiums around the golf course."

EIS rules. The Final EIS will comply with the EIS Rules on persons with no comments, Summary of Unresolved Issues, and responses to comments.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

FAX TRANSMITTAL
OCT 26 '92 15:27 ... 808 248-8147

To: AL CHONG
Dept: PP&E
From: Libert Landgraf
Co: KHMI
Fax #: 526-5748 (?)

P.1

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAII 96813-5249
PHONE (808) 586-3777
FAX (808) 586-3799

October 22, 1992

Mr. Libert Landgraf
Keola Hana Maui, Inc.
P.O. Box 519
Hana, Hawaii 96713

Re: Draft Environmental Impact Statement for the Hana Ranch Country Club

Dear Mr. Landgraf:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement (DEIS) for the Hana Ranch Country Club. We apologize for the delay in our comments.

The DEIS contains a very good discussion of the history and economics of the project. The section dealing with the area of social issues was also complete and forthright.

However, we found two areas which needed additional information. First, we found the information on water quality extensive but incomplete. Of particular concern is the response to the question: will the fresh water springs which form along the coast and mix with the sea water, will be tainted by pesticides and fertilizers?

Second, the DEIS did not include a discussion of land title. From time to time, the project plans have included parcels of land that were subject to a land exchange between the State of Hawaii and Keola Hana Maui, Inc., and lands disputed in quiet title actions. A discussion of these issues, or their resolution should also be included in the description of the project.

Again, thank you for the opportunity to participate in this project. If you have any questions please contact Lynn Lee, at 586-3777 in the Land and Natural Resources Division.

Sincerely,

Richard K. Paglinawan
Administrator

cc: Clayton Hee, Chair
Board of Trustees

PACIFIC PLANNING
ENGINEERING INC

November 23, 1992

Mr. Richard K. Paglinawan, Administrator
Office of Hawaiian Affairs
State of Hawaii
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Dear Mr. Paglinawan:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 22 regarding the above project. The following are responses to your comments:

Fresh water springs. A spring, by definition, is where ground water flows naturally from a rock or the soil onto the land surface or into a body of surface water (Bates and Jackson, 1980). Page 5 of Appendix E states "... pesticide concentrations at the top of the aquifer would be no greater than 1/76th of the lifetime drinking water Health Advisory Levels and generally much lower." Page 192 of Appendix E states "With concentrations this low in the ground water, it is unnecessary to attempt to determine concentrations that might occur down gradient of the site or as a result of ground water extrusion (springs) to the open coastline. The additional dilution would further reduce the pesticide concentrations to infinitesimal values, far below concentrations that are action levels or criteria for aquatic organisms."

Land title. Since the preparation of the Environmental Assessment, the project boundaries have been revised to exclude all lands where land ownership was questioned or State lands. The entire project site is owned by Keola Hana Maui, Inc., and there are no parcels where ownership is under dispute (Section 2.4 of the DEIS).

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

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OCT 07 1992

OFFICE OF STATE PLANNING
Office of the Governor

MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808) 587-2846, 587-2800
FAX: Director's Office 587-2846
Planning Division 587-2824

October 6, 1992

The Honorable Brian Miskae
Planning Director
Planning Department
County of Maui
200 South High Street
Wailuku, Maui 96793

Dear Mr. Miskae:

Subject: Comments on Draft Environmental Impact Statement for the Hana Ranch Country Club
Applicant: Keola Hana Maui, Inc.
Tax Map Key Nos.: 1-4-02: 7, 9 and 10; 1-4-02: 4 (por.) and 8; 1-4-03: 6; 1-4-03: 5 (por.); and 1-4-07: 4 (por.)
Hana, Maui

The Office of State Planning (OSP) has reviewed the Draft Environmental Impact Statement (DEIS), and offers the following comments.

The Applicant, Keola Hana Maui, Inc., is requesting an amendment to the Hana Community Plan for approximately 201 acres from Agriculture to Park designation. The subject property is classified within the State Agricultural Land Use District. The soils within the subject property are rated C, D and E by the Land Study Bureau.

The redesignation is being proposed for the development of an 18-hole golf course, clubhouse and related facilities at the Hotel Hana-Maui. According to the DEIS, the proposed golf course would "allow the Hotel Hana-Maui to become more competitive within the primary luxury hotel market." Further assurances should be given to determine the financial feasibility of the Hotel Hana-Maui with the addition of the proposed golf course.

The DEIS should address the relationship of the proposed project to the land use issues and recommendations contained in the following two reports published by OSP: 1) Golf Course Development in Hawaii: Impacts and Policy Recommendations; and 2) Five-Year Boundary Review, Maui County Assessment (Draft).

Thank you for the opportunity to comment. Should you have any questions, please call the Land Use Division at 587-2886.

Sincerely,

Harold S. Masumoto
Director

cc: Mr. Libert Landgraf
Mr. Alvin K.U. Chong
Mr. Brian Choy, OEQC

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. Harold S. Masumoto, Director
Office of State Planning
State of Hawaii
P.O. Box 3540
Honolulu, HI 96811

Dear Mr. Masumoto:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 6 regarding the above project. The following are responses to your comments:

Project feasibility. Section 7.5 of the DEIS and Appendix B fully discuss the feasibility of the project. Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The Kato Group, the major shareholder of Keola Hana Maui, Inc. (Keola), owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

Keola has sufficient financial resources to complete construction of the golf course if the project is approved in a timely manner.

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9165 ▲ FAX (808) 526 9748

Land use. The Final EIS will discuss the project's relationship to OSP's two reports: Golf Course Development in Hawaii: Impacts and Policy Recommendations; and Five-Year Boundary Review, Maui County Assessment (Draft).

Sincerely,

Alvin K. U. Chong
Project Manager

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

ESTHER UEDA
EXECUTIVE OFFICER

RECEIVED
SEP 09 1992

September 4, 1992

Mr. Brian Miskae
Planning Director
County of Maui Planning Department
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

Subject: Comments on Hana Ranch Country Club Draft Environmental Impact Statement

The Department of Business, Economic Development & Tourism has forwarded the subject Draft Environmental Impact Statement (DEIS) to our office for review and comment.

We have reviewed the subject DEIS and wish to make the following comments.

1) On page 20, under Section 2.3.1 - State Land Use Designations, it should be clarified that golf courses are permitted activities in the Agricultural District provided that they are not located within lands with soil classified by the Land Study Bureau as "A" or "B".

2) On page 58, under Section 6.2.1.1 - ALISH Classifications, the ALISH Classifications are not established by the State Land Use Commission as stated, but rather by the State Department of Agriculture, with assistance from the SCS and College of Tropical Agriculture, University of Hawaii.

We have no further comments to offer at this time.

Thank you for the opportunity to provide comments on this matter. If you should have any questions, please feel free to contact me or Leo Asuncion of my staff at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

cc: DBED
OEQC
Mr. Libert Landgraf
Mr. Alvin K.U. Chong

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Ms. Esther Ueda, Executive Officer
Land Use Commission
Department of Business, Economic Development & Tourism
State of Hawaii
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of September 4 regarding the above project. We shall include the suggested clarifications on the State Land Use designations and the ALISH classifications in the Final EIS.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9195 ▲ FAX (808) 526 9748

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OCT 09 [illegible]

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone (808) 956-7361
Facsimile 956-3980

October 7, 1992
RE:0610

Mr. Keona Fairbanks
Department of Planning
County of Maui
200 South High Street
Wailuku, Hawai'i 96793

Dear Mr. Fairbanks:

Draft Environmental Impact Statement (DEIS)
Hana Ranch Country Club and Golf Course
Hana, Maui

Keola Maui Hana Inc. is proposing to construct the Hana Ranch Country Club in the Hana district on the island of Maui. The project site is located 1.8 miles south of Hana Town on approximately 201 acres of existing pasture land. The Hana Ranch Country Club will be an 18-hole championship golf course measuring approximately 6,930 yards. This "semi-private" golf course will be open to guests of the Hotel Hana-Maui, members of the Hana Ranch Country Club, day visitors to Hana and the resident community. Construction is planned to begin in late 1993, and be completed in 1995. Support facilities include a clubhouse, maintenance facilities, driving range, and approximately 150 parking spaces. The clubhouse (39,900 square feet) is expected to be a two story building which will include the following facilities: pro shop, administrative offices, full service restaurant, lounge (bar), meeting rooms, snack shop, kitchen, locker facilities, and golf cart storage areas. The restaurant will be able to accomodate approximately 200 persons, and is scheduled to be open to the public seven days a week. A six-acre driving range will be operated in conjuction with the golf course. The developer has explicitly stated that they will not develop any additional hotel rooms, luxury homes or condominiums.

The Environmental Center has reviewed the Hana Ranch Country Club and Golf Course DEIS with the assistance of James Mak, School of Economics; Paul Ekern, (Emeritus) Water Resources Research Center; Terry Hunt and Carolyn Abad, Anthropology; Jon Matsuoka, School of Social Work; Peter Nicholson, Civil Engineering; and Alex Buttaro, Environmental Center.

Paper Conservation

Significantly less paper would have been needed had the text been single spaced and printed on both sides of each page. Incorporating this format would reduce bulk and production costs.

Historic and Archaeological Resources (Section 6.9)

Our reviewers expressed concern that the survey methods used by Cultural Surveys Hawai'i (CSH) to identify sites, as well as their means for determining site function and significance, do not meet federal and state requirements. CSH must seek the views of local community members in identifying sites and in determining their function and significance during the site inventory phase and not later during the data recovery phase as CSH (Appendix G, page 106) suggests. If CSH were to meet this requirement many more sites might be given an "E" significance. The following laws and government guidelines recommend or require such public involvement:

1) The Department of Land and Natural Resources Draft for Title 13, Subtitle 6, Chapter 147 (State Historic Preservation Division, Historic Preservation Division Rules Governing Procedures for Historic Preservation Review, 1989) states that identification of historic properties "shall involve consulting with recorded oral traditions and interviewing persons knowledgeable of the undertaking's area," and that the oral traditions and interview "findings must be presented in the Archaeological Inventory Survey" (Section 13-147-7). Although these are draft guidelines, the State Historic Preservation Division has been implementing them, and CSH indicates that their later data recovery plan "will be developed and implemented in accordance with State Historic Preservation Office guidelines (also in draft form) to ensure conformance with all applicable County, State and Federal Requirements" (section 6.9.2, page 119). Their Archaeological Inventory Survey should also conform to these standards.

2) National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties by Parker and King (1990) explains that sites significant to traditional cultures are difficult to identify using conventional means. Thus they acknowledge that "the existence and significance of such locations often can be ascertained only through interviews with knowledgeable users of the area, or through other forms of ethnographic research" (Parker and King, National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties, National Park Service, Washington D.C.; 1990, page 2).

3) The U.S. Congress Office of Technology Assessment (OTA) (United States Congress, OTA, Technologies for Prehistoric & Historic Preservation, OTA-E-319. September 1986, page 43) states that "archival research and interviewing (oral history) are important first steps" in prehistoric and historic preservation research."

4) The Code of Federal Regulations Chapter 36 Part 800.1(c)(2)(iv) (Department of the Interior 1986) states that "members of the public with interests in an undertaking and its effects on historic properties should be given reasonable opportunity to have an active role in the Section 106 process." This would require that the federal agency involved and the State Historic Preservation Officer "seek and consider the views of the public when taking steps to identify historic properties, evaluate effects, and develop alternatives."

The significance criterion "E" which CSH uses ("Site has cultural significance; probable religious structure (shrines, heiau) and/or burials present") (section 6.9.1, page 115) does not conform to standards in the DLNR Draft Rules Governing Procedures for Historic Preservation Review (DLNR, Historic Preservation Division Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports, Chapter 147) which use a much broader definition. State rules define Criterion "E" as those sites which "have an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups of the state" (DLNR, Historic Preservation Division Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports, 1989; Chapter 147, Section 13-146-6[b][5]). Additionally, the rules define "cultural significance" to mean "the tangible and intangible contributions or values of a historic property to the native Hawaiian people or to other ethnic groups in the state" (DLNR, Historic Preservation Division Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports, 1989; Section 13-146-2). And that "for the native Hawaiian people, it has been clearly documented that minimally, burials and traditional religious places are considered culturally significant" (DLNR 1989b: Section 13-146-2). Given the broader definition cited above, it becomes imperative that CSH consult with community members in identifying and evaluating historic properties. Such community members will likely see more than just Heiau and burials as having significance to their culture.

CSH uses a very arbitrary definition of a "site." Some of their individual sites may better be evaluated as features within larger (and possibly more significant) sites. This is especially important for those "sites" which are spatially clustered. Archaeological research of such clustered sites would warrant that they be investigated as a set since their possible relationships to one another should be addressed. A more traditional Hawaiian view of some the sites might also require that they be dealt with as larger conglomerate entities.

CSH (1992b:105-106) supports Keola Hana Maui's plan to "incorporate (preserve) virtually all sites within the golf course area itself." From a Hawaiian perspective, the loss of integrity of these sites placed within a golf course would be tantamount to actually destroying the sites. The traditional meaning Hawaiians attribute to such sites will be lost when they are surrounded by artificially manicured lawns and foreign foliage. The limited access community members will likely have to appreciate those sites is also an issue when considering whether "preservation," in the terms described by Keola Hana Maui, has any real benefit to the community.

The brief description CSH provided of their envisioned data recovery plan (Appendix G, page 105) calls into question their conclusion that 20 sites (Table 6.9.1, page 112) can be adequately mitigated by undergoing such data recovery prior to destruction. The only two research questions CSH describes for the data recovery phase deal with "providing a basis for Hana-area chronology" and determining site functions with more certainty (Appendix G, page 105). Destructive excavation to merely determine the culture history of the area and to better identify what it is and what will be destroyed is not a sound archaeological procedure and is not acceptable given the archaeological "conservation ethic." Because of the destructive nature of data recovery and the impending destruction of the project itself, a much more comprehensive data recovery plan needs to be drafted and presented in the EIS so that all concerned can be determine if future data recovery efforts will be adequate for those sites for which data recovery is recommended.

Socio-Economic Factors (Section 7.0)

1) Does the concern that this golf course is a prelude to luxury residential development potentially constitute a negative psychological impact upon some of Hana's residents.

2) If yes, how will this negative impact be mitigated?

3) What type of economic data are available to convince residents that golf course development is not merely a prelude to luxury housing units?

The DEIS implies positive impacts stemming from the fact that one business entity will retain a major role in determining Hana's economy (section 7.3.2, page 210). Our reviewers note that one major landowner does not necessarily benefit the community in terms of providing them with a good working relationship with one entity. It can also be viewed as a source of consolidated power which impedes community self-determination.

The DEIS states that "previous studies on golf courses have found that golf course impacts in property values are geographically localized around the perimeter of the golf course" (section 7.3.2, page 138).

4) What are the citations and references for these previous studies?

It would be helpful to provide (at least in an appendix) more information regarding methodologies, results, etc.

The DEIS states that "for Hana residents to accept this facility as part of its recreational resources, they need to feel that they have physical, financial and psychological access" (section 7.3.2, page 139).

5) How does the developer intend to make Hana's residents feel that they have physical, financial, and psychological access to the golf course?

The DEIS states that "the golf course and clubhouse facilities will be made available to Hana residents which will preclude social conflicts regarding economic disparity and exclusivity" (section 7.3.2, page 140). Access to facilities does not necessarily imply utilization by Hana people. Numerous other barriers may preclude their usage.

6) Are there any potential socially uncomfortable factors which may discourage resident usage, and if so, what are they?

It is assumed that green-fees and club memberships are high at luxury resorts.

7) If Hana residents have a desire to play golf, will there be special "kamaaina-type" rates for them?

The Focus Groups Summary (section 7.4.1, page 147) needs more detailed description.

8) How were the surveys conducted?

9) Who was involved?

10) What was the rational behind: a) selection of participants; b) questions asked; and c) conclusions reached?

A survey and "key informant" interviews are mentioned on page 136, yet no subsequent mention of it was made in the report. Questions regarding the rationale also apply here. Please answer questions 8-10 for the "key-informants," to better disclose how this interview process was conducted.

11) How might the various potentially impacted environmental resources (e.g., water pollution) endanger the continuation of cultural and recreational activities (e.g., fishing, gathering)?

12) What are the potential social/psychological implications of cultural/recreational disruption?

13) What are the potential social consequences of having an influx of outsiders entering Hana (whether permanent or visiting) who represent divergent subcultures or countries?

Preliminary Geotechnical Engineering Exploration

The geotechnical report appears adequate within the limitations of identifying only the existing soil depths, soil types and some moisture and density results. Coverage of the site is somewhat limited due to the small number of borings made, but a good effort was made to augment the boring data with the results of a surface geophysical investigation which is helpful in delineating subsurface soil strata.

No specific recommendations were made for design purposes, and no detailed testing was performed in order to evaluate the engineering properties and/or qualities of the soils and rock at the project site. For the purposes of design for the stability of construction roads, areas to be graded, and for foundations of any structures to be constructed, a more detailed and in-depth investigation of the subsurface soils and rock should be performed in order to identify the engineering properties pertaining to soil shear strength, bearing capacity, and erodability.

Our reviewers note that as a preliminary engineering report, this study appears to be sound and comprehensive with sufficient attention to detail. However, this is only a preliminary report and as such, insufficiently details engineering properties such as shear strength, bearing capacity, and erodability. These engineering characteristics should be included given their possible implications to the economic success of this golf course. Our reviewers are concerned about the trafficability, as well as modification of the aggregation and infiltration rates of the Hana soil as a consequence of the thixotropy and irreversible drying of the Hydrandept - former Hydrol Humic Latosol. Numerous studies point toward major problems in construction and maintenance of the soil under golf course use. As a reference, we note that page 37 of the 1972 volume of Hawaii Soil Surveys, referring to ash-derived soils on Hawaii, states that the "B horizon hardens irreversibly into black, sharp, angular, very hard, fine pebble sized aggregates."

While the density and moisture tests are helpful, such tests only identify the soil as it exists and insufficiently address the properties that need to be detailed for the purposes of design and assessment of the potential environmental consequences. If the preparers of this document do not intend to provide the above suggested information, on what basis is the existing information deemed sufficient to determine engineering design characteristics and environmental impacts?

Economic Arguments

The Market Feasibility and Economic Impact Study (Appendix B) prepared by PKF Hawai'i (PKF) argues that hotel occupancy at Hotel Hana would rise from 50 to 75 percent, based on the financial prognosis that operating losses will be less with the golf course than without. This prognosis is an assumption which lacks adequate empirical or factual support. We note that room rates at Hotel Hana have risen much faster than rates at comparable luxury resorts. Our reviewers expressed skepticism towards the proposed project's economic viability, and questioned whether a golf course alone, without massive real estate development of golf-frontage properties, will make the project viable.

1) If the occupancy only rises to 60%, what will be the impact on operating losses?

PKF argues that the golf course will be able to sell 1000 corporate memberships in Japan at $200,000 each.

2) What is the basis for the assumption of market demand for such memberships?

3) If they are unable to sell those 100,000 memberships, what will be economic consequence and possible courses of action that may result? Conversely, if the sale is successful, what will be the implications of that level of foreign investment with regard to policy articulation? Isn't it likely that investors will apply leverage to develop real estate fronting the course as a way to protect their investments?

The DEIS notes on page 160 that "the projections for the combined hotel and golf course show a positive trend of reduced losses that is expected to eventually become net operating income, but the Hotel without a golf course will continue to lose large sums of money indefinately."

4) What will ultimately turn losses into profits?

5) When are losses expected to be turned into profits?

6) What evidence is used for determining what will turn losses into profits and when the conversion will occur?

Our reviewers note that the addition of a golf course on Lana'i does not appear to be saving the hotels from financial failure.

7) What is the effect of the new golf course on occupancies at the two Lana'i luxury resorts?

8) Was there a 25% increase in occupancy?

9) If the Lana'i hotels did not experience the increase that is expected for Hana, what will be done to assure similar shortcomings do not occur in Hana?

Summary

Our reviewers expressed serious concern regarding the lack of sufficient archaeological, social, and cultural, economic, and geotechnical information. Additional information, studies, and analyses should be provided in the FEIS. The justifications for these requests are provided by EIS Rules Sections 11-200-14, 11-200-16, and 11-200-17, which require that relevant data be obtained, necessary studies be conducted, and all relevant and feasible consequences and implications of an action be disclosed and evaluated.

Thank you for your time and consideration and we hope our comments are helpful.

Sincerely,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: OEQC
Libert Langraf, Keola Hana Maui Inc.
Alvin Chong, Pacific Planning and Engineering, Inc. ✓
Roger Fujioka
Paul Ekern
Jon Matsuoka
Terry Hunt
Peter Nicholson
Carolyn Abad
Alex Buttaro

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. John T. Harrison, Ph.D.
Environmental Coordinator
University of Hawaii Environmental Center
State of Hawaii
2550 Campus Road, Crawford 317
Honolulu, HI 96822

Dear Mr. Harrison:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7, 1992 regarding the above project. The following are responses to your comments:

Historic and archaeological resources. Cultural Surveys Hawaii (CSH) report was prepared in full compliance with the applicable State and Federal requirements. The State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) reviewed CSH's report and found the report to be adequate, except for a few minor comments which will be incorporated in the Final EIS. SHPD letter states "It appears that all sites within the project area have been identified and that adequate information has been collected to assess their significance."

CSH has interviewed and has taken part of field trips to the project area with "persons knowledgeable of the undertaking area." CHS has incorporated "recorded oral traditions" into the Cultural Setting section of Appendix G. Based on first hand knowledge of sites within the project area, the SHPD reviewer has concurred with the initial significance assessment of all sites in the project area except one (Site 2742).

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The plan to incorporate sites into the project is a distinct improvement from being under commercial cane cultivation or cattle pasturage. Benefits to the community will go beyond direct "appreciation" of these sites. The remnant nature of sites make visual appreciation difficult at best. The community will benefit in terms of having the major landowner in Hana aware that historic sites are important to the community and any development planning needs to take into account historic preservation concerns. Finally, the more sites are preserved, the more there is a preservation bank of sites available for future appreciation and research.

The Data Recovery Plan is not formulated until after the Inventory Survey has been reviewed and approved. The Data Recovery Plan is then reviewed by SHPD and other concerned parties. Thus, a "comprehensive data recovery plan" can, procedurally only be formulated after the Inventory Survey approval.

Socio-economic. Keola is not planning any land sales nor luxury residential developments around the project site. Presently, luxury homes are common in Hana and continue to be built. The appropriate government agencies, (not Keola) have the responsibility of controlling the development of luxury homes around the project and in Hana. If other landowners develop luxury residential units in response to the project, the potential for negative psychological impacts is expected to be minimal, as discussed below.

First, many Hana residents are apprehensive about major change in general. On a community and on an individual level, there is concern about changes resulting from development. The concern about whether the golf course will be a prelude for further development would be consistent with, and would stem from the community's apprehension about change in general.

Second, the extent of any negative impact of this concern needs to be weighed against concerns about other types of impacts, such as the loss of employment and the possibility of having to leave Hana. In the focus groups, it was found that the more serious concern of the kupuna and adults is having to leave Hana due to lack of employment opportunities. Luxury development, which is already present in Hana, would therefore not have as much psychological impact as the threat of having to leave Hana.

Section 7.3.2 of the DEIS also discusses the continued presence of Keola as follows: "The other side of continuing the company and its operations is that one entity will retain a major role in determining Hana's economy. Changes to the economy by other entities will be limited and difficult because of differences in scale."

The Office of State Planning's Golf Course Development in Hawaii: Impacts and Policy Recommendations reported that previous studies have found that Hawaii's golf courses have very limited impacts on nearby property values. The report states, "In both the short- and long- term time frame, however, golf courses have been found to have minimal impact on property values."

Section 4.1.2 of the DEIS states "The clubhouse will be open to the guests of the Hotel Hana-Maui, members of the Hana Ranch Country Club, day visitors and the resident community." The clubhouse's meeting rooms will also be made available for the community's use. The Final EIS will state "the golf course and clubhouse facilities will be made available to Hana residents which will help mitigate social conflicts regarding economic disparity and exclusivity." Section 4.1.1 of the DEIS states "Although green fees have not been formulated for the different proposed users, Keola intends to offer "Kamaaina" rates to Hawaii residents and charge market rates to hotel guests and day visitors."

The focus groups, surveys, and key informant interviews are discussed in detail in Appendix L.

Section 6.3.2 of the DEIS clearly states the project's effects on ground and surface waters will be well within water quality standards and will not, therefore, affect cultural and recreational activities such as fishing. Consequently, there would not be any social/psychological implications of cultural/recreational disruptions.

Section 7.3.2 of the DEIS discusses the probable impacts of changes in overnight visitors. Golf course members and other Hotel guests are expected to have a limited effect on residents. First of all, non-local visitors have been staying at the Hotel for more than 45 years. Secondly, the over half of a million annual day visitors to the Hana region will clearly have a greater impact than the additional 11,000 annual Hotel guests with the project. And finally, golf course members are expected to visit Hana infrequently, staying at the Hotel only once or twice a year.

It is likely that the social impact of having more foreign visitors will be similar to that of interacting with people of different social and economic backgrounds, regardless of the origin of the visitors. The present culture of Hana is already one which represents assimilation. Throughout Hana's modern history, different cultures have constantly blended into the prevailing culture, which is based on Hawaiian values and practices. People of Chinese, Filipino and Japanese ancestry have worked with Hana residents on the plantations, and many have made Hana their home. The 1990 census indicates that the proportion of Caucasians has increased significantly during the 1980's, and the culture has been even further impacted. Thus, in spite of the introduction of different cultures, Hana is still predominantly Hawaiian in its culture, its attitude and in daily practices.

Geotechnical. As the reviewer correctly states the geotechnical study conducted is documented in a preliminary engineering report. A detailed investigation to obtain engineering properties of the subsurface soils and rock is typically performed during design (when the site structure locations and requirements are known) and not during the EIS process.

The United States Department of Agriculture, Soil Conservation Service, has mapped the surface soils at the site as the Hana Series silty clay loam, consisting of weathered volcanic ash and cinder deposits. Similar deposits have been encountered at other project sites in the State. It has been the experience of Pacific Geotechnical Engineers, Inc. (PGE) that practical and reasonable soil and site improvement methods have been successfully used at these sites to improve trafficability. These methods could be implemented at the site, if necessary, during site grading and construction of the proposed construction roadways and parking facilities. In addition, the ranch did not experience any major problems during grading of the Hana soils for their current facilities.

The existing topsoil supports the pasture grass. Current plans call for it to be stripped off and stockpiled for later reuse. After stripping off the topsoil, the B-horizon and underlying soil zones will be graded to form the golf course fairways and greens. After this, the stockpiled top soil will be placed over the graded soils. If any irreversible drying occurs of the graded soils, it is likely to improve the drainage and subsurface root zone profile, but should not limit the soils performance as a medium for growing and maintaining quality turfgrass.

With respect to soil erodibility, by way of comparison, it is reasonable to assume that the establishment of a dense cover of turfgrass will greatly reduce erodability at the site. When the present state of the land (heavily grazed pastureland) is compared to a continuous stand of healthy, well-maintained turfgrass, it can be logically concluded that the pastureland has a greater amount of runoff than the turfgrass.

Based on the available subsurface information obtained during the PGE study, it appears that subsurface conditions at the site generally consist of a mantle of sandy clayey silts on the surface, underlain by hard basaltic rock and clinker deposits at shallow depths of on the order of 4 to 5 feet below the existing ground surface. PGE concluded these subsurface conditions should not pose significant foundation design and construction difficulties for the proposed clubhouse and maintenance facilities.

Economic. Section 5.1 of the DEIS, the No-Action Alternative, discusses the implications of achieving a 60 percent occupancy rate at the Hotel.

Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The statement "PKF argues that the golf course will be able to sell 1,000 corporate memberships in Japan at $200,000" is incorrect. That information was provided by the Kato Group, the major shareholder of Keola. The Kato Group owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

Assuming no changes to the Hotel, except for the proposed golf course, and based on the projected trending of the golf course and Hotel, the combined operations should be profitable in the year 2014. Should there be a dramatic turn in events of higher than projected occupancy, average daily rate, green fees, rounds of golf or a substantial decrease in expenses, combined profits would be realized sooner.

Lanai Hotels. There are many differences between the hotels on Lanai and Hana that make meaningful comparisons difficult. The Hotel Hana-Maui, for example, has been in operation since 1946 and accordingly has an established name and reputation. The Lodge at Koele and the Manele Bay Hotel have only been operating since 1990 and 1991, respectively. The Lanai hotels have different operating themes, have had to train a labor force with limited hotel experience, and are in the process of establishing Lanai as a luxury resort destination. Despite these differences, Lanai Hotel officials have confirmed the beneficial effects their golf course has had on their hotel occupancy levels. These officials have stated that the golf course has increased their hotel occupancy levels by 15 - 20 percent, and expect larger increases in the future.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

DEPARTMENT OF
HUMAN CONCERNS
COUNTY OF MAUI

October 7, 1992

Mr. Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
P.O. Box 519
Hana, Maui, Hawaii 96713

SUBJECT: <u>Draft Environmental Impact Statement For The Hana Ranch Country Club</u>

Dear Mr. Landgraf:

Thank you for the opportunity to review the Draft of the <u>Environmental Impact Statement For The Hana Ranch Country Club.</u>

We are requesting that the following questions be addressed:

1. Specifically, what kind of jobs would be created by the new Golf Course Development?
2. What would be the income levels of these positions?
3. Would these new jobs increase the need for additional housing?
4. If housing is to be provided, whether for sale or rent, at what prices would these units be available for?

If you have any questions regarding this matter, please call Deputy Director Henry Oliva or myself at 243-7255.

Sincerely,

Stephanie Aveiro
STEPHANIE AVEIRO
Director of Human Concerns

SA:md

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Ms. Stephanie Aveiro, Director
Department of Human Concerns
County of Maui
200 South High Street
Wailuku, HI 96793

Dear Ms. Aveiro:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7 regarding the above project. The following are responses to your comments:

Job titles and income levels. Table XI-1 of Appendix B (page XI-3) is a preliminary list of golf course and clubhouse jobs and average annual salaries.

Need for housing: sales or rentals: and prices. Section 7.2 of the DEIS discusses the current housing efforts in Hana and the probable impacts of the golf course project on housing.

The non-profit Hana Affordable Housing and Community Development Corporation (HAHCDC) was created to develop affordable housing for the residents of Hana. Keola has played the key role of sponsor for this organization. It has been instrumental in getting it started. To this end, Keola has provided assistance to the HAHCDC in the form of start-up, training, orientation, studies, surveys, workshops, legal and consultant fees, travel, inspection tours, clerical support, technical resources and funding. They have previously committed a donation of 15 acres of land for a single-family affordable housing project.

In addition to the above assistance to the HAHCDC, Keola will provide further direct support (i.e., land, funding, or in-kind services) to mitigate the housing needs of the project. However, the HAHCDC is a free standing entity, separate from and independent of Keola. To the extent that Keola resources, financial, staffing or otherwise are accepted, the HAHCDC will retain its independent status.

Accordingly, a memorandum of understanding will be executed to clearly delineate the on-going relationship between Keola and HAHCDC, particularly the types of financial and other types of support which Keola may give to the HAHCDC, as both parties work to increase the supply of affordable housing for the residents of Hana.

It should be noted, that a significant number of Hana residents that currently work outside of Hana have expressed a strong desire to work at the golf course in Hana which would reduce the housing needs of the project.

Under the HAHCDC programs, single family homes (house and lot) are expected to be sold for approximately $100,000, and affordable rental rates would be based on appropriate government housing agencies' guidelines. Residents who are currently renting, therefore, are not expected to be displaced as a result of the project.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

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LINDA CROCKETT LINGLE
Mayor

BRIAN W. MISKAE
Director

ROBERT K. KEKUNA, JR.
Deputy Director

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RECEIVED
OCT 10 1992

BILL MEDEIROS
Long Range Division

COLLEEN M. SUYAMA
Current Planning Division

KALVIN KOBAYASHI
Energy Division

October 7, 1992

Mr. Alvin Chong
Pacific Planning and Engineering, Inc.
1221 Kapi'olani Blvd, Suite 740
Honolulu, Hawai'i 96814

Dear Mr. Chong,

Re: Draft Environmental Impact Statement for the Proposed <u>Hana Ranch Country Club and Golf Course.</u>

The Maui Planning Department has reviewed the above referenced Draft Environmental Impact Statement (DEIS) and offers the following comments.

Overall the DEIS is easy to follow and well formatted. Delineating proposed mitigation measures under a separate heading for each section would bring further clarity to the document.

Our specific comments are in the areas of project feasibility, impacts on the physical environment, socio-economic factors and impacts on infrastructure and public facilities.

<u>Project Feasibility</u>

The feasibility argument rests on the assumption of selling 1,000 golf club memberships within one year's time for $200,000 each. Is this assumption reasonable given today's global economic situation? What is the current selling price of equivalent memberships in Japan? Does the applicant have any other financing alternatives?

If the project goes ahead with the proposed financing, combined balance sheets continue to show a net loss through the year 2003, beyond which no figures area given. How can the company sustain operations without additional income generation? How might that income be generated?

Does the proposed financing scheme transfer ownership equity to those who purchase memberships? What would happen if the company fails before the golf course is completed? Would membership owners then have interest in Keola's land holdings?

Has Keola pursued other avenues such as improvement of the Hotel's service, and efficiency of operations in order to boost occupancy rates and control costs? What is the impact of vacation rentals on the Hotel's efforts to boost occupancy?

<u>Environment</u>

<u>Brush Clearing</u> The DEIS states that 680 acres of brush land is proposed to be cleared for pasture reclamation to offset the loss of acreage to the golf course. What is the environmental impact of the brush clearing operation?

<u>Historic Sites</u> The DEIS needs more discussion on impacts to historic sites. How many of the 23 sites within the project area will be preserved? How many destroyed? What mitigation measures are proposed? Which sections of the railroad grade will be preserved and which will not be? What percentage of the roadway bed, railroad bed and historic wall will be preserved? Will the preserved sites be accessible to the public? Will they be interpreted? How close is the proposed clubhouse to the heiau? What visual and sound buffers are proposed? Is any restoration and interpretation for the heiau proposed? What is the potential impact of errant golf balls from the dog-leg configuration of Fairway #2?

<u>Visual Resources</u> What methodology was used to assign values to the visual resource classification analysis? In this department's experience, the mauka view of open pastures and rolling hills surrounding the golf course site and Hana town is an important open space with high aesthetic value recognized by visitors and residents alike.

<u>Socio-Economic Factors</u>

While several concerns are mentioned in the context of residents' fears and expectations, the DEIS fails to make an empirical analysis of what impacts will occur. The DEIS should disclose the applicant's best detailed estimates of: wages for golf course jobs, percentage of local employees, measurable changes to Hana's Hawaiian community, interactions between Japan nationals and Native Hawaiians, increased land sales attributable to the golf course development, increased juvenile delinquency and changes in other social indicators.

The DEIS does not adequately address mitigation measures for possible socio-economic impacts. Each section should clearly disclose the potential impacts and corresponding mitigation measures. Will the jogging trail and its use by the community's youth be continued? What specific measures can be developed to address the potential impacts listed above?

Infrastructure

Water What is the total capacity and daily pumpage from both County and Keola sources combined? Will increased demand by the project require a new pump for the County well?

Wastewater Where on the property will the packaged plant and leaching field be located? At which pumping stations will accumulated sludge be disposed?

Solid Waste How many years will the Hana landfill's life be shortened by the project? What measures will be taken to reduce reuse and recycle solid waste?

Police The DEIS states that youth in Hana dislike tourists, and perceive the golf course as destroying heiau and taking Hawaiian land. What impact might the project combined with these socio-economic factors have on police protection requirements?

Health Care What is the present acreage of the Hana Medical Center site and the size of the existing facility?

Thank you for your consideration of our comments. If further clarification is needed please contact Mr. Keoni Fairbanks of my staff.

Very Truly Yours,

BRIAN MISKAE
Director

cc: Mayor
OEQC
L. Landgraf
B. Medeiros
K. Fairbanks

PACIFIC PLANNING
& ENGINEERING INC

November 23, 1992

Mr. Brian Miskae, Director
Planning Department
County of Maui
250 South High Street
Wailuku, HI 96793

Dear Mr. Miskae:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7 regarding the above project. The following are responses to your comments:

Project feasibility. Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The Kato Group, the major shareholder of Keola Hana Maui, Inc. (Keola), owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

Keola has sufficient financial resources to complete construction of the golf course if the project is approved in a timely manner.

Section 7.5.2.1 of the DEIS estimates the sale of 1,000 golf memberships will provide over $19,000,000 to finance projected operating losses. Table I-1 of Appendix B (page I-9) projects an available cash balance of over $1,500,000 at the end of 2003. If this cash balance is insufficient to fund operating losses after 2003, the company could borrow against its real estate equity in the Hotel and golf course. Preliminary estimates show the combined Hotel and golf course operations achieving profitability by the year 2014.

Section 5.2 of the DEIS discusses the feasibility of implementing hotel management strategies to increase hotel occupancy by: increasing marketing efforts, reducing hotel rates, and promoting different themes. In addition, the Hotel has implemented the following types of operating programs:

1. Effective cost reduction program.
2. Cross training of managers.
3. Aggressive employee training.
4. Installation of modern reservation and payment systems.
5. Development and implementation of a staffing guide system.
6. Extensive kitchen cost controls.
7. Consolidated and reduced truck trips to Wailuku/Kahului, etc.
8. Team approach to maintenance.

Although there are no "official" statistics for vacation rentals in Hana, it is believed these rentals have a limited impact on the occupancy levels of the Hotel Hana-Maui. These vacation rentals do not provide the types and levels of service that the Hotel does and, therefore, attracts a different type of visitor. Illegal rental units, however, should be required to comply with all applicable zoning, taxes and other laws and regulations.

<u>Environment</u>.

Brush clearing. No significant environmental impacts are expected. Keola has conducted brush clearing operations for many years. When the trees and brush are cleared, the grasses quickly cover the areas under the trees and brush. The brush clearing machine also mulches the branches into pulp and thus no solid waste is generated.

Historic sites. Cultural Surveys Hawaii recommended nine sites for preservation (Sites 2711, 2712, 2714, 2715, 2722, 2723, 2742, 2744 and 2746). Sites 2742, 2744 and 2746 are listed for selective preservation.

Keola is committed to preserving as many sites as possible. Of the 19 significant sites in the project area, 10 sites are proposed to undergo archaeological data recovery and 9 sites are proposed to be preserved. Mitigation measures include the development of a detailed Data Recovery Plan, Interim Preservation and Protection Plan, and Long-Term Preservation Plan for acceptance by the State Historic Preservation Division.

The section of railroad grade in the project area is a very small portion of the entire railroad grade system in the Hana area. Within the project site, the railroad grade will be incorporated in Hole #2 and will be minimally affected. The roadbed would be affected by Holes # 7, 8, 10, 16, and 18, and the access road. The roadbed sections through Hole # 7, 8, 10, and 18, however, are indistinct and essentially dirt four-wheel drive paths. The historic wall will be preserved and every effort will be made to design cart paths to utilize existing breaches in the wall or to not require new breaches.

Keola will cooperate with the community to provide access to the public. Interpretation of the archaeological sites will be provided. The interpretation, for example, could include signs and a "storyline" of the cultural significance of the Hana area.

The closest distance between the clubhouse and the heiau is approximately 400 feet. Landscaping will be provided as a visual and sound buffer for the heiau. Interpretation and possibly stabilization (i.e. removal of large detrimental trees) will be provided for the heiau.

Hole #2 is not expected to affect the heiau because of the large distance from the heiau and the topography of the area. The heiau is situated on top of a hill, while the apex of the dog leg is in a swale below the hill top.

Visual resources. Values assigned to the design principles were derived from the Coastal View Study. This study provided pictures of views characterizing low, moderate and high visual qualities which served as a framework for assigning values in the assessment. The Final EIS will incorporate Maui Planning Department's experience that the open pastures and rolling hills surrounding the project site is an important open space with high aesthetic value.

Socio-Economic. Although empirical information is normally not used for social impact analyses nor is it a requirement under the EIS rules, the following information is provided in response to your comments:

Wages. Table XI-1 of Appendix B (page XI-3) is a preliminary list of golf course and clubhouse jobs and average annual salaries.

Local employees. Keola estimates that at least 75 percent of the employment needs can be recruited from Hana. Hana residents and previous Hana residents (kamaaina) who wish to return will be given job placement priority for full and and/or part-time employment.

Hana's Hawaiian community. Section 7.3 and 7.4 of the DEIS discuss the project's probable impacts on the Hana Community and Hana's Hawaiian Community, respectively. Golf course members are expected to have a limited effect on residents. First of all, non-local visitors have been staying at the Hotel for more than 45 years. Secondly, the over half of a million annual day visitors to the Hana region will clearly have a greater impact than the additional 11,000 annual Hotel guests with the project. And finally, golf course members are expected to visit Hana infrequently, staying at the Hotel only once or twice a year.

It is likely that the social impact of having more foreign visitors will be similar to that of interacting with people of different social and economic backgrounds, regardless of the origin of the visitors. The present culture of Hana is already one which represents assimilation. Throughout Hana's modern history, different cultures have constantly blended into the prevailing culture, which is based on Hawaiian values and practices. People of Chinese, Filipino and Japanese ancestry have worked with Hana residents on the plantations, and many have made Hana their home. The 1990 census indicates that the proportion of Caucasians has increased significantly during the 1980's, and the culture has been even further impacted. Thus, in spite of the introduction of different cultures, Hana is still predominantly Hawaiian in its culture, its attitude and in daily practices.

The social impact assessment found there is no universal agreement on the subjective characteristics of the Hawaiian culture, much less empirical measures of the culture.

Land sales. Keola does not plan any land sales around the golf course project site. Regarding other landowners around the project site, no one knows how many may choose to sell their properties.

Juvenile delinquency and other social indicators. The Office of State Planning's report entitled Golf Course Development in Hawaii: Impacts and Policy Recommendations, dated January, 1992 and the social impact assessment for this project did not find any health, social or agency information which indicated that golf courses are related to juvenile delinquency and other social problems.

Mitigation measures. The potential socio-economic impacts of the project on the Hana community do not fall into measurable categories. Many of the fears are unfounded or based on an apprehension about development and change in general; other concerns stem from cultural philosophies which are not universally acceptable and therefore not possible to measure. The impacts that can be analyzed in tangible terms include hunting and gathering trails and the economic benefits of the project. Hunting trails are discussed in Section 8.10 and economic benefits are discussed in Sections 7.5 and 7.6 of the DEIS. In addition, pages 69 through 71 of Appendix L and Section 7.4.2 of the DEIS describe mitigation measures to address the non-quantifiable effects of the project.

It is assumed that the "jogging trail" referred to is one of the five hunting trails near the project site. Section 8.10 discusses the project's impacts on these hunting trails.

Infrastructure.

Water. The total pump capacity of the County and Keola water sources is 1.2 million gallons per day (mgd). In 1991, the daily pumpage from both sources was 0.38 mgd. The project's water demand will not require the installation of new pumps for the County wells.

Wastewater. The packaged plant and leaching field will be located in an open area adjacent to the driving range northeast of the clubhouse site. Accumulated sludge will be infrequently pumped out and disposed of at the Kahului Wastewater Pump Station. This plan is based upon current sludge disposal practices employed by the County's Department of Public Works (DPW) and private cesspool pumping firms serving the Hana area.

Solid waste. The County DPW currently does not take measurements pertaining to the capacity of the Hana landfill or solid waste generation rates of the Hana community. Consequently, it is not possible to quantify the effect the project will have on the life of the landfill. However, the DPW staff indicated the relatively small amount of rubbish generated by the project would have a negligible effect on the life of the landfill.

Keola is currently participating in recycling efforts to reduce the amount of daily solid waste loads being disposed of at the landfill site. Limbs, branches, flowers and other plant materials from Hotel operations are presently disposed of at Keola's composting site. Organic wastes generated from the maintenance of the golf course's landscaping and vegetation will also be utilized for mulching and composting. Steps will also be taken to promote and encourage recycling, reuse, and waste reduction practices by the project's employees, members, and guests.

Police. Section 8.6.2 of the DEIS discusses the project's probable impacts on police protection services. The County police "confirmed that they don't expect major problems resulting from the project." See previous discussion on increased juvenile delinquency and other social indicators.

The youths' concerns with the project stem from their misperceptions of the project. No heiaus will be destroyed nor will any Hawaiian lands be taken. The one heiau located outside of the project site, in fact, will be preserved. The youths' dislike of tourists (primarily the over 500,000 annual day visitors) may stem from their general apprehension toward change in general which is reflected in their concern over increased development and the building of condominiums. Keola does not plan any land sales or developments around the project site.

Health care. The Hana Medical Center is located on approximately 12 acres of land. The sizes of the medical facility and two nurses quarters are approximately 2,600 square feet and 2,900 square feet, respectively.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

LINDA CROCKETT LINGLE
Mayor
GEORGE N KAYA
Director
CHARLES JENCKS
Deputy Director

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
LAND USE AND CODES ADMINISTRATION
250 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

AARON SHINMOTO P.E.
Land Use and Codes Administration
EASSIE MILLER P.E.
Wastewater Reclamation Division
RALPH NAGAMINE P.E.
Engineering Division
BRIAN HASHIRO P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

October 23, 1992

MEMO TO: Brian Miskae, Planning Director

F R O M: George N. Kaya, Director of Public Works George Kaya

SUBJECT: Draft Environmental Impact Statement Submitted by the State of Hawaii/Office of Environmental Quality Control for the Proposed Hana Ranch Country Club at Hana, Maui, TMK: 1-4-02:7, 9, and 10, 1-4-02:Portion 4 and 8, 1-4-03:6 1-4-03:Portion 5 and 9 1-4-07:Portion 4

We have reviewed the above request and have no comments to offer at this time.

FC:sn
(1035f/p19)

xc: Office of Environmental Quality Control
Keola Hana Maui, Inc.
Pacific Planning & Engineering, Inc.
Engineering Division
Solid Waste Division

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. George N. Kaya, Director
Department of Public Works
County of Maui
250 South High Street
Wailuku, HI 96793

Dear Mr. Kaya:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of October 23 regarding the above project. Although you did not have any comments, your letter will be included in the Final EIS.

Sincerely,

Alvin K. U. Chong
Project Manager

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521 9165 ▲ FAX (808) 526 9746

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
P.O. BOX 1109
WAILUKU, MAUI, HAWAII 96793-7109

November 16, 1992

Mr. Brian Miskae
Planning Director
Maui Planning Department
250 South High Street
Wailuku, Maui Hawaii 96793

Re: Hana Ranch Country Club; TMK 1-4-2:7,9 & 10, and portions 4 & 8, 1-4-3:6 and portions 5 & 9, 1-4-7: portion 4
Water Dept. ID # PL 91-81

Dear Mr. Miskae,

After reviewing the subject EIS, we still have some concerns regarding the advisability of a golf course and country club in this proximity to a permanent water source. To make a fair determination of potential drinking water impacts, we recommend draw-down calculations which take into account all of the wells and the probable limited extent of aquifers in the area. Approval should be deferred until these calculations can be properly performed by a mutually agreeable party.

Should the project receive approval, we recommend that the applicant be required to monitor the root zone, water table, in-stream and near shore organisms for any chemicals applied to the surface. We also recommend reporting requirements to provide for accountability with regard to the integrated pest management plan. This plan identifies 16 pesticides recommended for use on the golf course. Chemical choices can change with time and new registrations. We have enclosed a partial list of pesticides currently registered for use on turf to illustrate just how complex these decisions can be. Leachability and Run-off potentials listed are from SCS evaluations of the pesticides themselves, and do not account for soil interactions. Reporting requirements will help to ensure that pesticide application frequency is kept to a minimum and that less desirable pesticides are avoided.

The applicant should be required to install low flow devices in the club house.

Sincerely,

for David Craddick
Director
elk

cc: Pacific Planning & Engineering, Inc.; Keola Hana Maui, Inc.

"By Water All Things Find Life"

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. David Craddick, Director
Department of Water Supply
County of Maui
P. O. Box 1109
Wailuku, HI 96793

Dear Mr. Craddick:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of November 16 regarding the above project. The following are responses to your comments:

Water supply. Section 8.1 of the DEIS and Appendix D fully discusses the project's probable impacts on the water supply in the Hana region. In terms of the available ground water supply in the Hana area, the State Commission on Water Resource Management has estimated a sustainable yield of 48 million gallons per day (gpd) for the Kawaipapa Aquifer System which comprises the Hana region. In comparison to a sustainable yield of 48 mgd and an existing water use of less than 1.0 mgd from the Aquifer System, the project will require only 30,000 gallons per day (gpd) of potable water.

Concerning drawdown calculations which take into account all of the wells and possible limited extent of aquifers in the area, only the Wananalua Well (Keola) or the Hamoa Well (County DWS) are being considered to meet the project's 30,000 gpd water requirement. The drawdown data of these two wells were analyzed and as shown in the attached graphs, the drawdown in the Hamoa Well was stable at 4.9 feet during a four day pumping test by the State Division of Water and Land Development. Therefore, the drawdown data indicate the Hamoa Well has a sustainable capacity of 1,000,000 gpd.

Similar analysis of the drawdown data in the Wananalua Well indicate it has a sustainable capacity of 575,000 gpd based upon a stable drawdown of 0.6 feet during a 48 hour constant rate pumping test.

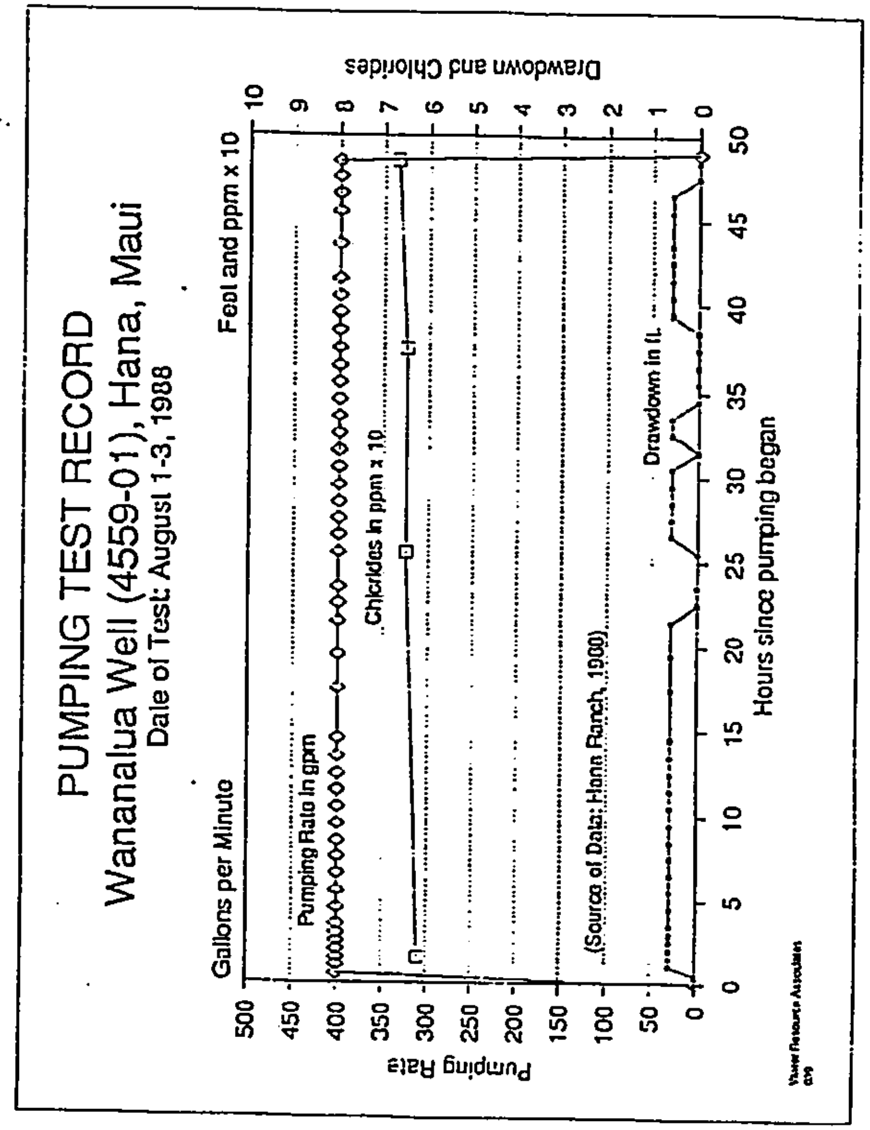
Consequently, meeting the project's water requirement of 30,000 gpd from either well will have negligible impact on the wells or the aquifers they tap.

Chemical usage. Section 6.3.2 of the DEIS clearly states the project's effects on ground and surface waters will be well within water quality standards. Section 6.3.3 of the DEIS also states that "Keola will fully comply with the State Department of Health's 12 conditions applicable to new golf course developments, including the establishment of baseline groundwater data and the implementation of an approved groundwater monitoring plan and system." The groundwater monitoring plan will address monitoring of the root zone using lysimeters and monitoring of groundwater using wells.

Keola supports the reporting of pesticide use on an annual basis. Although the pesticide table attached to your letter provides useful information, site-specific and pesticide-specific decisions require considerations of vegetation type, climate, hydrogeology, soils, and pesticide toxicity, mobility and persistence.

Sincerely,

Alvin K. U. Chong
Project Manager



15907 Maubert Avenue
San Leandro, California 94578
October 30, 1992

County of Maui,
Department of Planning
200 South High Street
Wailuku, Maui, HI 96793

Attention: Mr. Keone Fairbanks

Subject: Hana Ranch Country Club - Draft Environmental Impact Statement

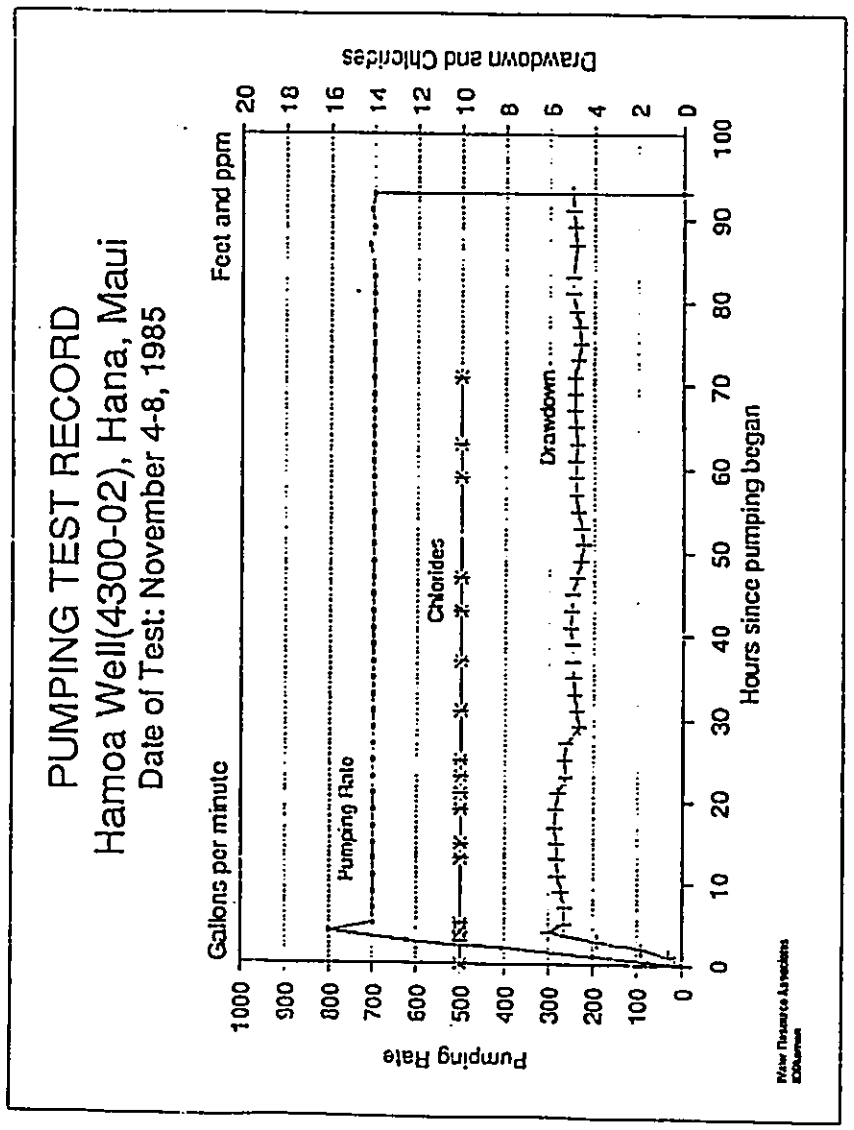
I understand that the comment period for the subject document ended on October 7, 1992, but as an Owner of property in the project area, I think it important that my comments be heard and incorporated into the final report. I feel I should have been given timely notice of the subject project. Instead, I had to call Hawaii and request a copy. Technically, is it a requirement for you to notify property owners in the project area?

An initial review of the report showed two glaring errors, which I will discuss below. I will provide further written comments within ten days, after a more complete review.

The report begins with two glaring misconceptions. On page 2, Section 1.2, Keola Hana Maui, Inc. is listed as the Owner; and again on page 20, Section 2.4, Land Ownership, "The entire project area is owned by Keola...". Their statements are lies. The truth is that I own property in the project area.

Secondly, on page 233, Section 12.0 Summary of Unresolved Issues, provides in its entirety:

> "Keola has and will continue to work closely with the Hana Community and public agencies to assure their concerns and ideas are incorporated into the design of the project as much as possible. It is expected that the large majority of issues will be resolved to the satisfaction of the community, government and Keola."



Keola Hana is attempting to acquire my property over my continuing strong objections so there is an Unresolved Issue, on calendar to be heard by the Hawaii Supreme Court.

I appreciate your assistance.

Sincerely,

Cheryl Duke

Cheryl Helekunihi Duke

cc: Keola Hana Maui, Inc.
P.O. Box 519
Hana, HI 96713
Attention: Mr. Libert Landgraf

Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, HI 96814
Attention: Mr. Alvin K. U. Chong

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Ms. Cheryl H. Duke
15907 Maubert Avenue
San Leandro, California 94578

Dear Ms. Duke:

Subject: Hana Golf Course Environmental Impact Statement

Thank you for your letter of October 30 regarding the above project. We understand the Hawaii Supreme Court has dismissed you appeal on August 26, 1992. Furthermore, the project boundaries were revised to exclude the property you were contesting on portions of tax map key 1-4-02-8, and all lands where land ownership was questioned or State lands. The entire project site is owned by Keola Hana Maui, Inc., and there are no parcels where ownership is under dispute (Section 2.4 of the DEIS).

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

ISAAC DAVIS HALL
ATTORNEY AT LAW
2087 WELLS STREET
WAILUKU, MAUI, HAWAII 96793
(808) 244-9017
FAX (808) 244-6775

OF COUNSEL:
G. RICHARD GESCH

RECEIVED

October 7, 1992

CERTIFIED, RETURN RECEIPT REQUESTED

Office of Environmental Quality
Control
State of Hawaii
220 S. King St., 4th floor
Honolulu, HI 96813

Mr. Alvin K.U. Chong
Pacific Planning &
Engineering, Inc.
122 Kapiolani Blvd., #740
Honolulu, HI 96814

Re: Comments of Friends of the Hana Coast on Draft Environmental Impact Statement ("DEIS") for the Hana Ranch Country Club

Dear Office of Environmental Quality Control
and Mr. Alvin K.U. Chong

This letter is written on behalf of Friends of the Hana Coast, Inc. ("FHC"), an environmental and cultural non-profit organization located in Hana. FHC is concerned that adequate environmental analysis takes place for any proposed development, providing Hana families with the information necessary to determine whether or not the benefits of proposed projects outweigh the cultural and environmental costs of the project. FHC has the following comments on the Draft Environmental Impact Statement ("DEIS") for the Hana Ranch Country Club:

1. Economic Costs and Benefits
The economic analysis contained in the DEIS is insufficient to allow any conclusion that the construction of a golf course resort will provide economic stability to the Hana community. This is particularly so with respect to a "stand alone" golf course. The available evidence tends to indicate, instead, that "stand alone" golf courses are only the first phase of surrounding residential and commercial development which necessarily follows. Because this type of development may easily bring with it many adverse social and economic impacts, it must be addressed.

2. Viability of agricultural pursuits
The finding in the DEIS that agricultural pursuits are not viable in Hana is self-serving and unsupported.

3. Adverse impacts of golf courses
The DEIS does not adequately discuss either the social or environmental adverse impacts directly caused by golf courses.

The DEIS is inadequate for many other reasons. FHC is primarily concerned at this time that the DEIS does not adequately assemble, analyze and disclose the impacts of the project, making it impossible for Hana families to make a reasoned decision on whether to support this major proposed change in a unique community.

Sincerely yours,

Isaac Hall

IH/jp
cc: Friends of the Hana Coast
Keola Hana Maui, Inc.

PACIFIC PLANNING
& ENGINEERING INC

November 23, 1992

Friends of the Hana Coast
c/o Mr. Isaac D. Hall
2087 Wells Street
Wailuku, HI 96793

Dear Mr. Hall:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 7 regarding the above project. The following are responses to your comments:

Economic costs and benefits. First of all, the economic analyses is very comprehensive and fully supports the feasibility of the project. Secondly, the project is not a "stand alone" golf course as it will serve as an integral part of the existing Hotel Hana-Maui. The purpose of the project is to provide a seriously needed amenity to the existing Hotel that will enable it to be more competitive in the luxury hotel market. Finally, Section 4.1 of the DEIS clearly states "There are no plans to increase the number of guestrooms or cottages at the Hotel Hana-Maui, nor to construct luxury homes or condominiums around the golf course."

Viability of agricultural pursuits. Your statement is incorrect. Section 5.3 of the DEIS discussed the potential viability of various agricultural crops and concluded the crops would not be *sufficiently* profitable to offset the operating losses of the Hotel Hana-Maui nor meet the project objectives described in Section 3.2 of the DEIS.

Furthermore, the State Department of Agriculture has determined that "the DEIS has adequately addressed our concerns on agricultural lands and resources and the impact of pesticide use."

Adverse impacts of golf courses. We can not respond to your comments because they are too general and vague. Social and other impacts are fully discussed in Sections 6.0 through 8.10.

Sincerely,

Alvin K. U. Chong
Alvin K. U. Chong
Project Manager

RECEIVED

To: Pacific Planning and Engineering
1221 Kapiolani Blvd., Honolulu, HI 96814

Attention, Al Chong, project analyst
Via fax number 1-808-526-9748

From: Lisa Hamilton, Conservation Chair, Maui Group, Hawaii Chapter, Sierra Club.
Re.: Draft EIS, proposed Hana Ranch Golf Course and Club.

This Draft EIS is inadequate for several important reasons.

I. FINANCING.

The purpose of an Environmental Impact Statement (EIS) is to provide the information the public and governmental agencies need to be able to make informed and wise decisions. Not only primary, but secondary socio-economic impacts must be fully discussed.

The Kato Group, the applicant and the principal trans-national owner of the 97 room Keola Hana-Maui Hotel and about 5,000 acres surrounding it, intends to raise funds for the project by selling memberships to the Hana Ranch Golf Club. The applicant is "confident that 1,000 corporate memberships can be sold" in Japan for $200,000 each. The $200 million dollars raised would then be used to pay Keola's existing debt of $132 million and then pay estimated construction costs of $43 million for the golf course and club house.

Pannell Kerr Foster, Inc., a leading analyst of golf course development retained by the Kato Group to evaluate the Hana Ranch Golf Course for the EIS states flatly: "the analyst has not performed any market research or analysis and accordingly does not offer any opinion whatsoever with respect of membership plans."

The failure of the EIS to adaquately address the financial aspects of the proposal is a serious omission. To be in compliance with Hawaii State EIS law, it is necessary this omission be corrected.

SCENARIO A: GOLF COURSE APPROVALS GRANTED: SUFFICIENT CORPORATE MEMBERSHIPS SELL.

Hana, where still a significant portion of the resident population has Hawaiian blood, has been called the "Last Hawaiian place". But as with the rest of Hawaii, the Hawaiian people have suffered significant loss of control over their ancestrial lands.

The EIS must show how an investment by up to 1,000 Japanese corporations in a Hana Ranch golf club will influence the lifestyle of the people of Hana now and their children's lifestyles without further erosion of traditional land utilization.

How many employees would each investing Japanese corporation expect the Hana community to host? Will these visitors be satisfied with Hana's quiet and lack of night life? What additional ammenities would a corporate entity require in return for a $200,000 investment in the Hana Ranch Golf Club? What secondary impacts on infrastructure can be expected?

In Japan, speculation in golf club memberships is a multi-million dollar business. The Tokyo Stock Exchange maintains a golf club index. Memberships are negotiable, bought and sold via computer trading terminals. Directories listing course statistics are inches thick. Golf club memberships are "a great investment", according to Hideo Hayashi, assistant sales manager, GGS Co., Ltd., a Tokyo firm involved in 1,000's of golf club membership transactions per year. "Even if the club goes bankrupt, the land alone is worth a fortune", he is quoted in the March 3, 1991, Sunday Oregonian. According to Gen Morite, International Liaison officer of Global Network for Anti-Golf Course Action, the golf club construction boom was fueled by membership sales. It's a "money making scheme" he says. Trade in memberships is dominated by investors interested not so much in golf as speculation.

Because the system has been unregulated in Japan, it has been plagued by scandal and corruption. Recently "51,000 Japanese golfers have been up in arms, allegedly victims of an $800 million swindle involving the sale of fraudulent golf course memberships", according to a piece the June 1992 issue of Business Toyko entitled "Golf's Muddy Green: In the scandal-ridden business of membership brokerages..." In an attempt to curb rampant speculation, the Japanese government has indicated it will pass "The Golf Membership Regulation Act" in 1993. This will prohibit the sale of memberships before construction of a course is complete.

SCENARIO B: GOLF COURSE APPROVALS GRANTED: INSUFFICIENT MEMBERSHIPS SELL.

Maui County approval for building a golf course in Hana will not guarantee the sale of memberships to Japanese corporations. Yet the applicant states in the EIS that "closing of the Hotel appears inevitable without the golf course" and economic "devastation (for Hana would result) since Keola employs an estimated 26 per cent of the projected workforce, not to mention the effect on virtually all other business in Hana..." (Draft EIS I, page 8).

What happens if too few memberships sell to finish the golf course? Japan is experiencing the same global recession experienced in the US. The golf course boom has bust. "Membership prices went up 10 times in three years and then dropped 50%" says one analyst. Membership prices are predicted to continue to fall. The price of a membership at the Honolulu Country Club is reportedly $69,000. Under the circumstance, is it reasonable to expect Hana memberships, where the weather is often overcast and wet, to sell for nearly 3 times the Honolulu price?

[illegible] above, golf memberships in Japan are seen as a "great [illegible]" because "even if the club goes bankrupt, the land alone is [illegible]".

[illegible] the uncertainties in the golf club membership market in Japan, [illegible] global recession and in terms of the weather, inappropriateness of [illegible] for a golf course, the Final EIS must show how the Hotel would avoid closing if the golf course cannot be built because inadaquate memberships sales. What happens to Hana residents if too few corporate memberships are sold, the golf course can't be built and the Hotel closes for that reason? In what ways would these foreign corporate membership investors influence land use, development patterns, land title, land value and property taxes, absent the golf course?

SCENARIO C: THE GOLF COURSE DENIED.

The EIS states that closing of the Hotel appears inevitable without the golf course". Except for an infusion of corporate membership investors at Hana, what difference is there between golf course denied and golf course failed, as far as Hotel closing is concerned? This question must be addressed in the Final Hana Ranch EIS.

II. QUIET TITLES, EASEMENTS, ARCHAEOLOGICAL SITES.

As many as half of the parcels which include the area of the proposed Hana golf course have been subject of Actions in Court to Quiet Title. The Final EIS must disclose the status of each of these actions, on a case by case basis. Prior to any approvals for the whole project area, it must be shown how each and every parcel within the project area has clear and undisputed title.

Keola's deeds show trail easements crossing the project area. The Final EIS must show how access to these trails will be recognized and maintained.

Archaeological and burial sites within the project area must have protection. The Final EIS must show on a case by case basis how this will be accomplished.

The people of Hana, of Maui and the agencies need more information to understand the implications of this proposal. The Final EIS must address these omissions so that wise and informed decisions can be made.

Respectfully submitted, Lisa Hamilton
SR Box 190, Hana, HI 97813

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Ms. Lisa Hamilton
SR Box 190
Hana, Hawaii 96713

Dear Ms. Hamilton:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter regarding the above project. The following are responses to your comments:

Financing. Sections 7.5 and 7.6 of the DEIS discusses in depth the financial aspects of the project. Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The Kato Group, the major shareholder of Keola Hana Maui, Inc. (Keola), owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU HAWAII 96814 ▲ TELEPHONE (808) 521-9165 ▲ FAX (808) 526-6748

Section 7.3 and 7.4 of the DEIS discuss the project's probable impacts on the Hana Community and Hana's Hawaiian Community, respectively. Golf course members are expected to have a limited effect on residents. First of all, non-local visitors have been staying at the Hotel for more than 45 years. Secondly, the over half of a million annual day visitors to the Hana region will clearly have a greater impact than the additional 11,000 annual Hotel guests with the project. And finally, golf course members are expected to visit Hana infrequently, staying at the Hotel only once or twice a year.

Section 8.0 of the DEIS discusses the project's probable impacts on infrastructure and public facilities.

Keola has sufficient financial resources to complete construction of the golf course if the project is approved in a timely manner.

Section 5.1 of the DEIS discusses the implications of not implementing the project, i.e., the No-Action Alternative. The basic difference between the No-Action Alternative, the denial of the project or the failure of the project is Keola's willingness and commitment to further invest its capital to provide economic stability for the Hotel and the Hana Community.

Quiet title. Since the preparation of the Environmental Assessment, the project boundaries have been revised to exclude all lands where land ownership was questioned or State lands. The entire project site is owned by Keola and there are no parcels where ownership is under dispute (Section 2.4 of the DEIS).

Easements. Section 8.10.1 of the DEIS discusses the project's impacts on hunting trails and mitigation measures.

Archaeological sites. Section 6.9 of the DEIS discusses historic and archaeological sites in the project site and the immediately surrounding area. There are no burial sites within the project boundaries.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

HANA COMMUNITY ASSOCIATION

October 5, 1992

County of Maui Department of Planning
Brian Miskae, Director
Keone Fairbanks, contact for accepting authority
200 S. High Street
Wailuku, Maui, Hawaii 96793

Subject: Comments on Draft Environmental Impact Statement for proposed Hana Ranch County Club, Hana, Maui.

The Hana Community Association (HCA) submitted questions and concerns regarding the proposed project in response to the Environmental Impact Statement preparation notice in a letter dated March 20, 1992, from our Board of Directors and through comments offered by the Hana Community Negotiations Committee dated March 8, 1992. The Hana Community Association is a member of the Hana Community Negotiations Committee.

The HCA Board of Directors offers the following comments and questions on the Draft Environmental Impact Statement. First, regarding the questions raised in our March 20, 1992 letter. We quote each of the questions from that letter followed by additional questions and/or comments.

1. "Will the golf course provide financial stability to the Hotel Hana-Maui?"

The question of financial stability is dealt with through revelation of the sale of golf course memberships. We have a number of questions regarding these memberships. 1) What proof can be offered that 1,000 memberships can be sold at $200,000 each? 2) Did the major shareholder of Keola do a formal survey of the 10,000 members of its existing golf courses to determine the projected number of memberships? 3) What are the names and locations of the four golf courses owned and operated by Keola's major shareholder that were referred to in the draft EIS? 4) Will the golf course memberships be sold on a commodities market or stock exchange? 5) Will golf course membership sales transactions take place in Hawaii, Japan or elsewhere? 6) Are the golf course membership sales taxable in the place of sale? 7) Keola projects borrowing one hundred and sixty (160) million dollars in interest free loans from the sale of golf course memberships. How can these loans ever be repaid, considering that the financial projections made in the draft EIS show that the operation will continue to loose money even after a golf course is in operation ? 8) What would be the projected result to Keola Hana Maui Inc.'s Hana properties at the time the one hundred and sixty million dollars in loans are due for repayment?

2) "Is the proposed "golfer" target market a market that the Hotel Hana-Maui can be competitive in since many other golf resorts are located on Maui in places where the weather conditions are much more stable and conducive to playing and where there are other activities for family members who may not want to play golf?"

Founded and incorporated in 1953 as a tax-exempt non-profit organization to develop and maintain a unified community spirit amongst the people of Hana
POST OFFICE BOX 202, HANA, MAUI, HAWAII 96713

We did not find a complete answer to this question.

3) "If the golf course fails to provide the financial stability necessary to sustain the Hotel Hana-Maui, will Keola or a subsequent owner use this to justify further development?"
We found no definite answer to this question. In Section 5.0, Page 38-39, Alternatives to the Proposed Action, the draft EIS states "In the event that staff and other cost reduction measures were unsuccessful, economic actions could include selling all of the company's assets, or portions of assets (ex. parcels of land) to achieve financial return objectives. The sale of part or all of Keola's assets could result in more landowners which would increase the potential and options for development". We request the final EIS to include a complete projected selling off of assets scenario and to show how this would "increase the potential and options for development".

4) "Since the Hotel Hana-Maui is currently financially unstable, have the following items been taken into consideration? a. Is the recently developed "cottage industry" of vacation rental homes a factor in the declining occupancy of the Hotel Hana-Maui? b. Is the current management by Sheraton and their target market the best market for Hotel Hana-Maui?"
We find no answer to the question of vacation rentals in the draft EIS. These operations, many illegal under existing zoning regulations, are in competition with the Hotel Hana-Maui. Vacation rentals may also be a factor in the rental housing market which is part of questions 6 and 7. Please answer this question in the final EIS. We find the question under b. also unanswered.

5. "Does Hana have enough employment resources available to serve the Hotel, the golf course, and other amenities?"
Under Section 7.0, Socio-Economic Factors (P.133), an in-migration of up to 36 households, 112 persons, is projected.

6. "If the golf course operation requires an influx of employees, is there adequate housing available to handle such an influx?"
Clearly, there is not presently adequate housing available.

7. "Will an influx of new residents and the increased demand for rental housing cause a rise in rent values thereby displacing residents who can not afford higher rents or making the rent values too high for people to pay?"
We find the question unanswered.

8. "How will a possible influx of new residents affect the current infrastructure of the community, i.e. schools, parks, beaches, medical and police facilities, etc...?"
The answer given for schools (Section 8.8, Educational Facilities p.189-191) is incorrect in the draft EIS based upon the statement on page 191 that "the project will not affect Hana School." We understand the Hana PTSA will give a complete response on the issue of impact upon the school. We will say simply that the school is already overcrowded and the projected increase in resident population will add to this problem. The answer for medical facilities (Section

9.2.6 State Health Functional Plan, P. 218-219) is incorrect in the draft EIS based upon the statement on page 219 that "The Proposed Action is expected to have very little or no effect on health care facilities or services". The addition of 36 families will certainly amplify existing problems at the Hana Medical Center with facilities, equipment and staff. We would suggest a meeting with the Hana Medical Center Staff and Hana Public Health Nurse to clarify this issue. We suggest that a closer look be taken at impacts upon parks, particularly the Hana Youth Center and recreational programs, and beaches. At times, for example, Hamoa Beach is crowded to overcrowded. Will the projected influx of new residents and additional visitors at the Hotel Hana-Maui create the need for sewage treatment facilities at that beach?

9. "Will the golf course development cause land values to escalate and therefore taxes to rise?"
We find no answer to this question.

10. "The ownership of the land currently proposed to be used for the golf course is in dispute. The ownership must be settled prior to development or approvals for development."
That is a statement, not a question. It is our understanding, at this time, that disputed lands are no longer part of the proposed project.

11. "The current site of the golf course includes possible State of Hawaii ceded lands. These lands must be identified and appropriate State agencies notified and questioned regarding the affects of this type of use on these lands."
Again, a statement. It is our understanding, at this time, that no State of Hawaii lands or ceded lands are being proposed as part of the proposed golf course.

12. "Will run off from the golf course affect the waters along the shoreline?"
13. "Will the intensified use of pesticides and herbicides affect the coastal waters?"
14. "The areas along the shoreline are critical to the local residents who use the area for fishing and gathering of edible substances to supplement their families food needs as well as to perform native cultural activities. Will intensified uses of pesticides, herbicides, and fertilizers affect these waters thereby affecting these activities?"
15. "Will the golf course and the maintenance practices necessary to sustain it, such as the use of pesticides, herbicides and fertilizers, affect the aquifer and/or ground water in the area?"
For the purpose of this response we have lumped questions 12-15 together, since they are closely related. There is information offered in the draft EIS relating to these questions. However, we would request comprehensive information be provided on alternatives to the use of pesticides and herbicides. We also request that no chemical and low chemical use options be put forward in the final EIS.

16. "A thorough study of the proposed site must be done to identify

significant archeological sites."
We request the complete archeological study be included in the final EIS. We request a proposed plan for conservation of the archeological sites identified in the draft EIS.

17. "How will the current infrastructure of the community be affected by this development and the increased tourist activity that it will bring?"

18. "What would be the social affects caused by the sale of memberships to foreign nationals upon a community that has had limited exposure to foreign national tourism?"
Under Hana Community, Section 7.3,page 139, Social Interactions, there is a statement "Foreign visitors provide opportunities for cultural exchanges as well as barriers". We would like to see an expansion of information on the "opportunities and barriers".

19. "What would be the impacts on the Hana airport facilities, which is currently serviced by only Aloha Island Air, when substantial freight increase occurs due to the transport of golf club bags?"
We have not found an answer for the question.

As a member of the Hana Community Negotiations Committee the Hana Community Association helped to formulate comments submitted March 8, 1992, by the Negotiations Committee. We request that a comprehensive and indexed response to issues and concerns raised be included in the final EIS.

We look forward to receiving the final Environmental Impact Statement. We would like to express our appreciation to all those who have participated in this process.

Sincerely yours

Anthony J. Pu

Anthony J. Pu, Chair
for the HCA Board of Directors

John Blumer-Buell
Robert Carroll
Haunani Collins
Kalani English
Annie Rahl
Laureen Tanaka-Sanders
Bob Vogele

cc: Keola Hana Maui, Inc., Libert Landgraf
Pacific Planning and Engineering, Inc., Alvin K.U. Chong

PACIFIC PLANNING
& ENGINEERING, INC

November 23, 1992

Mr. Anthony J. Pu, Chair
Hana Community Association
P. O. Box 202
Hana, HI 96713

Dear Mr. Pu:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 5, 1992 regarding the above project. The following are responses to your comments:

Hotel financial stability. Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The Kato Group, the major shareholder of Keola Hana Maui, Inc. (Keola), owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. The coordination of membership sales will be managed by the Kato Group's own offices. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

The golf course branch of the Kato Group owns, has built, maintains and operates four private 18-hole championship golf courses throughout Japan. The Yokonami Golf Course in the Kochi Prefecture and the Mashuko Golf Course in Hokkaido, opened in July, 1977. Gifu Inaguchi Golf Course located in Gifu Prefecture was completed in April, 1986. The Ibaraki Royal Country Club which is located about one hour from Tokyo via the Joban Super Expressway, had its grand opening in September, 1991.

Membership sales are not taxable, they are considered "deposits". However, if a membership is resold at a price that is higher than the purchase price, a tax will be leveled on the "gain".

It has been the experience of the Kato Group since 1977 that memberships are rarely redeemed and need to be repaid. Keola believes it is unlikely for a large number of members to terminate, and even more unlikely for a sizable number of members to terminate at the same time. If repayment of the deposits should occur, Keola expects there would be an adequate demand to absorb resales of any terminated memberships. Furthermore, based on the projected trending of the golf course and Hotel, the combined operations should be profitable in the year 2014.

Golfer target market. Section 7.5.1 of the DEIS discusses the market analysis of golf courses in Hawaii. Regarding the effects of weather conditions, the Pali golf course and Oahu Country Club on Oahu and the Princeville golf courses on Kauai are considered to be very desirable and successful golf courses even though they experience higher average rainfall than other golf courses. Princeville's Prince golf course, for example, experiences an average rainfall of 75-85 inches per year (which is higher than Hana) and is still rated as of the ten best resort golf courses in the U.S.

The Hotel Hana-Maui offers a variety of activities (tennis, horseback riding, croquet, guided tours of historical sites, swimming, snorkeling, jogging, hiking and more), in a secluded environment. The proposed golf course, combined with the diverse range of activities presently offered will enable the Hotel to effectively compete with the other golf courses on Maui.

Further development. Section 5.1 of the DEIS discusses the implications of not implementing the project, i.e., the No-Action Alternative. The basic difference between the No-Action Alternative, the denial of the project or the failure of the project is Keola's willingness and commitment to further invest its capital to provide economic stability for the Hotel and the Hana Community.

Keola is confident that the project will be successful and does not anticipate failure nor major liquidation of its assets.

Vacation rental homes. Although there are no "official" statistics for vacation rentals in Hana, it is believed these rentals have a limited impact on the occupancy levels of the Hotel Hana-Maui. These vacation rentals do not provide the types and levels of service that the Hotel does and, therefore, attracts a different type of visitor. Illegal rental units, however, should be required to comply with all applicable zoning, taxes and other laws and regulations.

Hotel management. ITT Sheraton is one of the largest and most respected hotel management companies in the world. They are well known for their business and first class hotels worldwide. Although they are not presently well recognized as primary luxury hotel operators in the U.S., they have acquired the management of approximately five such properties including the Hotel Hana-Maui and the Princeville Hotel on Kauai. Given adequate time, there is no reason to believe that ITT Sheraton will not become recognized as a primary luxury hotel operator.

The target market for the Hotel is the primary luxury resort visitor. Due to the limited number of hotel rooms, large physical size of its common areas and substantial investment by Keola into the Hotel's land and infrastructure, the targeting of a lower class market will not generate adequate revenues to yield bottom line profits. The Hotel's average room rate is comparable to most luxurious resorts in Hawaii.

Employment. Section 7.5.3.1 of the DEIS indicates the Hotel has adequate staffing to service the expected increase in hotel occupancy. Keola estimates that at least 75 percent of the golf course employment needs can be recruited from Hana. Hana residents and previous Hana residents (kamaaina) who wish to return will be given job placement priority for full and and/or part-time employment.

Housing. Section 7.2 of the DEIS discusses the current housing efforts in Hana and the probable impacts of the golf course project on housing.

The non-profit Hana Affordable Housing and Community Development Corporation (HAHCDC) was created to develop affordable housing for the residents of Hana. Keola has played the key role of sponsor for this organization. It has been instrumental in getting it started. To this end, Keola has provided assistance to the HAHCDC in the form of start-up, training, orientation, studies, surveys, workshops, legal and consultant fees, travel, inspection tours, clerical support, technical resources and funding. They have previously committed a donation of 15 acres of land for a single-family affordable housing project.

In addition to the above assistance to the HAHCDC, Keola will provide further direct support (i.e., land, funding, or in-kind services) to mitigate the housing needs of the project. However, the HAHCDC is a free standing entity, separate from and independent of Keola. To the extent that Keola resources, financial, staffing or otherwise are accepted, the HAHCDC will retain its independent status.

Accordingly, a memorandum of understanding will be executed to clearly delineate the on-going relationship between Keola and HAHCDC, particularly the types of financial and other types of support which Keola may give to the HAHCDC, as both parties work to increase the supply of affordable housing for the residents of Hana.

It should be noted, that a significant number of Hana residents that currently work outside of Hana have expressed a strong desire to work at the golf course in Hana which would reduce the housing needs of the project.

Under the HAHCDC programs, single family homes (house and lot) are expected to be sold for approximately $100,000, and affordable rental rates would be based on appropriate government housing agencies' guidelines. Residents who are currently renting, therefore, are not expected to be displaced as a result of the project.

<u>Infrastructure</u>. The project's probable impacts on the infrastructure and public facilities are discussed in Section 8.0 of the DEIS. The Final EIS will incorporate the comments of the Hana High and Elementary School PTSA.

<u>Land values</u>. The Office of State Planning's <u>Golf Course Development in Hawaii: Impacts and Policy Recommendations</u> reported that previous studies have found that Hawaii's golf courses have very limited impacts on nearby property values. The report states, "In both the short- and long- term time frame, however, golf courses have been found to have minimal impact on property values."

Since Keola owns the entire project site and most of the land around the project site, they will be the landowner most affected by any increase in property taxes.

<u>Land title</u>. Since the preparation of the Environmental Assessment, the project boundaries have been revised to <u>exclude all</u> lands where land ownership was questioned or State or ceded lands. The entire project site is owned by Keola, and there are no parcels where ownership is under dispute (Section 2.4 of the DEIS).

<u>Water quality</u>. Section 6.3.2 of the DEIS clearly states the project's effects on ground and surface waters will be well within water quality standards and will <u>not</u>, therefore, affect cultural and recreational activities such as fishing and food gathering activities.

Comprehensive information on alternatives to the use of pesticides and herbicides is presented in Appendix E. As noted in the DEIS, the turf management program is based on the principle of Integrated Pest Management, and relies on a variety of cultural, mechanical, biological and chemical methods to control turf pests. As stated on page 117 of Appendix E, "A pesticide application will be made when there is no alternative measure for control." None of the pesticides are recommended for application to the entire site.

<u>Archaeological sites</u>. Section 6.9 of the DEIS fully discusses the archaeological and historic sites within and adjacent to the project site. Cultural Surveys Hawaii (CSH) report was prepared in full compliance with the applicable State and Federal requirements. The State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) reviewed CSH's report and found the report to be adequate, except for a few minor comments which will be incorporated in the Final EIS. SHPD letter states "It appears that all sites within the project area have been identified and that adequate information has been collected to assess their significance."

Introduction of foreign nationals through the sale of memberships. Section 7.3 and 7.4 of the DEIS discuss the project's probable impacts on the Hana Community and Hana's Hawaiian Community, respectively. Golf course members are expected to have a limited effect on residents. First of all, non-local visitors have been staying at the Hotel for more than 45 years. Secondly, the over half of a million annual day visitors to the Hana region will clearly have a greater impact than the additional 11,000 annual Hotel guests with the project. And finally, golf course members are expected to visit Hana infrequently, staying at the Hotel only once or twice a year.

It is likely that the social impact of having more foreign visitors will be similar to that of interacting with people of different social and economic backgrounds, regardless of the origin of the visitors. The present culture of Hana is already one which represents assimilation. Throughout Hana's modern history, different cultures have constantly blended into the prevailing culture, which is based on Hawaiian values and practices. People of Chinese, Filipino and Japanese ancestry have worked with Hana residents on the plantations, and many have made Hana their home. The 1990 census indicates that the proportion of Caucasians has increased significantly during the 1980's, and the culture has been even further impacted. Thus, in spite of the introduction of different cultures, Hana is still predominantly Hawaiian in its culture, its attitude and in daily practices.

The opportunities referred to are similar to those which have already occurred. In the focus groups, it was indicated that people have shared their exchanged ideas regarding food preparation and meals; it was pointed out that many plantation terms are a mixture of Hawaiian, Japanese, Chinese and Filipino words. The barriers are also present. There are still ethnic and cultural differences which prevail in Hana, as they do elsewhere in Hawaii.

Hana Airport. An estimated 3 to 5 passengers per flight would be golfers (with golf bags). This small number of passengers and baggage would not impact the Hana Airport facilities.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

RECEIVED
OCT 14 1992

October 5, 1992

Mr. Alvin K. U. Chong
Pacific Planning & Engineering
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Dear Mr. Chong:

The Hana High and Elementary School PTSA wishes to bring to your attention several inconsistencies in the Draft Environmental Impact Statement that your company prepared for Keola Hana Maui, Inc. for their proposed Hana Ranch Country Club.

On page 13 regarding "Educational Facilities", paragraph 5 reads that "according to the State Department of Education, the project will not affect Hana High and Elementary School." This statement is incorrect. This proposal will have an affect on the Hana High and Elementary School.

Addressing pages 189-191, Section 8.8, "Educational Facilities" we would like to bring to your attention page 190, Section 8.82, under probable impacts, paragraph 2. At present, we are dividing our secondary portable between two teachers. Our Counselor is in a practice room in the band building. Our IRA teacher is using the teacher's dining room as a class-room. The Kamehameha reading project is located in 1/3 of the art classroom. The Kamehameha Pre-school program has been delayed because the portable to house them was not completed in September. The 6th grade students (43) have been divided with 31 children in one portable classroom and the remaining 12 children located in the teacher's workroom. A portable is to be built for them, but no starting or completion date has been given. There is no space available for our computer program, also.

On page 191 under "Proposed Action", we feel that the proposed project will indeed have an affect on the Hana High and Elementary School. The 1992-1993 enrollment is now at 461 students. We cannot accomodate our present student body now. We are extremely concerned that any increase in enrollment would put a severe burden on our school and the faculty as well. At present, we are in deep need of more facilities and if more students were added, we would need additional faculty, also.

Thank you for this opportunity to let us respond and share our concerns with you and we look forward to them being corrected in your Final Environmental Impact Statement for the proposed Hana Ranch Country Club.

Sincerely,

Robert Carroll

Robert Carroll, President
Hana High and Elementary School PTSA

Enclosures

cc: Keola Hana Maui, Inc.
County of Maui, Department of Planning

July 22, 1992

Meyer M. Ueoka
Board of Education
2103 Wells Street
Wailuku, Hawaii 96793

Dear Mr. Ueoka:

Patricia Eason, Principal of Hana High and Elementary School, requested on June 29, 1992, through Lokelani Lindsey, Maui District Superintendent, the need for a new office building to free and fully utilize the space they are now using in Building C for classrooms as originally intended.

On July 1, 1992, the Hana High and Elementary School PTSA wrote to Mrs. Lindsey supporting this office building and also stating the need for a permanent six room classroom building.

At present, we are dividing our secondary portable between two teachers. Our Counselor is in a practice room in the band building. Our IRA teacher is using the teacher's dining room as a classroom. The Kamehameha School reading project teacher is located in 1/3 of the art classroom. The Kamehameha Pre-School program will be delayed because the portable to house them will not be ready by September. The 6th grade students (42 children) will either be in one portable or between the portable and a room located under the gymnasium. A portable is to be built for them, but no starting or completion date has been given. There is no space available for our computer program, also.

Any other programs that might be made available for our children, whether through the DOE, Kamehameha School or other sources will be difficult or impossible to implement because of the lack of classroom space available.

Hana is growing and our school must grow along with it. With our limited facilities, we cannot give our children the educational opportunities they need now. If we do not plan for permanent classroom and office facilities now, we will not be able to hold our own, much less handle future demands for classroom space and programs.

Enclosed is the desired location of the proposed office and six room classroom building which would be used by our intermediate students (6th, 7th, and 8th grades). Having these students with the high school and lower grades is

not desirable because of the physical and emotional development at these ages. Most discipline referrals are for students in this age level.

We look forward to working with you one these vitally important matters.

Sincerely,

Robert Carroll

Robert Carroll, President
Hana High and Elementary School PTSA

xc: Charles Toguchi, Superintendent
Department of Education

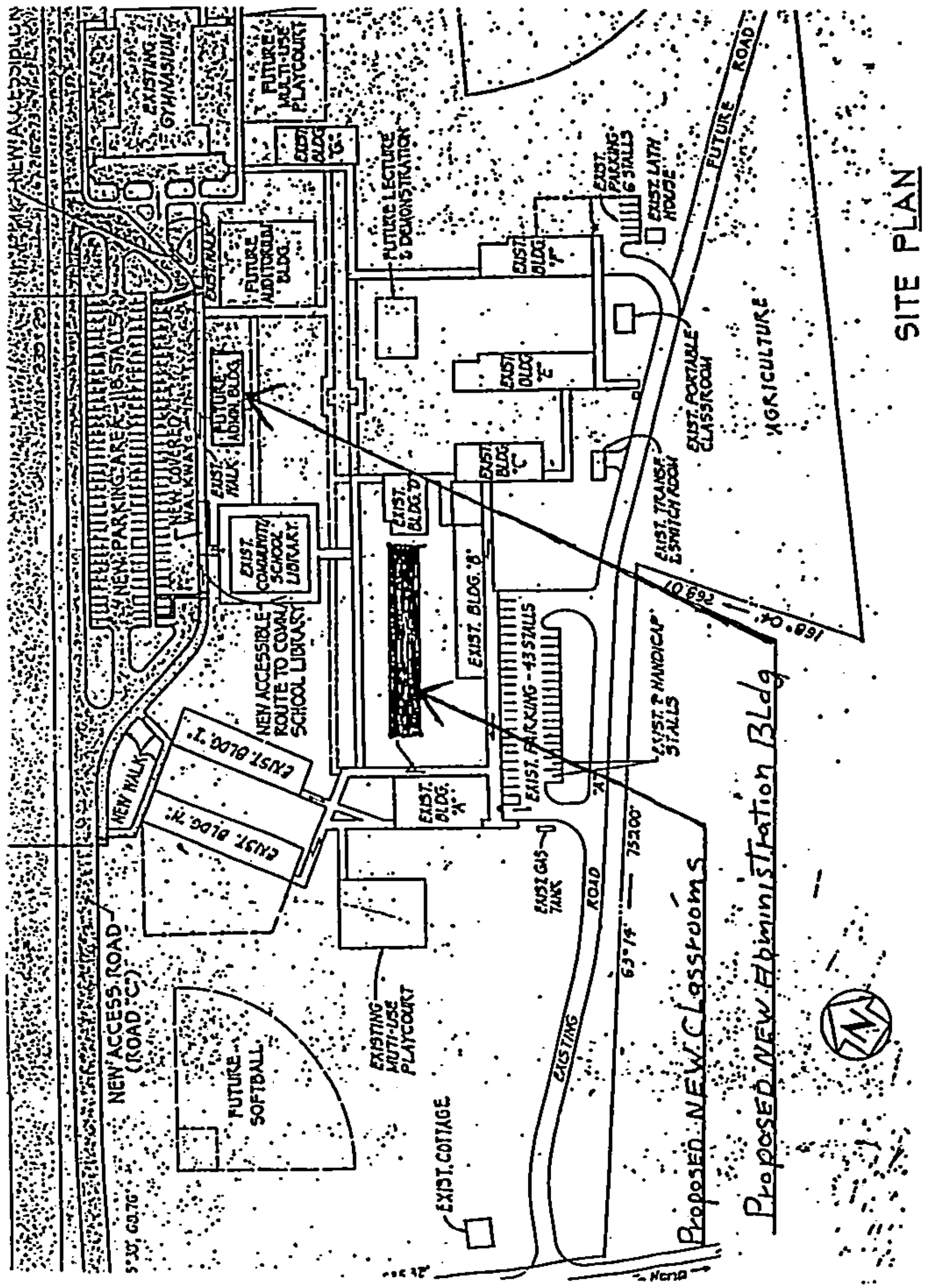
Alfred Suga, Assistant Superintendent
Business Services, Department of Education

Lokelani Lindsey, District Superintendent
Department of Education

Patricia Eason, Principal
Hana High and Elementary School

Joe Souki, Chairperson
House Finance Committee

Senator Malama Solomon



PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Robert Carroll, President
Hana High and Elementary School PTSA
P. O. Box 128
Hana, HI 96713

Dear Mr. Carroll:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 5, 1992 regarding the above project. The following response will be incorporated into the Final EIS:

The assessment conducted for the DEIS indicated the project is expected to have a minimal impact to Hana High and Elementary School based upon an increase of up to 112 residents. This was a conservative estimate because it assumed each job created would result in a new family migrating to Hana. Keola Hana Maui, Inc., however, expects a significant number of jobs to be filled by Hana residents that currently work outside of Hana who want to return to Hana to work. Consequently, the additional students from the project would be lower, resulting in reduced demands on the school.

Sincerely,

Alvin K. U. Chong
Project Manager

06 October 1992.

Department of Planning
County of Maui
250 South High Street
Wailuku, Maui, Hawaii 96793

Attention: Keoni Fairbanks

Subject: Comments to the Draft Environmental Impact Statement for the Hana Ranch Country Club and Golf Course

Dear Mr. Fairbanks:

The Hana Community Negotiations Committee, having reviewed the Draft Environmental Impact Statement for the Hana Ranch Country Club and Golf Course, finds that its concerns, as expressed in its comments previously submitted, have not been fully and adequately discussed within the contents of the Draft Environmental Impact Statement.

Accordingly, the Hana Community Negotiations Committee does hereby submit these same comments as its Comments to the Draft Environmental Impact Statement for the Hana Ranch Country Club and Golf Course.

Thank you for your attention to this matter.

Sincerely,

Bill Fuhrmann
Chair of the Hana Community Negotiations Committee

Attachment:
Comments from the Hana Community Negotiations Committee

Copies transmitted to:

Keola Hana Maui, Inc. as Applicant
Pacific Planning and Engineering, Inc. as Consultant
Office of Environmental Quality Control

cc: Negotiations Committee

COMMENTS OFFERED

by the

Hana Community

Negotiations Committee

as a

Consulted Party

Submitted March 08, 1992.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

Prefacing Comments

This submittal of Comments Offered by the Hana Community Negotiations Committee is provided pursuant to publication of the EIS Preparation Notice on the Hana Ranch Golf Course as was published in the OEQC Bulletin, Volume IX, No.3, dated February 8, 1992.

This submittal of Comments Offered by the Hana Community Negotiations Committee is sequenced as follows:

Any questions or comments regarding this submittal and the contents contained within should be directed to:

Bill Fuhrmann
Community Negotiator and
Chair of the Hana Negotiations Committee
Post Office Box 183
Hana, Maui, Hawaii 96713

Telephone: 248-8345 (Office)
248-8300 (Home)

Section "A"

BACKGROUND

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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BACKGROUND

The residents of Hana, at a community meeting scheduled by the Hana Community Association who provided via a community wide mailout notice to all residents of the Hana District, decided to engage in contructive, good faith dialogue with representatives of Keola Hana Maui, Inc. regarding Keola's proposed development of a golf course in Hana. On February 20, 1991, the residents of Hana decided the following:

WHY NEGOTIATIONS ??

"to let Hana's people, with Hana's sensitivities, solve Hana's problems, with Hana type solutions"

conditioned upon:

(1) the residents of Hana would select their representatives, which they did:

REPRESENTING the Sensitivites of Hana: these Residents of Hana as members of the Negotiations Committee:

Bill Fuhrmann-Community Negotiator & Chair of the Negotiations Committee

Joe Ahuna II-Agricultural Concerns

Harry Hasegawa-Business Concerns

John Hanchett Sr.-Property Owners Concerns

Henry Kahula Sr.-Lifetime Hana Residents' Concerns

Bob Getzen-Recent Hana Residents' Concerns

Randy Medeiros Jr., Tau'a Pahukoa, & Anela Lind-Hana Student Residents' Concerns

Bruce Lind, Joseph Kaina & Bennett Medeiros-Current Lifestyle Concerns

Geraldine Carroll-Cultural & Archeological Preservation Concerns

Bob Bradley-Environmental & Ecological Concerns

Terry Lee Poaipuni & Bob Casey-Other Concerns

Roland Torres-Keola(non-union) Employees' Concerns

Sharol Nani-Smith-Keola(unionized) Employees' Concerns

John Blumer-Buell & Mike Minn-Hana Community Association's Concerns

BACKGROUND (continued)

and conditioned upon:

(2) That all terms and conditions of settlement be presented to the residents of Hana, who will, by secret ballot majority vote, determine their decision on having a golf course in Hana.

The Hana Community Association has commited to engage in implementation of this "ratification" process.

As of yet, no terms and conditions of settlement have been framed in the negotiations between the Negotiations Committee and representatives of Keola Hana Maui, Inc..

In order for the Negotiations Committee to have a clear focus on the issues and concerns regarding the proposed golf course project, the following question was framed as the:

QUESTION IN NEGOTIATIONS:

"Will Keola Hana Maui's proposed golf course fulfill its(KHM's) financial objectives <u>WHILE</u> the residents of the Hana District are able to retain the balance and the harmony of the community's lifestyle, cultural and social qualities, and rural and environmental qualities ?"

A complex question when simplified means:

"Will the golf course help Keola, and if it does, will Hana be the Hana the residents of Hana want Hana to be ?"

This Question identifies: <u>Hana's problems</u>

Keola needs to be financially sound and operationally profitable;
Residents of Hana who are employees of Keola need stabilized employment with sufficient income to support themselves and their families;
The community of Hana needs to have the major economic entity within the community stabilized and operationally viable.

This Question defines: <u>Hana Type Solutions</u>

Hana's solutions must retain the essence of Hana:
the community's lifestyle;
the community's cultural and social qualities;
the community's rural and environmental qualities.
Hana's solutions must be acceptable to all residents of Hana.

Essentially, the negotiations process is simply:

"to let Hana's people, with Hana's sensitivities, solve Hana's problems, with Hana type solutions"

Nothing more; nothing less.

Section "B"

COMMENTS OFFERED

BY THE

HANA COMMUNITY

NEGOTIATIONS COMMITTEE

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

The Comments offered by the Hana Community Negotiations Committee are contained within this report and are sequenced as follows:

SECTION I

Comments offered

by the

Hana Community

Negotiations Committee

on

Economic Issues and Concerns

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

<u>General Comments to Economic Issues:</u>

The major deterrent to progressing through the discussions necessary to find resolution of the community's concerns regarding the proposed golf course development has been the ambiguities of the evidence provided on Economic Issues.

While there is little dispute that the economic viability of Keola Hana Maui, Inc., as the major employer and provider of income for the residents of Hana, is essential to the community's economic well-being, no evidence has been presented, by the Environmental Assessment or during the course of negotiations, which would allow for analysis and examination of factors relevant to the decline in the hotel's occupancy performance. The residents of Hana, through the Negotiations Committee, need opportunity to examine these factors. The residents of Hana, through the Negotiations Committee, need assurances that Keola has taken as much remedial action as possible to cure the problems affecting the occupancy performance of the hotel. While it can be credibly argued that certain factors, such as the current recession and the effects of the Gulf War, are beyond the remedial ability of Keola, similarly the ability of the hotel's occupancy performance would have to be analyzed without consideration of these factors. The analysis of the hotel's ability to attract guests should only be measured in terms of the factors within the control of the owners and the management of Hotel Hana Maui.

The development of a golf course, a stand alone golf course without surrounding and/or complementary development, is a "big ticket" item. While it is Keola's financial ability that will allow for the development of this "big ticket" item, it is the residents of Hana, current and future, who will be paying for this development. Accordingly, the effects and impacts over the long term retirement of this purchase requires full and complete analysis and discussion.

Based on this question: "Will the golf course project be the economic salvation for Keola and this community or will the golf course project place primarily this community and secondarily Keola in economic jeopardy ?", the Comments offered by the Hana Negotiations Committee in this section are the primary concerns which need full and complete analysis and discussion, <u>prior</u> to examination of the social, cultural, and environmental effects and impacts of the proposed project.

<u>General Comments to Economic Issues (continued):</u>

Of noteworthy clarification, the Negotiations Committee, in its discussions, on and off the record, with representatives of Keola Hana Maui, Inc., has not indicated its doubts of Keola's desire to be a long term partner in the economic future of Hana. The Negotiations Committee has made Keola's representatives aware that while Keola has the viable option to leave Hana, most of the residents of Hana, with roots imbedded by generations of ancestral tenancy, do not have such an option. Both, the Negotiations Committee and Keola's representatives, do <u>not</u> want to be parties to (a) cause dislocation of Hana's residents; or, (b) cause displacement of Hana's heritage; or, (c) cause devaluation of the lifestyle, traditions, cultural and social values of Hana's people.

The Negotiations Committee proposes that the sequence for assessing the Economic Issues be as follows:

(a) Determining and the assessing the factors which have been influential in the declining occupancy performance of the hotel.

(b) Determining and assessing the remedial actions which can be undertaken to address the influence of these factors.

(c) Determining and assessing the remedial options then necessary to improve the occupancy performance of the hotel.

(d) Subsequent the determinations, assessments, and analysises of the remedial options which may be necessary, a full and complete assessment of the proposed action to develop a golf course should be presented. Such assessment should focus on the economic benefits and the economic risks to Keola as well as to the community.

The Negotiations Committee believes this sequence of assessing the Economic Issues will help to determine the validity of the justification for the proposed golf course.

The next step, assuming valid economic justification has been established for the proposed golf course, is to analyze and discuss the effects and impacts, immediate and long-term, of the golf course project on the economic well-being and economic future of both Keola and the community.

The Comments offered by the Hana Community Negotiations Committee on Economic Issues and Concerns are being offered in the context of these General Comments on Economic Issues.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

Issue: Credible and Complete Justification for project

A critical examination and discussion of the factors which have contributed to the decline of the hotel occupancy performance needs to be provided.

The examination conducted by the Negotiations Committee of Environmental Assessment indicates that such notable factors as

(a) the effects of changes in ownership over the last ten years;
(b) the effects of the renovations and build-out of the hotel complex;
(c) the effects of changes of management;
(d) the effects of changes of market orientation;
(e) the effects of escalated room rates;
(f) the effects of community's relationship with the hotel's guests;
(g) the effects of the changes within the workforce from a pre-dominant local Hawaiian employee complement to a more visible less local Hawaiian employee complement;
(h) the effects of the considerable changes within the supervisory ranks on the morale and effectiveness of the rank and file employees;
(i) the effects of the limited employment resources within the community; and,
(j) the effects of shortfall of infrastructure within the hotel;

were never identified or discussed. Without a full and complete examination of these and other factors, the effects and cumulative impacts of these factors upon the occupancy performance of the hotel, and proposed remedial actions to address these factors, the Environmental Impact Statement will similarly fail to offer credible and complete justification for the proposed development of the golf course.

The Negotiations Committee has previously expressed its concern that the precedent two owners of Hotel Hana-Maui have justified their needs for their additional development with claims of improving the hotel's occupancy performance and their companys' economic viabilities. As Keola Hana Maui is the third owner within the last ten years to iterate such claims, the community, through the Negotiations Committee, seeks a more thorough examination of these claims.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Alternative Remedies

A critical examination and discussion of alternative remedies to cure the hotel's occupancy shortfall needs to be provided.

The Negotiations Committee and the residents of the Hana community must be able to discern whether the proposed golf course when compared with other alternatives is the best of the remedies offered to cure the hotel's occupancy shortfall.

ISSUE: Hotel Hana Maui's capability to compete

A critical examination and discussion of Hotel Hana Maui's capability to compete with the other luxury resort properties needs to be provided.

The Negotiations Committee needs to be able to analyze the capability of Hotel Hana Maui to compete with the other luxury resort properties, especially if the singular element to be competitive is the development of the proposed golf course. If other elements are necessary to be considered in Hotel Hana Maui's desire to be at a competitive level with the other resort properties, such elements should be identified, examined, and analyzed as well.

ISSUE: Attainability of Objective

A critical examination and analysis of the golf course being able to sufficiently attract the numbers of guests and/or prolong the stays of the guests in order to validate the attainability and/or sustainability of the level of occupancy desired needs to be provided.

The Negotiations Committee needs to be able to analyze if the proposed golf course will be able to attain and then sustain the projected level of occupancy necessary for the hotel to be operationally viable.

ISSUE: Community's Economic Dependency

A critical examination of the effect the proposed golf course will have on the community's economic dependency upon tourism as its essential source of income needs to be provided, particularly with the experiences of the effects of the recession and the Gulf War crisis upon tourism.

ISSUE: Examination of Environmental Assessment

As the Environmental Assessment failed to:

(a) analyze and discuss the effects and impacts of the proposed golf course upon the community's economic viability;

(b) analyze and discuss the effects and impacts of the proposed golf course upon the community's limited employment resources;

(c) analyze and discuss the effects and impacts of Hana's weather upon the viability of the golf course and the resulting effects and impacts upon the hotel's occupancy;

(d) analyze and discuss the correlation of weather playable periods with peak occupancy periods;

(e) analyze and discuss the effects and impacts upon the hotel's workforce caused by sustained high levels of occupancy;

(f) analyze and discuss the effects and impacts of the sale of "membership fees" upon the capitalization of the golf course project and upon the continued operational viability of the golf course;

(g) analyze and discuss the economic feasibility of the golf course project and its effects and impacts upon the viability of Keola Hana Maui, Inc.;

(h) analyze and discuss the effects and impacts of the proposed golf course upon Keola's proposed Town Center project; and,

(i) analyze and discuss the effects and impacts of the proposed golf course upon the long term financial capabilities of those employees of the hotel who desire to purchase homes for themselves and their families;

the Environmental Impact Statement should provide such critical analysises, and substantial and credible discussions of these issues.

ISSUE: The Evidence of the Environmental Assessment

As the evidence provided in the Environmental Assessment, based on some incredible assumptions, predicted about $ 1.5 million in operational losses for the hotel and golf course combined annually, the Environmental Impact Statement needs to provide, through credible analysis and thorough discussion, sufficient evidence to overcome the evidence of the Environmental Assessment.

If the Environmental Impact Statement is unable to credibly overcome the evidence of the Environmental Assessment, then this question:

"Is the proposed golf course project really going to help Keola financially, or will the proposed golf course hurt Keola financially, and then jeopardize the residents of Hana who depend on Keola for their economic well-being?"

will still remain on the minds of the members of the Negotiations Committee as well as on the minds of the residents of Hana.

ISSUE: The Golf Course: the "Cure-all" or "Part of the Cure"

If the Environmental Impact Statement is only able to present credible evidence that shows the golf course project will offer partial cure to the economic viability question, then the Environmental Impact Statement will need to offer, with credible analysis and thorough discussions, the other parts of the cure.

Given the development proposals of the past owners, the specter of "what else is necessary" will be the primary haunting factor in the acceptability of the golf course proposal by the residents of Hana. The Negotiations Committee feels the community will not accept the golf course proposal if it is only a partial cure unless the rest of the cure is also analyzed, discussed and then found to be acceptable.

ISSUE: Community Economic Concerns

The Negotiations Committee, during the course of its negotiations with representatives of Keola Hana Maui, Inc., did present and discuss several of the community's economic concerns relative to potential adverse impacts resulting from the development of the golf course.

These community economic concerns are being re-submitted as part of the Negotiations Committee's comments offering. This submittal consists of three(3) pages and are attached hereto.

COMMUNITY'S CONCERN

Viability of district's economic interests;

business, tourisim, agriculture, ranching

Common Concerns

There are two(2) major concerns common to the businesses of the district:

1) the sustainability of the district's employment resources

and

2) the effect of escalated land values

Employment Resources:

The ability of the community to supply added workers to fulfill the employment needs created by the proposed golf course is a major concern for the following reasons:

1) Without a definitive base-line study to discern the number of employable persons within the district to fulfill the jobs being created by the project, leads to the concern that Keola, as the major employer of the area, with unionized operations and contractual benefits, will be at a severe competitive advantage in attracting employable residents to work its operations. Of concern then is the ability of the smaller employers to compete for workers. The smaller employers do not have the financial ability to import and house workers from the outside. In most cases, the smaller employers are unable to offer wages and benefits comparable to Keola's offerings. The smaller employers are able to offer different work conditions, different work environment, and certain other social and cultural advantages as enticement for their employees.

Many Hana residents do not desire to be employed in the more regimented operations of a hotel. Some desire the "flexibility" of strictly daytime hours, some enjoy the more social benefit of weekends off, some feel more comfortable in a setting of "less social interaction with customers". The "hospitality" aspect, the "production regimentation", the "inflexibility" of scheduling, more the "time off" vs. the "time on" scheduling, the requisite "grooming", the ability to converse, the supervisory organization of a hotel operations, the "promotional and seniority" requirements, and the "regimentation" inherent of a large employer, are some of the more notable factors deterring Hana residents from seeking employment at the hotel.

Further, many Hana residents prefer "outdoor" type of work. While the golf course may well add to the number of "outdoor" type jobs, with the promotional and seniority requirements of the hotel, many of the golf course jobs will be filled by "in-house transfers".

Continued to next page.

COMMUNITY'S CONCERN

Viability of district's economic interests:
business, tourism, agriculture, ranching

Employment Resources (continued)

Resulting from the "in-house transfers" will be vacancies of "entry level positions" such as bushelp, dishwashers, etc. These jobs, by their nature, go begging currently within the resident employment pool, primarily due to the jobs being "low totem pole" jobs with inflexible work schedules and back of the house production required jobs. With a workforce that is quite young, promotional opportunities will be limited. These entry level positions may be viewed as more permanent positions.

From the community's perspective, seeking to have a more diversified economic base, the golf course promotes to the contrary with its appetitie for employees, on the golf course and within the hotel. The employment population will be more concentrated with a single employer than current.

The need for employees does not only affect businesses, for if the supply cannot meet the demand, secondary employment opportunities will be created. However, with secondary employment comes the continued problem of determining which employer is the primary employer with the expectation of its employees to first fulfill that employer's primary needs. The social and cultural impact of parents being employed in more than one job needs to be assessed.

In summary, the need to have the smaller employers operationally viable with an adquate supply of employees remains a concern, a concern that can only be best addressed after a definitive base-line study regarding the district's employment resources has been conducted.

Escalated Land Values

The concern that the development of agricultural lands will cause escalation of land prices is a major concern to businesses that require a land base for viability.

1) Agricultural interests are concerned that escalated land prices will effect their profitability, especially with higher tax assessments.

2) Agricultural lands, it is feared, will be further subjected to pressures to sell or develop.

3) Ranching lands will face similar pressures.

4) Additionally, ranching lands will be diminished, on Hana Ranch lands, by at least 250 acres. While the replacement of these lands is projected, the factors concerning productivity of these lands has not been addressed as well as the added costs to replace these lands.

Continued to next page.

COMMUNITY'S CONCERN

Viability of district's economic interests:
business, tourism, agriculture, ranching

Additional Concerns

These two major reasons remain concerns by their own volition, yet become more severe with the evidence currently on record that the golf course project will not be economically viable and that the hotel will still sustain losses, though if the current reports are accurate, the losses will be less.

With the unanswered question as to what else is neccessary for Keola to achieve viability, the additional severity of these two concerns cannot be measured.

Of noteworthy concern is What if the Golf Course project does not achieve its financial objectives. Will these businesses be able to operate without the hotel as a major employer ? In most cases the retail businesses are complementary, provide support services for the guests at the hotel and for the employees of the hotel. The agricultural operations and ranching operations while not necessarily dependent upon the hotel, many of their employees have an indirect dependency upon the hotel. The extent of that indirect dependency varies yet in total is quite substantial to the overall economic well being of those employees.

Overall, the economic well-being of the community is affected by the economic well-being of the district's major employer. Likewise, the economic well-being of the major employer has to be analyzed for the impacts to the economic well-being of the community. Shifting of the employment resources to help one without concern for the effect upon the other will upset the well-being of both. Without consideration for the impacts of escalated land values and the sustainability of the district's employment resources, puts both, the community and Keola in jeopardy.

Further, development required to achieve economic viability beyond what is being proposed will likewise have tremendous effect on the well-being of the community and of Keola.

Other Economic Concerns

The following concerns, hopefully, will be addressed by the Employment Resources Study.

1) Employability of residents, noting constraints and desires
2) Stability and viability of employment opportunities.
3) Sufficiency of future employment opportunities.
4) Types of future employment opportunities.

SECTION II

Comments offered

by the

Hana Community

Negotiations Committee

on

Community's Concerns

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

===

<u>General Comments to Community's Concerns:</u>

The Comments offered by the Hana Community Negotiations Committee as the Community's Concerns in this section are conditioned on the following Economic Assumptions:

(a) The applicant has credibly proven the economic necessity of having the golf course developed.

(b) The golf course proposal will attain the financial objectives of the applicant.

(c) The golf course proposal will be credibly able to maintain the financial objectives of the applicant.

(d) The community's economic well-being will not be adversely effected by the proposed golf course project; or if adversely effected, then such effects will be credibly and sufficiently mitigated.

(e) The applicant is able to prove through credible and acceptable evidence that no further development will be necessary to support and/or complement the hotel and/or the golf course.

In the event any of the foregoing Economic Assumptions are invalidated, in whole or in part, due to the determinations, the examinations, the analysises, and/or the discussions of the Economic Issues and Concerns presented in the preceding section and/or due to the determinations, the examinations, the analysises, and/or discussions of the Concerns Arising Out of Negotiations, as presented in the succeeding section, the Negotiations Committee should be allowed opportunity to respond to the effects and/or impacts caused by such invalidations.

Accordingly, the Comments offered by the Hana Community Negotiations Committee in this section as Community's Concerns are being presented subject to the foregoing conditions.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: <u>Community's Concerns regarding the Proposed Golf Course Development</u>

Assuming the applicants, through the presentation of credible evidence and substantive discussions within the Environmental Impact Statement, is able to cross the threshold issue, that the proposed golf course project, of and by itself, will fulfill the applicant's financial objectives, then the Negotiations Committee offers the following comments:

(a) Impact on property owners;

(b) Impact on traditional cultural and social values;

(c) Impact on social interactions of residents; impact on social interactions between residents and guests/patrons;

(d) Sustainability of subsistence lifestyles, farming, fishing, hunting;

(e) Impacts on burdened infrastructure;

(f) Impacts on recreational resources;

(g) Impacts on historical evidence of culture and perpetuation of existing culture;

(h) Impacts on sustainability of natural, environmental, and ecological resources; and,

(i) Impacts on long range planning; impacts on existing community plan.

These comments are substantially the concerns presented to Keola Hana Maui, Inc., without opportunity for discussion, on October 17, 1991. These concerns were framed within the premise of the golf course project being the exclusive development necessary to cure the economic viability issue. Accordingly, the Environmental Impact Statement should examine, analyze, and discuss these concerns within the same governing premise. In the event, the current characteristics of the proposed project are altered, the Negotiations Committee should be given opportunity to respond to such alterations and/or the effects of such alterations.

These comments are offered by the Negotiations Committee as an attachment of ten(10) pages hereto.

COMMUNITY'S CONCERN

Impact on property owners

Major Concerns

This issue covered two major areas: (1) land ownership disputes on parcels within the project site and (2) the effect upon property owners caused by the proposed development.

Land Ownership Disputes

Several parcels of land within the project site are encumbered by litigation over ownership based on Keola's filing of Actions to Quiet Title (AQT). While none of the parcels are lands of residential habitation, there are several current Hana residents who have rights of ownership to these parcels. Some parcels are owned by descendents of former Hana residents. As best as can be determined, all parcels for which AQT's were filed are owned partially by Keola and partially by current and/or former residents.

Resolution of these disputes are not within the domain of the golf course negotiations. However, due to the relationships between the members of the Negotiations Committee and the defendants, the Committee did not want to negotiate issues of the golf course which indicated support of the project site upon lands within dispute. Accordingly, the parties in negotiations came to an understanding that these disputes needed to be settled before negotiations on the physical location of the golf course became an issue on the table. Keola agreed to notice the Committee as disputes were resolved but not of the terms and conditions of resolution of those disputes.

Aside from the parcels of the AQT type dispute, the question was raised by a representative of the John Medeiros Sr. Estate that lands to which the Medeiros Estate has title was also part of the proposed development. At the Committee's request, Keola has agreed to show that the Medeiros Estate land is not part of the proposed development.

Further, the State of Hawaii claims title to a parcel within the proposed project site, however, the State has granted Keola permission to proceed with its applications. Further, information subsequently furnished, indicates that the State parcel contains "ceded lands", currently a very politically sensitive issue.

Keola has subsequently presented to the Committee that it is "re-designing" the golf course to exclude the parcels of dispute and the State's parcel. Upon provision of evidence to the Committee that all lands for the proposed development are wholly and entirely owned by Keola and evidence that the Medeiros Estate parcel is not part of the project, this area of concern should be mitigated if not eliminated.

Continued to next page.

COMMUNITY'S CONCERN

Impact on property owners

Effect upon property owners

The second major concern deals with primarily the effect upon property owners caused by the development.

The effect is of two parts: (1) the escalated property taxes which follow escalated land values and (2) the pressures caused by the escalation of land values.

The concern of property owners is the perception that golf course development, of its own volition, escalates land values. While this is a problem (or benefit) to lands surrounding the golf course, the concern escalates with the understanding that Keola, as the owner of the surrounding properties, desires not to develop these lands. Such a desire, it is believed, does not eliminate property values from escalation; such a desire causes the shift of pressures of escalated property values to other properties. Keola, as a major land owner, may be able to withstand these pressures. Yet if the shifting pressures reach areas such as Kaeleku, Hakaalae, Puuiki, Hamoa, on out to Wailua, then the property owners of lands within those areas will be effected. As many of those property owners are long-time kamaaina families, the fear is that this pressure would further cause dislocation and displacement of Hawaiian families from family lands.

The other part of this concern is the impact of property taxes caused by escalated land values. Again the focus of the concern is on the long-time kamaaina families being adversely effected by higher taxation, either by the indirect effect of the shifting of escalated land values or by the direct effect of neighboring property owners yielding to the pressures to develop their properties or to sell their properties at the higher value.

This concern remains active as no long term enduring mitigative measures have been discussued.

COMMUNITY CONCERNS

Impact on traditional cultural and social values

The Concern

A fundamental element of the question of Negotiations:

Will Keola Hana Maui's proposed golf course development fulfill its (KHM's) financial objectives WHILE the residents of the Hana District are able to retain the balance and harmony of the community's lifestyle, cultural and social qualities, and rural and environmental qualities ?

is the delicate nature of "the balance and harmony" and the effect of the proposed development upon that "balance and harmony". While the Committee is concerned about the delicate balance and the fragility of the harmony for all residents of the Hana District as a whole, special consideration is tendered to those residents with deeply rooted ancestral ties to the district. These particular residents, if the "balance and harmony" is upset or altered adversely, have, in reality, two choices to consider:

1) to adjust to living an altered lifestyle, within a a changed cultural environment with different social values, caused by artificially stimulated development;

or

2) to react with the militancy currently exhibited by other Hawaiian communities to protect their rights of birth.

Given the current unrest and uneasiness among many of the residents, the latter scenario is most probable.

However, neither scenario is desirable. The residents' ability to retain the "balance and harmony" of the community's lifestyle, cultural and social values is essential. Loss of such diminishes the perception of Hana as the "last Hawaiian place".

FURTHER, DEFINING "HANA'S LIFESTYLE" is essential to determine the viable options to consider for retaining the "balance and harmony".

COMMUNITY CONCERN

Impact on the social interactions of residents

By and large the social interactions of the Hana residents have been harmonious. Perhaps the term "Hana accepts those who accept Hana" best depicts the essence of this harmony.

The concern is that the golf course, once developed, would be a magnet, not only, as Keola claims, attracting guests to the hotel, attracting residents to Hana who have a specific desire to reside in a golf course environment, not necessarily a desire to reside in Hana. The fear that these residents will be more "socially class conscious" and not accept "Hana as Hana", then causing a distinction among residents. This distinction will have a disconcerting influence on the social interaction among residents.

The gravity of this concern can be more adequately analyzed once the viability of the project is discerned.

COMMUNITY CONCERN

Social interactions between residents and guests/patrons

The concern regarding the social interactions between residents and guests of the hotel and patrons of the golf course is predicated on the proposed international marketing of memberships in the golf course.

While Hana residents are tolerant of tourists, exposure to tourists from international markets has been very limited. How well the Hana residents interact with tourists from international ports with the anticipated increase of such tourists into Hana due to marketing of membership fees remains a concern.

Further analysis of this concern is contemplated once the marketing of membership fees becomes more definitive.

COMMUNITY CONCERNS

Sustainability of subsistence lifestyles
farming, fishing, hunting

For Clarification

A vast majority of the kamaaina ..lana residents depend on subsistence lifestyle activities, such as farming, fishing and hunting to supplement the furnishments necessary for their families and themselves. Added to this kamaaina element are some non-kamaaina residents. Of note, by mahele of large catches, primarily akule, other residents benefit from these subsistence activities.

Major Concerns

The major concern is sustainability and continuance of these activities. The influencing factors of this concern are evident with the community's concerns on:

a) the economic viability and sustainability within the community as a whole and within Keola as an entity, primarily as economic viability is the moving force causing changes and such changes have to be analyzed as to impacts then being generated.

b) the sustainability of the natural resources based on the potentiality of environmental changes caused by development.

c) the social changes evolving from the proposed development, such as increased residential population, the cultural differences which may come with the influx of new residents and the potential competition for certain resources, competition which directly affects the sustainability of these resources.

d) the adverse impacts such as escalated land values which tag along with certain types of development.

As these influencing factors have been or are being presented as Community Concerns under different headings, the foregoing identification is designed to show the inter-relationship of those concerns with this concern.

Of further significance, the Environmental Assessment addresses the potentiality of contamination of Coastal Waters yet does not with any degree address the significance of the Coastal Waters, the predominant natural element essential to sustainability of subsistence lifestyles.

COMMUNITY CONCERNS

Impacts on burdened infrastructure

1) Water Supply and Resources

a) current shortfall of County water supply evident by continuance of Wailua Surface Water Catchment as source; potential remedy to supplant this source is to install another well on the Kawaipapa Aquifer.

b) further compounding the shortfall of the County's supply is evidenced by the Report within the Environmental Assessment noting the County's system being adequate until 2010.

2) Solid Waste Disposal

Additional burden to disposal of solid waste will be generated by the clubhouse operations and the landscaping requirements of the golf course.

Potential mitigation; prohibit use of disposable containers made of non-biodegradable substances or of materials with limited re-cyclable value.

3) Medical Facilities

Additional burden to medical facilities from golf course patrons, additional guests at hotel, additional employees and families being brought into or attracted into area due to additional employment opportunites generated or caused by golf course.

4) Educational Facilities

Additional burden to educational facilities from additional employees with families being brought into or attracted into area due to employment opportunities generated or caused by golf course.

5) Police and Fire Services

Additional burden to police services from golf course patrons, additional guests at hotel, resident population increase due to additional employment opportunities, the escalation of social problems due to additional impacts on housing, the change of working conditions and pressures caused by inadequate sufficiency of employable residents, other social problems which may generate due to social interactions with new residents to area.

Additional burden to fire services caused by increase in resident population and increase in housing inventory.

6) Housing

Additional burden to acute shortfall of affordable residential housing due to increased resident population to satisfy the additional employment requirements generated or caused by the golf course.

COMMUNITY CONCERNS

Impacts on recreational resources

1) Beach areas

Additional burden to limited beach areas due to additional guests at hotel; due to increase resident population to satisfy additional employment requirements generated or caused by the golf course.

Hamoa Beach is already overburdened during periods of peak hotel occupancy. The next alternative beach area is Hana Bay, currently used primarily by residents. Fairly crowded conditions exist at Hana Bay during holidays and weekends of good weather and sea conditions.

2) Outdoor recreational activities areas

Limited areas for picnicing and similar outdoor recreational activities exist within Hana area. Such areas are normally extensively utilized by overland day visitors. Additional burden due to increased resident population to satisfy additional employment requirements generated or caused by the golf course will become evident.

3) Sport activities areas

Hana Ball Park is the primary, with Hana School area being the only other site, area for organized sports activites. Court sports such as tennis, volleyball and basketball utilize this area with the Hana School gym also available for volleyball and basketball. Field sports such as soccer, baseball and softball use primarily the Hana Ball Park. With resident population increased to satisfy employment requirements generated or caused by the golf course, the Hana Ball Park will become burdened to satisfy the community's needs for organized sports activities, both field and court sports.

COMMUNITY CONCERNS

Impacts on historical evidence of culture and perpetuation of existing culture

Historical Evidence

Concern still remains over the completeness of the survey of archeological inventory on the proposed golf course site. This concern can be mitigated to a substantial degree with additional field trips involving former residents and/or descendants of former residents who may have some personal knowledge of any other evidences. Similarly, field trips involving former employees of Hana Ranch may help to discern the completeness of the inventory.

However, such filed trips should be scheduled at such time as the project site becomes finalized.

Existing Culture

Concern remains regarding the continuance of the existing local culture, not in a museum like setting, but perpetuation of a living culture.

As previously covered, the essence of the living local culture evolves around the natural resources, the land, the water, and the sea. Adverse impacts to these natural resources will manifest as adverse impacts to the living local culture.

Another essential element of the living local culture is the subsistence lifestyle activity, evidenced by farming, fishing and hunting. These activities are influenced by economic viability and stability within the community and within Keola as an entity, with actions to vitalize economic viability being generators of potential adverse impacts to local living culture. However, at this point in time, not being able to analyze these "actions to vitalize economic viability", any analysis of potential adverse impacts would be primarily conjecture and speculation.

COMMUNITY CONCERNS

Impacts on sustainability of natural, environmental, and ecological resources

Major Source of Concern

The major source of concern of sustainability of these resources centers on the potentiality of contamination due from use of chemicals on the golf course.

The potentiality of contamination of:

a) the ground water with the golf course situated on the major aquifer which supplies the seven(7) wells providing potable water to the residents of the area.

b) the coastal waters which provides the flora and fauna caught and gathered by a majority of the local kamaaina residents and shared with many other local residents as well as non-resident friends and families.

The other area of concern, with an anticipated increase in resident population, is the adequacy of the resources to furnish the needs of the residents.

Impact on Culture

The fundamental tenets of the local culture, primarily Hawaiian, not only in blood but in heart, are wai (water), kai (ocean) and aina (land), the principle elements of the natural resources. Adverse impacts to these principle elements will adversely effect the local culture.

Effect of Environmental Assessment

The Environmental Assessment addresses the potentiality of contamination and offers as the mitigative measure "proper management and application by trained personnel". Failing to offer any other remedy and based on the acute sensitivity of the community on sustainability of these natural resources, the Committee remains discomforted with chemical usage upon the golf course. Without sufficient protection of these natural resources, essential not only to the health and safety of the residents, the cornerstones of local lifestyle and local culture, the well-being of Hana as a community remains jeopardized.

COMMUNITY CONCERNS

Impacts on long range planning

The major concern is that the golf course development by its purpose and by its creation will become a hub of major concern on many of the elements for consideration in long range planning.

At this time, lacking adequate and sufficient insight on the viability of the proposed project and the viability of Keola Hana Maui, Inc. and the resultant impact on the viability of Hana as a whole, clarity and definitiveness of these impacts to long range planning cannot be determined.

Of acute concern is the fact that this proposed development is being advanced by Keola without an opportunity for discussions on the needs of the community, the concerns of the community, the desires of the community, being held in a long range planning forum. The opportunity for expression of the community's needs, concerns, and desires is limited to the parameters of the forum concerning the proposed golf course exclusively. While other forums, such as discussions on Access, are being held, these forums are again confined to the issue of discussion.

Another major concern relating to long range planning is the inability to date of having a socio-economic baseline study for the Hana region engaged and conducted. Such data would be essential in determining residents attitudes and concerns and then framing the issues germane to planning the future of the Hana area.

COMMUNITY CONCERNS

Impacts on existing Community Plan

The most evident impact is that the current Hana Community Plan must be amended to allow for the proposed golf course development. Given the timing and delay of having the current Community Plan going through a revision process, it appears the amendment may receive approval prior to the revision of the current Plan being approved.

Of legal interest is the scenario of having the revised Plan negate the amendment.

This concern dovetails with the concern on long range planning, although the life of the revised Plan is to be only ten (10) years and long range planning, by the perception of the community, should encompass a far longer period, certain prohibitions or restrictions placed into the revised Plan will have long range impact.

The Community Plan Review/Revision process is a compatible forum for discussions on long range planning, although the processing of the Plan Amendment and subsequent approval may negate some of the discussions or cause a refocus of the discussions on certain issues inherent in long range planning dialogue.

SECTION III

Comments offered

by the

Hana Community

Negotiations Committee

on

Community Concerns

Arising from Negotiations

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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General Comments to Community Concerns Arising from Negotiations

The Comments offered by the Hana Community Negotiations Committee within this section as Community Concerns Arising from Negotiations need to assessed from the focus of (a) the context of negotiations; (b) the dynamics of negotiations; and (c) the interactions between the parties in the negotiations forum. Accordingly, the Negotiations Committee offers this subjective description:

The negotiations process was entered into voluntarily by both parties with some external influence by political and government forces being exerted upon the parties to engage in the process as a method of resolving their differences within Hana. Elements essential to the negotiations process, such as trust between the parties and "good faith" representations being conveyed between the parties, though not visibly evident at the onset of the process, did become evident as the relationship of the parties evolved.

The Community Concerns Arising from Negotiations are the by-products of the negotiations process.

Of these concerns, the following:

(a) Sales Agreement with Rosewood;

(b) Understanding the Impact of Economics;

(c) Prohibitions on further development-protective remedies;

(d) Golf Course Project-linkage to Town Center and to Affordable Housing Project;

are influenced, in whole or in part, to the validity of the Economic Assumptions delineated in the General Comments to the Community's Concerns (See page II-2). Accordingly, if any effects and/or impacts caused by any invalidations, in whole or in part, to these Economic Assumptions become evident relative to the foregoing concerns, the Negotiations Committee should be allowed opportunity to respond to the effects and/or impacts caused by such invalidations.

Accordingly, the Comments offered by the Hana Community Negotiations Committee in this section as Community Concerns Arising from Negotiations are being presented subject to the application of such conditions.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: Community Concerns arising from Negotiations

Certain community concerns became evident during the course of negotiations between representatives of Keola Hana Maui, Inc. and the Negotiations Committee.

While these community concerns surfaced during the course of negotiations, they do have substantive influence on the proposed golf course project. The Environmental Impact Statement should discuss these concerns. Accordingly, the Negotiations Committee offers these concerns as its comments.

These comments, provided as attachments hereto, are identified as follows:

(a) Sales Agreement with Rosewood; Understanding the Impact of Economics (2 pages);

(b) Prohibitions on further development-protective remedies (2 pages);

(c) Golf Course Project-linkage to Town Center and to Affordable Housing Projects (1 page); and,

(d) Philosophical Compatibility; Defining "Hana's Lifestyle" (1 page).

COMMUNITY'S CONCERN

Sales Agreement with Rosewood

Qualifications

While this issue is a community concern, it is a non-negotiable matter. Keola entered into a contractual agreement with Rosewood, the precedent owner, which impacts the tone and tenor of the negotiations between Keola and the community.

Effect of Sales Agreement

An issue of primary focus and extensive dialogue during our earlier negotiations session was the provision of the Sales Agreement with Rosewood which requires the Purchaser (Keola Hana Maui, Inc.) to pursue with all due diligence and best efforts all actions necessary to gain approval to develop a championship , eighteen (18) hole golf course with other related amenities.

Keola representatives have disclosed that upon Keola gaining approval to develop such golf course, Keola is required to pay an additional $ 25 million to Rosewood. Further, if Keola does not pursue the necessary actions with all due diligence and best efforts, Keola would be in default and owe the same sum to Rosewood.

The Sales Agreement set the initial filing dates as well as governs other timeline matters.

Effect on Economic Viability

This additional debt burden further impacts the economic viability of the proposed project.

Keola has been provided the attached diagram entitled:

UNDERSTANDING THE IMPACT OF ECONOMICS

Provision of this diagram was necessary for Keola to understand why so much of the Committee's initial focus was aimed at the Economic Viability issues and concerns.

UNDERSTANDING THE IMPACT OF ECONOMICS

Understanding the rationale for requests for information regarding economics and other financial considerations.

SIMPLE ECONOMIC EQUATION

REVENUES/INCOME		EXPENSES/COSTS		ECONOMIC VIABILITY
Sale of membership fees 20% retention Income from Operations Golf Course Hotel Ranch Other Enterprises	less	Cost of assets purchased from Rosewood (??) Cost of fulfillment of Sales Agreement (??) Cost of Development of Golf Course (E.A.) Cost of Development of portion of Town Center (??) Cost of Financing Loans (??) Membership Fees @ 80% (??) Cost of Impact Fees (??) Cost of Operations Golf Course (E.A.) Hotel (E.A.) Ranch (??) Other Enterprises (??) Cost of Community Benefits (??)	yields	Keola Hana Maui Hotel Golf Course Ranch Other enterprises Employment Stability Affordability of Housing Community Viability Economic Social Agricultural Cultural Environmental Lifestyles Residential
SUM OF ALL REVENUES and ALL INCOME	less	SUM OF ALL EXPENSES and ALL COSTS	yields	DECISION OF THE RESIDENTS OF HANA

COMMUNITY'S CONCERN

Prohibitions on further development (protective remedies)

Commitment to future development

Based on the evidences of the current Economic Impact Section of the Environmental Assessment, the concern is whether the community is setting itself up for a claim for future development being necessary to remedy the shortfalls of the proposed development.

The community, by and large, is concerned about the economic well-being of Keola. The need to have a stable economic operations by the area's largest single employer is recognized. The economic stability then creates stable employment for the employees of this employer. Many of these employees currently reside in over-crowded homes, therefore they need and desire their own homes. While this is not an argument that the proposed project must provide housing, the nature of the hotel operations is a business that is labor intensive and requires a high number of residents to staff its operations. Accordingly, the hotel and the other entities supplementing or complementing the hotel operations should be required to provide housing for its employees, with or without a golf course. Without provision of housing, the workforce remains destabilized, subjected to employees needs for suitable housing. While Hana does not provide unlimited economic opportunities, many residents will endure the economic limitations offset by their cultural and social attractions to the area if provided suitable housing. However, such suitable housing can only be provided in an economically stable environment.

Therefore, the proposed project, lacking the assurances of being economically viable, further destabilizes the economic environment. The fear that the community, by adopting the proposed project, must later adopt further development to (1) stabilize the economic viability of the major employer as well as its own economic vitality and (2) stabilize the economic viability of the employee residents who are then encumbered by purchases of suitable housing, remains a haunting element in the mindset of the residents.

The proposed project must be able to realisically achieve its financial objectives and the community must then be able to have prohibitive measures put into place against further development. For the community to support this development, without realistic assurances of it achieving its financial objectives, and, then to also require prohibitions on future development, is economic suicide.

Noteworthy of this point, even those residents who have indicated a willingness to support the golf course project do so with severe reservations about further development.

Continued to next page.

COMMUNITY'S CONCERN

Prohibitions on further development (protective remedies)

Viability of the Project

While the evidences currently available indicates the proposed project will still sustain operational losses, there is a major concern about the overall viability of the project.

As the evidence indicates the current operations do not sustain operational expenses, this evidence fails to assess the current debt service of Keola. What the evidence does indicate, that with an appreciably higher occupancy, operational losses will be diminished though the degree of diminishment is still debatable. Accordingly, if this evidence is valid, then the way to reduce losses is to increase occupancy without the increase of losses.

To date, the evidence does not show how occupancy will be adequately and sufficiently increased by the proposed project. The record merely reflects an assumption without adequate evidence to validate such an assumption. The assumption being that the proposed golf course will, by its creation, attract sufficient occupancy to reduce operational losses. This assumption, without further evidence, is purely speculative. The resultant economic formula does not factor in the additional debt service incurred by the development of the proposed golf course. If the purchase price established by the media is $ 63 million, then the new debt service burden will be easily doubled by Keola's own evidence. Further, while the evidence refers to sale of membership fees, the marketability of such fees has not been established. Of note, Keola has indicated that membership fees are really interest free loans, repayable at 80% to 90% of principle within 10 years.

The viability of the proposed project remains questionable based on the speculative assumption that a golf course in Hana will attract a sufficient degree of occupancy for the hotel to diminish operational losses, an assumption that lacks evidence of a formal market study, and the speculative assumption which references, again without a market study, the inclusion of membership fees without discounting 80% to 90% of such fees as loans repayable within 10 years. Further, without adequate consideration of current debt service and then the doubling of such debt service by the development of the proposed project, this community and its representatives on the Negotiations Committee find the project as non-viable and of further jeopardy to Keola's and well as the community's economic well-being.

COMMUNITY'S CONCERN

Golf Course Project-linkage to Town Center and to Affordable Housing Projects

Background

The initial representations by Keola Hana Maui were that Keola was planning three (3) projects; the Golf Course Project, the Hana Town Center Project, and the Affordable Housing Project. During presentations of these projects, Keola representatives emphasized that each project "stood alone", independent of the other projects.

During negotiations regarding the Golf Course project, Keola maintained this posture.

May 11th Meeting

During the meeting of may 11, 1991, between representatives of Keola Hana Maui and employees of Keola Hana Maui, the following statement was made by Masamichi (Ted) Kato, who is a Director, a Vice-President and Treasurer, and is also the son of Hasami Kato, the Chairman of the Board and Chief Executive Officer of Keola Hana Maui, Inc., to the employees, "No Golf Course, No Housing."

Current Status

Discussions subsequent the May 11th meeting have revealed that both the Hana Town Center project and the Affordable Housing project are linked to the Golf Course project realizing its financial objectives, Keola as a corporate entity achieving economic viability and Keola's employees attaining the resultant employment stability. With particular emphasis to the affordable housing project, the prospective home purchaser-employee must be able to have a comforting measure of employment stability and a realistic expectation of continued employment to repay a mortgage. Without this realistic expectation of continued employment for prospective home purchaser-employees, the financing of the affordable housing project is jeopardized.

With the Town Center project, much of the proposed development will focus on improving the infrastructural shortfalls of the hotel facilities. If improved occupancy at the hotel, the primary purpose for development of the golf course project, is not attained, then many of the infrastructural improvements may not be necessary.

COMMUNITY'S CONCERN

Philosophical Compatibility

Developing a mindset during negotiations is critical for productive and fruitful dialogue. The earlier discussions and meetings were conducted in an atmosphere of skepticism with some degree of distrust.

Current Status

Agreement of the minds has been reached that the community of Hana and Keola Hana Maui have a partnership relationship. Both parties are concerned about the economic vitality of the other; both have the same objectives although differences regarding the proposed solutions to achieve these objectives still need to be worked out. The community's economic viability is Keola's concern and Keola's economic viability is the community's concern.

Both, Keola and the Negotiations Committee, have expressed "on the record" commitments to continue to negotiate their differences.

COMMUNITY'S CONCERN

Defining "Hana's Lifestyle"

The parties have agreed that in order to analyze and critique the non-economic impacts, both beneficial and adverse, the term "Hana's Lifestyle" needs to have a mutually acceptable definition.

Several sessions have been held in a "brain-storming" mode between the parties without success to define this term. Accordingly, a facilitator to help the parties find a mutually acceptable definition has been contacted and by agreement between the parties will be engaged to provide such assistance.

SECTION IV

Comments offered

by the

Hana Community

Negotiations Committee

on

the Environmental Assessment

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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<u>General Comments to the Reports contained within the Environmental Assessment for the Hana Ranch Golf Course</u>

Within this section the Hana Community Negotiations Committee offers its comments to the contents of the Environmental Assessment prepared for the Hana Ranch Golf Course.

Further, the Negotiations Committee concurs with the comments offered by the various agencies as their respective reviewing comments on the contents of the Environmental Assessment. These comments are incorporated within the Department Report from the Department of Planning, County of Maui, submitted to the Maui Planning Commission for its consideration and action on January 14, 1992.

For clarification of certain reports contained within this section, references are made to revised studys and/or revised reports. The Negotiations Committee did not, and has not received any revised studys and/or revised reports. However, in its analysis of the reports germane to issues concerning the physical location and/or design of the proposed project site, the Negotiations Committee was and still is under the impression the project site may be re-designed and/or perhaps relocated due to the ownership of lands being disputed (see discussion contained within Section II Community's Concerns).

The Negotiations Committee requests opportunity to respond on any issues related to the project site and/or project design once the exactness of the project site and/or project design is finally established.

With that proviso, the Negotiations Committee offers as its comments in this section its reports on the contents of the Environmental Assessment for the Hana Ranch Golf Course.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: <u>Environmental Assessment Report</u>

ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE

The Negotiations Committee offers as its comments on this report contained within the Environmental Assessment a copy of a memorandum from Bill Fuhrmann, Community Negotiator and Chair of the Negotiations Committee to the Negotiations Advisory Committee and the Research and Support Committee, subject matter being: General Concerns regarding the Environmental Assessment ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE.

This memorandum, consisting of three(3) pages, was previously provided to representatives of Keola Hana Maui, Inc. on October 17, 1991.

The provision of this memorandum is for informational notice specifically. A more extensive and comprehensive presentation of the comments offered by the Negotiations Committee regarding the community's concerns on the economic effects and impacts of the proposed golf course project are contained within the scope of Section I. Economic Issues and Concerns; within parts of Section II. Community's Concerns; and within parts of Section III. Concerns Arising from Negotiations.

To: The Negotiations Advisory Committee and the Research and Support Committee

From: Bill Fuhrmann, Community Negotiator and Chair of the Negotiations Committee

Subject: General Concerns regarding the Environmental Assessment
ECONOMIC IMPACT STUDY OF THE PROPOSED HOTEL HANA MAUI GOLF COURSE

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Basically this is a recital of an excerpt from the Record of Negotiations, Session of 25 July 1991.

RECORD OF NEGOTIATIONS

Page # 4 of 4.

Session of 25 July 1991.

D) Community's Exceptions to Economic Impact section of Environmental Assessment

Community's Positions: Basically the Economic Impact section is substantially flawed, based on many incredible assumptions and many unrealistic factors.

Keola's Response: Agreed, need to have the consultants made aware of this. Suggest that the consultants hear directly from the community on these problems. Need to work out a schedule for this meeting with the consultants.

Community's Response: Understand that this is not the feasibility study but the Economic Impact section. The assumptions such as no formal market study, just analysis of comparable resorts without comparisons of all elements of these resorts. The assumption that the study assumes a fully operational and mature operations means six to seven years away with late 1992 for approvals, 18 to 24 months for construction, and another two years for stabilization of operations. Unrealistic factors such as 365 days of playability, given Hana's weather. Use of 1989 expenses when Keola was not owner until late 1989 and did not have operations manager until 1990. The whole Economic Impact Section is flawed.

Keola's Response: Again, agreement. Let's meet with consultants, it better they hear from you on these problems directly.

Community's Response: Let's get this meeting scheduled, here in Hana, in Honolulu, wherever is most convenient.

By MEMORANDUM

TO: BILL FUHRMANN

FROM: LIBERT LANDGRAF

DATE: AUGUST 1, 1991.

SUBJECT: RECORD OF NEGOTIATIONS - JULY 25, 1991

Accepted.

Based on the foregoing excerpts of the records of the parties in negotiations, the parties agreed that the Economic Impact Section of the Environmental Assessment is flawed.

Continued to next page.

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The following is taken from the personal notes of Bill Fuhrmann:

Monday 19 August 1991.

10:35 Meeting at offices of Pannel, Kerr, Forster with Ernest A. Watari along with Jerry D. Fitzgerald of Ronald M. Knoll Consulting Group and Libert Landgraf

Libert explained to Watari the purpose for the meeting
(a) based on the negotiations between the community and Keola, the parties agreed that major flaws existed with the Economic Impact Section; and
(b) Keola felt it was best that Pannel Kerr Forster hear directly of these flaws from the community.

Watari explained that given the time constraints and the specifications of the contracted study, Pannel, Kerr, Forster prepared its report. Keola did not want a formal market study. Keola wanted a comparison of Hotel Hana Maui with comparable resort hotels and analysis of the performance of Hotel Hana Maui.

I identified for Watari some of the flaws of the Economic Impact Study as seen by the Negotiations Committee.

a) lack of a formal market study

b) citing quotes from studies; studies not identified nor provided.

Watari responded that studies are from other projects done by Pannel, Kerr, Forster or from studies done by the State. Not able to release studies done for other clients; studies by State are public records.

I further identified the failure to show that the "rest and relaxation" segment of the luxury market, formerly Hotel Hana Maui's orientation, is no longer a viable market.

Watari responded that the "rest and relaxation" segment is a very limited segment of the luxury market, less of a target than the "activity oriented" segment.

I further inquired about the viability of the "eco-tourist" market.

Watari responded that the "eco-tourist" market probably could not afford Hotel Hana Maui room rates.

(PERSONAL OBSERVATION: As Watari continued to be defensive in responding to the flaws identified, it appeared that to continue to point out flaws would be counter-productive. I decided to withhold presentation of additional flaws and concerns until such time as Keola decided to do another study and then advance these concerns for comment within the new study.)

Continued to next page.

The following is taken from the personal notes of Bill Fuhrmann:

22 August 1991.

Met with Landgraf 10:00 to 11:30 at HCA office:
Discussed briefly need to screen the revised feasibility study before being commissioned; to check if the issues and concerns are going to be answered by new study, otherwise certain issues may remain unanswered. Landgraf agreed, will let me know when specifications of new study are being drawn up.

19 September 1991.

Met with Landgraf 10:00 to 11:30 at Keola's office:
Was informed that Keola met with Pannel Kerr Forster on 18 September 1991; PKF reworked their proposal, PKF commissioned to do revised Economic Impact Study; will factor in membership fees. Landgraf indicates with the membership fees factored into economic viability, project will work. Ted Kato explained how the membership fees would work, 10% to 20% retained, 90% to 80% refundable after 10 years, however, will earn interest off of this portion during the interim. PKF was eager to do new study; should have preliminary work done within 10 days. Will advise me when draft is in.

09 October 1991.

Met with Landgraf 15:00 to 17:30 at Keola's office.
Has not yet received draft of revised Economic Impact study. Left call with PKF regarding study.

17 October 1991.

Met with Landgraf 09:00 to 11:00 at Keola's office.
Still has not received draft of revised Economic Impact Study.

Other flaws with current Economic Impact Study.

a) Lack of credible insight and evaluation of hotel's occupancy performance, especially with the decline as compared to other resorts.

b) failure to show how golf course will enhance hotel's occupancy.

c) failure to analyze impact of golf course on community's economic viability; employment shortage

d) failure to analyze correlation of weather to peak occupancy to playable days on golf course, (late summer in Hana-low occupancy, wet winter in Hana-high occupancy).

e) failure to analyze impacts on work force with sustained 75% occupancy.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Reports

NOISE STUDY FOR THE HANA RANCH GOLF COURSE PROJECT
and
AIR QUALITY STUDY FOR THE PROPOSED HANA RANCH GOLF COURSE PROJECT

Analysis of both of these sections of the Environmental Assessment indicate both studys reference two(2) distinctive time frames for consideration.

The first time frame analyzes the issues during the period of construction. As the impacts deriving from construction may deviate due to relocation of the golf course, analysis of such impacts will be more productive once the location of the project site becomes final and absolute.

The second time frame analyzes the issues during the period of operations and often references the impacts in relations to neighboring properties. Until such time as the project site is firm, analysis of impacts in relations to neighboring properties, at this point in time, appears more speculative than substantive.

CONCERNS FROM THE COMMUNITY REGARDING these two(2) sections has yet to become evident. However, further analysis which, once location of project site is finalized, will be undertaken may disclose evidence of such concerns.

CONCERNS REGARDING NOISE IMPACTS caused by aircraft traffic due to Keola's proposed mode of accommodating the construction personnel shall be analyzed once such mode is determined to be final.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: Environmental Assessment Report

CHEMICAL USAGE FOR THE PROPOSED KEOLA HANA MAUI GOLF COURSE

The general concern is the growing sensitivity of the district's residents of the potentiality of contamination due to the use of chemicals as fertilizers and pesticides for the golf course.

Based on the current location of the golf course upon the major aquifer and that efforts to relocate the golf course would still result in its location being on this aquifer, the potential for contamination of the ground water remains a haunting element.

Further, the potential contamination of coastal waters due to runoff likewise remains a haunting element.

The report does not refute the potential for contamination; the report only offers mitigative measures. The most discomforting element of the mitigative measures is that the essence of mitigation is vested with "proper management and application by trained personnel". The discomforting element is aptly depicted in the saying "..to err is human".

If this be the only potential practicable remedy offered, then it is incumbent upon this community to insure against human error. How such insurance is manifested remains the trick.

HOWEVER, THE REPORT FAILS TO OFFER any other remedy to the potentiality of contamination. Until such time as all other possible remedies are explored, the major concern, a concern of severe gravity, still remains as an essential problem to development of the golf course.

CONCERN: BASED ON THE INFORMATION PROVIDED, the lack of consideration for alternative methods to enhance the landscaping of the golf course without use of chemicals causes grave concerns regarding the golf course development. In order to mitigate these concerns other alternatives should at least be considered and analyzed.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

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ISSUE: Environmental Assessment Report

WATER RESOURCES AND SUPPLY FOR PROPOSED HANA GOLF COURSE

Of general concerns based on this layman's analysis of this section of the Environmental Assessment are the following:

1) This report indicates a high degree of permeability within the soil of the area due to the composition of the soil and the underlain subsoil.

   CONCERN: BASED ON THIS INFORMATION, the concern is the effect of chemicals sifted down within the soil to the water table.

2) The Kavaipapa Aquifer extends from Kaeleku to Waiohonu, the source of potable water for seven(7) wells. Three(3) of the wells are owned by the County of Maui-Wakiu A, Wakiu B, and Hamoa; three(3) of the wells are owned by Keola-Kaeleku, Helani, and Wananalua; and the seventh(7th) well is owned by Keaka-Wai and is located in Mokae.

   The County is currently capable of providing 500,000 gallons per day of potable water and relys on a surface water source at the Wailua intake for an additional 100,000 gallons per day.

   Keola is currently capable of providing 960,000 gallons per day of potable water from its three(3) wells.

   Provision capability figures for the Keaka-Wai well are not available.

   The estimated provision capability of these seven(7) wells located on the Kavaipapa aquifer is 1.5 million gallons per day of potable water.

   The proposed golf course project site is situated on the Kavaipapa aquifer. The proposed location situates the golf course between the Wananalua Well and the Hamoa Well.

   CONCERN: BASED ON THIS INFORMATION, the concern is the potential contamination of the primary potable water source for the Hana area.

3) The report indicates that the County Water System's wells are expected to meet the water needs of the Hana area to the year 2010.

   CONCERN: BASED ON THIS INFORMATION, the potential shortfall of the County's system has been identified. Potential remedy of this shortfall needs immediate consideration. Of possible remedy is provision of potable water from Keola's Wananalua Well or consideration by the County of installing another well upon this aquifer with the location of this well being important.

Continued to next page.

4) The report indicates the need to have a viable source for irrigation of the golf course with specific references to two(2) golf courses located in areas of similar magnitude of annual rainfall.

These two(2) golf courses, per the report, used between 47,000 gallons per day to 65,000 gallons per day with higher usage of 81,400 gallons per day to 97,200 gallons per day to irrigate the greens only during mid-August to mid-September.

Further, for fire protection, is the requirement of a reserve storage capacity of 240,000 gallons.

The clubhouse facilities are estimated to use between 20,000 gallons to 30,000 gallons per day, based on typical usage.

The clubhouse, which requires potable water, will draw from the Wananalua Well.

Irrigation water, estimated at 100,000 gallons per day, will, by the reports explicit expressions, be met by utilizing the Wananalua Well source, on-site reservoir storage and possibly off-site reservoir storage with rain catchment.

The on-site reservoir storage appears by the composition and inferences of the report to be three(3) on-site ponds. The three(3) ponds will be supplied by the irrigation system. The storage capacity of these ponds are not indicated within the report. Further, these ponds are to provide the required reserve storage capacity for fire protection.

The off-site reservoirs, for possible use, by indication from the report, are two(2) small open reservoirs in need of restoration work and connection work to the on-site ponds. A third off-site reservoir with rain catchment capability provides stock water supply for cattle operations. The capacities of these off-site reservoirs were not disclosed.

The fire protection requirement will be met by the irrigation system.

CONCERN: BASED ON THIS INFORMATION, the report indicates the necessity of having irrigation capabilities for the golf course. The only identified currently viable source of water is Keola's Wananalua Well, a major source of potable water. Although other possibilities are referenced, which also includes the Helani Well, another source of potable water, the report identifies potable water sources as the viable source for irrigation and fire protection with possible development of "non-potable" water sources.

Continued to next page.

5) The report does reference Fertilizers and Pesticides Contamination, recognizing the potential for contamination and offering mitigative measures.

The conclusionary remarks are indicative of this facet of the report: "In general, with proper management and application by trained personnel, the proposed golf course is not expected to present a threat to the existing quality of runoff and ground water."

CONCERN: BASED ON THE INFORMATION provided within the report and the tenor of the expressions of the report, the concern is to prohibit the contamination of the water source in total and not to only decrease the probability of contamination.

6) The report does address Waste Water Disposal by offering what "should be" done as an appropriate method of disposal. Yet the report does not show with a degree of comfort that the wastewater disposal will not contaminate the groundwater resources.

CONCERN: BASED ON THE INFORMATION provided in the report, prohibiting the contamination of the ground water source remains a concern.

7) The report does address, minimally, Storm Runoff and Drainage, and Coastal Waters. Basically the report analyzes the relation of Storm Runoff and Drainage, and the impact to Coastal Waters compared to current conditions, with the following excerpt being indicative; "...surface runoff from the project site will not be increased above existing conditions." The report indicates there is no data currently available on the quality of the coastal waters and that no long-term impact on the coastal waters is expected. The report also states "...the potential for fertilizer and pesticide contamination from intermittent runoff and subsurface percolation which may reach coastal waters is expected to be minimal and insignificant."

CONCERN: BASED ON THE INFORMATION provided within the report and the tenor of the expressions of the report, the concern remains to prohibit the contamination of the Coastal Waters in total.

GENERAL CONCLUSION

The report on the WATER RESOURCES AND SUPPLY FOR PROPOSED HANA GOLF COURSE lacks sufficient substance to relieve the Negotiations Committee of its concerns regarding the potential contamination of the ground water source, the potential contamination of the coastal waters. Further, this report indicates that the identified viable sources for irrigating the golf course and supply of water for fire protection are from potable water sources, the Wananalua Well and possibly the Helani Well. The use of such potable water sources contradicts representations previously and

Continued to next page.

continuously made assertions by Keola Hana Maui, Inc. that non-potable water will be used to irrigate the golf course.

In the event that Keola Hana Maui, Inc. does develop non-potable water sources for irrigation, the costs of such development needs to be factored into the costs of the project and the overall viability equation.

THIS ANALYSIS DOES NOT INCLUDE the impacts, especially relating to runoff, drainage, and coastal waters, caused by the construction of the golf course. This matter can only be addressed once the design and/or location of the golf course is finalized. Of note, the actual location of the site will probably remain on the Kawaipapa aquifer, therefore the concerns relating to the aquifer should by and large remain constant. Similarly, use of potable water, given the location of the sources, would probably remain constant. The other issues of Fertilizer and Pesticide Contamination, Waste Water Disposal, Storm Runoff, Drainage, and Coastal Waters may need some alteration based on design and location, however, the concerns of this report are relevant to the disclosures of the Environmental Assessment and the inadequate expressions of such disclosures.

THIS REPORT ADDRESSES THE GENERAL CONCERNS, specifics which need further, more expert, analysis should be done at a later time. Such specific, more expert examination can best be productive only when design and location are final, grading and erosion control reports are then amended, if necessary, and the inadequacies of the disclosures of the current Environmental Assessment are remedied.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

TRAFFIC IMPACT ASSESSMENT REPORT FOR THE HOTEL HANA-MAUI GOLF COURSE

Analysis of this section of the Environmental Assessment is deterred by the following:

1) The access to the project site is identified as a road directly mauka of the current Haneo'o Road junction off of Hana Highway.

   This identified access contradicts other depictions of the access to the project site as located away from this junction.

   Analysis of traffic will differ dependent upon the access to the project being a turn off going mauka or an intersection where traffic may move in any of three directions.

2) The specifics of patronage of the golf course is still, at the time of the development of this report, being researched and studied by consultants retained by Keola Hana Maui, Inc..

   If definitive data becomes available through this current study, such needs to be factored into the traffic impact.

3) At the time of the development of this report, Keola Hana Maui, Inc. was seriously considering redesign and/or relocation of the project site. Based on that disclosure, analysis of the traffic impact should be held in abeyance pending finalization of the project site.

Based on the foregoing, analysis of this section of the Environmental Assessment was not undertaken.

CONCERNS DUE EXIST, that impact from traffic generated by the golf course be minimal at worst or non-existant at best.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

ARCHEOLOGICAL INVENTORY SURVEY OF THE PROPOSED HANA RANCH GOLF COURSE

Initial analysis of this section was undertaken by the Research and Support Committee, who prepared overlays of the depiction showing the identified Archeological Sites imposed upon the Project Site. Further, a brief field trip, which included members of the Island Burial Council and a state archeologist, was undertaken.

Further analysis was deterred by the disclosure that Keola Hana Maui, Inc. was considering a possible redesign or a possible relocation of the golf course site.

CONCERNS STILL REMAIN regarding the completeness of the survey, specifically in relation to sites of evidences not yet identified. Continued efforts to involve former residents and/or descendants of former residents of the area to help discern the completeness of the survey remains a primary objective of the Committee. Further, consideration to have former employees of Hana Ranch involved in this discernment is another primary goal of the of the Committee.

FURTHER ANALYSIS AND ADDITIONAL CONCERNS may become evident upon finalization of the golf course site location.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Report

SOCIAL IMPACT ASSESSMENT FOR HANA RANCH COUNTRY CLUB

Full analysis of this section of the Environmental Assessment is deterred in large measure by the yet unanswered economic viability question. Upon full disclosure of all essential ingredients of the economic viability recipe, comments to the adequacy of the assessment of Social Impacts will be more meaningful and less speculative.

However, the following flaws are, and unless remedied, remain evident:

1) The demographical information, by and large, is antiquated, being at least ten (10) years old. More recent data is available via the SMS Research Study on Housing in Hana and possibly the 1990 Census Reports.

2) The mitigation measures proposed, after lengthy discussion of the social impacts, are inappropriate responses to the impacts identified. In essence, the mitigative measure was a "No Action" alternative.

3) The list of recommendations dealt primarily with encouraging Keola "to improve its relationship with the community" and recommendations of how hotel management should deal with guest relations and with employee relations.

ADDITIONAL CONCERNS may become more evident upon disclosure of the essence of the economic viability information.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: Environmental Assessment Reports

BOTANICAL SURVEY HANA GOLF COURSE
and
SURVEY OF AVIFAUNA AND FERAL MAMMALS FOR A HANA GOLF COURSE E.A.

Analysis of both of these sections of the Environmental Assessment is at best a superficial reading of the contents contained within each report.

CONCERNS FROM THE COMMUNITY REGARDING each of these sections has yet to become evident.

Based on the lack of evidences as to any concerns of the community regarding these two(2) sections, as Chair of the Negotiations Committee, it is my recommendation that positions on these sections be held in abeyance pending the requisite critiques, which will evolve as part of the processing of the review of the Environmental Assessment, becoming part of the record on these elements.

FURTHER ANALYSIS MAY BECOME necessary if the project site is relocated.

SECTION V

CLOSING COMMENTS

offered by the

Hana Community

Negotiations Committee

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

General Comments to Closing Comments

The comments offered in this section by the Hana Community Negotiations Committee are specific to the desire of the Negotiations Committee to be involved as a "hands-on" consulted party during the preparation and development of the Environmental Impact Statement for the Hana Ranch Golf Course.

A "partnership" relationship was created during the course of negotiations between the Negotiations Committee and the representatives of Keola Hana Maui, Inc.. This relationship was the most tangible and beneficial result of the negotiations process. Accordingly, the Negotiations Committee desires to maintain its partnership role by being a "hands-on" active partner in this relationship.

COMMENTS OFFERED BY

the Hana Community Negotiations Committee

ISSUE: The Role of the Hana Community Negotiations Committee as a "consulted party".

The Hana Community Negotiations Committee seeks to be a "hands on" consulted party during the development of the Environmental Impact Statement.

As the fundamental purpose for the residents of Hana to engage in negotiations with Keola Hana Maui, Inc. is to:

"LET HANA'S PEOPLE, WITH HANA'S SENSITIVITES, SOLVE HANA'S PROBLEMS, WITH HANA TYPE SOLUTIONS"

the participation by the Negotiations Committee as a "hands-on" consulted party enhances the fulfillment of this purpose.

This purpose is negated to a substantive degree if the Draft Environmental Impact Statement is prepared exclusively by the applicant's consultants. If such be the desired course of action, then the Negotiations Committee is forced to become a "reactionary" party rather than a "consulted" party.

For historical information purposes, attached is a two paged letter, dated 23 October 1991, from the Community Negotiator and Chair of the Negotiations Committee to the Chief Operating Officer and Spokesperson for Keola Hana Maui, Inc. on the subject of the POSITION OF NEGOTIATIONS COMMITTEE. The position of the Negotiations Committee remains as was described in that letter.

While the Negotiations Committee may lack the expert insight on some of the technical issues presented in an Environmental Impact Statement, the members of the Negotiations Committee do have the expert insight on the sensitivities and concerns of the residents of Hana. The Negotiations Committee feels that type of insight is of essential importance in the development and preparation of the Environmental Impact Statement. As the problems the proposed project is attempting to solve are Hana's problems and effects Hana's people, the Negotiations Committee requests, as the selected representatives for Hana's people, to be a "hands-on" consulted party in the development and the preparation of the Environmental Impact Statement.

23 October 1991.

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
P.O. Box 519
Hana, Maui, Hawaii 96713

Subject: POSITION OF NEGOTIATIONS COMMITTEE

Dear Libert,

The purpose of this letter is to clarify the position of the Negotiations Committee regarding the desire, as expressed during our Negotiations Session of 17 October 1991, of Keola Hana Maui to refer to its consultants the following:

a) The Community's Concerns regarding the Proposed Golf Course; and,

b) The General Concerns regarding the Environmental Assessment.

The concern of the Negotiations Committee is not referral. The General Concerns regarding the Environmental Assessment should, as a matter of course, be referred to Keola's consultants. Those concerns are expressed criticisms of their work product. The Community's Concerns regarding the Proposed Golf Course, as I explained, represent the community's views as conveyed to the Negotiations Committee from the community's viewing perspective. Referral of these concerns to the consultants retained by Keola is discretionary and of no concern to the Negotiations Committee. Similarly is referral of both of these concerns to the agencies critiquing the Environmental Assessment.

The concern of the Negotiations Committee is remedy. The General Concerns of the Environmental Assessment by nature will find remedy through the discernment of the adequacy of the Environmental Assessment. On the other hand, the Community's Concerns regarding the Proposed Golf Course should find remedy through the negotiations process. As the fundamental purpose for our negotiations is to " LET HANA'S PEOPLE, WITH HANA'S SENSITIVITIES, SOLVE HANA'S PROBLEMS ", the Negotiations Committee is concerned that this purpose will be negated if by referral of the Community's Concerns regarding the Proposed Golf Course to its consultants Keola is seeking to have these consultants rebut, through refinement of their reports and proposed mitigative measures, the sensitivities of the community. Then the process designed to achieve resolution is lost and then supplanted by a process designed to achieve dissolution.

Continued on next page.

For the integrity and continuance of negotiations, the parties, the committee representing the community and the spokespersons representing Keola, should not be constrained to debating the merits and demerits of the consultants' rebuttals nor constrained to adoption or rejection of the mitigative measures they propose. The parties in negotiations should be allowed to debate the merits and demerits of their concerns, to create their own solutions, and to determine their own mutually satisfactory resolution.

The community must feel comforted that its points of view have been explored, its issues and concerns discussed and debated, and its problems resolved in a mutually satisfactory mode. Arbitrary imposition of solutions by outside parties does not meet this test. Further, from my experiences, if such arbitrary imposition is unilateral, the reaction to this kind of act will negate any possible merits of the solutions being imposed.

Accordingly, it is and shall continue to be the position of the Negotiations Committee:

" LET HANA'S PEOPLE, WITH HANA'S SENSITIVITIES, SOLVE HANA'S PROBLEMS ! "

Nothing more, nothing less.

As to having Keola's consultants available as resources to the parties in negotiations, an offer tendered by the Negotiations Committee during our last session, the issue remains on the table for further consideration. Once it has been determined that Keola desires continuance of negotiations and that the concerns of the Negotiations Committee, as expressed in this letter, have been satisfactorily addressed, then I suggest that dialogue between the parties' negotiators commence on this proposal.

If you desire clarification of the foregoing, please contact me directly.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

cc: Negotiations Committee

Section "C"

CORRESPONDENCE

08 March 1992.

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793

SUBJECT: Request to be a Consulted Party

Dear Brian;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

Applicant: Keola Hana Maui, Inc.
Consultant: Pacific Planning & Engineering, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

08 March 1992.

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713

SUBJECT: Request to be a Consulted Party

Dear Libert;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

<u>Accepting Authority</u>

Maui Planning Commission

<u>Consultant</u>

Pacific Planning & Engineering, Inc.

<u>Office of Environmental Quality Control</u>

cc: Negotiations Committee

08 March 1992.

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

SUBJECT: Request to be a Consulted Party

Dear Jonathan;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee requests to be a Consulted Party.

Enclosed with this letter is the submission of the Hana Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

Copies to:

Accepting Authority: Maui Planning Commission

Applicant: Keola Hana Maui, Inc.

Office of Environmental Quality Control

cc: Negotiations Committee

08 March 1992.

Brian J.J. Choy
Director
Office of Environmental Quality Control
220 South King Street
Central Pacific Plaza, Fourth Floor
Honolulu, Hawaii 96813

SUBJECT: Notice of the Requests of a Consulted Party

Dear Mr. Choy;

Pursuant to the EIS Preparation Notice published in the OEQC Bulletin, Volume IX, No. 3, dated February 8, 1992, the Hana Community Negotiations Committee filed Requests to be a Consulted Party and concurrently submitted its Comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana to:

Brian Miskae
Maui Planning Commission
250 South High Street
Wailuku, Maui, Hawaii 96793 as the Accepting Authority

Libert Landgraf
Chief Operating Officer
Keola Hana Maui, Inc.
Post Office Box 519
Hana, Maui, Hawaii 96713 as the Applicant

Jonathan Shimada
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814 as the Consultant

Enclosed with this letter is the submission of the Hana Community Negotiations Committee of its Comments on the proposed action by Keola Hana Maui, Inc..

If you have any questions regarding this matter or of the material contained within the Comments Offered by the Hana Community Negotiations Committee, please contact me.

Sincerely,

Bill Fuhrmann
Community Negotiator and
Chair of the Negotiations Committee

cc: Keola Hana Maui, Inc.
Maui Planning Commission
Pacific Planning & Engineering, Inc.
Negotiations Committee

23 March 1992.

RECEIVED
MAR 25 1992

Alvin K.U. Chong
Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

Subject: Additional Comments regarding the Hana Golf Course

Dear Al;

Pursuant to your letter of March 10, 1992, the Hana Community Negotiations Committee submits its offering of additional comments on the proposed action by Keola Hana Maui, Inc. to develop a golf course in Hana.

Enclosed you will find this submittal.

If you have any questions regarding this matter, please contact me directly.

Sincerely,

Bill Fuhrmann

Bill Fuhrmann
Community Negotiator and
Chair of the Hana Negotiations Committee

Copies to:

Maui Planning Commission
Keola Hana Maui, Inc.
Office of Environmental Quality Control

cc: Negotiations Committee

ADDITIONAL
COMMENTS OFFERED BY
the Hana Community Negotiations Committee

==

Issue: <u>Effect of the international economic situation upon the hotel's capability to achieve its occupancy objective.</u>

A credible examination and discussion regarding the effect of the international economic situation upon the hotel's capability to achieve its occupancy objective.

Issue: <u>Effect of the national economic situation upon the hotel's capability to achieve its occupancy objective.</u>

A credible examination and discussion regarding the effect of the national economic situation upon the hotel's capability to achieve its occupancy objective.

Issue: <u>Effect of national politics upon the sale of golf course memberships in Japan.</u>

A credible examination and discussion regarding the effect of national politics upon the marketing and sale of golf course memberships in Japan by Keola Hana Maui, Inc..

PACIFIC PLANNING
ENGINEERING, INC

November 23, 1992

Mr. Bill Fuhrmann, Chair
Hana Community Negotiations Committee
P. O. Box 183
Hana, HI 96713

Dear Mr. Fuhrmann:

Subject: Hana Golf Course Environmental Impact Statement (DEIS)

Thank you for your letter of October 6, 1992 regarding the above project. It appears your review of the DEIS was incomplete, as all of your comments were considered and addressed in the DEIS. To assist you in your review, we have referenced the DEIS sections that addresses your comments.

Economic Issues

Economic justification. Section 3.1 discusses the need for the project. Section 5.2 discusses three hotel management strategies to increase hotel occupancy including: increasing marketing efforts, reducing hotel rates, and promoting different themes.

Alternatives. Section 5.0 discusses alternatives to the project including: no action, hotel management strategies, agricultural crops, and beef production.

Hotel market. Section 3.1 discusses the need for the project and the Hotel's ability to compete in the luxury hotel market.

Golf course market. Section 7.5.1 discusses the market analysis for golf courses in Hawaii.

1221 KAPIOLANI BOULEVARD ▲ SUITE 740 ▲ HONOLULU, HAWAII 96814 ▲ TELEPHONE (808) 521-9195 ▲ FAX (808) 526-9748

Economic dependency. Section 3.0 discusses the project need and objectives. As the largest employer and landowner in the Hana region, the economic stability of Keola Hana Maui, Inc. (Keola) and its hotel operations is very important to the region. Keola, for example, employs about one fourth of Hana's available workforce at the Hotel Hana-Maui.

Section 5.1 discusses the No-Action Alternative. Section 7.5 and 7.6 discusses the economic impacts of the project.

Environmental assessment. Section 7.5 and 7.6 discusses the economic impacts of the project. Regarding the effects of weather conditions, the Pali golf course and Oahu Country Club on Oahu and the Princeville golf courses on Kauai are considered to be very desirable and successful golf courses even though they experience higher average rainfall than other golf courses. Princeville's Prince golf course, for example, experiences an average rainfall of 75-85 inches per year (which is higher than Hana) and is still rated as of the ten best resort golf courses in the U.S.

Section 7.5.2.1 of the DEIS discusses the sale of golf course memberships. The Kato Group, the major shareholder of Keola, owns and operates four very successful golf courses in Japan. They are confident they can sell more than 1,000 memberships, but want to limit the number of memberships sold. During a recent survey of their 10,000 members, more than 1,000 members indicated they were interested in purchasing Hana golf memberships.

The Kato Group's members have generally not been affected by current economic conditions in Japan and other locations. When membership sales are initiated, the transactions will be handled and overseen by Japanese national banks and not stock exchanges. The coordination of membership sales will be managed by the Kato Group's own offices. Members will not have any ownership interests in Keola nor its land holdings in Hana. Currently, memberships comparable to Keola's plan are selling for approximately $200,000.

The Hana Town Center project will not be developed in conjunction with the golf course project. The Town Center project is currently on hold and would be an incremental upgrading or replacement of already existing facilities such as the Hana Store, purchasing, engineering, motorpool and laundry facilities.

Table XI-1 of Appendix B (page XI-3) is a preliminary list of golf course and clubhouse jobs and average annual salaries.

Economic cure. Section 7.5 and 7.6 discusses the economic impacts of the project. Section 4.1 clearly states "There are no plans to increase the number of guestrooms or cottages at the Hotel Hana-Maui, nor to construct luxury homes or condominiums around the golf course."

Employment. Section 7.5 discusses employment opportunities for the golf course and Hotel. Table XI-1 of Appendix B (page XI-3) is a preliminary list of golf course and clubhouse jobs and average annual salaries. It should be noted, that a significant number of Hana residents that currently work outside of Hana have expressed a strong desire to work at the golf course in Hana.

Keola estimates that at least 75 percent of the golf course employment needs can be recruited from Hana. Hana residents and previous Hana residents (kamaaina) who wish to return will be given job placement priority for full and and/or part-time employment.

Land values. The Office of State Planning's Golf Course Development in Hawaii: Impacts and Policy Recommendations reported that previous studies have found that Hawaii's golf courses have very limited impacts on nearby property values. The report states, "In both the short- and long- term time frame, however, golf courses have been found to have minimal impact on property values."

Since Keola owns the entire project site and most of the land around the project site, they will be the landowner most affected by any increase in property taxes.

Section 6.2.2 describes the reclaiming of 680 acres of brush land for grazing to offset the withdrawal of 201 acres for the project. Pages 31 and 32 of Appendix C discuss the minimal impact the project will have on ranching activities.

Community Concerns

Land title. Since the preparation of the Environmental Assessment, the project boundaries have been revised to exclude all lands where land ownership was questioned or State or ceded lands. The entire project site is owned by Keola, and there are no parcels where ownership is under dispute (Section 2.4 of the DEIS).

Property owners. See the above response on land values. Section 4.1 clearly states "There are no plans to increase the number of guestrooms or cottages at the Hotel Hana-Maui, nor to construct luxury homes or condominiums around the golf course."

Cultural and social values. Section 7.3 and 7.4 of the DEIS discuss the project's probable impacts on the Hana Community and Hana's Hawaiian Community, respectively. Golf course members are expected to have a limited effect on residents. First of all, non-local visitors have been staying at the Hotel for more than 45 years. Secondly, the over half of a million annual day visitors to the Hana region will clearly have a greater impact than the additional 11,000 annual Hotel guests with the project. And finally, golf course members are expected to visit Hana infrequently, staying at the Hotel only once or twice a year.

It is likely that the social impact of having more foreign visitors will be similar to that of interacting with people of different social and economic backgrounds, regardless of the origin of the visitors. The present culture of Hana is already one which represents assimilation. Throughout Hana's modern history, different cultures have constantly blended into the prevailing culture, which is based on Hawaiian values and practices. People of Chinese, Filipino and Japanese ancestry have worked with Hana residents on the plantations, and many have made Hana their home. The 1990 census indicates that the proportion of Caucasians has increased significantly during the 1980's, and the culture has been even further impacted. Thus, in spite of the introduction of different cultures, Hana is still predominantly Hawaiian in its culture, its attitude and in daily practices.

Subsistence lifestyles. Section 6.3.2 clearly states the project's effects on ground and surface waters will be well within water quality standards and will not, therefore, affect cultural and recreational activities such as fishing and food gathering activities. Section 8.10 discusses hunting and fishing activities.

Infrastructure and public facilities and services. Water - Section 8.1; solid waste - Section 8.3; medical facilities - Section 8.9; educational facilities - Section 8.8; police and fire - Sections 8.6 and 8.7; housing - Section 7.2; and recreational activities - Section 8.10.

Section 7.2 of the DEIS discusses the current housing efforts in Hana and the probable impacts of the golf course project on housing.

The non-profit Hana Affordable Housing and Community Development Corporation (HAHCDC) was created to develop affordable housing for the residents of Hana. Keola has played the key role of sponsor for this organization. It has been instrumental in getting it started. To this end, Keola has provided assistance to the HAHCDC in the form of start-up, training, orientation, studies, surveys, workshops, legal and consultant fees, travel, inspection tours, clerical support, technical resources and funding. They have previously committed a donation of 15 acres of land for a single-family affordable housing project.

In addition to the above assistance to the HAHCDC, Keola will provide further direct support (i.e., land, funding, or in-kind services) to mitigate the housing needs of the project. However, the HAHCDC is a free standing entity, separate from and independent of Keola. To the extent that Keola resources, financial, staffing or otherwise are accepted, the HAHCDC will retain its independent status.

Accordingly, a memorandum of understanding will be executed to clearly delineate the on-going relationship between Keola and HAHCDC, particularly the types of financial and other types of support which Keola may give to the HAHCDC, as both parties work to increase the supply of affordable housing for the residents of Hana.

It should be noted, that a significant number of Hana residents that currently work outside of Hana have expressed a strong desire to work at the golf course in Hana which would reduce the housing needs of the project.

Archaeology. Section 6.9 discusses the historic and archaeological resources within and adjacent to the project site. The State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) reviewed the archaeologist's report and found the report to be adequate, except for a few minor comments which will be incorporated in the Final EIS. SHPD letter states "It appears that all sites within the project area have been identified and that adequate information has been collected to assess their significance."

Existing culture. See the above responses on cultural and social values, and subsistence lifestyles.

Miscellaneous

Future development; project viability. Section 4.1 clearly states "There are no plans to increase the number of guestrooms or cottages at the Hotel Hana-Maui, nor to construct luxury homes or condominiums around the golf course."

Keola is confident that the project will be successful and does not anticipate failure nor major liquidation of its assets. Section 7.5 discusses the golf course and hotel operations, including detailed financial information.

Town Center and affordable housing. See the above responses on environmental assessment (Town Center), and infrastructure and public facilities and services (housing).

Noise and air. The noise study is summarized in Section 6.5 and included in its entirety in Appendix I. The air quality study is summarized in Section 6.6 and included in its entirety in Appendix H.

Chemical usage and water. Section 6.3.2 clearly states the project's effects on ground and surface waters will be well within water quality standards and, therefore, will not affect cultural and recreational activities such as fishing and food gathering activities.

Comprehensive information on alternatives to the use of pesticides and herbicides is presented in Appendix E. As noted in the DEIS, the turf management program is based on the principle of Integrated Pest Management, and relies on a variety of cultural, mechanical, biological and chemical methods to control turf pests. As stated on page 117 of Appendix E, "A pesticide application will be made when there is no alternative measure for control." None of the pesticides are recommended for application to the entire site.

Section 8.1 discusses water supply.

Traffic. The traffic study is summarized in Section 8.4 and included in its entirety in Appendix M.

Social. The social impact assessment study is summarized in Sections 7.1 - 7.4 and included in its entirety in Appendix L.

Sincerely,

Alvin K. U. Chong

Alvin K. U. Chong
Project Manager

APPENDIX B

**MARKET FEASIBILITY AND ECONOMIC IMPACT STUDY
OF THE PROPOSED HANA RANCH COUNTRY CLUB
AT THE HOTEL HANA MAUI**

Prepared by Pannell Kerr Forster, June 1992

KEOLA HANA MAUI, INC.

Market Feasibility and Economic Impact Study
of the Proposed Hana Ranch Country Club
at the Hotel Hana Maui

June 1992

PKF
HAWAII

Represented by
The CPA Consulting Group Inc
A Professional Corporation

Pioneer Plaza
900 Fort Street Mall Suite 1330
Honolulu, Hawaii 96813-3714
Telephone (808) 521-1021
FAX (808) 531-2353

June 12, 1992

Mr. Theodore Kato
Keola Hana Maui, Inc.
1088 Bishop Street, Suite 1210
Honolulu, Hawaii 96813

Dear Mr. Kato:

In accordance with your request, we have completed our Market Feasibility and Economic Impact Study of the Proposed Hana Ranch Country Club at the Hotel Hana Maui.

The conclusions reached are based on our present knowledge of the lodging and resort golf course markets in the competitive areas as of the completion of our fieldwork on December 31, 1991.

The estimated market support shown in this report is intended to reflect performance of the golf course for the period 1994-2003 and for the hotel's operations, with and without the proposed golf course, for the period 1992-2003.

The market feasibility is based on an evaluation of the present economy of the area, but does not take into account nor make provisions for the effect of any sharp rise or decline in local or general economic conditions not presently foreseeable. Thus, any changes from the assumptions or estimates used in this study after the report date, due to unforeseen economic or other future changes in the environment, may lead to higher or lower actual results when compared to this report. In addition, since projected operating results are based on estimates and assumptions that are subject to uncertainty and variation, we do not represent them as results that will actually be achieved.

It should also be noted that all golf membership information presented in the report was provided by Keola Hana Maui, Inc. Pannell Kerr Forster has not performed any research to substantiate this information. Accordingly, we do not offer any opinion whatsoever with respect to any aspect of the membership plan.

As in studies of this type, the estimated results are based upon competent and efficient management and presume no significant change in the competitive position of the hotel and golf course markets in the immediate area from that as set forth in this report.

The terms of our engagement are such that we have no obligation to revise or update this report to reflect events or conditions which occur subsequent to the date of the completion of our fieldwork.

The study and report thereon do not include the possible impact of government restrictions, zoning, environmental regulations, licensing requirements or other such matters on the project.

This report has been prepared primarily for the use and guidance of yourself and interested parties in determining the potential economic impact of the proposed Hana Ranch Country Club development. It is understood that our report may be provided to County of Maui officials for their review and evaluation and will be used to further assist you in obtaining the necessary approvals to proceed with the proposed development. In this regard, it is further understood that our report will be included with the Enviornmental Impact Statement of the project. However, as is customary in assignments of this nature, neither our name nor the material submitted may be reproduced in whole or in part, or included in any prospectus, newspaper publicity, or as part of any printed material or part of any other study or report, or used in offerings or representations in connection with the sale of real estate, securities, memberships or participation interests to the public, unless consented to in writing by Pannell Kerr Forster.

We would be pleased to hear from you if we can be of further assistance in the interpretation and application of our findings and conclusions. We express our sincere appreciation to you and your associates for the cooperation extended to us during the course of our engagement.

Very truly yours,

Pannell Kerr Forster

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SUMMARY AND OVERVIEW

SECTION I
EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

INTRODUCTION

This report presents an analysis of the market demand for the proposed 18-hole Hana Ranch Country Club, its estimated impact on the market demand and performance of the Hotel Hana Maui, and its estimated economic impact to the County of Maui. Although the Hotel Hana Maui has a long and rich history of providing the highest quality service and accommodations, its room occupancy performance has declined 48 percent since 1978, to a level 26 percent below its competitors. The hotel achieved only 74 percent of its fair share in 1991 of its market. Key reasons for this decline are the significant increase in luxury hotel rooms in Hawaii; additional competitive secluded hotels, such as the Lodge at Koele, Manele Bay Hotel and Princeville Hotel; new resort destinations, such as Wailea with its critical mass of hotels, amenities and activities; the changing visitor demographic trends and travel patterns; and the lack of an activity oriented experience, such as golf. Various economic alternatives have been considered, however, it appears that a golf course may be the most economically viable solution.

The popularity of golf has increased at a phenomenal rate, particularly with the affluent segment of the population as they pursue a more active lifestyle. It is this same affluent group of people that patronize luxury hotels and resorts. Consequently, luxury resorts that do not provide golf are at a serious competitive disadvantage to those that do.

The addition of a championship golf course will allow the Hotel Hana Maui to become more competitive within the primary luxury hotel market allowing it a chance for survival. Although combined estimates of the Hotel and golf course operations do

not reflect profits during the projection period, losses are substantially reduced and eventual profitability would be inevitable.

In addition, the anticipated proceeds from the sale of golf memberships is expected to fund 100 percent of golf course construction costs, allow the payoff of all existing debt thereby eliminating the accompanying interest expense and permit the refund of cash advances from Keola Hana Maui, Inc.'s (Keola) parent company. The remaining membership sales proceeds would be invested to help increase revenues and be used to fund negative cashflows from operations until they become profitable.

Furthermore, the golf course construction, golf operation and increased Hotel operations will provide millions of dollars of capital improvements, payroll and various tax revenues to the people and communities of Hana and Maui. The golf course development will also create temporary jobs during its construction and permanent jobs upon completion. These new jobs will help to offset any Hotel staff reductions and reduce unemployment. It is also anticipated that badly needed new housing will be constructed as a result of the development. All of these expected benefits far out weigh possible negative impacts, if any, of the development.

Without the golf course to provide a substantial influx of capital and boost in the Hotel's operations, the Hotel will continue to suffer tremendously. Estimated operating losses approaching $3,000,000 annually are projected to worsen with each year of operation. It would be just a matter of time before the Hotel would be forced to close causing severe economic loss to the Hotel's owners and employees, tourist related businesses and Hana, Maui itself.

SUMMARY HIGHLIGHTS

Golf Course Construction Costs and Funding by Golf Memberships

All information presented on golf course construction costs and funding by golf memberships was provided by Keola . Pannell Kerr Forster has not performed any market research or analysis to substantiate this information and accordingly does not offer any opinion whatsoever with respect to any aspect of the construction costs or membership plans.

Since 1978, the major shareholder of Keola has owned and operated four golf courses in Japan with a combined membership approximating 10,000 members. Based on these years of extensive experience, Keola and its principals are fully qualified and knowledgeable in golf course operations and memberships. With its vast experience and existing membership base in Japan, Keola intends to sell international corporate memberships in the proposed golf course. They are confident that 1,000 corporate memberships can be sold to existing members of its affiliate's golf courses at a price of $200,000 each, which would generate membership fees of $200,000,000.

Golf course construction costs are estimated to be $43,000,000 and represents the added value to the real property. Deducting these costs from the membership fees generated would leave excess funds available of $157,000,000. Keola's existing debt, which presently approximates $83,000,000, would be paid off with the excess funds and result in the elimination of a substantial amount of interest expense. Excess funds would also be used to refund all cash advances from Keola's parent, which is estimated will approximate $49,000,000 by the end of 1993. The remaining $25,000,000 would be invested to generate additional revenues and used to fund negative cashflows from operations until operations become profitable. Assuming a 6 percent interest rate, the excess funds are estimated to earn $3,647,000 over the projection period. Table I-1 presents an Estimated Statement of the Source and Use of Funds.

Golf Course Operations

The proposed 18-hole championship Hana Ranch Country Club includes a 39,000 square foot clubhouse and six acre driving range. The golf course would be the primary amenity of the Hotel Hana Maui and be used predominantly by guests of the Hotel. Scheduled to be operational in 1994, the golf course is expected to show net operating income by 1998. Table I-2 includes a summary of the projected performance of the golf course during the ten year period 1994 to 2003.

Hotel Operations with the Golf Course

It is anticipated that the competitiveness of the Hotel Hana Maui will improve considerably upon the completion of the proposed golf course. Consequently, occupancies are projected to be 55 percent in the year before the scheduled 1994 opening of the golf course and gradually increasing to a stabilized 75 percent in 1998. Although the projected increase in occupancy, along with a concurrent increase in average daily rate, will not allow the Hotel Hana Maui to realize positive net operating income during the projection period, it does continually reduce the net operating loss from a estimated $2,813,000 loss in 1993 to a $1,240,000 loss in 2003, or an average annual reduction over the ten year period of 7.9 percent. Table I-2 includes a summary of the Hotel's projected financial performance with the golf course during the period 1991 to 2003.

Combined Hotel and Golf Course Operations

The net results of the Hotel Hana Maui and the Hana Ranch Country Club are combined in Table I-2, since the proposed golf course is intended to improve the Hotel's operations to a performance level wherein on a combined basis the operations will be economically viable. Although the projected hotel and golf operations on a combined basis do not result in net operating income during the projection period, estimated net operating losses are expected to be reduced from a $2,813,000 hotel loss in 1993 to a $853,000 combined loss in 2003. This represents an annual average improvement of 11.3 percent.

More importantly, the estimated loss reduction when comparing the combined operations to the Hotel projection without the golf course is even more substantial. For example, the projected net loss for the Hotel without the golf course in 2003 is $3,012,000 as compared to a $853,000 combined loss. In aggregate, the net losses for the combined operations and hotel without golf course for the twelve year period 1992-2003, totals $19,174,000 and $32,364,000, respectively, or a net improvement of $13,190,000. This projected positive trend indicates that the combined hotel and golf operations should eventually generate net operating income whereas the hotel by itself will only continue to lose more money each year.

Estimated Additional Tax Revenues to the County of Maui

Development of the proposed golf course will also benefit the County of Maui and ultimately the Hana district through additional tax revenues generated. Although additional tax sources can be far reaching given the economic multiplier effects of additional payroll, consumer spending, etc. to the area, only additional primary tax revenues have been addressed. Total estimated additional primary tax revenues by type for the projection period 1992-2003, follows:

Individual State income tax	$1,420,000
General excise tax	3,211,000
Real property tax	842,000
Transient accommodations tax	1,216,000
Total estimated additional primary tax revenues	$6,689,000

Impact on Employment

Development of the golf course would create jobs in construction for approximately twenty months and continuing jobs connected with the golf course operation. These new jobs will help to offset any hotel staff reductions and reduce unemployment. The following is an estimate of the number of jobs created and the resulting payroll in 1991 dollars.

	Number of Jobs	Average Annual Earnings	Total Payroll
Construction phase	90	$43,900	$3,951,000
Golf course operation	36	$18,100	$650,000

Impact on Potential Staff Reduction

Our study indicates that no increase in hotel staffing from its current level would be required despite a projected increase in occupancy to 75 and 60 percent occupancies, respectively, for the hotel with and without the golf course from the 1991 level of 46 percent.

Staffing as of December 1991 amounted to 190 full-time and 52 part-time employees, equaling 216 equivalent full-time employees. Assuming 2.5 employees per occupied room are required to adequately service the hotel, 182 employees would be required at 75 percent occupancy and 145 employees at 60 percent occupancy. This apparent over staffing situation may be partially due to the small number of rooms in relation to the size of the property and its common areas, which require maintenance regardless of the occupancy level.

Needless to say, this problem will eventually need to be addressed. The social and economic impact of a major staff reduction would be devastating and very far

TABLE I-1

KEOLA HANA MAUI, INC.
HOTEL HANA MAUI AND HANA RANCH COUNTRY CLUB
ESTIMATED STATEMENT OF SOURCE AND USE OF FUNDS

YEAR	SOURCE OF FUNDS: GOLF MEMBERSHIP FEES	SOURCE OF FUNDS: KEOLA HANA INC. CAPITAL CONTRIBUTION	SOURCE OF FUNDS: INTEREST INCOME @ 6%	SOURCE OF FUNDS: TOTAL	USE OF FUNDS: GOLF COURSE CONSTRUCTION	USE OF FUNDS: HOTEL OPERATING (LOSSES)	USE OF FUNDS: GOLF OPERATING PROFIT (LOSSES)	USE OF FUNDS: CAPITAL & DEBT REDUCTION	USE OF FUNDS: INTEREST EXPENSE (NOTE 1)	USE OF FUNDS: TOTAL	CASH BALANCE AVAILABLE
1992	--	$7,727,000	$0	$7,727,000	--	($2,711,000)	--	--	($5,016,000)	($7,727,000)	$0
1993	$100,000,000	0	0	100,000,000	($43,000,000)	(2,813,000)	--	($49,171,000)	(5,016,000)	($100,000,000)	0
1994	$100,000,000	0	0	100,000,000	--	(2,663,000)	($334,000)	($82,756,000)	(2,066,000)	($87,819,000)	12,181,000
1995	--	0	731,000	731,000	--	(2,433,000)	(246,000)	--	--	($2,679,000)	10,233,000
1996	--	0	614,000	614,000	--	(2,088,000)	(121,000)	--	--	($2,209,000)	8,638,000
1997	--	0	518,000	518,000	--	(1,806,000)	28,000	--	--	($1,778,000)	7,378,000
1998	--	0	443,000	443,000	--	(1,500,000)	190,000	--	--	($1,310,000)	6,511,000
1999	--	0	391,000	391,000	--	(1,562,000)	199,000	--	--	($1,363,000)	5,539,000
2000	--	0	332,000	332,000	--	(1,627,000)	208,000	--	--	($1,419,000)	4,452,000
2001	--	0	267,000	267,000	--	(1,469,000)	220,000	--	--	($1,249,000)	3,470,000
2002	--	0	208,000	208,000	--	(1,527,000)	230,000	--	--	($1,297,000)	2,381,000
2003	--	0	143,000	143,000	--	(1,240,000)	244,000	--	--	($996,000)	1,528,000
	$200,000,000	$7,727,000	$3,647,000	$211,374,000	($43,000,000)	($23,439,000)	$618,000	($131,927,000)	($12,098,000)	($209,846,000)	

NOTE:
(1) INTEREST EXPENSE COMPUTED BASED ON 6 PERCENT INTEREST RATE.
ALSO ASSUMES THE DEBT REDUCTION TAKES PLACE AT THE END OF THE YEAR.

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TABLE I-2

HOTEL HANA MAUI AND
HANA RANCH COUNTRY CLUB
STATEMENT OF ESTIMATED COMBINED NET OPERATING INCOME (LOSS)
COMPARED TO HOTEL HANA WITHOUT GOLF COURSE

YEAR	HOTEL: OCCUPANCY	HOTEL: AVERAGE DAILY RATE	HOTEL: GROSS REVENUE	HOTEL: NET OPERATING INCOME (LOSS)	GOLF: ANNUAL ROUNDS	GOLF: AVERAGE GREEN FEES	GOLF: GROSS REVENUE	GOLF: NET OPERATING INCOME (LOSS)	INTEREST INCOME	COMBINED NET OPERATING INCOME (LOSS)	HOTEL WITHOUT GOLF COURSE: OCCUPANCY	HOTEL WITHOUT GOLF COURSE: AVERAGE DAILY RATE	HOTEL WITHOUT GOLF COURSE: GROSS REVENUE	HOTEL WITHOUT GOLF COURSE: NET OPERATING INCOME (LOSS)	NET OPERATING LOSS DIFFERENCE
1992	52.0%	$266.70	$9,791,000	($2,711,000)	-	-	-	-	-	($2,711,000)	52.0%	$266.70	$9,791,000	($2,711,000)	$0
1993	55.0%	280.00	10,873,000	(2,813,000)	-	-	-	-	-	(2,813,000)	55.0%	280.00	10,873,000	(2,813,000)	0
1994	60.0%	327.00	13,051,000	(2,663,000)	18,883	$88	$2,650,000	($334,000)	-	(2,997,000)	57.0%	294.00	11,834,000	(2,727,000)	270,000
1995	63.0%	336.10	14,387,000	(2,433,000)	19,827	93	2,921,000	(246,000)	731,000	(1,948,000)	59.0%	308.70	12,858,000	(2,557,000)	(609,000)
1996	67.0%	355.00	16,066,000	(2,088,000)	21,006	97	3,264,000	(121,000)	614,000	(1,595,000)	60.0%	324.20	13,734,000	(2,255,000)	(660,000)
1997	71.0%	372.00	17,876,000	(1,806,000)	22,344	102	3,651,000	28,000	518,000	(1,260,000)	60.0%	340.40	14,420,000	(2,356,000)	(1,096,000)
1998	75.0%	391.40	19,826,000	(1,500,000)	23,603	107	4,076,000	190,000	443,000	(867,000)	60.0%	357.40	15,141,000	(2,610,000)	(1,743,000)
1999	75.0%	411.00	20,818,000	(1,562,000)	23,603	113	4,220,000	199,000	391,000	(972,000)	60.0%	375.30	15,899,000	(2,729,000)	(1,757,000)
2000	75.0%	431.60	21,861,000	(1,627,000)	23,603	118	4,439,000	208,000	332,000	(1,087,000)	60.0%	394.00	16,693,000	(2,853,000)	(1,766,000)
2001	75.0%	453.10	22,951,000	(1,469,000)	23,603	124	4,667,000	220,000	267,000	(982,000)	60.0%	413.70	17,527,000	(2,806,000)	(1,824,000)
2002	75.0%	475.80	24,101,000	(1,527,000)	23,603	130	4,895,000	230,000	208,000	(1,089,000)	60.0%	434.40	18,404,000	(2,935,000)	(1,846,000)
2003	75.0%	499.60	25,306,000	(1,240,000)	23,603	137	5,140,000	244,000	143,000	(853,000)	60.0%	456.10	19,325,000	(3,012,000)	(2,159,000)

SOURCE: PANNELL KERR FORSTER

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reaching to the employees and Hana community. Consequently, additional facilities or amenities that will increase the hotel's occupancy and/or create more jobs, such as the golf course, will help to diminish the potential for staff reductions.

Other Impacts

Although the study focused on the primary impacts directly attributable to the proposed golf course development, secondary impacts will occur resulting from effects of the economic multiplier through the Hana economy. The major secondary impacts are as follows:

- Housing Construction - Increased employment and capital expenditures for residential construction of up to 36 units to house golf course employees.
- Expanded Employment in Other Sectors - Expanded employment in support industries such as retail, wholesale, public works, etc. due to an increased population and payroll base.
- New Business Development - Expanded business opportunities due to an increased economic base.
- Preservation of Open Space - A golf course by its nature preserves open space and provides artistically landscaped and well-maintained areas. It may also provide needed buffer zones between commercial developments and residential communities.

Hotel Operations Without the Golf Course

If the proposed golf course is not constructed, the Hotel will probably not survive as it will be at a significant disadvantage against its primary luxury hotel competitors that have newer facilities, more amenities, less isolated locations and more flexibility to discount prices. Stabilized occupancy has therefore been estimated at 60 percent, with an average daily room rate of $254, which is what the Hotel averaged in 1991. A summary of projected operating results is presented in Table I-2.

Although occupancy and operating efficiency can continue to be improved, the Hotel will soon reach a point of diminishing returns because of the projected low occupancy level, the relatively low average daily rate compared to its primary competitors and the unfavorable relationship of the size of the Hotel's infrastructure to the small number of guest rooms. Faced with fierce competition, coupled with the physical constraints of the existing property, it is highly unlikely that the Hotel will ever generate a volume of business great enough to allow Keola to break even. Under these circumstances the Hotel will eventually need to reassess its operating strategy, including class of operation, market position and staffing levels.

Despite such adjustments, however, it is apparent that Keola will still be faced with substantial losses due to its large debt service and other non-operating expenses. As such, the closing of the Hotel appears inevitable without the golf course development and golf membership funding. Needless to say, the economic effect would be devastating since Keola employs an estimated 26 percent of the projected workforce, not to mention the effect on virtually all other businesses in Hana.

SECTION II

OVERVIEW OF THE HOTEL HANA MAUI
AND PROPOSED HANA RANCH COUNTRY CLUB

OVERVIEW OF THE HOTEL HANA MAUI AND PROPOSED HANA RANCH COUNTRY CLUB

INTRODUCTION

The Hotel Hana Maui is one of the most prestigious luxury resorts in Hawaii with a rich history in providing accommodations to the elite luxury traveler. In recent years, however, a substantial number of luxury properties have entered into the competitive market, with additional luxury properties scheduled to open in the next several years. Because of this marked increase in competition within the luxury market, the Hotel has suffered a significant decline in occupancy and is performing at a level substantially below market averages for luxury hotels statewide.

In recognizing the dependence of the Hana community on the resort as the area's primary employer, Keola Hana Maui, Inc. (Keola) has begun to explore ways to increase the resort's viability and competitiveness in Hawaii's luxury resort market. Keola has, therefore, requested Pannell Kerr Forster to assess the financial impact that may accrue to the Hotel should a golf course be developed at the resort.

SUMMARY AND CONCLUSION

The Hotel Hana Maui enjoys a secluded and exclusive ambiance that has appealed to the elite luxury traveler in years past. The limited direct access into Hana via the Hana Airport and the 44 mile scenic drive on the winding Hana Highway adds to the resort's charm and exclusivity. With the substantial increase in competition in the luxury resort market and the demand for more active recreational options by today's traveler, the Hotel is at a competitive disadvantage as it is the only primary

luxury resort without access to golf course facilities. The proposed golf course should increase the competitiveness of the resort in Hawaii's primary luxury market.

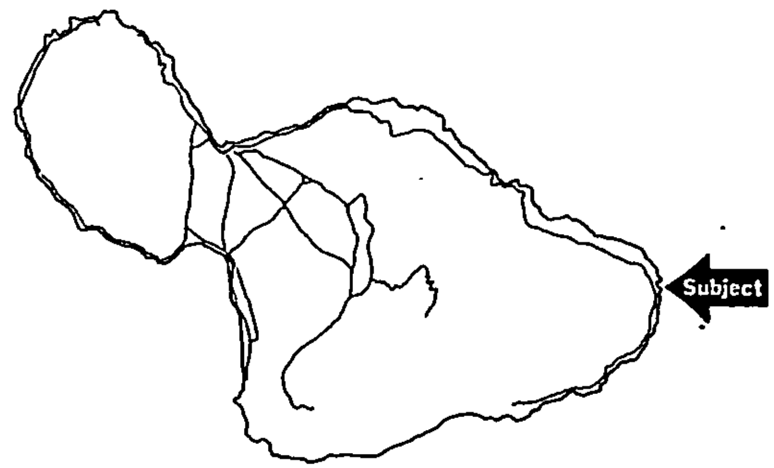
OVERVIEW OF THE HOTEL HANA MAUI

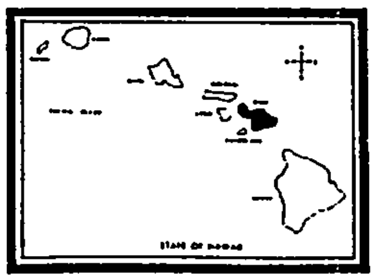
Completed in 1946, the Hotel Hana Maui is located on the southeastern coastline of Maui in the town of Hana (see Figure II-1), which has a population of approximately 1,800 residents. In 1989, the hotel increased its size from 73 to 97 units. The 97 units are composed of 56 spacious guestrooms, 40 seaside cottages with jacuzzis, and an exclusive plantation home. Including the hotel, which is sprawled over approximately 30 acres, Keola owns about 5,140 acres of land in the surrounding Hana area, with a private beach and expansive ranch land. The resort offers tennis facilities, a fitness center, two swimming pools and horseback riding as part of its guest activities. An inclusive American meal plan is mandatory for all non-Hawaii resident hotel guests.

The resort's market has traditionally focused on the lucrative independent luxury traveler, particularly celebrities and public figures desiring a peaceful and secluded experience. Accordingly, with the rest and relaxation segment of the luxury market, guest activities and retail facilities have been kept at a minimum. This tranquil environment is further enhanced by the absence of television sets from all guest rooms. Activities outside the confines of the resort are also minimal as the resort represents the focal point of the commercial activity in Hana.

Recently, however, numerous market research studies have indicated a shift in the luxury market to a more activity oriented market that expects more guest activities and amenities. Combined with the increase in other destination resorts that offer a

FIGURE II-1
ISLAND OF MAUI





similar exclusive experience, but with more guest activities, the performance of the Hotel Hana Maui has declined substantially.

The Hotel recently changed management companies effective July 1, 1990, with ITT Sheraton Corporation assuming control from Rosewood Corporation. Despite this change and some initial operational improvements, however, the Hotel continues to operate substantially below its competitive market average.

OVERVIEW OF THE PROPOSED HANA RANCH COUNTRY CLUB

Golf Course

The proposed semi-private Hana Ranch Country Club is an 18-hole championship course located approximately 1.8 miles south of Hotel Hana Maui and mauka of Hana Highway. The total project encompasses approximately 201 acres including a clubhouse, driving range, parking lot and maintenance facilities.

The purpose of the project is to service Hotel Hana Maui's guests, golf course members, day visitors and Hana residents, while at the same time enhance the resort's attractiveness and enable it to be economically viable. Golf course operations will be during daylight hours with different green fees for the different users.

Clubhouse

The clubhouse has been conceptualized as a two story, 39,000 square feet structure housing a pro shop, administrative office, full service restaurant, lounge, community rooms, snack shop, kitchen, locker facilities, and golf cart storage. A seating capacity of 200 persons is planned for the restaurant which will be open to the general public seven days a week with the other clubhouse facilities. The substantial size of the clubhouse, particularly its meeting and banquet rooms, was designed to supplement Hotel Hana Maui's facilities which can only accommodate meetings of up to twenty people.

Driving Range

The approximate six acre driving range will be operated in conjunction with the golf course only during daylight hours. It will be open to the same patronage of the golf course and clubhouse facilities.

Construction Costs

Estimated construction costs provided by Keola are as follows:

Golf course and driving range	$35,000,000
Clubhouse	8,000,000
Total estimated construction costs	$43,000,000

Memberships

The major shareholder of Keola has owned and operated four golf courses in Japan since 1978, with a combined membership approximating 10,000 members. Keola's principals have years of extensive experience and knowledge in golf course operations and memberships and using, in part, its membership base in Japan, Keola intends to sell international corporate memberships in the proposed golf course.

It should be noted that all of the information presented in this section was provided by the management of Keola. Pannell Kerr Forster has not performed any market research or analysis to substantiate this information. As such, we do not offer any opinion whatsoever with respect to any aspect of the membership plan.

Keola predicts that it will be able to sell at least 1,000 corporate memberships at a sales price of $200,000 each, to existing members of the Kato Group golf courses within a one year period. This will yield the following membership fees to finance construction costs:

Fee per corporate membership	$ 200,000
Number of corporate memberships	x1,000
Total membership fees	200,000,000
Less total construction costs	(43,000,000)
Remaining funds available	$157,000,000

Assuming that the above is attained, 100 percent of the project's construction costs will be financed through proceeds of the membership sales. Anticipated excess funds from the sale of memberships will be used to payoff all of Keola's existing debt, which presently approximates $83,000,000, and therefore eliminating a substantial amount of interest expense. In addition, funds advanced by Keola's parent, which is estimated to approximate $49,000,000 by the end of 1993 will be refunded using excess membership funds. The approximate $25,000,000 remaining in excess funds would be used to fund negative cashflows from operations and be invested to help increase revenues. All of this will result in Keola being in a significantly better financial position from which to maintain the operation and absorb operating losses until the combined operations become profitable.

It is anticipated that there will be no individual memberships and 1,000 will be the maximum number of corporate members. The membership fee comprises a 20 percent non-refundable initiation fee and a 80 percent non-interest bearing deposit, refundable after 10 years if the member wishes to terminate membership. Memberships will be transferable and it is believed that the 1,000 member level will be maintained regardless of terminations. Members will not be assessed dues or green fees, but will be subject to all other charges. It is further anticipated that the number of members playing the course at any one time will be insignificant to the overall operation and, therefore, should not be a disruption of normal operations.

ACCESS

Air Access

All commuter air service to and from the Hana Regional Airport is via Maui's Kahului Airport. Consequently, flights originating from other Hawaiian airports have between one to three stops to and from Hana. Visitors wishing to drive usually fly into Kahului and then drive the scenic 44 mile winding "Road to Hana" with a driving time of approximately 90 minutes. According to hotel management, guests are split quite evenly with respect to their choice of transportation into Hana.

The Kahului Airport is able to support wide-bodied aircraft that provides direct flights from the U.S. mainland. With a major renovation planned, the Kahului Airport should be able to accommodate increased traffic. Tables II-1 and II-2 present a summary of air service at the Kahului Airport.

TABLE II-1

KAHULUI AIRPORT
PASSENGERS ENPLANED/DEPLANED
1983 - 1991

YEAR	INTERISLAND PASSENGERS	OVERSEAS PASSENGERS*	TOTAL
1983	3,343,653	321,085	3,664,738
1984	3,596,625	480,871	4,077,496
1985	3,586,088	719,447	4,305,535
1986	3,729,541	999,789	4,729,330
1987	3,632,503	864,001	4,496,504
1988	3,446,912	972,321	4,419,233
1989	3,664,104	1,081,411	4,745,515
1990	3,819,729	1,117,242	4,936,971
1991	3,610,038	1,131,863	4,741,901

SOURCE: STATE OF HAWAII DEPARTMENT OF TRANSPORTATION - AIRPORTS DIVISION

* Consists primarily of direct flights from the U.S. mainland

TABLE II-2

KAHULUI AIRPORT

COMMERICAL AIRCRAFT TAKE-OFFS/LANDINGS
1983 - 1991

YEAR	AIR CARRIER TAKE-OFFS/LANDINGS	AIR TAXI* TAKE-OFFS/LANDINGS	TOTAL COMMERCIAL TAKE-OFF/LANDINGS
1983	57,425	28,588	86,013
1984	67,230	37,128	104,358
1985	71,745	43,777	115,522
1986	78,820	56,361	135,181
1987	76,368	54,845	131,213
1988	61,990	60,385	122,375
1989	56,981	63,444	120,425
1990	56,532	75,923	132,455
1991	51,668	74,410	126,078

SOURCE: STATE OF HAWAII DEPARTMENT OF TRANSPORTATION - AIRPORTS DIVISION

* Classified as commercial aircraft with 60 passengers or less

Because of facility constraints and the lack of lighting, the Hana Regional Airport is limited to daytime flights of small commuter aircraft with limited capacity. Aloha Island Air provides the only regularly scheduled commercial aircraft service to and from Hana with five daily flights. Since aircraft capacity is 18 persons, the total daily and annual capacities are 90 and 32,850, respectively. The actual number of passengers enplaned and deplaned in 1991 of 11,829 and 11,854, respectively, which is only slightly more than one-third of total capacity, indicates under utilization of existing air carrier service. Tables II-3 and II-4 present a summary of air service at the Hana Regional Airport.

TABLE II-3

HANA AIRPORT
PASSENGERS ENPLANED/DEPLANED
1984 - 1991

YEAR	ENPLANED PASSENGERS	DEPLANED PASSENGERS	TOTAL
1984	9,682	9,219	18,901
1985	10,721	10,250	20,971
1986	8,769	8,469	17,238
1987	10,848	11,211	22,059
1988	11,377	11,630	23,007
1989	13,042	12,254	25,296
1990	11,216	11,005	22,221
1991	11,829	11,854	23,683

SOURCE: STATE OF HAWAII DEPARTMENT OF TRANSPORTATION - AIRPORTS DIVISION

TABLE II-4

HANA AIRPORT
COMMERCIAL AIRCRAFT SERVICE
December 1991

AIR CARRIER	NUMBER OF DAILY FLIGHTS	CAPACITY	TOTAL DAILY CAPACITY
ALOHA ISLAND AIR	5	18	90

SOURCE: HANA AIRPORT AND ALOHA ISLAND AIR

Automobile Access

The road to Hana represents the only road leading into the Hana district. It is characterized by numerous valleys which result in equally as many hairpin turns and several single-lane bridges. The lush and dramatic coastline, along with the numerous waterfalls that line the road makes the drive appealing to many visitors of Maui. Because of its orientation along the windward coast, however, the road is susceptible to periods of heavy rainfall and occasional landslides that may force closing of the roadway. Fortunately, such closings are fairly infrequent. Table II-5 presents 24-hour traffic counts on the road to Hana for sampled days during the period 1983 to 1989.

TABLE II-5
24-Hour Daily Traffic Volume To and From Hana

Year	Traffic Count
1989	3,079
1987	3,135
1985	2,876
1983	2,249

Source: Department of Transportation - Highways Division

Note: Counts are for vehicles traveling in both directions during a 24-hour period on Hana Highway prior to Uakea Road and entry into Hana, in each year stated. As of December 1991, a more recent count had not been performed.

In discussions with airline management, airport officials and Department of Transportation - Highways Division, the recent downturn in overall visitor arrivals to Maui has created some excess carrying capacity for both the air carriers and roadways. We, therefore, believe this excess carrying capacity of current air and automobile traffic facilities would be able to support an increase in hotel occupancy that may result from development of a golf course.

ECONOMIC OVERVIEW

The 1990 Census of Population and Housing is presented on Table II-6, however, further social and economic information from that census is not yet available. According to the U.S. Bureau of the Census, the resident population of Hana in 1980 and 1990 was 1,423 and 1,895, respectively. This represents a 33.17 percent increase for an average annual growth of 2.91 percent over that ten year period. Using this growth factor, the extrapolated population for 1988 and 1991 would approximate 1,789 and 1,950, respectively.

A 1988 study by the State of Hawaii Department of Business, Economic Development and Tourism estimated an available workforce of approximately 850 people in Hana. This workforce represented 47.51 percent of the projected 1988 population. Assuming that the workforce percentage of the total population remains relatively stable, the projected workforce in 1991 approximated 926 people. This number appears reasonable as there were 1,079 people in 1990 of workforce age (18 to 64 years old). The 1988 study also estimated unemployment in Hana to be 1.5 percent.

The Hotel Hana Maui, Hana Ranch, gas station and general store are all owned by Keola, making it the largest land owner and employer in Hana. As of December 1991, the Hotel alone had 190 full-time and 52 part-time employees representing 26.13 percent of the projected workforce and 12.41 percent of the projected population. The remainder of the workforce are employed by the county or state government, the school district, or the ranching, fishing, wholesale and retail industries. It is obvious, however, that most of the economic base in Hana is tied directly or

TABLE II-6

1990 Census of Population and Housing
040 Hawaii
050 Maui County
140 Tract 301 (Hana District)

Total housing units	763
OCCUPANCY AND TENURE	
Occupied housing units	539
Owner occupied	332
Percent owner occupied	55.4
Renter occupied	257
Vacant housing units	174
For seasonal, recreational, or occasional use	134
Homeowner vacancy rate (percent)	2.4
Rental vacancy rate (percent)	3.5
Persons per owner-occupied unit	3.35
Persons per renter-occupied unit	2.75
Units with over 1 person per room	152
UNITS IN STRUCTURE	
1-unit, detached	575
1-unit, attached	33
2 to 4 units	23
5 to 9 units	0
10 or more units	0
Mobile home, trailer, other	25
VALUE	
Specified owner-occupied units	272
Less than $50,000	31
$50,000 to $99,000	66
$100,000 to $149,000	43
$150,000 to $199,999	34
$200,000 to $299,999	40
$300,000 or more	53
Median (dollars)	137,500
CONTRACT RENT	
Specified renter-occupied units paying cash rent	124
Less than $250	31
$250 to $499	41
$500 to $749	35
$750 to $999	10
$1,000 or more	7
Median (dollars)	422
RACE AND HISPANIC ORIGIN OF HOUSEHOLDER	
Occupied housing units	589
White	277
Black	2
Percent of occupied units	0.3
American Indian, Eskimo, or Aleut	3
Percent of occupied units	0.5
Asian or Pacific Islander	301
Percent of occupied units	51.1
Other race	6
Hispanic origin (of any race)	39
Percent of occupied units	6.5

Source: U.S. Bureau of the Census
State of Hawaii, Department of Business, Economic Development and Tourism

TABLE II-6
(Continued)

1990 Census of Population and Housing
040 Hawaii
050 Maui County
140 Tract 301 (Hana District)

Total population	1,855
SEX	
Male	958
Female	897
AGE	
Under 5 years	237
5 to 17 years	424
18 to 20 years	77
21 to 24 years	79
25 to 44 years	616
45 to 54 years	169
55 to 59 years	71
60 to 64 years	67
65 to 74 years	139
75 to 84 years	53
85 years and over	22
Median age	31.1
Under 18 years	661
Percent of total population	33.3
65 years and over	175
Percent of total population	9.2
HOUSEHOLDS BY TYPE	
Total households	589
Family households (families)	387
Married-couple families	255
Percent of total households	50.1
Other family, male householder	35
Other family, female householder	57
Nonfamily households	202
Percent of total households	34.3
Householder living alone	156
Householder 65 years and over	42
Persons living in households	1,818
Persons per household	3.09
GROUP QUARTERS	
Persons living in group quarters	77
Institutionalized persons	0
Other persons in group quarters	77
RACE AND HISPANIC ORIGIN	
White	737
Black	7
Percent of total population	0.4
American Indian, Eskimo, or Aleut	15
Percent of total population	0.8
Asian or Pacific Islander	1,124
Percent of total population	59.3
Other race	12
Hispanic origin (of any race)	174
Percent of total population	9.2

Source: U.S. Bureau of the Census
State of Hawaii, Department of Business, Economic Development and Tourism

indirectly to the performance of the resort and the resort's payroll. As such, a substantial staff reduction at the Hotel or the closing of the Hotel would have a significant economic impact on the Hana Community.

CLIMATE

With its location on the windward coast and its close proximity to the coastal mountain range, Hana receives the most rainfall on Maui, averaging approximately 65 inches per year over the last five years. It should be noted, however, that rainfall within Hana also varies, and depending on its location, the golf course may receive more or less rain than the average for Hana in general. It should also be noted that Princeville, which receives some of the highest rainfall in the State, supports a world class golf resort operation. Table II-7 presents average temperature and rainfall statistics for Hana and other resort districts in Hawaii.

TABLE II-7

RAINFALL AND TEMPERATURE DATA FOR RESORT AREAS IN HAWAII

GEOGRAPHIC AREAS	MEAN ANNUAL RAINFALL	MEAN ANNUAL TEMPERATURE
HANA, MAUI	65	73.9
KIHEI, MAUI	14	75.1
WAILEA, MAUI	14	75.1
KAANAPALI, MAUI	16	75.7
KAPALUA, MAUI	35	75.7
KALUAKOI, MOLOKAI	20	75.0
POIPU, KAUAI	40	75.9
LIHUE, KAUAI	44	75.0
PRINCEVILLE, KAUAI	86	72.6
WAIKIKI, OAHU	25	76.2
KAHALA, OAHU	25	76.2
SOUTH KOHALA, HAWAII	10	78.5
KAILUA-KONA, HAWAII	25	74.7
HILO, HAWAII	135	73.0
LANAI CITY, LANAI	33	72.8

SOURCE: HAWAII STATE DEPARTMENT OF LAND AND NATURAL RESOURCES. WATER AND LAND DEVELOPMENT DIVISION

COMPETITIVE ISSUES

As will be discussed in greater detail in Section VII of this report, the competitive pressures in the luxury market have increased substantially with the addition of a number of new luxury properties in the market. Additional luxury properties are planned throughout the early 1990s, which will add further pressure to the already competitive market. In a recent study of the primary luxury market prepared by Pannell Kerr Forster, occupancies are estimated to decrease to a low of 57 percent by the year 1994, with a rebound to the low 70 percent occupancy level by the late 1990s. It is therefore clear that those properties that offer a more differentiated and innovative visitor experience will fair better than those properties offering less amenities and guest activities.

In this light, it should be noted that all of the major luxury resorts both existing and planned are directly affiliated to at least one golf course to service its hotel guests or have access to golf facilities due to the proximity of the hotel. Many of the new resorts are able to offer two to three golf courses to its guests, or at a minimum, tee time privileges at other courses which provides a variety of golfing experiences. Without such a golf course amenity, the Hotel Hana Maui is at a distinct competitive disadvantage in the luxury resort market, making the survival of the Hotel very difficult.

ALTERNATIVE STRATEGIES

Various alternative strategies, other than a golf course, have been suggested and considered. The most obvious and frequently suggested alternatives which fall into four basic categories are presented and discussed below. Since these alternatives do not appear to offer a viable economic solution of any significance because of the

reasons provided, in-depth research has not been conducted on any of the alternatives.

Agriculture

The existing land of Hana Ranch has been diagnosed as being marginally suitable for agricultural purposes. In addition, to provide any significant economic assistance to Keola, the volume of business would have to be at a level much higher than what the Hana community could support. Consequently, produce and livestock would have to be exported to other areas of Maui and the State of Hawaii. Due to Hana's restricted ingress and egress, however, the cost of export transportation would be prohibitive, thus making this proposition economically unfeasible.

Increased Marketing Efforts

Primary luxury hotels in Hawaii incurred marketing expenses averaging 5.6 percent of total revenue in 1990, with all categories of Hawaii hotels averaging 4.0 percent. In comparison, Hotel Hana Maui incurred marketing expenses of 13.5 percent and 10.8 percent of total revenue in 1990 and 1991, respectively, which approximates $1,000,000. Since the Hotel's marketing expense ratio is already substantially higher than its competitors, it does not seem plausible that occupancy will substantially increase if more money were spent towards marketing. This is based on the assumption that ITT Sheraton, one of the world's largest and most successful hotel operators, is properly targeting its marketing efforts and using marketing dollars effectively.

Discounting Rates and Lowering Hotel Standards

Hotel Hana Maui has consistently marketed itself as a secluded world class luxury resort for the wealthy. It has spent years and millions of dollars on creating this elite image. Regaining this image once it is lost will be even more difficult and expensive. However, once room rates are discounted substantially or luxury standards are lowered, this world class luxury image will be destroyed.

The strategy of discounting rates to increase room occupancy is normally successful for non-primary luxury hotels with a medium to high room count, whereby the substantial increase in occupied rooms creates a volume of room revenue and economies of scale large enough for the hotel to break even or yield operating profit. Ninety-seven rooms, however, is too small an inventory to create the necessary volume of revenue to make this strategy effective. In addition, major discounting will tend to have a negative impact on primary luxury class guests who are less price sensitive and may interpret the discount as a reduction in service, class of operation and prestige. Continued discounting ultimately leads to the lowering of hotel standards and downward repositioning of the hotel in the market place.

Although the lowering of hotel standards will save operating costs, discriminating luxury class guests will notice the reduction in standards and service and would probably not return. The hotel will then be forced to discount its rates to match its lowered standards, thus repositioning itself downward in the market place. Consequently, the strategies of discounting room rates and lowering hotel standards will not work effectively with the Hotel Hana Maui because of its limited number of rooms, orientation as a primary luxury hotel and large capital investment by Keola.

Promotion of Ecotours, a Health Spa and Hawaiian Culture, Arts and Crafts

Keola has given consideration to the promotion of various attractions such as ecotours, a health spa, Hawaiian cultural, arts and crafts activities, ocean

activities and tennis. All of these activities are already being provided to varying degrees and must be expanded in the future to be competitive in offering a wide array of options. Although these are necessary activities expected of a primary luxury resort, they are not major tourist attractions which would significantly increase room occupancy if expanded.

A 1988 University of Hawaii study entitled Tourist Attractiveness of Hawaii by County, examined the attraction of Hawaii as a viable tourism destination by determining attractivity indices of its four counties. A set of 16 attracting criteria was developed within six subcategories and is presented and explained on Table II-8. The results of the survey, as presented on Tables II-9 and II-10, show that ecotours, health spas, and Hawaiian cultural, arts and crafts activities rank very low (bottom one-third) in attractiveness. In comparison, ocean and land sports ranked fourth and fifth, respectively, in attractiveness. Ocean activities, however, are rather limited in Hana due to the normally rough ocean conditions and concern over guest safety.

TABLE II-8
CRITERIA FOR TOURISTIC ATTRACTIVENESS

Criteria	Considerations
A. Natural Factors	
1. Natural beauty	General topography; flora and fauna; proximity to lakes, rivers, sea; islands and islets; caves; waterfalls
2. Climate	Amount of sunshine; temperature; winds; precipitation; discomfort index
B. Social Factors	
3. Festivals, fairs, and exhibits	Music and dance festivals; sports events and competitions; concerts; cultural events; commercial fairs
4. Attitudes towards tourists	Local congeniality and treatment of tourists; aloha spirit
5. Distinctive local features	Folk dress; folk music and dances (not organized); local cuisine; folk handicrafts; specialized products; Polynesian Cultural Center; luaus; local architecture; churches; monuments; art museums
C. Historical Factors	
6. Ancient ruins	Existence, condition, and accessibility of ancient ruins; heiaus; petroglyphs
7. Religious significance	Religious importance, in terms of present religious observances and practices
8. Historical prominence	Extent to which a site may be well known because of important historical events and/or legends (e.g., Pearl Harbor)
D. Recreation and Sports	
9. Land sport facilities	Golf; tennis
10. Ocean-related sports	Swimming; surfing; snorkeling; scuba diving; fishing; boating
11. Facilities conducive to health, rest, and tranquility	Health spas; hot-water spas; hiking trails; picnic grounds
E. Infrastructure, food, and shelter	
12. Infrastructure above "minimal touristic quality"	Highways and roads; water, electricity, and gas; safety services; health services; communications; public transportation facilities
13. Food and lodging facilities above "minimal touristic quality"	Hotels; restaurants; condos; resorts; camping facilities
F. Shopping, Educational, and Evening Activities	
14. Shopping facilities	Souvenir and gift shops; handicraft shops; department stores; boutiques; duty free shops; groceries and accessities
15. Nighttime recreation	Night clubs; discotheques; theaters; dinner shows and cruises
16. Educational facilities	Archaeological and ethnographic museums; zoos; botanical gardens; aquariums; commercial parks

Source: University of Hawaii Touristic Attractiveness of Hawaii By County,
By Juanita C. Liu, Ph.D. and Jan Auyong, Ph.D.

TABLE II-9
ATTRACTIVITY SCORES FOR MAUI, 1986

RANK	ATTRACTIVITY ITEM	RANK SUM
1.	Climate	436.5
2.	Natural Beauty	422.5
3.	Food & Lodging Above "Minimal Touristic Quality"	405.5
4.	Ocean Sports	375.0
5.	Land Sports	340.5
6.	Shopping Facilities	310.5
7.	Infrastructure Above "Minimal Touristic Quality"	302.0
8.	Attitudes Towards Tourists	241.5
9.	Nighttime Activities	239.0
10.	Historical Prominence	224.0
11.	Distinctive Local Features	179.0
12.	Festivals, Fairs, and Exhibits	178.0
13.	Facilities Conducive to Health, Rest, and Tranquility	144.0
14.	Ancient Ruins	118.5
15.	Educational Facilities	100.5
16.	Religious Significance	63.0

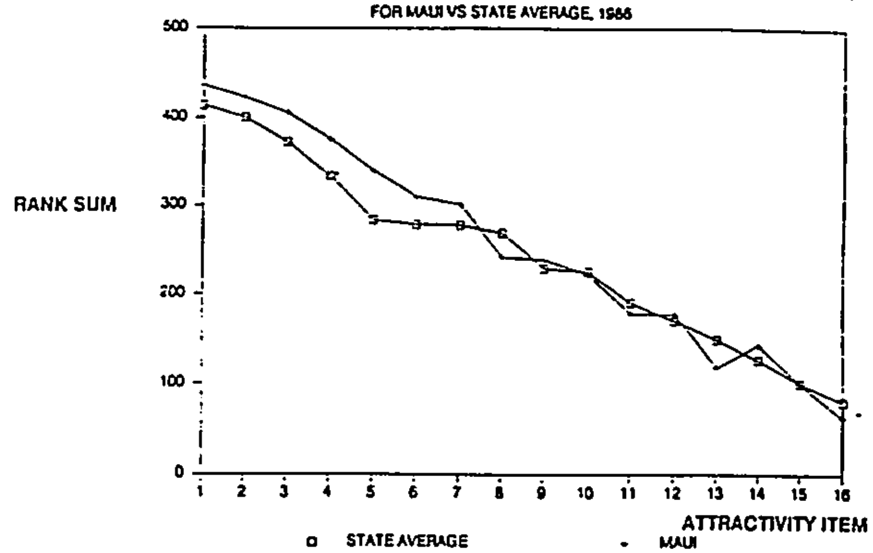
Source: University of Hawaii Touristic Attractiveness of Hawaii By County,
By Juanita C. Liu, Ph.D. and Jan Auyong, Ph.D.

GOLF COURSE

TABLE II-10

ATTRACTIVITY SCORES

FOR MAUI VS STATE AVERAGE, 1986



KEY TO ATTRACTIVITY

1. CLIMATE
2. NATURAL BEAUTY
3. FOOD & LODGING ABOVE "MINIMAL TOURISTIC QUALITY"
4. OCEAN SPORTS
5. LAND SPORTS
6. SHOPPING FACILITIES
7. INFRASTRUCTURE ABOVE "MINIMAL TOURISTIC QUALITY"
8. ATTITUDES TOWARDS TOURISTS
9. NIGHTTIME ACTIVITIES
10. HISTORICAL PROMINENCE
11. DISTINCTIVE LOCAL FEATURES
12. FESTIVALS, FAIRS, AND EXHIBITS
13. ANCIENT RUINS
14. FACILITIES CONDUCIVE TO HEALTH, REST, AND TRANQUILITY
15. EDUCATIONAL FACILITIES
16. RELIGIOUS SIGNIFICANCE

Source: University of Hawaii Touristic Attractiveness of Hawaii By County,

By Juanita C. Liu, Ph.D. and Jan Auyong, Ph.D.

SECTION III

OVERVIEW AND COMPARATIVE ANALYSIS OF RESORT GOLF IN HAWAII

OVERVIEW AND COMPARATIVE ANALYSIS OF RESORT GOLF IN HAWAII

INTRODUCTION

Golf first originated in Hawaii with the opening of the Moanalua Golf Course on the Island of Oahu in 1898. Since 1928, professional golfers have come each year to Hawaii to play in the Hawaiian Open at the Waialae Country Club. Today, there are 68 golf courses in Hawaii, including private, public, municipal, resort and military courses.

Many associations promote and coordinate golf tournaments in Hawaii for groups from the U.S. mainland and more recently from Asian markets such as Japan. The most prominent of these associations is the Hawaii State Golf Association, which is affiliated with the United States Golf Association (USGA).

Besides the Hawaiian Open, Hawaii hosts a number of other major golf tournaments with national and international exposure, including, the LPGA Kemper Open, the LPGA Hawaiian Ladies Open, the Kapalua International, and the PGA Senior Skins Game, to name a few.

The increasing popularity of golf as a sports leisure activity and the increasing demand for golf as part of a vacation and resort experience has resulted in resort destinations, such as Hawaii, to focus on the need for golf facilities as an important guest amenity. This section presents an overview of the Hawaii golf market, supply and demand for resort golf courses in Hawaii and a comparative analysis of existing resort golf facilities.

SUMMARY HIGHLIGHTS AND CONCLUSIONS

A total of nine, three primary and six secondary, existing comparable resort golf courses to the proposed Hana Ranch Country Club have been identified. With twenty-nine existing resort golf courses and five more nearing completion in Hawaii, there are few resorts and luxury hotels that are not directly associated with a golf course. Golf has undoubtedly become an essential amenity for a resort hotel, particularly in the highly competitive and demanding luxury market. As future hotel developments are biased towards the luxury market, twenty-five additional resort golf courses are under construction or being planned.

DEMAND FOR GOLF

Golf used to be viewed as a "rich man's" sport. Today, however, golf is viewed as a recreational sport that can be enjoyed by men, women and children alike, of virtually all ages and incomes. In Golf Participation in the United States, 1991 Edition by the National Golf Foundation (NGF), it was estimated that golfers in the U.S. increased from 19.9 million in 1986 to 27.8 million in 1990, representing a compound annual growth rate of 8.7 percent. This total is comprised of three golfer populations: juniors (aged 12 to 17, playing at least one round annually); occasional (aged 18 or older, playing 1 to 7 rounds annually); and core golfers (aged 18 or older, playing at least 8 rounds annually). Their respective compounded annual growth rates were 10.0, 11.9 and 5.2 percent. The NGF further estimates that 2.75 million people played golf for the first time in 1990 of which 42.8 percent were female.

The interest in golf has been rapidly increasing over the years in Hawaii as well. Golf's popularity in Hawaii has been further impacted by the lush and beautifully designed golf courses and Hawaii's moderate climate that allows ideal year round playing conditions. In addition, Hawaii has been promoted nationally and internationally as a golfer's paradise directly by the travel industry and indirectly by the television broadcasts of professional golf tournaments played in Hawaii.

Golf has, therefore, become a major Hawaiian tourist activity and attraction, especially for mainland U.S. and Japanese visitors. The combined tourist and resident demand for golf in Hawaii has substantially exceeded available supply.

EXPENDITURE PATTERNS AND PROFILE

Golf is the only major sport where participants play and spend more as they age. Although the sport of golf has shed its image of a "rich man's" sport, it still tends to cater to and is played by the more affluent enthusiast. This is particularly true with respect to private and resort golf courses. The NGF's 1991 survey event shows that Core Golfers' mean household income was $50,800, almost one third above the national average, and 42.8 percent of all golfers have household income of $50,000 or more.

Just the initial investment in equipment conservatively costs a typical golfer around $600. Once equipped, the golfer then faces increasing green fees as a result of high land and development costs of constructing a golf course, combined with high maintenance costs and a general situation of the demand for golf exceeding supply of golf course facilities.

Green fees at many elite American courses can exceed $150 for 18 holes and be sold out a year in advance. In Japan, where golf is one of the top sports, prices at the best resorts seem almost irrelevant. As reported in the previously mentioned

Business Week article, extravagantly high membership fees are charged at exclusive courses, such as $2.4 million for membership in the prized Koganei Country Club because it is only 30 minutes from Tokyo's western suburbs.

GOLF MEMBERSHIPS

Although golf memberships to private and semi-private country clubs is nothing new to America, the Japanese are selling such memberships to U.S. golf courses in Japan at unbelievable prices based on American standards. For example, an article in the November 17, 1990, Honolulu Advertiser reported that Japanese owners of five Hawaii golf courses are marketing in Japan memberships to those courses at prices ranging from 15 to 25 million yen for first time offerings. This converts to $120,000 to $200,000 using a conversion rate of 125 yen per U.S. dollar. Prices increase with each offering with fifth round prices as high as 50 million yen or $400,000. The number of "international" memberships per course vary, are fully transferable and may be sold on the open market in Japan.

IMPACT OF GOLF ON DEVELOPMENT AND TOURISM

In a March 27, 1989 Business Week article, NGF estimated that 7 million golfers took a golf trip in 1988 and spent a total of $7.8 billion on travel and lodging. Also in that article, the Vice President of Golf Operations of Marriott Corporation, the largest golf resort operator, was quoted as saying, "There's no question that golf has raised our occupancy levels." Marriott studies show that 95 percent of the corporate groups staying at resorts would have gone elsewhere if golf had not been available. Furthermore, the President of Hyatt Corporation stated, "We have changed our thinking with regard to our whole resort expansion program. We simply would not build a resort without golf today."

The availability of golf at a resort not only increases its hotel room occupancy level, but also revenues at all related facilities, including food, beverage and retail sales.

Golf has a tremendous impact on the economy of Hawaii. Due to the high demand for golf, virtually all major resorts and hotels in Hawaii and travel agencies worldwide offer packaged golf vacations. With the exception of Waikiki, golf has become a mandatory amenity for the success of virtually all Hawaiian resorts and hotels. Although Waikiki does not have a golf course connected to any of its hotels due to its dense urban location, several tour and golf tour operators provide golf tours to tourists staying in Waikiki.

The Hawaii Prince Hotel is a prime example of how important golf is to a resort hotel. Located in Waikiki, the Hawaii Prince Hotel is so convinced that golf is a necessary amenity to its success that it is presently constructing a 27-hole course for its guests. The golf course is located off of Fort Weaver Road in Ewa, which is an approximate 30 to 40 minute drive one way from the hotel. Preferred starting times will be provided to hotel guests who will be shuttled to and from the course. The course will be open to public play with Kamaaina rates during selected days and times. No memberships to the course are planned at this time.

Major professional golf tournaments played in Hawaii also attract hundreds of players, their families and fans from around the world. For example, the Hawaiian Open has consistently attracted over 50,000 spectators over the past several years.

Consequently, new resort developments and expansion plans for existing resorts must consider a golf course as a necessary amenity, no different from a swimming pool, tennis courts and fitness facilities. A course must be viewed not so much from a standpoint of creating a profitable operation in and of itself, but for the purpose of creating an overall successful and profitable resort. Resorts require the on going infrastructure necessary to support it and may include housing and condominium development. Such developments can enhance the environment and boost the economy of the community by providing additional jobs and attracting more visitors.

SUPPLY ANALYSIS OF RESORT GOLF FACILITIES IN HAWAII

Resort golf courses, for purposes of this study, have been defined as those that are specifically associated with a resort hotel or are in close proximity, even though they are not specifically classified as a resort course, since they provide access to hotel guests. For this reason, our listing of resort golf courses may differ from those of other sources. Presently, there are twenty-nine resort golf courses existing in Hawaii (see Table III-1) with an additional five resort courses presently under construction and near completion. In addition, there are numerous resort golf courses proposed and/or planned, however, most of these have been delayed indefinitely due to the current economic slowdown in Hawaii and investment environment in Japan where most of the golf development investment capital was projected to come from.

With the exception of Waikiki, just about every resort destination in Hawaii has golf facilities in, adjacent to or near the resort. This fact clearly indicates the popularity and competitive importance of having golfing facilities at a resort destination in Hawaii, without even addressing the demand factors. Hotel Hana Maui is one of only very few resort destinations that is at a competitive disadvantage of not having a golfing facility.

TABLE III-1

CENSUS OF HAWAII RESORT GOLF COURSES

Golf Resort	Number Of Holes	Year Opened	Par	Course Length (Yds) Champshp	Course Length (Yds) Regular	Green & Cart Fees Hotel Guest	Green & Cart Fees Kamaainas	Green & Cart Fees Other	Designer/ Architect	Facilities	Professional Tournaments	Visitor Accommodations # Rooms	Visitor Accommodations Hotel Name
Island of Hawaii													
Mauna Kea Beach Resort													
Mauna Kea Beach	18	1964	72	7,114	6,365	$75	n/a	$125	Trent Jones, Sr.	b,r,ch,sb,ps,lr,cr,dr,pg,tc	Shell's World of Golf	310	Mauna Kea Beach Hotel
Mauna Lani Resort													
Francis Brown (North)	18	1981	72	6,968	6,335	$65	$70	$130	Cain/Flint	b,r,ch,sb,ps,lr,cr,dr,pg,tc	PGA Sr. Skins Game	351	Mauna Lani Bay Hotel
Francis Brown (South)	18	1991	72	7,015	6,370	$65	$70	$130	Nelson/Wright	b,r,ch,sb,ps,lr,cr,dr,pg,tc		550	Ritz Carlton Mauna Lani
Waikoloa Resort													
Beach Course	18	1981	70	6,507	5,920	$70	n/a	$90	Trent Jones, Jr.	b,r,ch,sb,ps,cr,dr,pg,tc	Amoretto Golf Ladies Club Championship	1,241	Hyatt Regency Waikoloa
King's Course	18	1990	72	6,594	6,010	$80	n/a	$95	Weiskopf/Morrish	b,r,ch,sb,ps,lr,cr,dr,pg,tc		543	Royal Waikoloan Hotel
Waikoloa Village Course	18	1972	72	6,687	6,142	$42	$35/$52	$42	Trent Jones, Jr.	b,r,ch,sb,ps,cr,dr,pg,tc		76	Resort Condos
Kona Country Club												535	Kona Surf Resort,
Ocean	18	1966	72	6,509	6,165	$60	$35	$70	Bell	b,r,ch,sb,ps,lr,cr,dr,pg		1,545	Other Hotels & Condos
Mauka	18	1991	72	n/a	n/a	$60	$35	$70	Nelson/Wright	b,r,ch,sb,ps,lr,cr,dr,pg			
Seamountain Golf Course	18	1974	72	6,492	6,106	$30	$36	$30	Snyder	b,r,ch,sb,ps,cr,dr,pg,tc		20	Seamountain Resort Condo

Source: Pannell Kerr Forster
Hawaii Visitor Bureau
Hawaii Golf Guide

Legend: b-hotel or condo accommodations
r-restaurant/lounge
ch-clubhouse
sb-snack bar
ps-proshop/lessons
lr-locker room
cr-club/other rentals
dr-driving range
pg-putting green
tc-tennis courts

TABLE III-1 (Continued)

CENSUS OF HAWAII RESORT GOLF COURSES

Golf Resort	Number Of Holes	Year Opened	Par	Course Length (Yds) Champshp	Course Length (Yds) Regular	Green & Cart Fees Hotel Guest	Green & Cart Fees Kamaainas	Green & Cart Fees Other	Designer/ Architect	Facilities	Professional Tournaments	Visitor Accommodations # Rooms	Visitor Accommodations Hotel Name
Island of Maui													
Kapalua Bay Resort													
Bay Course	18	1975	72	6,761	6,151	$60	$40	$90	Palmer	b,r,ch,sb,ps,cr,dr,pg	Ping Kapalua International	194	Kapalua Bay Hotel
Village Course	18	1980	71	6,611	5,981	$60	$40	$90	Palmer	b,r,ch,sb,ps,cr,dr,pg	Isuzu Kapalua Open		
Plantation Course	18	1991	73	7,263	6,547	$60	$40	$90	Crenshaw	b,r,ch,sb,ps,lr,cr,dr,pg	Kirin World Cup		
Royal Kaanapali													
North Course	18	1962	72	7,179	6,305	$100	$50	$100	Trent Jones, Sr.	b,r,ch,sb,ps,lc,cr,dr,pg	LPGA Kemper Open	4,192	Kaanapali Resort-Hyatt Regency Maui, Maui Marriott, Sheraton Maui, Royal Lahaina, Westin Maui, Kaanapali Beach Hotel, Various Resort Condos
South Course	18	1977	72	6,758	6,250	$100	$50	$100	Snyder	b,r,ch,sb,ps,lc,cr,dr,pg	First Development Srs.		
Wailea Resort													
Blue Course	18	1972	72	6,743	6,152	$65	$65	$115	Snyder	b,r,ch,sb,ps,lr,cr,dr,pg,tc	Women's Kemper Open	2,685	Wailea Resort-Grand Hyatt, 4 Seasons, Stouffer, Intercontinental, Kea Lani, various Condos
Orange Course	18	1978	72	6,810	6,304	$65	$65	$115	Snyder	b,r,ch,sb,ps,lr,cr,dr,pg,tc			
Makena Golf Course	18	1981	72	6,739	6,210	$55	$55	$100	Trent Jones, Jr.	b,r,ch,ps,lr,cr,dr,pg,tc		300	Maui Prince Hotel
Island of Molokai													
Kaluakoi Golf Club	18	1977	72	6,564	6,187	$50	n/a	$70	Robinson	b,sb,ps,cr,dr,pg		177	Kaluakoi Resort
Island of Lanai													
Koele Golf Course	18	1991	72	7,014	6,217	$75	n/a	$130	Robinson/Norman	b,r,sb,ps,cr,dr,pg	Merrill Lynch Srs. Shootout	102	Lodge at Koele
												250	Manele Bay Hotel

Source: Pannell Kerr Forster
Hawaii Visitor Bureau
Hawaii Golf Guide

Legend: b-hotel or condo accommodations
r-restaurant/lounge
ch-clubhouse
sb-snack bar
ps-proshop/lessons
lr-locker room
cr-club/other rentals
dr-driving range
pg-putting green
tc-tennis courts

TABLE III-1
(Continued)

CENSUS OF HAWAII RESORT GOLF COURSES

Golf Resort	Number of Holes	Year Opened	Par	Course Length (Yds) Champion	Course Length (Yds) Regular	Green & Cart Fees Hotel Guest	Green & Cart Fees Kamaaina	Green & Cart Fees Other	Designer/Architect	Facilities	Professional Tournaments	Visitor Accommodations # Rooms	Visitor Accommodations Hotel Name
Island of Oahu													
Turtle Bay Country Club	18	1971	70	6,411	5,871	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Turtle Bay Hilton
Makaha Resort: Sheraton Makaha	18	[illegible]	72	7,091	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	Sheraton Makaha
Makaha Valley C.C.	18	[illegible]	71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
Ko'Olina Golf Club	18	1990	72	6,867	6,252	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Island of Kauai													
Kauai Lagoons: Kiele Golf Course	18	1988	72	7,070	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Westin Kauai
Kauai Lagoons Golf Course	18	1989	72	6,942	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Princeville Resort: Makai Golf Course	27	1972	72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Trent Jones, Jr.	[illegible]	[illegible]	[illegible]	Sheraton Princeville Hotel
Prince Golf Course	18	1990	72	7,309	[illegible]	[illegible]	[illegible]	[illegible]	Trent Jones, Jr.	[illegible]	[illegible]	[illegible]	[illegible]
Kiahuna Golf Club	18	1986	70	6,353	5,631	[illegible]	[illegible]	[illegible]	Trent Jones, Jr.	[illegible]	[illegible]	2,861	[illegible]
Poipu Bay Golf Course	18	1991	72	6,959	5,819	[illegible]	[illegible]	[illegible]	Trent Jones, Jr.	[illegible]		[illegible]	Hyatt Regency Kauai

Sources: [illegible]

Legend: [illegible]

COMPARABLE SUPPLY

Primary Comparable Supply

The primary comparable supply was determined based on two criteria:

1. A resort golf course associated with a single hotel; and
2. An isolated resort destination.

Based on these criteria, Kaluakoi, Koele and Sea Mountain at Punaluu golf courses, which have played a significant role in attracting guests to its respective resorts, were considered primary comparables. Because these are isolated golf resorts with a single hotel, these golf courses have not been optimally utilized. In 1990, these isolated facilities averaged only 23,800 rounds of golf for the year compared to the other more developed and less isolated resorts which averaged 40,400 rounds.

Discussions with managers of these isolated resorts has clearly indicated that their hotel facilities would be substantially hurt if their golf facilities were eliminated. Presently, these isolated resorts estimate that up to 25 percent of their guests utilize their golf facilities and comprise as much as 92 percent of total golf course play.

A brief description of these primary comparable resort golf facilities follows.

Kaluakoi Golf Course

The Kaluakoi Golf Course is located on the island of Molokai as part of the Kaluakoi Resort which includes 177 hotel rooms and 176 resort condominium units. The 18-hole par 72 championship golf course was built in 1977 and designed by well known golf course architect Ted Robinson. Currently, green fees are $50, for hotel guests and

$70 for others. Facilities include a driving range, practice green, club rentals and snack bar.

Koele Golf Course

The Koele Golf Course on the Island of Lanai, was completed in 1991. This Ted Robinson/Greg Norman-designed golf course is part of the resort comprising the 102-room luxury Lodge at Koele. The 18-hole championship course provides two distinctly different experiences on the front and back nines with dramatic and spectacular scenery. In its inaugural year of opening, this course is already the host to the nationally televised Merrill Lynch Senior's Shootout Golf Tournament. Green fees are currently $75 for hotel guests and $130 for non-guests.

Sea Mountain at Punaluu

The Sea Mountain at Punaluu Golf Course is located about sixty miles south of Hilo on the Island of Hawaii. The 18-hole course opened in 1974 and was designed by Arthur Jack Snyder. It is associated with the 28-room Sea Mountain Condo Resort. Present facilities include a driving range, practice greens and clubhouse. Regular green fees are currently $50, with a Kamaaina rate of $26. Management has announced plans to renovate the course, build a new clubhouse and construct a 100-room inn.

Secondary Comparable Supply

We have also selected several other resort golf facilities which we believe to be comparable on a secondary basis. These golf courses are similar to the primary comparable destinations, but are not considered as isolated since access is easier and other resorts and larger supporting residential communities are in closer proximity. A brief description of these resort golf facilities is provided below.

Kauai Lagoons Golf & Racquet Club - Kiele and Lagoons Course

Kauai Lagoons Golf and Racquet Club is comprised of two courses designed by Jack Nicklaus. The Kiele and Lagoons Courses are both 18-hole courses located next to the 846-room Westin Kauai Hotel. The Kiele Course is considered the more demanding of the two and has the reputation as one of the toughest courses in the State. These courses host several professional tournaments including the Women's Skins Game, LPGA Worldwide Championship, and the PGA Skins Game. Green fees for the Kiele Course are $70 for Hawaii residents, $105 for hotel guests and $135 for non-hotel guests. Green fees for the Lagoons Course are $45 for residents, $75 for hotel guests and $95 for non-hotel guests. Facilities include a restaurant, driving range, practice greens and club rental.

Makaha Valley Country Club

The Makaha Valley Country Club is located across the street from the Sheraton Makaha Resort and Country Club. Opened in 1969, this 18-hole, par-71 public course was designed by William F. Bell. Green fees range from $30 to $36 for Hawaii residents and $70 for non-residents. Amenities include a clubhouse, driving range, practice greens and golf club rental.

Makena Golf Course

The 18-hole Makena Golf Course is located on the Island of Maui approximately 20 miles from the Kahului Airport. The course, designed by Robert Trent Jones, Jr., opened in 1981 and is adjacent to the 300-room Maui Prince Hotel. The Makena Golf Course provides beautiful views, challenging golf holes and all the amenities of a luxury resort. Green fees are $55 for hotel guests and Hawaii residents and $100 for others. Facilities include a clubhouse, driving range, practice range and club rentals.

Mauna Kea Beach Golf Course

The 18-hole championship, par-72 Mauna Kea Beach Golf Course is located within the Mauna Kea Resort, South Kohala Coast, Island of Hawaii. The course was designed by Robert Trent Jones, Sr. and is considered one of the finest courses in the world. The average green fees are $75 for hotel guests and $125 for non-hotel guests. The facility includes a pro shop, putting green, driving range, restaurant and bar.

Sheraton Makaha Resort and Country Club

The Sheraton Makaha Resort and Country Club is located in Makaha Valley approximately one hour west of Honolulu. Opened in 1967, the par-72 course was designed by William F. Bell and is associated with the 189-room Sheraton Makaha Hotel. Green fees are $65 for Hawaii residents, $70 for hotel guests and $135 for others. Facilities include a driving range, practice greens, golf club rental and clubhouse.

Turtle Bay Country Club

This 18-hole par-72 course was originally designed by George Fazio in 1971 and later redesigned by Arnold Palmer in 1984. The course is part of the Turtle Bay Resort located in Kahuku on the northern most tip of Oahu. Hilton Corporation manages the 486-room hotel and 88 private cabanas. The Turtle Bay Country Club was host to the PGA Senior Skins Game and the LPGA Hawaiian Ladies Open. Amenities include a putting green, driving range, snack bar and pro shop. The current average green fees are $68 for hotel guests, $99 for non-guest and $43 for Hawaii residents.

Other Competitive Supply

Since the proposed Hana Ranch Country Club would be part of a luxury resort destination, all other luxury golf resorts in Hawaii would be considered its

competitive market, even though a course is not exactly comparable. These competitive resort golf courses are briefly described below.

Kapalua Golf Club

The Kapalua Resort, Maui has three 18-hole courses, The Bay, Village and Plantation Course, the last of which opened in 1991. The courses are associated with the luxurious 194-room Kapalua Bay Hotel.

Kiahuna Golf Club

This 18-hole, par-70 course on Kauai provides golf facilities to the Kiahuna Plantation Resort Condominium, Sheraton Kauai, Stouffer Waiohai Beach and Poipu Beach Hotels and other resort condominiums.

Ko'Olina Golf Club

This 18-hole course opened in 1990 to primarily provide golf facilities to the future luxury hotels in the Ko'Olina Resort. Another 18-hole course is in the planning stages. Included among the several hotels planned for this resort are the Four Seasons and Hotel Ihilani Resort and Spa (scheduled to open in 1993).

Mauna Lani Resort

The two Francis H. I'i Brown Golf Courses, North and South, are located within this South Kohala Coast resort. They are both 18-hole par-72 courses which primarily serve the 351-room Mauna Lani Bay Hotel and the 550-room Ritz Carlton Mauna Lani.

Poipu Bay Golf Course

This 18-hole course was recently completed in 1991 and is primarily associated with the 601-room Hyatt Regency Kauai.

Princeville Resort Golf Courses

This Kauai resort has the 27-hole Makai Course and the 18-hole Prince Course. The golf courses are amenities to the Sheraton Princeville Hotel, Hanalei Bay Resort, and other resort condominiums.

Royal Kaanapali Golf Courses

The Royal Kaanapali includes two 18-hole golf courses, North and South, and is accessible to hotels at the Kaanapali Resort which include: Hyatt Regency Maui, Kaanapali Beach Hotel, Maui Marriott, Royal Lahaina, Sheraton Maui, Westin Maui, and various resort condominiums.

Waikoloa Resort

The Waikoloa Resort consists of two 18-hole golf courses, the Waikoloa Beach and Waikoloa King's Golf Clubs. The courses are available to the 1,241-room Hyatt Regency Waikoloa and the 543-room Royal Waikoloan Hotel.

Wailea Golf Club

The Wailea Blue and Orange are the two 18-hole golf courses of the Wailea Golf Club. The courses are accessible to several Wailea Resort hotels including: Four Seasons Wailea, Grand Hyatt Wailea, Kea Lani, Maui-Intercontinental, Stouffer's Wailea, and various Wailea Resort condominiums.

Future Competitive Supply

The trend in hotel development over the next five years is heavily oriented toward luxury accommodations. As such, several new resort golf courses are under construction or are being planned to complement the planned new and existing hotels. Future resort golf course additions include ten on the Island of Hawaii,

five on Maui, six on Oahu, two on Kauai, and one each on Molokai and Lanai. The following Table III-2 provides a brief description of these planned additions.

SURVEY RESULTS

As part of our study for the proposed Hana Ranch Country Club, we conducted a survey analyzing operating revenues, expenses, and level of play of several resort golf courses in Hawaii. Table III-3 presents an overview of the courses surveyed showing number of holes, annual rounds played, mix of play and standard green and cart fees.

The participating resort courses reported varying levels of usage, ranging from 7,500 to 64,000 annual rounds at the 18-hole courses and 46,600 to 74,200 rounds at the 36-hole courses, resulting in an overall average of 33,800 rounds per 18-holes. The mix of play between, hotel guests and non-hotel guests also varied widely, resulting in overall average of 45 percent patronage from hotel guests and 55 percent from non-hotel guests. This variation between courses with respect to the number of rounds played and player mix is directly related to the proximity and accessibility of the course to a major resident population base. In such situations, the annual rounds played and the percentage of non-hotel guests will be higher. Consequently, by including only the most isolated and inaccessible courses, the average annual rounds played drops to 23,800 and the percentage of hotel guest play increases to an average 77 percent.

Table III-4 reflects the composite averages of the survey's financial information. Revenues generated from all operated departments, such as golf course, food and beverage, and pro shop, averaged $3,186,600 or $177,000 per hole. Green and cart fees averaged $108,400 per hole representing 61 percent of total revenues.

TABLE III-2

FUTURE COMPETITIVE SUPPLY OF RESORT GOLF COURSES
STATE OF HAWAII
AS OF DECEMBER 1991

GOLF COURSE NAME	RESORT NAME	LOCATION	# HOLES	EXPECTED COMPLETION
*** Hawaii ***				
Hapuna Beach Prince Golf Course	Hapuna Beach Prince Hotel	South Kohala	18	7/92
The Regent Kona Coast Golf Club	The Regent Kona Coast Hotel	North Kona	18	1994
TPC at Ka'upulehu #1	Four Seasons Hotel at Ka'upulehu	North Kona	18	1994
TPC at Ka'upulehu #2	Four Seasons Hotel at Ka'upulehu	North Kona	18	1995
O'oma II Resort Golf Course	O'oma II Mixed Use Project	North Kona	18	1996
Chalon International Golf Course	Mahukona Lodge	Mahukona	18	N/A
Hawaiian Riviera Golf Course	Hawaiian Riviera Resort	Ka'u	54	N/A
Kohanaiki Resort (aka Kona Iki)	Kohanaiki Resort	North Kona	18	N/A
*** Maui ***				
Makena Golf Course	Makena Resort	Kihei	18	10/92
Wailea Gold	Wailea Resort	Wailea	18	Mid 1993
Wailea 670	Wailea Resort	Wailea	36	1994
Kaanapali	Kaanapali Resort	Lahaina	18	N/A
*** Oahu ***				
The Hawaii Prince Golf Club	The Hawaii Prince Hotel	Ewa Beach	27	9/92
Turtle Bay Country Club	Turtle Bay Hilton	Kahuku	18	9/92
Ko 'Olina #2	Ko 'Olina Resort	Ewa	18	1995
Lihi Lani	Lihi Lani Resort	Pupukea	18	N/A
Makaha Valley Country Club	Sheraton Makaha Resort	Makaha	9	N/A
Malaekahana	Kuilima Resort	Kahuku	18	N/A
*** Kauai ***				
Nemmeter/Ninini Point	The Westin Kauai #2 (Running Waters)	Ninini Point	18	N/A
Poipu Bay Resort Golf Course	Hyatt Regency Kauai	Poipu	18	N/A
*** Molokai ***				
Kaluakoi	Kaluakoi Hotel	West Molokai	27	1995
*** Lanai ***				
Manele Golf Course	Manele Bay Hotel	Manele Bay	18	N/A

Source: Pannell Kerr Forster
City & County of Honolulu, Department of Land Utilization
City & County of Hawaii, Planning Department
City & County of Maui, Planning Department
City & County of Kauai, Planning Department

TABLE III-3

STATE OF HAWAII
SURVEY OF RESORT GOLF OPERATIONS
FOR THE YEAR 1990

	COURSE A	COURSE B	COURSE C	COURSE D	COURSE E	COURSE F	COURSE G	COURSE H	AVERAGE
GENERAL STATISTICS*									
NUMBER OF HOLES	18	36	18	36	18	18	18	18	18
ANNUAL ROUNDS PLAYED	46,627	46,601	51,331	76,239	64,000	17,410	7,538	30,042	33,799
MIX OF PLAY									
HOTEL GUESTS	60%	25%	70%	55%	13%	N/A	97%	61%	47%
OTHER	40%	75%	30%	45%	87%	N/A	3%	39%	53%
STANDARD GREEN & CART FEES									
HOTEL GUESTS	$65	$55	$75	$65	$70	$50	$75	$50	$63
NON-GUESTS	$130	$85	$125	$115	$125	$50	$130	$70	$105
KAMAAINA DISCOUNTS	$70	$50	$125	$65	$65	$26	$130	$70	$75

SOURCE: SURVEY OF RESORT GOLF COURSES CONDUCTED BY PANNELL KERR FORSTER
HAWAII GOLF

TABLE III-4

STATE OF HAWAII
SURVEY OF RESORT GOLF OPERATIONS
RESULTS OF OPERATIONS
FOR THE YEAR ENDING 1990

	COMPOSITE AVERAGE	RATIO	AMOUNT PER ROUND	AMOUNT PER HOLE
Holes:	18			
Rounds:	33,799			
Revenues:				
Green Fees	$1,950,472	61.21%	$57.71	$108,360
Food & Beverage	325,712	10.22%	7.35	18,095
Pro Shop Sales	613,331	19.25%	17.29	34,074
Other Income	297,133	9.32%	8.79	16,507
Total Revenue	3,186,647	100.00%	91.14	177,036
Departmental Expenses:				
Golf Course Maintenance	946,623	48.53%	26.68	52,590
Food & Beverage	202,156	62.07%	4.56	11,231
Pro Shop	507,485	82.74%	14.30	28,194
Total Departmental Expenses	1,656,264	51.98%	45.55	92,015
Net Departmental Income	$1,530,384	48.02%	$45.59	$85,021

SOURCE: Survey of Resort Golf Courses conducted by Pannell Kerr Forster

Total departmental expenses aggregated 52 percent of total revenues. Golf course maintenance was 49 percent of green fee revenues representing $52,600 per hole. Food and beverage expenses averaged 62 percent of its revenues and pro shop operating expenses averaged 83 percent of sales. The total operating profit margin averaged 48 percent of total revenue or $85,000 per hole.

Reflected on Table III-5 are the pertinent operating statistics on a per hole basis summarizing the high, low and average values. It is important to note that the low values are predominantly from the primary comparable courses whereas the high values reflect the operations of resort courses that are not as isolated, have easier access and have the support of other resorts and residential communities which are in close proximity.

TABLE III-5

STATE OF HAWAII
1990 SURVEY OF RESORT GOLF OPERATIONS
ANALYSIS OF OPERATIONAL STATISTICS ON A PER HOLE BASIS

OPERATIONAL STATISTICS	HIGH	LOW	AVERAGE
GREEN AND CART REVENUES	$277,780	$29,920	$135,450
DRIVING RANGE AND RENTALS REVENUES	$44,160	$7,310	$34,320
PRO SHOP REVENUES	$133,280	$4,380	$53,220
MAINTENANCE AND REPAIR EXPENSES	$100,000	$12,490	$70,120
TOTAL REVENUES	$372,220	$30,630	$216,600
TOTAL OPERATING EXPENSES	$163,120	$34,420	$97,180
NET OPERATING EXPENSES	$101,890	$17,090	$27,060

SOURCE: SURVEY OF RESORT GOLF COURSES CONDUCTED BY PANNELL KERR FORSTER

SECTION IV

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HANA RANCH COUNTRY CLUB

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HANA RANCH COUNTRY CLUB

INTRODUCTION

The estimates of operating results for the proposed Hana Ranch Country Club for the ten year period 1994 to 2003, are based primarily on an evaluation of our survey results of comparable existing resort golf courses in Hawaii. Where applicable, information from our survey of Hawaii country clubs and Pannell Kerr Forster's 1990 edition of Clubs in Town and Country were used for reference. Our projections are based on a 1990 representative year because our survey results reflect annual operations for 1990. These estimates are dependent on the following assumptions:

- The golf course is designed by an internationally recognized golf course designer, is well maintained, and suitable for tournament play.
- The golf course operation is managed by Sheraton or some other recognized and knowledgeable operator who will cooperate and work closely with the hotel management.
- An extensive marketing campaign will be initiated and maintained to introduce and market the golf course and will include a hotel room and golf package.
- The hotel attains the estimated 75 percent stabilized occupancy.
- The sale of international memberships attains the price and absorption levels projected by Keola Hana Maui, Inc.

The Uniform System of Accounts for Clubs, published and endorsed by the Club Managers Association of America and in general use throughout the industry, has been used in the classification of income and expenses in this report. In conformity with this system of account classification, only direct operating expenses are charged to operating departments of the golf course. The general overhead items

which are applicable to operations as a whole are classified as undistributed operating expenses and include expenses such as administrative and general, heat, light and power, and repairs and maintenance.

The projected operating statistics of the Hana Ranch Country Club compared to the survey results of resort golf courses is presented in Table IV-1. The Statement of Estimated Annual Operating Results is presented in Tables IV-2. As is the case in all estimates of this nature, we are not in a position to guarantee the results, nor is any warranty intended that they can be achieved.

INFLATION

While we cannot be certain about future inflationary trends for Hawaii, we have estimated inflation to remain relatively stable at 5 percent throughout the projection period.

MANAGEMENT

We assume that the golf course facility will be managed by an experienced operator with an international reputation and marketing network. It is also assumed that the operator will manage the operation on a world class luxury resort level, at least equivalent to that of the hotel and be able to aggressively market the course and hotel as well. Additionally, exceptional cooperation between the management of the hotel and the golf facility to uniformly provide the highest quality of service to the resort's clientele is imperative.

ANNUAL ROUNDS OF GOLF

The various components necessary to compute the annual rounds of golf are described below along with the rationale supporting our estimates.

TABLE IV-1

KEOLA HANA MAUI INC.
HANA RANCH COUNTRY CLUB
SURVEY OF COMPARABLE GOLF
COURSE OPERATIONS
RESULTS OF OPERATIONS

	HAWAII RESORT COURSES (1990)		HANA RANCH COUNTRY CLUB (1991)	
Holes:	18		18	
Rounds:	33,799		23,603	
Revenue(1)				
Green Fees	$58	61.2%	$76	62.9%
Food & Beverage	$7	10.2%	$15	12.4%
Pro Shop Sales	$17	19.2%	$25	20.6%
Other Income	$9	9.3%	$5	4.1%
Departmental Expenses:				
Golf Course Maintenance(2)	$52,590	48.5%	$53,000	53.0%
Food & Beverage(1)	$5	62.1%	$13	90.0%
Pro Shop(1)	$14	82.7%	$21	85.0%
Unapportioned Expenses(2)				
Administrative & General	$47,023	26.6%	$32,000	20.0%
Management Fee	--	--	3% of Total Revenues	
Heat, Light and Power	--	--	$8,000	5.0%
Repair and Maintenance	$0	--	$1,100	0.7%
Fixed Charges(2)				
Real Property Tax	$0	--	$4,500	2.8%
Insurance	$0	--	$2,600	1.6%

(1) Per Round
(2) Per Hole

SOURCE: PANNELL KERR FORSTER

TABLE IV-2

[illegible]

Market Mix of Play

The market mix of play between hotel guests, off-resort visitors and Hawaii residents was estimated based on the results of our survey of resort golf courses in Hawaii. Patronage by hotel guests ranged from a high of 92 percent to a low of 13 percent to total rounds played. Hotel guest patronage was highest for primary comparable courses and declined for courses that are less isolated, more readily accessible and located in close proximity to resident population bases. Accordingly, the Hana Ranch Country Club, due to its secluded location, limited accessibility and small surrounding community, will be very dependent on hotel guest patronage. Furthermore, since Keola does not anticipate that play by members will be that significant and members will not be charged a green fee, members have not been factored into the market mix. We have, therefore, projected the following market mix of play:

Market Mix	Percent
Hotel guests	90
Off-resort visitors	5
Hawaii residents	5
Total	100

Hotel Guest Patronage

Using our survey of resort golf courses, we selected those courses which most closely compared to the proposed course. We then multiplied the percentage of play attributable to hotel guests at these courses by the respective annual rounds played to derive rounds played by hotel guests. The rounds played by hotel guests were divided by the total hotel guest count to derive the percentage of hotel guests that played golf or the percentage of hotel guest patronage of the golf course. The results ranged from a high of 50 percent to a low of 20 percent, with an average of 28 percent. Based on the circumstances surrounding the proposed course, as previously described, we expect that guest patronage will be considerably above

average. Consequently, the guest patronage has been estimated at 40 percent, which is 5 percent higher than the mean point of our survey results or 12 percent higher than average.

Computation of Annual Rounds of Golf

Since the golf course will be very dependent upon the patronage of hotel guests, the rounds of golf played are directly related to hotel occupancy. Therefore, our projection of the annual rounds of golf is computed for each year based on the corresponding projected hotel occupancy. The following is an example of how the annual rounds of golf are computed based on a stabilized hotel occupancy year.

Available hotel rooms	97
Days in a year	x 365
Potential annual room nights	35,405
Estimated room occupancy	x 75 %
Estimated annual room nights	26,554
Double occupancy factor	x 2
Estimated annual hotel guests	53,108
Estimated guest patronage of golf course	x 40 %
Annual hotel guest golf rounds	21,243

Based on the market mix previously projected, the annual hotel guest golf rounds computed is used to compute the other market segments as follows:

Market Segment	Percent	Rounds
Hotel guests	90	21,243
Off-resort visitors	5	1,180
Hawaii residents	5	1,180
Total annual golf rounds	100	23,603

DEPARTMENTAL REVENUES

Green and Cart Fees

Based on an analysis of green and cart fees of comparable golf resorts in Hawaii, we have estimated the following in 1991 dollars:

Green and Cart Fees

Hotel Guests	Off-Resort Non-Hawaii Residents	Hawaii Residents
$75	$120	$55

Revenues are derived within each market segment by multiplying the estimated annual rounds of golf by the appropriate fee above and adding the results of each segment to derive the total green and cart fees.

Food and Beverage

The clubhouse food and beverage operation will consist of a restaurant, mixed grill and lounge. Although its primary market will be the golf course patrons, it will probably also provide banquets for the hotel guests and Hana residents, serve as a dining alternative for hotel guests and attract tourists passing through Hana.

The results of our resort golf survey showed food and beverage revenue per round of golf ranged from a high of $15.68 to a low of $4.69, with an average of $7.35. Due to the market mix of patrons and the very isolated location of the clubhouse, we estimate food and beverage revenue per round of golf to be $15.

Pro Shop

Pro shop sales per round of golf for the resort golf courses surveyed ranged from a high of $25 to a low of $4, with an average of $17. It was obvious from the results

of the survey that pro shop revenues were substantially greater for those associated with the more luxurious and prestigious resorts. This is attributable primarily to the affluence of the guests patronizing such resorts and the desire of visitors, both golfers and non-golfers, to acquire logotype merchandise of the resort as gifts or souvenirs since the use of such items is in vogue. Assuming that Keola will have well designed and superior quality merchandise that is professionally displayed, and based on the results of the survey, we project pro shop sales at $25 per round of golf.

Other Income

Other income includes revenue from the driving range, golf club rental, private room rental, vending machines and other miscellaneous income items. Surveyed resort courses reported a high of $21.42, a low of $1.06 and a average of $8.79 of other income per round of golf. Since we expect other income to be considerably less than average, we estimated it at $5.00 per round of golf.

DEPARTMENTAL EXPENSES

Golf Course Maintenance

Golf course maintenance expense includes related salaries and wages; payroll taxes and employee relations, course supplies and contracted services; repairs to equipment, course buildings, etc.; and other expenses. Course supplies includes water, seed, grass, flower, plants, fertilizer, insecticides, top soil, sand, gasoline, lubricants and other supplies.

Average maintenance costs per hole was approximately $53,000 for both resort golf courses and Oahu country clubs surveyed. Although certain costs maybe lower than comparable courses, such as the cost of water due to the heavier rainfall in Hana.

it is anticipated that such savings will be offset by higher costs in other areas like freight. We have, therefore, estimated maintenance expenses to be equal to the average of golf courses surveyed, or $53,000 per hole.

Food and Beverage

Food and beverage expenses, which includes cost of sales, payroll and related expenses and all other operating expenses, are typically very high at luxury golf resort clubhouses. Our survey of resort clubhouses showed food and beverage expenses as a percentage of applicable revenue, ranging from a high of 86 percent to a low of 29 percent, with an average of 62 percent. Due to the luxury class of operation and the expected low volume of business, we anticipate costs will be significantly higher than average. Some economies of scale, however, may be attained as the clubhouse will be operated by the hotel's management company. Based on this information, we estimated food and beverage expenses starting at 100 percent and decreasing to a stabilized 90 percent of applicable sales by the fifth year of operation, to reflect expected operational refinements over that period.

Pro Shop

Pro shop expenses includes cost of goods sold, payroll and related expenses and other operating expenses. The survey of resort courses reported pro shop expenses averaging 83 percent of sales, with a high of 130 percent and a low of 60 percent. Since the pro shop is expected to provide fine quality resort merchandise and service and because of the anticipated lower than average volume of business, we have estimated pro shop expenses starting at 95 percent and decreasing to a stabilized 85 percent of related sales in five years.

UNDISTRIBUTED OPERATING EXPENSES

Undistributed operating expenses are those expenses of the operation that have not already been allocated to a specific source of revenue. The explanation and rationale for such expenses follows.

Administrative and General

Administrative salaries and wages, payroll related expenses, fire insurance, printing, stationery, professional fees and the like are included as administrative and general expenses. Resort courses surveyed had such expenses as low as $23,000 per hole or 13 percent of total revenue and as high as $81,000 per hole or 88 percent of total revenue. The average expense reported was $47,000 or 46 percent of total revenue. Because these expenses tend to be more fixed in nature and not fluctuate significantly with the volume of play, which is expected to be low, it is more relevant to estimate costs on a per hole basis and not as a percentage of revenue. Accordingly, administrative and general expenses have been estimated at $32,000 per hole, which approximates the expenses of primary comparable resort courses surveyed.

Management Fee

Based on a PKF study of high-end daily fee golf courses on the U.S. West Coast, an annual management fee equal to 3 percent of gross revenues has been projected.

Heat, Light and Power

Response to this expense in our survey was too small to derive any meaningful information. On average, however, both Oahu and far west U.S. country clubs incurred energy expenses amounting to 4.7 percent of total revenue. Consequently, heat, light, and power has been estimated at 5 percent of total revenue.

Repair and Maintenance

Repair and maintenance expenses are for all facilities excluding the golf course operation. Since the facility will be new, such expenses should be less at the beginning, gradually increase and stabilize after about five years of operation. We have therefore estimated repair and maintenance expenses to start at 0.4 percent and increase to a stabilized 0.7 percent of total revenue in the fifth year of operation.

FIXED CHARGES

Real Property Tax

The land designated for the proposed golf course is currently zoned for agricultural use by the State Land Use Map and Hana Community Plan. Golf courses are permitted uses for lands zoned agriculture by the State of Hawaii. Recent Maui County policy to develop a golf course, however, requires a Community Plan Amendment to change the County land use designation from agriculture to PK-4 (Park-4) designation permitting golf course development. According to the Maui County Real Property Tax Assessment Office, the tax assessment rate for this new zone designation is not yet available. Resort courses are currently assessed at $70,000 per acre, with the tax rate at $4.75 per $1,000 of assessed valuation and has been used to estimate real property taxes for our projection. The detailed computation is provided in Section X and amounts to $81,000 per annum or $4,500 per golf hole.

Insurance

The premium cost of liability insurance covering the operation of the golf course and clubhouse are included in this category. Premiums, which are based on revenues of an operation for primary coverage and a fixed amount for excess coverage, were computed using rates obtained from an insurance broker and applied to estimated revenues.

SECTION V

OVERVIEW OF THE HAWAII VISITOR MARKET

OVERVIEW OF THE HAWAII VISITOR MARKET

OVERVIEW OF HAWAII'S VISITOR INDUSTRY

Hawaii remains a popular visitor attraction with its tropical climate, serene and scenic beauty, bountiful beaches, culture and history. The growing importance of Hawaii as a business center, including banking, military and government, real estate, construction, energy, and financial services also contributes significantly to Hawaii's visitor market. Although 1991 was forecasted to be a lackluster year for tourism due to the Persian Gulf War, Japanese economic slowdown, and U.S. mainland recession, visitor arrivals for the year were down only 2.1 percent compared to 1990. The long-term prospects for tourism remain favorable with visitors expected to reach 7.3 million in 1993. Based on moderate growth levels, visitors to the State of Hawaii are projected to increase to approximately 9.4 million in year 2000.

In 1991, there were 74,112 lodging units in the State which were available for transient use, as shown on Table V-1. Oahu, with its extensive variety of amenities and attractions, continues to have the largest concentration of lodging units with 38,022 (51.3 percent). The Island of Maui has the second largest room inventory with 18,241 (24.6 percent). In 1991, three new properties opened on Maui with a total of 1,502 rooms. Two additional properties aggregating 922 rooms are expected to open in 1992 and 1993. Thereafter, additions to supply are expected to be minimal until infrastructure problems, which include inadequate electricity and water facilities, are resolved. The Islands of Hawaii, Kauai and the combined count of Lanai and Molokai, follow with 9,384, 7,574 and 891 rooms, respectively.

TABLE V-1

VISITOR ACCOMODATION UNITS
STATE OF HAWAII

	1967	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
OAHU																
Waikiki	11,139	23,961	25,471	27,657	30,514	29,101	30,272	30,132	33,192	33,879	34,650	34,014	33,641	32,743	33,558	33,380
Ala Moana	N/A	1,776	1,659	1,589	1,716	1,677	1,662	1,643	1,634	1,609	1,682	1,682	1,664	1,536	1,531	1,706
Honolulu	688	129	129	130	67	67	55	67	67	74	67	67	75	75	75	446
Airport	399	702	691	691	692	688	691	698	695	693	706	694	734	694	720	716
Leeward Oahu	468	648	637	700	608	1,324	1,276	1,063	1,446	1,468	1,082	1,059	1,073	1,046	681	1,002
Windward Oahu	128	611	606	644	796	709	810	775	876	877	823	669	634	645	705	772
Total Oahu	12,822	27,827	29,193	31,411	34,393	33,566	34,766	34,378	37,910	38,600	39,010	38,185	37,841	36,739	37,270	38,022
MAUI																
Wailuku-Kahului	424	428	426	445	412	450	449	445	447	458	457	450	450	457	589	591
Lahaina-Kaanapali-Napili-Kapalua	1,172	4,922	4,832	5,323	6,172	6,652	7,333	7,785	8,163	8,262	7,894	7,929	8,776	9,273	9,285	9,673
Hana	65	88	89	89	88	83	87	89	108	97	94	57	135	92	163	159
Kula-Makawao-Paia	33	19	13	14	14	19	17	19	19	19	17	18	11	10	8	33
Kihei-Maalaea-Wailea	67	2,509	2,786	3,252	3,228	3,491	3,826	3,702	3,958	4,679	4,989	4,810	5,219	5,612	7,316	7,785
Total Maui	1,761	7,966	8,146	9,123	9,914	10,695	11,712	12,040	12,695	13,515	13,451	13,264	14,591	15,444	17,361	18,241
HAWAII																
Hilo-Honokaa	850	2,130	1,957	1,954	1,957	1,944	1,752	1,404	1,200	1,313	1,323	1,335	1,310	1,249	1,411	1,492
Naalehu-Kau	23	21	56	56	43	43	41	44	48	48	48	47	46	49	43	40
Volcano	37	38	38	38	38	37	37	37	37	37	37	38	38	38	75	133
Waimea-Kawaihae-Kohala	203	409	410	408	462	483	1,055	1,339	1,415	1,365	1,383	1,422	2,721	2,753	3,327	3,318
Kona	884	3,453	3,603	3,600	3,760	4,352	4,221	4,542	4,509	4,748	4,489	4,486	4,708	4,072	4,096	4,401
Total Hawaii	1,997	6,051	6,064	6,056	6,260	6,859	7,106	7,368	7,209	7,511	7,280	7,328	8,823	8,161	8,952	9,384
KAUAI																
Lihue	472	789	749	742	891	779	887	817	810	894	177	182	1,083	1,007	1,332	1,485
Wailua-Kapaa	290	1,711	2,060	2,073	2,143	2,263	2,027	2,059	2,166	2,221	2,721	2,721	2,735	2,784	2,672	2,206
HANALEI-HAENA	78	657	487	448	455	696	534	537	848	833	1,043	1,137	1,137	1,362	1,148	989
Poipu-Kukuiula	395	679	749	770	914	1,062	1,727	1,025	1,643	1,676	1,937	1,872	2,163	2,233	2,682	2,829
Kalaheo	N/A	20	20	20	20	20	20	25	22	22	32	32	50	--	--	65
Kokee	N/A	12	12	11	12	12	12	12	12	12	12	12	12	12	12	--
Total Kauai	1,235	3,868	4,097	4,064	4,435	4,832	5,207	4,475	5,501	5,656	5,922	5,956	7,180	7,398	7,846	7,574
LANAI AND MOLOKAI	133	431	534	531	569	550	566	640	641	637	645	585	577	584	808	891
TOTAL STATE OF HAWAII	17,948	46,143	48,034	51,185	55,571	56,502	59,357	58,901	63,956	65,919	66,308	65,318	69,012	68,326	72,237	74,112

NOTES: Visitor units for 1967 through 1984 are as of June of each year.
Visitor units for 1985 through 1991 are as of February of each year.

Source: Hawaii Visitors Bureau

MARKET DEMAND AND PERFORMANCE

The primary indicators of hotel market performance are the achieved occupancy and average daily room rate (ADR) levels. Tables V-2 and V-3 present these indicators by various geographic regions in Hawaii from 1981 through 1991. The results are from Pannell Kerr Forster's monthly Trends In the Hotel Industry - Hawaii with a sampling database representing nearly 70 percent of the total State visitor accommodations supply, including resort condominiums, and over 90 percent of those facilities with 200 rooms or more.

Over the 1981 - 1991 period, the average occupancy for the State ranged from the high sixties to the low eighties, as illustrated in Table V-2. Hawaii experienced its lowest occupancy during this period in 1981, when economic recession was impacting the market. Although the economy subsequently gained momentum in 1982, the State in general and Kauai in particular, were adversely affected in late 1982 and early 1983 by the effects of Hurricane Iwa which brought damage to many shoreline properties. A strong national economy, bitter weather conditions on the U.S. mainland, and vigorous promotional efforts by the visitor industry combined to make 1984 a very strong year with occupancies at their highest level since 1978. In 1985, however, the United Airlines pilots's strike weakened what would have been a year of moderate visitor growth to a year of relatively static statewide occupancy. With healthy visitor counts in 1986, spurred by heavily discounted airfares and terrorism in Europe, occupancy increased 5.1 percentage points from 1985. From 1987 through 1990, significant increases in eastbound visitors, particularly from Japan, were offset by the relatively soft westbound market, resulting in a occupancy decline slightly below the 1986 level. Statewide occupancy decreased from 1990 to 1991 by 6.4 percentage points to 72.41, representing an 8.1 percent decline. This was a direct result of the Persian Gulf War, economic recession on the U.S. mainland and general economic tightening in Japan.

TABLE V-2

HOTEL OCCUPANCY PERCENTAGES
STATE OF HAWAII
(1981 - 1991)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Waikiki On-Beach	72.05	72.69	74.69	81.74	79.25	84.21	86.53	85.66	86.21	84.90	77.37
Waikiki Off-Beach (with restaurant)	73.48	80.60	79.13	85.73	83.72	85.94	87.08	84.10	88.36	88.93	82.17
Waikiki Off-Beach (w/o restaurant)	75.95	80.09	74.47	73.81	80.38	84.45	87.98	84.20	86.54	88.43	82.98
Other Oahu	75.31	79.43	73.28	84.97	84.46	82.56	83.29	80.64	75.83	72.66	76.25
ISLAND OF OAHU	73.92	77.84	75.83	81.24	81.51	85.16	86.79	85.44	84.28	84.26	80.30
Hawaii - Hilo	35.27	37.68	39.16	58.21	57.79	52.72	55.30	49.84	54.72	59.06	58.33
Hawaii - Kona	49.45	46.95	47.02	54.89	57.54	64.53	62.46	58.37	63.67	66.76	58.60
Hawaii - Kohala Coast (1)									60.67	58.33	55.84
ISLAND OF HAWAII	44.87	44.04	44.66	55.58	57.59	62.15	60.83	56.41	60.84	61.67	57.22
Maui - Kaanapali (1)									75.07	76.32	71.47
Maui - West End	73.74	78.03	77.83	84.12	82.51	85.36	79.76	76.36	64.56	70.47	63.45
Maui - Other	58.14	61.41	67.03	70.27	69.55	76.55	66.92	64.41	62.96	59.60	52.39
ISLAND OF MAUI	70.30	73.87	75.21	80.48	78.50	82.73	76.22	73.35	69.23	70.10	63.35
Kauai - North (1)									48.91	44.71	45.36
Kauai - Central	68.47	63.40	59.27	63.03	62.58	74.83	71.80	64.19	69.90	68.51	60.38
Kauai - South End	46.23	44.21	50.16	63.07	70.12	82.74	80.58	71.81	79.17	73.56	56.04
ISLAND OF KAUAI	62.68	57.47	57.15	63.04	64.77	76.74	74.15	66.88	71.12	67.62	57.72
ISLAND OF MOLOKAI (2)							45.40	45.30	45.44	47.82	37.47
STATE OF HAWAII	68.11	70.44	69.73	76.03	76.13	81.20	81.09	78.52	78.79	78.80	72.41

NOTES: (1) Beginning in 1989, occupancy information was reorganized to recognize the Kohala Coast, Kaanapali, and North Kauai areas as distinct and seperate market areas.
(2) Reported as part of Maui through 1986.

SOURCE: PANNELL KERR FORSTER

TABLE V-3

AVERAGE DAILY ROOM RATES
STATE OF HAWAII
(1981 - 1991)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Waikiki On-Beach	61.04	61.15	62.49	68.66	84.13	94.80	106.94	121.68	121.49	134.97	133.10
Waikiki Off-Beach (with restaurant)	34.07	35.77	36.32	39.56	44.31	50.25	53.36	63.19	66.83	76.85	77.46
Waikiki Off-Beach (w/o restaurant)	27.30	28.69	30.21	31.06	35.41	37.90	42.24	46.18	48.21	54.16	55.98
Other Oahu	49.26	51.89	56.42	55.26	59.31	64.24	71.20	60.35	73.99	78.72	79.53
ISLAND OF OAHU	43.16	44.83	46.93	49.45	57.70	61.99	69.04	75.16	84.70	93.45	93.53
Hawaii - Hilo	30.53	30.01	30.41	32.30	34.88	35.22	36.14	41.60	50.11	56.60	64.04
Hawaii - Kona	52.81	53.70	55.42	64.06	71.39	81.84	94.24	99.00	75.01	78.15	78.77
Hawaii - Kohala Coast (1)									180.22	192.19	188.37
ISLAND OF HAWAII	47.16	47.37	48.84	57.17	64.06	73.88	82.21	87.28	121.27	125.31	129.10
Maui - Kaanapali (1)									152.16	146.63	129.66
Maui - West End	77.82	81.19	89.52	97.12	107.17	125.01	137.78	142.93	121.73	121.31	116.31
Maui - Other	53.84	51.50	52.82	61.26	75.61	80.91	93.43	101.25	103.66	106.54	124.78
ISLAND OF MAUI	73.44	75.02	81.60	88.89	98.51	115.33	127.05	133.70	133.64	130.49	125.05
Kauai - North (1)									95.62	79.47	90.34
Kauai - Central	54.67	55.65	56.54	63.03	59.28	65.82	74.89	79.23	75.82	77.45	74.69
Kauai - South End	61.90	67.53	72.41	63.07	93.55	87.85	98.17	106.22	118.55	128.85	130.90
ISLAND OF KAUAI	56.06	58.48	59.78	63.04	70.06	71.56	81.45	89.44	92.71	92.06	95.73
ISLAND OF MOLOKAI (2)							64.26	59.06	66.38	66.58	71.35
STATE OF HAWAII	49.87	51.78	54.78	76.03	68.84	72.67	80.09	87.25	96.11	102.10	101.89

NOTES: (1) Beginning in 1989, average rate information was reorganized to recognize the Kohala Coast, Kaanapali, and North Kauai areas as distinct and separate market areas.
(2) Reported as part of Maui through 1986.

SOURCE: PANNELL KERR FORSTER

In 1986, occupancy on the Island of Maui reached its highest level since 1978 with 82.7 percent. Since then, however, occupancy on Maui has steadily decreased to 63.4 percent in 1991. The decrease is due in part to the significant additions to room supply that occurred over this same period. In 1986, there were 13,451 visitor accommodation units on Maui. In 1991, the number of units had increased by 35.6 percent to 18,241 units. The decrease in occupancy rates on Maui also reflected Maui's high room rate coupled with the increasing competitiveness of resort destinations on the islands of Hawaii, Kauai, and most recently Lanai.

As shown in Table V-3 the overall State average daily room rate (ADR) went from approximately $50 in 1981 to $102 in 1991, representing a 7.4 percent average annual increase. The statewide ADR decreased by 0.2 percent of $0.21 from 1990 to 1991, for the same reasons that occupancy declined.

Maui's ADR has decreased over the past three years from $134 in 1988 to $125 in 1991. Prior to 1988, Maui was experiencing annual increases in ADR of between 8 and 17 percent. Due to Maui's special appeal, it was able to command such high rate increases until its peak in 1988 when it held a 53 percent premium over the State's ADR. However, Maui hotels had already priced themselves out of the market place. The high ADR, combined with the lure of new properties on other islands offering tourists better values, resulted in Maui occupancies declining from 1987. Recently, it appears Maui properties have been limiting rate increases and even discounting rates to recapture room night demand.

PROJECTED VISITOR PERFORMANCE: 1992-2003

The Hawaii visitor industry is impacted by a number of variables. For leisure oriented travelers, the economic condition of their country of origin plays an obvious role in discretionary spending. Competition from other resort destinations also has major impacts on visitor performance. Other variables such as weather conditions and fuel prices can also have dramatic effects. Hawaii's reinvestment in infrastructure and the ability of that infrastructure, in particular the supply of water and electricity, will be critical to its future competitiveness. Its ability to protect and maintain the environment, ambience and "Aloha Spirit" of the islands are also key determinants in the visitor industry's future performance and growth.

For the business traveler, government restrictions and trade can play an integral role in business travel. Any restrictions in business, either perceived or real, can have a detrimental effect on business development and investment. Conversely, an aggressive posture to foster business, including establishment of free trade zones in Hawaii, encouragement of foreign and mainland investment in Hawaii businesses can have a positive effect on the Hawaii business travel market. Other variables that can affect business growth and therefore business travel are tax policies, interest rates, savings in the capital markets and overall strength in the Hawaii, U.S. mainland and international economies.

Hawaii's mature tourist industry faces growing competition from other world destinations. In order to overcome this competition, large marketing expenditures by both private and public sectors will be required. On balance, it would appear that the positive growth factors may, in the long-term, outweigh any potential opposing forces. However, political and industry leaders must not become complacent. They must constantly strive to improve Hawaii as a vacation and business destination.

VISITOR PROJECTION THEORY

Introduction

Based on the foregoing discussion of the state of visitor levels in Hawaii to date, and barring any dramatic reversal of the underlying trends, moderate future growth can be expected. The magnitude of this future growth is, of course, dependent on external as well as internal forces, such as the state of the national economy, general political stability, availability of hotel accommodations, adequacy of air transportation and the sufficiency of water, electricity and visitor-related activities, among others.

Formulating predictions of any future event is subject to the vagaries and uncertainties of time. It is, however, a necessary tool in planning for growth. In the course of our work over the years with tourism in Hawaii we have studied several methods of projecting visitor arrivals and have settled on historical trend analysis, augmented with extensive research and interviews of travel professionals and economists as the most appropriate method of accomplishing projections. In analyzing previous projections prepared by Pannell Kerr Forster (PKF) and others, including The State Department of Business and Economic Development and Tourism, we have determined that this method has yielded more reliable long-term results than other methods. Hence, we will use our projections developed in this way throughout the remainder of this study.

Set forth in Tables V-4 through V-8 are the visitor forecasts for the State of Hawaii and the Islands of Oahu, Hawaii, Maui and Kauai.

TABLE V-4

HISTORICAL AND PROJECTED VISITORS
STATE OF HAWAII

		Westbound			Eastbound			Summary Total	
	YEAR	STATE VISITORS	ANNUAL INCREASE	MODIFIED TREND GROWTH	STATE VISITORS	ANNUAL INCREASE	MODIFIED TREND GROWTH	STATE VISITORS	ANNUAL RATE OF GROWTH
ACTUAL	1961	249,000			71,000			320,000	
	1962	280,000	12.4		83,000	16.9		363,000	13.4
	1963	333,000	18.9		96,000	15.7		429,000	18.2
	1964	440,000	32.1	22.8	104,000	8.3	16.1	564,000	31.5
	1965	567,000	23.3	26.3	120,000	15.4	23.9	687,000	21.8
	1966	687,000	21.2	25.3	149,000	24.2	26.5	836,000	21.7
	1967	893,000	30.0	20.9	232,000	55.7	28.0	1,125,000	34.6
	1968	1,016,000	13.8	18.7	299,000	28.9	29.2	1,315,000	16.9
	1969	1,181,000	16.2	16.0	346,000	15.7	22.9	1,527,000	16.1
	1970	1,326,000	12.3	15.0	421,000	21.7	15.5	1,747,000	14.4
	1971	1,430,000	7.8	15.4	389,000	(7.6)	14.1	1,819,000	4.1
	1972	1,783,000	24.7	13.3	462,000	18.8	12.3	2,245,000	23.4
	1973	2,068,000	16.0	11.0	563,000	21.9	8.7	2,631,000	17.2
	1974	2,185,000	5.7	12.6	602,000	6.9	11.7	2,787,000	5.9
	1975	2,207,000	1.0	9.3	622,000	3.3	8.0	2,829,000	1.5
	1976	2,552,000	15.6	8.1	669,000	7.6	2.7	3,221,000	13.9
	1977	2,763,000	8.3	7.6	670,000	0.1	7.0	3,433,000	6.6
	1978	3,031,000	9.7	6.8	639,000	(4.6)	7.9	3,670,000	6.9
	1979	3,139,000	3.6	3.2	821,000	28.5	8.1	3,960,000	7.9
	1980	3,046,000	(3.0)	3.6	888,000	8.2	8.1	3,934,000	(0.7)
	1981	2,975,000	(2.3)	2.4	960,000	8.1	9.2	3,935,000	0.0
	1982	3,279,000	10.2	3.6	964,000	0.4	6.8	4,243,000	7.8
	1983	3,396,000	3.6	4.1	972,000	0.8	5.9	4,368,000	2.9
	1984	3,721,000	9.6	7.6	1,134,000	16.7	7.3	4,855,000	11.1
	1985	3,709,000	(0.3)	5.3	1,176,000	3.7	10.8	4,885,000	0.6
	1986	4,257,000	14.8	4.8	1,349,000	14.7	14.2	5,606,000	14.8
	1987	4,204,000	(1.2)	5.0	1,596,000	18.3	11.5	5,800,000	3.5
	1988	4,265,000	1.5	5.1	1,878,000	17.7	14.0	6,143,000	5.9
	1989	4,705,000	10.3	1.5	1,937,000	3.1	11.1	6,642,000	8.1
	1990	4,720,000	0.3	2.0	2,251,000	16.2	9.2	6,971,000	5.0
	1991	4,569,000	(3.2)	1.9	2,256,000	0.2	7.4	6,825,000	(2.1)
PROJECTED									
	1992	4,615,000	1.0		2,459,000	9.0		7,074,000	3.6
	1993	4,675,000	1.3		2,668,000	8.5		7,343,000	3.8
	1994	4,745,000	1.5		2,881,000	8.0		7,626,000	3.9
	1995	4,830,000	1.8	1.40%	3,097,000	7.5	8.24%	7,927,000	3.9
	1996	4,927,000	2.0		3,314,000	7.0		8,241,000	4.0
	1997	5,026,000	2.0		3,529,000	6.5		8,555,000	3.8
	1998	5,116,000	1.8		3,741,000	6.0		8,857,000	3.5
	1999	5,193,000	1.5		3,947,000	5.5		9,140,000	3.2
	2000	5,266,000	1.4	1.74%	4,144,000	5.0	6.00%	9,410,000	3.0
	2001	5,334,000	1.3		4,343,000	4.8		9,677,000	2.8
	2002	5,398,000	1.2		4,543,000	4.6		9,941,000	2.7
	2003	5,457,000	1.1		4,743,000	4.4		10,200,000	2.6

Sources: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

TABLE V-5

HISTORICAL AND PROJECTED VISITORS
ISLAND OF OAHU

		Westbound				Eastbound				Summary Total	
	YEAR	STATE VISITORS	PERCENT TO OAHU	NUMBER TO OAHU	ANNUAL INCREASE	STATE VISITORS	PERCENT TO OAHU	NUMBER TO OAHU	ANNUAL INCREASE	TOTAL TO OAHU	ANNUAL INCREASE
ACTUAL	1977	2,763,000	87.98	2,431,000	---	670,000	99.85	669,000	---	3,100,000	---
	1978	3,031,000	86.44	2,620,000	7.77	639,000	99.84	638,000	(4.63)	3,258,000	5.10
	1979	3,139,000	84.17	2,642,000	0.84	821,000	99.76	819,000	28.37	3,461,000	6.23
	1980	3,046,000	81.75	2,490,000	(5.75)	888,000	99.66	885,000	8.06	3,375,000	(2.48)
	1981	2,975,000	80.47	2,394,000	(3.86)	960,000	99.69	957,000	8.14	3,351,000	(0.71)
	1982	3,279,000	85.94	2,818,000	17.71	964,000	99.69	961,000	0.42	3,779,000	12.77
	1983	3,396,000	79.12	2,687,000	(4.65)	972,000	99.49	967,000	0.62	3,654,000	(3.31)
	1984	3,721,000	78.26	2,912,000	8.37	1,134,000	99.38	1,127,000	16.55	4,039,000	10.54
	1985	3,709,000	76.38	2,833,000	(2.71)	1,176,000	99.57	1,171,000	3.90	4,004,000	(0.87)
	1986	4,257,000	74.04	3,152,000	11.26	1,349,000	99.70	1,345,000	14.86	4,497,000	12.31
	1987	4,204,000	73.33	3,083,000	(2.19)	1,596,000	94.30	1,505,000	11.90	4,588,000	2.02
	1988	4,265,000	70.72	3,016,000	(2.17)	1,878,000	97.50	1,831,000	21.66	4,847,000	5.65
	1989	4,705,000	68.14	3,206,000	6.30	1,937,000	95.20	1,844,000	0.71	5,050,000	4.19
	1990	4,720,000	67.20	3,172,000	(1.06)	2,251,000	96.82	2,179,000	18.17	5,351,000	5.96
	1991	4,569,000	63.25	2,890,000	(8.89)	2,256,000	96.18	2,170,000	(0.41)	5,060,000	(5.44)
PROJECTED											
	1992	4,615,000	63.00	2,907,000	0.59	2,459,000	96.00	2,361,000	8.80	5,268,000	4.11
	1993	4,675,000	62.00	2,899,000	(0.28)	2,668,000	95.75	2,555,000	8.22	5,454,000	3.53
	1994	4,745,000	61.00	2,894,000	(0.17)	2,881,000	95.50	2,751,000	7.67	5,645,000	3.50
	1995	4,830,000	60.00	2,898,000	0.14	3,097,000	95.25	2,950,000	7.23	5,848,000	3.60
	1996	4,927,000	59.00	2,907,000	0.31	3,314,000	95.00	3,148,000	6.71	6,055,000	3.54
	1997	5,026,000	58.00	2,915,000	0.28	3,529,000	94.75	3,344,000	6.23	6,259,000	3.37
	1998	5,116,000	57.00	2,916,000	0.03	3,741,000	94.50	3,535,000	5.71	6,451,000	3.07
	1999	5,193,000	56.00	2,908,000	(0.27)	3,947,000	94.25	3,720,000	5.23	6,628,000	2.74
	2000	5,266,000	55.75	2,936,000	0.96	4,144,000	94.00	3,895,000	4.70	6,831,000	3.06
	2001	5,334,000	55.50	2,960,000	0.82	4,343,000	93.75	4,072,000	4.54	7,032,000	2.94
	2002	5,398,000	55.25	2,982,000	0.74	4,543,000	93.50	4,248,000	4.32	7,230,000	2.82
	2003	5,457,000	55.00	3,001,000	0.64	4,743,000	93.25	4,423,000	4.12	7,424,000	2.68

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

TABLE V-6

HISTORICAL AND PROJECTED VISITORS
ISLAND OF HAWAII

		WESTBOUND				EASTBOUND				SUMMARY TOTAL	
	YEAR	STATE VISITORS	PERCENT TO HAWAII	NUMBER TO HAWAII	ANNUAL INCREASE	STATE VISITORS	PERCENT TO HAWAII	NUMBER TO HAWAII	ANNUAL INCREASE	TOTAL TO HAWAII	ANNUAL RATE OF GROWTH
ACTUAL	1977	2,763,000	32.18	889,000	---	670,000	7.46	50,000	---	939,000	---
	1978	3,031,000	31.51	955,000	7.42	639,000	7.20	46,000	(8.00)	1,001,000	6.60
	1979	3,139,000	28.51	895,000	(6.28)	821,000	6.82	56,000	21.74	951,000	(5.00)
	1980	3,046,000	25.94	790,000	(11.73)	888,000	5.18	46,000	(17.86)	836,000	(12.09)
	1981	2,975,000	22.72	676,000	(14.43)	960,000	4.79	46,000	0.00	722,000	(13.64)
	1982	3,279,000	21.56	707,000	4.59	964,000	4.88	47,000	2.17	754,000	4.43
	1983	3,396,000	21.76	739,000	4.53	972,000	4.53	44,000	(6.38)	783,000	3.85
	1984	3,721,000	20.53	764,000	3.38	1,134,000	4.67	53,000	20.45	817,000	4.34
	1985	3,709,000	18.85	699,000	(8.51)	1,176,000	5.36	63,000	18.87	762,000	(6.73)
	1986	4,257,000	18.51	788,000	12.73	1,349,000	5.86	79,000	25.40	867,000	13.78
	1987	4,204,000	18.65	784,000	(0.51)	1,596,000	5.64	90,000	13.92	874,000	0.81
	1988	4,265,000	18.34	782,000	(0.26)	1,878,000	5.48	103,000	14.44	885,000	1.26
	1989	4,705,000	20.13	947,000	21.10	1,937,000	8.98	174,000	68.93	1,121,000	26.67
	1990	4,720,000	20.82	983,000	3.80	2,251,000	8.35	188,000	8.05	1,171,000	4.46
	1991	4,549,000	21.26	971,000	(1.22)	2,256,000	8.50	192,000	2.13	1,163,000	(0.68)
PROJECTED											
	1992	4,615,000	21.50	992,000	2.16	2,459,000	9.00	221,000	15.10	1,213,000	4.30
	1993	4,675,000	22.00	1,029,000	3.73	2,668,000	9.50	253,000	14.48	1,282,000	5.69
	1994	4,745,000	22.25	1,056,000	2.62	2,881,000	9.75	281,000	11.07	1,337,000	4.29
	1995	4,830,000	22.50	1,087,000	2.94	3,097,000	10.00	310,000	10.32	1,397,000	4.49
	1996	4,927,000	22.75	1,121,000	3.13	3,314,000	10.25	340,000	9.68	1,461,000	4.58
	1997	5,026,000	23.00	1,156,000	3.12	3,529,000	10.50	371,000	9.12	1,527,000	4.52
	1998	5,116,000	23.25	1,189,000	2.85	3,741,000	10.75	402,000	8.36	1,591,000	4.19
	1999	5,193,000	23.50	1,220,000	2.61	3,947,000	11.00	434,000	7.96	1,654,000	3.96
	2000	5,266,000	23.75	1,251,000	2.54	4,144,000	11.25	466,000	7.37	1,717,000	3.81
	2001	5,334,000	24.00	1,280,000	2.32	4,343,000	11.50	499,000	7.08	1,779,000	3.61
	2002	5,398,000	24.25	1,309,000	2.27	4,543,000	11.75	534,000	7.01	1,843,000	3.60
	2003	5,457,000	24.50	1,337,000	2.14	4,743,000	12.00	569,000	6.55	1,906,000	3.42

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

TABLE V-7

HISTORICAL AND PROJECTED VISITORS
ISLAND OF MAUI

		WESTBOUND				EASTBOUND				SUMMARY TOTAL	
	YEAR	STATE VISITORS	PERCENT TO MAUI	NUMBER TO MAUI	ANNUAL INCREASE	STATE VISITORS	PERCENT TO MAUI	NUMBER TO MAUI	ANNUAL INCREASE	TOTAL TO MAUI	ANNUAL RATE OF GROWTH
ACTUAL	1977	2,763,000	48.17	1,331,000	---	670,000	6.42	43,000	---	1,374,000	---
	1978	3,031,000	48.60	1,473,000	10.67	639,000	6.73	43,000	0.00	1,516,000	10.33
	1979	3,139,000	46.99	1,475,000	0.14	821,000	6.70	55,000	27.91	1,530,000	0.92
	1980	3,046,000	46.98	1,431,000	(2.98)	888,000	6.87	61,000	10.91	1,492,000	(2.48)
	1981	2,975,000	47.13	1,402,000	(2.03)	960,000	7.81	75,000	22.95	1,477,000	(1.01)
	1982	3,279,000	49.28	1,616,000	15.26	964,000	9.34	90,000	20.00	1,706,000	15.50
	1983	3,396,000	50.21	1,705,000	5.51	972,000	12.76	124,000	37.78	1,829,000	7.21
	1984	3,721,000	50.01	1,861,000	9.15	1,134,000	13.49	153,000	23.39	2,014,000	10.11
	1985	3,709,000	49.45	1,834,000	(1.45)	1,176,000	14.29	168,000	9.80	2,002,000	(0.60)
	1986	4,257,000	47.12	2,006,000	9.38	1,349,000	15.12	204,000	21.43	2,210,000	10.39
	1987	4,204,000	45.46	1,911,000	(4.74)	1,596,000	14.16	226,000	10.78	2,137,000	(3.30)
	1988	4,265,000	44.22	1,886,000	(1.31)	1,878,000	17.04	320,000	41.59	2,206,000	3.23
	1989	4,705,000	44.12	2,076,000	10.07	1,937,000	20.29	393,110	22.85	2,469,110	11.93
	1990	4,720,000	41.42	1,955,000	(5.83)	2,251,000	17.34	390,000	(0.79)	2,345,000	(5.03)
	1991	4,549,000	41.02	1,874,000	(4.14)	2,256,000	17.52	395,000	1.28	2,269,000	(3.24)
PROJECTED											
	1992	4,615,000	42.00	1,938,000	3.42	2,459,000	18.00	443,000	12.15	2,381,000	4.94
	1993	4,675,000	43.00	2,010,000	3.72	2,668,000	18.50	494,000	11.51	2,504,000	5.17
	1994	4,745,000	44.00	2,088,000	3.88	2,881,000	19.00	547,000	10.73	2,635,000	5.23
	1995	4,830,000	44.50	2,149,000	2.92	3,097,000	19.25	596,000	8.96	2,745,000	4.17
	1996	4,927,000	44.75	2,205,000	2.61	3,314,000	19.50	646,000	8.39	2,851,000	3.86
	1997	5,026,000	45.00	2,262,000	2.59	3,529,000	19.75	697,000	7.89	2,959,000	3.79
	1998	5,116,000	45.25	2,315,000	2.34	3,741,000	20.00	748,000	7.32	3,063,000	3.51
	1999	5,193,000	45.50	2,363,000	2.07	3,947,000	20.25	799,000	6.82	3,162,000	3.23
	2000	5,266,000	45.75	2,409,000	1.95	4,144,000	20.50	850,000	6.38	3,259,000	3.07
	2001	5,334,000	46.00	2,454,000	1.87	4,343,000	20.75	901,000	6.00	3,355,000	2.95
	2002	5,398,000	46.25	2,497,000	1.75	4,543,000	21.00	954,000	5.88	3,451,000	2.86
	2003	5,457,000	46.50	2,538,000	1.64	4,743,000	21.25	1,008,000	5.66	3,546,000	2.75

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

TABLE V-6

HISTORICAL AND PROJECTED VISITORS
ISLAND OF HAWAII

		WESTBOUND				EASTBOUND				SUMMARY TOTAL	
	YEAR	STATE VISITORS	PERCENT TO HAWAII	NUMBER TO HAWAII	ANNUAL INCREASE	STATE VISITORS	PERCENT TO HAWAII	NUMBER TO HAWAII	ANNUAL INCREASE	TOTAL TO HAWAII	ANNUAL RATE OF GROWTH
ACTUAL	1977	2,763,000	32.18	889,000	---	670,000	7.46	50,000	---	939,000	---
	1978	3,031,000	31.51	955,000	7.42	639,000	7.20	46,000	(8.00)	1,001,000	6.60
	1979	3,139,000	28.51	895,000	(6.28)	821,000	6.82	56,000	21.74	951,000	(5.00)
	1980	3,046,000	25.94	790,000	(11.73)	888,000	5.18	46,000	(17.86)	836,000	(12.09)
	1981	2,975,000	22.72	676,000	(14.43)	960,000	4.79	46,000	0.00	722,000	(13.64)
	1982	3,279,000	21.56	707,000	4.59	964,000	4.88	47,000	2.17	754,000	4.43
	1983	3,396,000	21.76	739,000	4.53	972,000	4.53	44,000	(6.38)	783,000	3.85
	1984	3,721,000	20.53	764,000	3.38	1,134,000	4.67	53,000	20.45	817,000	4.34
	1985	3,709,000	18.85	699,000	(8.51)	1,176,000	5.36	63,000	18.87	762,000	(6.73)
	1986	4,257,000	18.51	788,000	12.73	1,349,000	5.86	79,000	25.40	867,000	13.78
	1987	4,204,000	18.65	784,000	(0.51)	1,596,000	5.64	90,000	13.92	874,000	0.81
	1988	4,265,000	18.34	782,000	(0.26)	1,878,000	5.48	103,000	14.44	885,000	1.26
	1989	4,705,000	20.13	947,000	21.10	1,937,000	8.98	174,000	68.93	1,121,000	26.67
	1990	4,720,000	20.82	983,000	3.80	2,251,000	8.35	188,000	8.05	1,171,000	4.46
	1991	4,569,000	21.26	971,000	(1.22)	2,256,000	8.50	192,000	2.13	1,163,000	(0.68)
PROJECTED											
	1992	4,615,000	21.50	992,000	2.16	2,459,000	9.00	221,000	15.10	1,213,000	4.30
	1993	4,675,000	22.00	1,029,000	3.73	2,668,000	9.50	253,000	14.48	1,282,000	5.69
	1994	4,745,000	22.25	1,056,000	2.62	2,881,000	9.75	281,000	11.07	1,337,000	4.29
	1995	4,830,000	22.50	1,087,000	2.94	3,097,000	10.00	310,000	10.32	1,397,000	4.49
	1996	4,927,000	22.75	1,121,000	3.13	3,314,000	10.25	340,000	9.68	1,461,000	4.58
	1997	5,026,000	23.00	1,156,000	3.12	3,529,000	10.50	371,000	9.12	1,527,000	4.52
	1998	5,116,000	23.25	1,189,000	2.85	3,741,000	10.75	402,000	8.36	1,591,000	4.19
	1999	5,193,000	23.50	1,220,000	2.61	3,947,000	11.00	434,000	7.96	1,654,000	3.96
	2000	5,266,000	23.75	1,251,000	2.54	4,144,000	11.25	466,000	7.37	1,717,000	3.81
	2001	5,334,000	24.00	1,280,000	2.32	4,343,000	11.50	499,000	7.08	1,779,000	3.61
	2002	5,398,000	24.25	1,309,000	2.27	4,543,000	11.75	534,000	7.01	1,843,000	3.60
	2003	5,457,000	24.50	1,337,000	2.16	4,743,000	12.00	569,000	6.55	1,906,000	3.42

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

TABLE V-7

HISTORICAL AND PROJECTED VISITORS
ISLAND OF MAUI

		WESTBOUND				EASTBOUND				SUMMARY TOTAL	
	YEAR	STATE VISITORS	PERCENT TO MAUI	NUMBER TO MAUI	ANNUAL INCREASE	STATE VISITORS	PERCENT TO MAUI	NUMBER TO MAUI	ANNUAL INCREASE	TOTAL TO MAUI	ANNUAL RATE OF GROWTH
ACTUAL	1977	2,763,000	48.17	1,331,000	---	670,000	6.42	43,000	---	1,374,000	---
	1978	3,031,000	48.60	1,473,000	10.67	639,000	6.73	43,000	0.00	1,516,000	10.33
	1979	3,139,000	46.99	1,475,000	0.14	821,000	6.70	55,000	27.91	1,530,000	0.92
	1980	3,046,000	46.98	1,431,000	(2.98)	888,000	6.87	61,000	10.91	1,492,000	(2.48)
	1981	2,975,000	47.13	1,402,000	(2.03)	960,000	7.81	75,000	22.95	1,477,000	(1.01)
	1982	3,279,000	49.28	1,616,000	15.26	964,000	9.34	90,000	20.00	1,706,000	15.50
	1983	3,396,000	50.21	1,705,000	5.51	972,000	12.76	124,000	37.78	1,829,000	7.21
	1984	3,721,000	50.01	1,861,000	9.15	1,134,000	13.49	153,000	23.39	2,014,000	10.11
	1985	3,709,000	49.45	1,834,000	(1.45)	1,176,000	14.29	168,000	9.80	2,002,000	(0.60)
	1986	4,257,000	47.12	2,006,000	9.38	1,349,000	15.12	204,000	21.43	2,210,000	10.39
	1987	4,204,000	45.46	1,911,000	(4.76)	1,596,000	14.16	226,000	10.78	2,137,000	(3.30)
	1988	4,265,000	44.22	1,886,000	(1.31)	1,878,000	17.04	320,000	41.59	2,206,000	3.23
	1989	4,705,000	44.12	2,076,000	10.07	1,937,000	20.29	393,110	22.85	2,469,110	11.93
	1990	4,720,000	41.42	1,955,000	(5.83)	2,251,000	17.34	390,000	(0.79)	2,345,000	(5.03)
	1991	4,569,000	41.02	1,874,000	(4.14)	2,256,000	17.52	395,000	1.28	2,269,000	(3.24)
PROJECTED											
	1992	4,615,000	42.00	1,938,000	3.42	2,459,000	18.00	443,000	12.15	2,381,000	4.94
	1993	4,675,000	43.00	2,010,000	3.72	2,668,000	18.50	494,000	11.51	2,504,000	5.17
	1994	4,745,000	44.00	2,088,000	3.88	2,881,000	19.00	547,000	10.73	2,635,000	5.23
	1995	4,830,000	44.50	2,149,000	2.92	3,097,000	19.25	596,000	8.96	2,745,000	4.17
	1996	4,927,000	44.75	2,205,000	2.61	3,314,000	19.50	646,000	8.39	2,851,000	3.86
	1997	5,026,000	45.00	2,262,000	2.59	3,529,000	19.75	697,000	7.89	2,959,000	3.79
	1998	5,116,000	45.25	2,315,000	2.34	3,741,000	20.00	748,000	7.32	3,063,000	3.51
	1999	5,193,000	45.50	2,363,000	2.07	3,947,000	20.25	799,000	6.82	3,162,000	3.23
	2000	5,266,000	45.75	2,409,000	1.95	4,144,000	20.50	850,000	6.38	3,259,000	3.07
	2001	5,334,000	46.00	2,454,000	1.87	4,343,000	20.75	901,000	6.00	3,355,000	2.95
	2002	5,398,000	46.25	2,497,000	1.75	4,543,000	21.00	954,000	5.88	3,451,000	2.86
	2003	5,457,000	46.50	2,538,000	1.64	4,743,000	21.25	1,008,000	5.66	3,546,000	2.75

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

TABLE V-8

HISTORICAL AND PROJECTED VISITORS
ISLAND OF KAUAI

		WESTBOUND				EASTBOUND				SUMMARY TOTAL	
	YEAR	STATE VISITORS	PERCENT TO KAUAI	NUMBER TO KAUAI	ANNUAL INCREASE	STATE VISITORS	PERCENT TO KAUAI	NUMBER TO KAUAI	ANNUAL INCREASE	TOTAL TO KAUAI	ANNUAL RATE OF GROWTH
ACTUAL	1977	2,763,000	28.37	784,000	---	670,000	26.27	176,000	---	960,000	---
	1978	3,031,000	29.03	880,000	12.24	639,000	24.10	154,000	(12.50)	1,034,000	7.71
	1979	3,139,000	27.33	858,000	(2.50)	821,000	21.56	177,000	14.94	1,035,000	0.10
	1980	3,046,000	26.63	811,000	(5.48)	888,000	15.99	142,000	(19.77)	953,000	(7.92)
	1981	2,975,000	25.65	763,000	(5.92)	960,000	15.52	149,000	4.93	912,000	(4.30)
	1982	3,279,000	23.33	765,000	0.26	964,000	13.80	133,000	(10.74)	898,000	(1.54)
	1983	3,396,000	21.11	717,000	(6.27)	972,000	11.01	107,000	(19.55)	824,000	(8.24)
	1984	3,721,000	21.90	815,000	13.67	1,134,000	11.73	133,000	24.30	948,000	15.05
	1985	3,709,000	22.49	834,000	2.33	1,176,000	12.67	149,000	12.03	983,000	3.69
	1986	4,257,000	23.89	1,017,000	21.94	1,349,000	13.49	182,000	22.15	1,199,000	21.97
	1987	4,204,000	24.60	1,034,000	1.67	1,596,000	6.33	101,000	(44.51)	1,135,000	(5.34)
	1988	4,265,000	24.48	1,044,000	0.97	1,878,000	7.35	138,000	36.63	1,182,000	4.14
	1989	4,705,000	24.19	1,138,000	9.00	1,937,000	7.90	153,000	10.87	1,291,000	9.22
	1990	4,720,000	23.71	1,119,000	(1.67)	2,251,000	7.44	167,000	9.15	1,286,000	(0.39)
	1991	4,569,000	23.66	1,081,000	(3.40)	2,256,000	7.48	169,000	1.20	1,250,000	(2.80)
PROJECTED	1992	4,615,000	24.50	1,131,000	4.63	2,459,000	8.00	197,000	16.57	1,328,000	6.24
	1993	4,675,000	25.00	1,169,000	3.36	2,668,000	8.50	227,000	15.23	1,396,000	5.12
	1994	4,745,000	25.50	1,210,000	3.51	2,881,000	9.00	259,000	14.10	1,469,000	5.23
	1995	4,830,000	25.75	1,244,000	2.81	3,097,000	9.25	286,000	10.42	1,530,000	4.15
	1996	4,927,000	26.00	1,281,000	2.97	3,314,000	9.50	315,000	10.14	1,596,000	4.31
	1997	5,026,000	26.25	1,319,000	2.97	3,529,000	9.75	344,000	9.21	1,663,000	4.20
	1998	5,116,000	26.50	1,356,000	2.81	3,741,000	10.00	374,000	8.72	1,730,000	4.03
	1999	5,193,000	26.75	1,389,000	2.43	3,947,000	10.25	405,000	8.29	1,794,000	3.70
	2000	5,266,000	27.00	1,422,000	2.38	4,144,000	10.50	435,000	7.41	1,857,000	3.51
	2001	5,334,000	27.25	1,454,000	2.25	4,343,000	10.75	467,000	7.36	1,921,000	3.45
	2002	5,398,000	27.50	1,484,000	2.06	4,543,000	11.00	500,000	7.07	1,984,000	3.28
	2003	5,457,000	27.75	1,514,000	2.02	4,743,000	11.25	536,000	6.80	2,040,000	3.23

Source: Historical - Hawaii Visitors Bureau
Projected - Pannell Kerr Forster

ROOM NIGHT AND OCCUPANCY PROJECTIONS

Projection Methodology

The number of visitors is the primary variable which influences projections of demand for hotel rooms in all visitor destination areas. Secondary variables include the portion of visitors utilizing hotels, average lengths of stay and double occupancy factors.

The quantity of visitors has been projected as set forth earlier by taking into consideration Hawaii's past visitor growth combined with a subjective analysis of the future outlook. In order to estimate the percentage of visitors utilizing hotels, the average length of stay and the double occupancy factor, reliance has been placed on published materials and our experience and data base of related information.

The following paragraphs discuss the secondary variables as they relate to room night demand.

Percentage of Visitors Utilizing Hotels

As gathered from the Hawaii Visitors Bureau (HVB) annual research reports, about 88 to 91 percent of overnight and longer Westbound visitors and 94 to 99 percent of overnight and longer Eastbound visitors to the Neighbor Islands, historically stayed in hotels, condominiums or a combination of both. We have projected this utilization factor to average approximately 90 and 96 percent for Westbound and Eastbound visitors, respectively.

Average Length of Stay

Average length of stay for each Island was obtained by PKF from its monthly Trends in the Hotel Industry - Hawaii (Trends) survey. Although the HVB also prepares estimates of average lengths of stay, the PKF averages were used because:

- The HVB average lengths of stay are for all visitors, including those not staying in hotels (e.g. individuals staying with friends and relatives).
- HVB tracks average lengths of stay in days whereas hotels and PKF track average lengths of stay in nights.
- PKF estimates are based on actual data received directly from the operating hotels and condominiums participating in the Trends survey as opposed to visitor prepared in-flight or airport sample surveys estimated by the HVB, which would tend to have a larger error rate.

Average length of stay for the Neighbor Islands is generally increasing with a corresponding decrease for Oahu. This trend is due to three primary reasons:

- The Neighbor Islands are emerging as true destinations as more visitors by pass Oahu and spend their entire stay on one or more neighbor islands.
- Promotional efforts of the HVB and Neighbor Island promotional organizations are aimed at attracting the longer staying FIT (Free and Independent Traveler).
- A high percentage of repeat visitors have already been to Oahu and would like to experience the Neighbor Islands.

Historical data on average lengths of stay for the years 1987 through 1991 are reflected below:

	1991		1990		1989		1988		1987	
ISLAND	EAST	WEST	EAST	WEST	EAST	WEST	EAST	WEST	EAST	WEST
OAHU	4.31	4.86	4.36	4.93	4.39	5.23	4.89	5.25	5.40	5.74
MAUI	2.28	4.41	2.44	4.73	2.10	4.11	2.16	4.46	2.43	4.29
KAUAI	1.31	3.46	1.42	3.76	1.63	4.01	1.12	3.82	1.77	3.62
HAWAII	2.07	4.19	2.13	4.32	2.73	3.99	2.38	4.84	3.52	4.20

SOURCE: PANNELL KERR FORSTER

Double Occupancy Factor

In developing room night requirements, it is also necessary to estimate the number of persons who will be occupying each room, commonly called the "double occupancy factor." The hotel participants in the PKF monthly Trends survey provide the total number of guests and the number of occupied rooms for their respective hotels and from these factors the double occupancy factor is derived. We have projected the double occupancy factor based also upon the following reasoning:

- Resort destination areas typically have high double occupancy factors because of family travel and the "sharing of rooms" among people in a tour party.
- The number of business travelers (typically single occupancy) is less apt to affect the overall double occupancy factor in a resort destination.

Double occupancy factors calculated for the years 1987 through 1991 are shown by island below.

	1991	1990	1989	1988	1987
Oahu	1.95	1.93	1.93	1.93	1.94
Maui	2.10	2.10	2.12	2.12	2.12
Kauai	2.25	2.15	2.25	2.15	2.17
Hawaii	2.07	2.01	2.08	2.03	1.99

Source: Pannell Kerr Forster

ROOM NIGHT DEMAND

The annual room nights estimated for 1991 through 2000 for the State of Hawaii and Islands of Oahu, Maui, Kauai, and Hawaii are presented in Table V-9 through V-13.

State of Hawaii

Since 1977, annual room night demand in the State of Hawaii has grown from slightly less than 13.2 million room nights to over 18.7 million room nights in 1991. This growth represents a total increase of 41.9 percent, or an average annual growth rate

TABLE V-9

HISTORICAL AND PROJECTED HOTEL ROOM DEMAND
STATE OF HAWAII

[illegible]

of 2.5 percent. During this time, State hotel occupancy rates have ranged between a low of 68 percent and a high of 81 percent, but have remained above 75 percent from 1984 through 1990, until it declined to 72.4 percent in 1991.

For the future, growth in room night demand is expected to continue at a moderate rate, reflecting the maturity of Hawaii's visitor industry. Room night demand is expected to increase from 18.7 million room nights in 1991 to over 27 million in year 2003, reflecting an average annual growth rate of 3.2 percent.

Because of large anticipated additions to hotel room inventory, occupancy is projected to remain in the mid-70's through 2003. After reaching a low of 71.8 percent in 1996, occupancies should increase steadily as the new supply is absorbed in the market and should reach 76.3 percent by the year 2003.

Island of Oahu

On the Island of Oahu, hotel room night demand has grown from 8.1 million room nights in 1977 to 11.1 million in 1991. This growth reflects a total increase of 36.8 percent, or an average annual growth rate of 2.26 percent. Occupancy rates during this period have fluctuated between a low of 72 percent and a high of 87 percent. For the five years, 1986-1990, occupancy rates remained above 85 percent, reflecting the steady growth in visitor arrivals to Oahu and minimal additions to the hotel room inventory.

In the next five years, however, 8,800 hotel units are slated for development on the Island of Oahu. The bulk of these additions are hotels associated with the Ko' Olina Resort, Turtle Bay Resort (Kawela Bay), Waterfront Redevelopment Project, and the Convention Center. While room night demand is projected to grow steadily

TABLE V-10

[illegible]

Source: Hawaii Visitors Bureau and Pannell Kerr Forster

through the next twelve years with an average annual rate of 3.1 percent, occupancy rates are projected to decrease slightly as the new hotels come on-line.

Occupancy rates, which dropped in 1991 to 80.3 percent from 86.3 percent in 1990, should hover in the low to mid-80's until 1996. At this point, the largest group of new hotels is expected to open and occupancy should decrease to 80.2 percent. Following this low, occupancy rates are estimated to increase steadily to the mid-80's again, as the new additions to supply establish themselves in the market.

Island of Maui

Since 1977, annual room night demand for the Island of Maui has grown from almost 2.6 to 3.9 million room nights in 1991. This growth represents a total increase of 51.9 percent, or an average annual increase of 3.3 percent. During this period, occupancy has fluctuated between a high of 84.0 percent and a low of 69.2 percent. In 1991, occupancy for the Island of Maui was 63.4 percent, down 9.6 percent from 70.1 percent in 1990, reflecting the impact of the Persian Gulf War, national economic recession and additions to room supply. However, over the next twelve years, room night demand is expected to increase at an average annual rate of approximately 3.3 percent, to reach 5.8 million room nights in the year 2003.

As previously noted, the additions of new hotel rooms in 1991, which included the Grand Hyatt Wailea and the Kea Lani Suites Hotel, contributed to the decline in room occupancy. Occupancy is expected to decrease further in 1992 to 61.5 percent and begin a slow recovery as the glut of hotel rooms are absorbed by demand. Steady increases are expected each year until an occupancy of 73.5 percent is reached in 2003.

TABLE V-11

[illegible]

Island of Kauai

Between 1977 and 1991, room night demand on the Island of Kauai grew at an average annual rate of 2.08 percent, from 1.2 million to 1.6 million room nights. This is a total increase of 33.4 percent. Occupancy rates for the same period ranged between 84.7 percent and 57.2 percent. In 1991, occupancy for the Island was 57.7 percent, a drop of 9.9 percentage points from 1990 due to the same reasons previously discussed.

Occupancy rates are projected to remain in the low-to-mid 60's through the next twelve years, as 968 new hotel units are added to Kauai's hotel room inventory. These additions will increase the Island's supply by 13 percent, and include 218 rooms for The Pointe at Poipu in 1994 and 750 rooms for the expansion at the Kauai Lagoons Resort in 1996.

This growth in supply is expected to be supported by continuous growth in demand. Room night demand is projected to increase from 1.6 million room nights in 1991 to 2.4 million in 2003, for a total growth of 50.1 percent and an average annual growth rate of 3.4 percent.

Island of Hawaii

In 1977, the Island of Hawaii had an annual room night demand of 1.3 million. By 1991, demand reached 2.0 million room nights, for an increase of 52.8 percent, or an annual average of 3.51 percent. During this period, occupancy fluctuated between a low of 44.0 percent in 1982 and a high of 63.7 percent in 1978. Occupancy has averaged almost 60 percent over the past five years.

TABLE V-12

[illegible]

Source: Hawaii Visitors Bureau and Pannell Kerr Forster

TABLE V-13

[illegible]

Source: Hawaii Visitors Bureau and Pannell Kerr Forster

The Island of Hawaii is expected to experience some of the strongest growth in demand within the Hawaiian Islands over the next ten years. This is due to the increasing number of first-time visitors who spend at least part of their stay on the Big Island, the increasing number of repeat visitors who are deciding to return to that island for their entire stay and the attraction of the world class resorts that have and are being developed on the island.

By the year 2003, demand is projected to reach 3.0 million room nights. This growth represents a 52.1 percent increase over 1991, or an average annual growth rate of 3.6 percent. Occupancy rates are expected to increase slightly over the next three years to 61.8 percent, but then drop to 56.2 percent in 1995 with the addition of new room supply. A slow, but steady growth is expected thereafter, increasing to a 60.5 percent occupancy in 2003.

VISITOR STATUS

An important characteristic of the travel market is the visitor's traveling status. In most instances, successful travel destination areas rely on a balanced mix of visitor segments. They typically draw on a healthy base of repeat travelers, lending to the importance of visitor satisfaction. However, the entities of the destination area must continually seek new market sources in attracting first-time visitors.

MARKET SEGMENTS

The traveling status of Hawaii's visitors can be segmented according to the traveler's itinerary and how it was planned. For the most part, there are two basic market segments of visitors to Hawaii who patronize transient facilities. These segments are Free Independent Travelers and group travelers. Each of these markets

may be further stratified by preferences for price, amenities, location, and type of facilities. A historical tabulation of westbound visitors by the aforementioned segments is presented on Table V-14.

Free Independent Travelers (FIT)

FIT visitors make up Hawaii's primary visitor market segment, representing 77 percent of all westbound visitors. This group includes those who come to Hawaii unassociated with organized group movements. Generally, these visitors are more affluent, look for better caliber accommodations, and do not desire to be shuffled about in a group from one prearranged activity to another. The majority utilize travel agent services, and a growing number are purchasing vacation packages, where accommodations and transportation are paid for in a lump sum. Such packages are more economical while maintaining the FIT's independent travel plans.

Since 1967, the market share of westbound FITs has fluctuated widely with a high of 86 percent in 1981, and a low of 60 percent in 1969. Despite these fluctuations, westbound FITs have always formed Hawaii's most important market segment, and this is expected to continue into the future. At present, Japanese FITs are relatively insignificant in the Hawaii market, but their numbers will increase with the trend toward more sophisticated travel expectations.

Group Market

The Group Market encompasses organized groups which can be subdivided into tour, incentive and meeting groups. A brief description of each follows.

TABLE V-14

WESTBOUND VISITOR MARKET SEGMENTS
STATE OF HAWAII
1967-1991

YEAR	TOTAL WESTBOUND VISITORS	FREE INDEPENDENT TRAVELERS VOLUME	FREE INDEPENDENT TRAVELERS ANNUAL % CHANGE	FREE INDEPENDENT TRAVELERS % OF W.B. VISITORS	GROUP TRAVELERS VOLUME	GROUP TRAVELERS ANNUAL % CHANGE	GROUP TRAVELERS % OF W.B. VISITORS
1967	893,103	554,885	----	62.13%	338,218	----	37.87%
1968	1,015,844	630,510	13.63%	62.07%	385,334	13.93%	37.93%
1969	1,181,029	705,100	11.83%	59.70%	475,929	23.51%	40.30%
1970	1,326,135	878,305	24.56%	66.23%	447,830	-5.90%	33.77%
1971	1,430,325	1,180,867	34.45%	82.56%	249,458	-44.30%	17.44%
1972	1,782,737	1,236,321	4.70%	69.35%	546,416	119.04%	30.65%
1973	2,067,861	1,374,133	11.15%	66.45%	693,728	26.96%	33.55%
1974	2,184,620	1,433,043	4.29%	65.60%	751,577	8.34%	34.40%
1975	2,207,417	1,467,183	2.38%	66.47%	740,234	-1.51%	33.53%
1976	2,551,601	1,624,529	10.72%	63.67%	927,072	25.24%	36.33%
1977	2,763,312	1,832,121	12.78%	66.30%	931,191	0.44%	33.70%
1978	3,030,999	2,014,446	9.95%	66.46%	1,016,553	9.17%	33.54%
1979	3,139,455	2,381,160	18.20%	75.85%	758,295	-25.41%	24.15%
1980	3,046,132	2,589,509	8.75%	85.01%	456,623	-39.78%	14.99%
1981	2,974,791	2,557,173	-1.25%	85.96%	417,618	-8.54%	14.04%
1982	3,278,525	2,449,050	-4.23%	74.70%	829,475	98.62%	25.30%
1983	3,396,115	2,506,450	2.34%	73.80%	889,665	7.26%	26.20%
1984	3,721,380	2,737,610	9.22%	73.56%	983,770	10.58%	26.44%
1985	3,708,610	2,810,200	2.65%	75.78%	898,410	-8.68%	24.22%
1986	4,256,390	3,277,280	16.62%	77.00%	979,110	8.98%	23.00%
1987	4,204,010	3,073,600	-6.21%	73.11%	1,130,410	15.45%	26.89%
1988	4,264,730	3,259,330	6.04%	76.43%	1,005,400	-11.06%	23.57%
1989	4,705,320	3,980,980	22.14%	84.61%	724,340	-27.96%	15.39%
1990	4,719,730	4,083,880	2.58%	86.53%	635,850	-12.22%	13.47%
1991	4,568,520	3,976,940	-2.62%	87.05%	591,580	-6.96%	12.95%

SOURCE: Hawaii Visitors Bureau, Annual Research Reports

Tour Groups

Tours encompass all organized tour group functions, including the various charter groups, and Group Inclusive Tour (GIT) packages. The convention and meetings market makes travel arrangements via tours, but is considered as a separate market segment. All of these tour offerings provide the prospective visitor with a broad choice of accommodations and extra amenities, which may include meals and optional tours around the Islands.

Westbound tour groups to Hawaii, as a percentage of total westbound visitors, increased until the mid-1970s. Off-beach properties in Waikiki and the majority of Neighbor Island hotels, in particular, have historically derived much of their business from tour functions. Over the past several years, the westbound tour segment has fallen to a 13.5 percent share in 1990, due to proportionate increases in FITs. In contrast, 80 percent of all Japanese visitors are associated with tour groups. The trend towards increasing travel independence will have a changing impact on this segment for both domestic and international travel.

Incentive Groups

A relatively new and rapidly growing segment of the groups market has been the emergence of the incentive group which according to the Hawaii Visitors Bureau expended approximately $210 million in Hawaii for incentive travel in 1990. It is comprised of visitors who are recipients of awards for structured competitions among company and organization personnel to strive for higher productivity and sales quotas. These visitors are highly sought after since they generally frequent the luxury lodging properties and have, as a part of prepaid packages, substantial food, beverage, entertainment and recreational expenditures.

This segment now represents a 2.0 percent share of the total Hawaii market and more substantially, 28 percent of the combined meetings, conventions and incentive travelers to Hawaii.

Meeting Groups

Hawaii hosts a wide range of group meeting functions, produced primarily by corporations and associations, and include functions commonly referred to as conventions and conferences. The importance of this market segment is recognized by many hotels in Hawaii, as illustrated by their dedicated meeting facilities and sales staff. These groups generally require first-class and occasionally luxury accommodations and often hold profitable special functions, including theme banquets.

Corporate gatherings occur for reasons ranging from board meetings to sales, management, and administrative functions. The corporate meetings market in Hawaii is generated mainly from the continental United States. According to the U.S. Travel Data Center, close to $100 billion is spent on travel by American companies annually, representing nearly 30 percent of all travel spending in the U.S. To capture a share of this lucrative market, many hotel operators in Hawaii are redefining their marketing strategies and renovating their facilities. Conversions of separate executive floors with luxurious accommodations are being made in some hotels while others have added boardrooms. These facilities are being complemented by improved business services and fitness facilities.

Generally, associations are classified as education, engineering and scientific, fraternal and social, labor unions, local, state and federal officials or employees, professional, religious, specialized business, social service, trade associations and veterans or military. The professional category represents the greatest potential source of business for Hawaii, with special emphasis on the medical professions. Although Hawaii attracts a fair amount of small to mid-sized association functions, the lack of a convention center has limited the State's ability to accommodate large association gatherings.

The group meetings market represents a substantial market potential because of its rapid expansion in recent years. It is important to note that although the average length of stay of visitors in this segment is slightly less than that of the entire market of visitors, their occupational make-up is decidedly higher in the areas of professional and managerial skills. This infers that they command higher incomes, patronize higher rated facilities, and have greater expenditures. This business segment also serves as an excellent marketing tool by enticing and encouraging participants to bring their spouses and families with them to the meeting. Participants who are first time visitors will also be tempted to return to Hawaii on vacation with their families. In this regard, Hawaii's future appears bright due to aggressive programs of both the HVB and hotels in the group meetings business, and the growth and improvement of facilities.

In recent years, the proposal to develop a convention center in Honolulu has gained momentum in all sectors of the community. A site on Kalakaua Avenue in Waikiki, which is currently occupied by the International Market Place, had been chosen by the State as the location for the convention center. However, the private developer has recently declined the project, which leaves the State searching for another site and developer. Additionally, a second convention center has been approved for private development at the former Aloha Motors site at Kalakaua Avenue and Kapiolani Boulevard and is projected to be completed by 1995.

SECTION VI
LUXURY VISITOR MARKET OUTLOOK

$75,000 are assumed to prefer luxury-caliber facilities, with those on the high end of this category preferring ultra-luxury accommodations.

As luxury demand can be generated by households with $50,000 or more annual effective buying income (EBI) (defined by Sales and Marketing Management to be personal income less personal tax and non-tax payments), we reviewed the historical growth of households with EBIs greater than $50,000. The data reveals rising affluence in the 20 metropolitan areas that produce the greatest number of visitors to Hawaii. Economic expansion, which has characterized the 1980's, has resulted in a profound increase in the number of households with EBI equal to or greater than $50,000. In 1986, there were approximately 5.3 million households in Hawaii's top 20 U.S. metropolitan origin areas with $50,000 or greater EBIs . By 1988, this number had increased to about 5.9 million households, and by 1990, this number had risen to an unprecedented 7.4 million households. This increase corresponds to an average annual growth rate of almost 10 percent. Clearly, these growth rates would indicate that the long term prospects for Hawaii's luxury market remain healthy.

As presented in Table VI-1, nearly 30 percent of all households in Hawaii's top 20 metropolitan visitor origin areas had EBIs greater than $50,000 in 1990, 8.2 percentage points higher than the national average. This logically illustrates Hawaii's strong market presence in areas with more affluent households. In 1990, 58 percent of westbound visitors to Hawaii had annual household incomes greater than or equal to $50,000. Additionally, 32 percent had annual household incomes over $75,000. As a percentage of visitors to each island, Maui had the largest proportion of travelers earning $75,000 or more, comprising 34 percent of visitors to Maui (see Table VI-2).

TABLE VI-1

TABLE VI-2

SURVEY OF HAWAII VISITOR INCOMES
AND ISLANDS VISITED
1990

PERCENT

1990 ANNUAL INCOME	STATE	OAHU	MAUI	MOLOKAI	LANAI	KAUAI	BIG ISLAND
LESS THAN $35,000 (NET)	14%	16%	12%	17%	6%	11%	12%
UP TO $15,000	1	1	0	1	0	1	1
$15,000-$24,999	4	5	3	5	0	3	4
$25,000-$29,999	3	4	3	2	4	3	4
$30,000-$34,999	6	6	6	9	2	5	4
$35,000 TO $75,000 (NET)	48%	51%	48%	51%	61%	49%	47%
$35,000-$39,999	4	5	3	3	2	5	4
$40,000-$44,999	8	9	8	10	11	7	9
$45,000-$49,999	9	10	9	6	11	9	8
$50,000-$74,999	26	27	27	31	38	29	26
$75,000 OR MORE (NET)	32%	27%	34%	27%	29%	33%	33%
$75,000-$99,999	15	14	15	12	5	16	15
$100,000-$149,999	11	9	12	5	10	13	11
$150,000-$199,999	3	3	4	6	3	2	3
$200,000 OR MORE	3	2	4	4	1	2	3
NO ANSWER	7	7	6	6	4	6	7

SOURCE: HAWAII VISITORS BUREAU

Although the increase in American household affluence will be favorable for Hawaii's luxury resort hotels and for other resort facilities worldwide, competition for this lucrative market is also increasing rapidly resulting in the need to offer an innovative and differentiating visitor experience to compete for this discriminating market segment.

U.S. Workforce Implications

Tomorrow's U.S. travelers will be extremely demanding hotel guests, due largely to the demands and stress found in the workplace. Job frustrations will bring the need for job escape. According to an article in the Wall Street Journal, there will be so many people in the 25 to 44 year age group that there will not be enough middle management jobs to which they can aspire. In addition, their work will be fragmented, lacking in autonomy and repetitious. The causes will include the demise of the industrial sector and the streamlining of management and labor through new technology. With declining opportunities for promotions, people are going to look elsewhere for the mental and spiritual satisfaction they once derived from their jobs.

For those in the senior management level, increased stress from the competitive market and work environment will also demand a greater return on time and money spent on leisure activities. Stress due to corporate takeovers, streamlining of management, and more responsibility inherent at the senior management level will lead to greater expectations and relief from vacation time. To this group, the return on their leisure dollar will not be nearly as important as the return on their leisure minute.

LUXURY VISITOR MARKET OUTLOOK

INTRODUCTION

Hawaii offers a strong visitor product that is considered a leader in the world visitor industry market. Hawaii's year-round ideal climate, exotic location and culture, highly developed tourist infrastructure and U.S. Statehood creates a unique blend of attractive elements that is extremely successful internationally. Although Hawaii is a mature visitor destination, it has maintained its success through continued strong development of the visitor industry throughout the State and through market segmentation.

The luxury market has gained substantial focus from the Hawaii visitor industry in recent years. With rising incomes, double incomes from two working spouses, increased leisure time, and an aging population with more wealth and less financial obligations due to smaller families, the demand for luxury accommodations has increased dramatically over the past decade. In response, renovations of existing properties and development of new luxury projects has more than kept pace. In this Section, we will analyze the factors of demand for this market.

SUMMARY HIGHLIGHTS AND CONCLUSIONS

A strong and resilient U.S. economy has lead to an increasingly affluent population. Households with incomes of $50,000 or greater in 1985 dollars are expected to generate demand for luxury accommodations. Using a 5 percent inflation factor, the starting point for this high income group is $63,800 in 1990 dollars and $81,400 in 1995 dollars. Ultra-luxury demand is expected to be derived from those income groups with $75,000 annual income and above in 1985 dollars, or at least

$95,700 and $122,200 in 1990 and 1995 respectively, after the inflation factor is applied.

In analyzing the top 20 cities comprising Hawaii's U.S. market, those households with incomes of $50,000 and above represented 12.77 percent of total households in 1985. By 1995, this group is projected to increase to 16 percent. As Hawaii is believed to attract more than its proportional share of this group, Hawaii's potential luxury market is expected to grow above 16 percent of all visitors to Hawaii by 1995. More importantly, those households with $75,000 (1985 dollars) of income and above are expected to grow faster during the years 1985 to 1995 than any other household income segment, averaging 4.37 percent per year. It is expected that this income group will grow from 3.9 percent to 5.0 percent of the total population by 1995. It is estimated that by 1995, about 16.2 million households will have incomes higher than $50,000 (1985 dollars) and 5.1 million households are expected to generate above $75,000 income per year (1985 dollars).

While demand for luxury accommodations is expected to increase due to this rising affluence, it is also clear that competition for this lucrative market will also grow correspondingly. This competition will be found not only in Hawaii, but also worldwide. Differentiation and innovation of the luxury visitor experience will be a key determinant in successfully attracting this market.

DEPENDENCE ON U.S. ECONOMIC VITALITY

Due to the discretionary and flexible nature of travel, Hawaii, Europe, Mexico, and other visitor destination areas are affected by the general health of the United States economy. This susceptibility to domestic and international conditions was evident during the Persian Gulf War and deepening U.S. recession, which had an unfortunate convergence during the first quarter of 1991. Travel during that quarter was down 14 percent in Hawaii, 7 percent in the Caribbean, and 20 percent in Guam.

As to be expected, the purchase of luxury goods and services, including travel, is usually postponed in times of economic uncertainty. The U.S. stock market crash in October 1987, however, raised speculation among travel industry experts about the soundness of this reasoning as Hawaii and its luxury market proved to be quite resilient to this significant economic event. The crash should have lead to cutbacks in travel by the lucrative free and independent travelers, particularly those individuals in the middle-income bracket. Vacations to destinations such as Hawaii and the Caribbean were expected to be replaced with trips to less expensive destinations, and although the first quarter of 1988 saw a decline in visitor arrivals to Hawaii, the rest of the year through 1989 was a surprising period of relative growth, including Hawaii's luxury market.

The shift in global economic attention toward the Pacific Basin will also benefit Hawaii's resort market. With the continued flourishing of business activity in the region, the number of business and pleasure travelers will undoubtedly accelerate. Hawaii is in a prime location to take advantage of the U.S. - Pacific Basin economic interaction.

An example of this interaction is the foreign currency exchange rate, which has been an impetus for Japanese travel to Hawaii. Although the value of the yen has fluctuated against the U.S. dollar over the last 20 years, the devaluation of the U.S. dollar and the vast amounts of Japanese exports in 1971 were notable beginnings of the appreciation of the yen for the next 10 years. During the early 1980s, when

the U.S. imposed greater controls on Japanese imports and domestic interest rates declined, the U.S. dollar regained its strength. However, in 1986, the dollar was devalued in an effort to make U.S. exports cheaper and more competitive. The appreciation of the yen was a dramatic change to prior years' exchange rates and has had a favorable impact on Japanese travel, particularly to Hawaii. In addition to the Japanese markets, visitors from other areas, including Australia, New Zealand and particularly Europe have also taken advantage of the weak dollar.

Growing Affluence of U.S. Households

An important trend that will help bolster Hawaii's luxury resort market is the projected increase in American affluence over the next several decades. This affluence will be augmented by the aging of the baby-boom generation, whose disposable incomes have risen to unprecedented levels when compared to earlier generations. Factors contributing to their affluence include a strong and growth-oriented economy, marriage postponement, two-earner households, and fewer children. Americans of this generation will have a significant impact on the travel market, as they will be the key consumers for years to come.

The prime indicator of household affluence is annual income generation. In 1982, the Hawaii Visitors Bureau reported that 31.6 percent of Hawaii's westbound visitors had pre-tax household incomes that were greater than $50,000 (current data not available). Correlating past trends with changes in the general price level, we now estimate this percentage to exceed 40 percent. An annual household income of $50,000 or greater in 1985 dollars was assumed as a minimum threshold in focusing on the potential luxury FIT market for Hawaii. Households with incomes in the $50,000 - $75,000 range are generally capable of generating both first-class and luxury visitors. However, visitors from households with annual incomes greater than

The ramifications for the hotel industry, particularly the resort market, are strong. Two-worker families mean two short vacations instead of one long one, and more three-day weekend vacations. The trend toward shorter work weeks will also increase leisure activities. Additionally, consumers' lives will be so harried and pressured that they will demand pampering when they are on vacation, which means they will expect every service and amenity imaginable. Those in the hotel industry will have to tailor their product to these needs. Customers will want physical and mental activities and it would be wise to provide them with "personal growth" vacations.

Demographic Trends

"Baby Boomer Generation" The Baby Boomer generation is making its way to the forefront with respect to dominating population trends and economic forecasts. It is projected that by the year 2000, the number of households headed by individuals between the ages 35 and 54 will be approximately 50 percent of the 145 million households in the U.S. Currently nearly one half of U.S. households earning $30,000 or more are comprised of boomers and by the year 2000, the 35 - 54 age group will have increased its buying power by 70 percent.

An important aspect of the boomer generation is the renewed interest in marriage and family. As boomers become older and settled, marriage and family life are once again becoming the fashion. A significant trend and one that hoteliers must keep a constant watch on is the need to accommodate boomer family vacations. Since many boomers are having children, a greater portion of their income is being spent on buying a home and raising a family. Vacation trips for boomer families are not the secluded, romantic or exotic vacation to far away destinations, but rather are planned closer to home. Trips now focus on destinations that do not require long travel time and provide family entertainment, such as theme parks.

This is not to say that travel to exotic locations will be a thing of the past, but rather, such locations must offer facilities and amenities that will attract the growing boomer family market. The hoteliers must learn to take advantage of the boomers' orientation to the print media, which, according to American Demographics, boomers are highly susceptible to. Sophisticated promotional material may help to sway the boomer traveler. One must also acknowledge that the harried work schedule of a two-earner boomer household makes it more difficult to plan vacations and therefore, the tendency will be to plan shorter but more frequent vacations. Furthermore, this has created a situation where vacation decisions are more impulsive and spur of the moment, with much less lead time.

Hectic boomer lifestyles, especially for the subgroup known as "yuppies", have grown to include buying quality goods or goods that do not have a reputation for breaking down, simply because yuppies do not have time to take products in for repair and maintenance. Likewise, yuppies look at quality when planning a vacation. Furthermore, yuppies like most boomers are also exhibiting the general trend of settling down and raising a family and are spending less lavishly on themselves and more on their children.

Compared to prior generations, boomers are the most educated generation comprising approximately 50 percent of all college graduates in the country. Accordingly, boomers have a more global view of the world. According to Meetings News, older boomers, those born between 1946 and 1957 (35 - 44 age group), have an "enormous appetite for travel."

Silver Market - Another growing market force will be the silver, or senior market. Although this group (50 years and older) currently comprises roughly a quarter of the total population, they are the most affluent consumer group in the U.S. The silver group no longer has large cash outflows for high ticket items, such as purchasing a home, or putting kids through college. They are now enjoying the benefits of retirement or near retirement and can now pamper and spend more money on themselves. By the year 2000, this group will control over 40 percent of the nation's discretionary income and is anticipated to be in the best financial shape of any age group.

Looking towards the future, the growth of the senior market becomes even more significant, especially as boomers reach retirement age. In addition, the average life expectancy may be increasing from today's 75 to a high of 80 years within a decade. As boomers begin retiring with their affluent status and earlier travel experiences, the silver market will gradually become one comprising of more discriminating travelers, with more time and money to travel.

Hoteliers must start planning for the growth in the silver market. Unlike the baby boomer family travel market with an emphasis on activities, the older traveler prefers to travel to increase their knowledge. The emphasis will be away from physical activities to more cultural activities such as visiting historical destinations like Europe. The senior market must not be viewed as a group of people who are incapable of performing any type of physical activity, but rather the type of activity must be geared to the physical limitation of older people. The senior market, in general, is a healthier, more active group compared to seniors of earlier years.

Meetings Market Trends

To be successful and remain competitive, Hawaii's luxury hotels will need to attract a greater share of the lucrative U.S. corporate and incentive markets. As reported

in the Meeting News, expectations are high for significant growth in this market due to changes in corporate structures (downsizing and decentralizing) and the career-switching nature of the baby boom generation. Both trends will increase the need for meetings to train executives.

The future requirement of the meeting planners will parallel the needs of the evolving affluent travel market. Meeting News predicts that:

> ". . . quality, variety and excitement reign supreme. Attendees, raised on MTV, VCRs, movies, television and computers, will demand stimulating audio-visual programming and clamor to actively participate in the learning process. They won't waste their time on meetings without substance. Recreational programming will also be affected by the well-educated and worldly attendee's need for constant stimulation and new experiences. Simple attractions and basic food functions won't do. There has to be an opportunity for attendees to participate in the action, feel the flavor of the place. As attendees get more demanding, service may soon take a precedence over price."

Since the coming of age, more and more boomers are converting their resort meeting into family vacations. However, these travelers do not expect to be constantly baby-sitting their children, but rather they expect the hotel to offer childrens' programs and activities.

Incentive Groups - A relatively recent market development has been the emergence of the incentive group segment. It most commonly is comprised of award winning recipients of structured competitions among company personnel to strive for higher productivity and sales quotas. These visitors are highly sought after since they generally frequent luxury lodging properties and have, as part of prepaid packages, substantial food, beverage, entertainment and recreational expenditures.

Hawaii's primary U.S. competitors in this market segment are Florida, California, Nevada and Arizona. International competitors include Mexico, the Bahamas and the Caribbean.

Baby boomer incentive travelers, according to Meeting News, indicated that resorts were the most popular incentive choice. Getting away from a hectic, fast-paced work schedule makes destinations offering sun and warm weather fun attractive get-away spots. Water sport activities, especially high status activities, such as sailing and windsurfing are now the rage amongst the baby boomer incentive travel group.

Baby boomer incentive travelers are status conscious and place a greater emphasis on going to the right place at the right time. It is difficult, however, to determine where the right place is at any given time. An important media in helping to establish the right place is printed promotional material because boomers, as mentioned earlier, are highly susceptible to the print media. Marketing to the baby boomers should also emphasize novelty, style, well known brand names and health. Status conscious boomers prefer name brands with established reputations, and resort facilities that offer health activities such as health spas, golf and tennis.

SECTION VII

HISTORICAL AND PROJECTED PERFORMANCE OF THE LUXURY VISITOR MARKET IN THE STATE OF HAWAII

HISTORICAL AND PROJECTED PERFORMANCE OF THE LUXURY VISITOR MARKET IN THE STATE OF HAWAII

INTRODUCTION

Because of the rising affluence of the visitor market to Hawaii, the demand for luxury accommodations increased at a fairly strong pace during the latter part of the 1980s. In response to this demand, resort developers have been building luxury properties at a correspondingly fast rate. This section analyzes the supply of luxury properties and its growth in demand historically and in the near future.

SUMMARY HIGHLIGHTS AND CONCLUSIONS

With the introduction of 4,650 new primary and secondary luxury rooms to the competitive luxury market over the next four years, the overall luxury market occupancies are expected to show minimal growth through 1996, followed by a stronger recovery period in which occupancies will steadily rise to 72 percent by the year 2000. It is important to note, however, that these are averages. Many hotels, especially the stabilized properties, will perform above the average while newer and less competitive properties will perform below.

THE SUPPLY OF LUXURY FACILITIES

In the distant past, such hotels as the Royal Hawaiian in Waikiki were considered to be luxury hotels, but these have been surpassed by hotels offering more extensive services, amenities and seclusion. During the recent past, the luxury market has been dominated by three hotels: the Kahala Hilton on Oahu, the Hotel Hana Maui on the Valley Isle, and the Mauna Kea Beach Hotel on the Island of Hawaii. Some of these hotels have added rooms over the years but their stature has remained relatively intact. In 1964, Kahala Hilton began operations and the

following year the Mauna Kea Beach Hotel opened its initial 154 rooms to guests. It was during that time that Hotel Hana Maui, long the favorite of many vacationing elite, experienced its first major competition. Some of the later entries to the primary luxury market were the 194-room Kapalua Bay Hotel which opened in 1978, the 351-room Mauna Lani Bay Hotel which opened in 1983, the 456-room Halekulani Hotel which opened in 1983, and most recently, the 380-room Four Seasons Wailea which opened in 1990.

Over the years, hotels have become increasingly segmented resulting in subclassifications of hotel categories. Within the Hawaii luxury market, two major segments have evolved and are typically referred to as primary and secondary luxury class hotels. All of the properties described in the preceding paragraph are judged to be primary luxury hotels, while properties such as the Hyatts and Westins fall within the secondary luxury classification. Although factors distinguishing a primary from a secondary luxury hotel are not clearly defined, primary luxury hotels generally offer a higher level of service, fewer, but larger rooms and provide an atmosphere of tasteful elegance. Secondary luxury properties tend to be larger with higher densities and "flashier" facilities.

There are currently 16 primary and 8 secondary luxury hotels that represent the luxury competition in the State. These properties are competitive based on their location within resort areas of Hawaii, reputation, rate structures and facilities offered. A brief description of each hotel is presented in Table VII-1.

Additions to Supply

The trend in hotel development from 1990 through 1995, which has and will affect each of the major islands in the State, is heavily oriented towards luxury accommodations.

TABLE VII-1

INVENTORY OF LUXURY HOTELS
STATE OF HAWAII

	YEAR OPENED	TOTAL ROOMS AVAIL.	MEAL PLANS	SINGLE	DOUBLE	SUITE	ADDITIONAL PERSON	PRINCIPAL AMENITIES	CONDITION OF BEACH	LARGEST BANQUET ROOM CAPACITY	MIX OF BUSINESS (FIT/GROUP)	SIZE OF STANDARD GUEST ROOM (SQ. FT.)	OCEAN VIEW ROOMS (NUMBER/PCT.)
PRIMARY LUXURY													
FOUR SEASONS WAILEA	1990	380	EP	$300-$500	$300-$500	$700-$5000	$50	B,P,G,T	VERY GOOD	480	55/45	600	375/99
HALEKULANI	1983	456	EP	$270-$380	$270-$380	$475-$2400	$45	B,P	EXCELLENT	380	80/20	540	375/75
HOTEL HANA MAUI	1948	97	AP	$295-$395	$295-$395	$495-$775	$140	B,P,G,T	GOOD	N/A	100/0	N/A	N/A
KAHALA HILTON	1964	369	EP	$210-$520	$210-$520	$625-$2400	$35	B,P	VERY GOOD	240	90/10	637	133/43
KAPALUA BAY	1978	194	EP	$215-$400	$215-$400	$500-$1750	$35	B,P,G,T	GOOD	250	81/19	529	175/89
KOELE LODGE	1990	102	MAP	$275-$350	$275-$350	$700-$900	$30	P,G,T	NONE	90	100/0	N/A	N/A
KONA VILLAGE RESORT	1962	125	AP	$375-$490	$375-$490	$490-$615	$115	B,P,T	GOOD	150	100/0	600	117/65
MANELE BAY	1991	250	MAP	$295-$445	$295-$445	$500+	$30	B,P,G,T	EXCELLENT	300	100/0	700	187/75
MAUI PRINCE	1986	310	EP	$190-$330	$190-$330	$400-$800	$50	B,P,G,T	GOOD	76	90/10	433	248/81
MAUNA KEA BEACH	1965	310	EP,MAP	$230-$350	$230-$350	$610-$820	$25	B,P,G,T	EXCELLENT	150	70/30	550	280/67
MAUNA LANI BAY	1983	351	MAP	$260-$395	$260-$395	$475-$2500	$50	B,P,G,T	VERY GOOD	450	80/20	550	323/92
RITZ-CARLTON MAUNA LANI	1990	550	EP	$250-$425	$250-$425	$500-$2500	$35	B,P,G,T	GOOD	1000	55/45	575	N/A
ROYAL HAWAIIAN	1927	526	EP	$195-$280	$195-$280	$300-$1650	$25	B,P	EXCELLENT	480	65/35	575	343/58
SHERATON MOANA (1)	1901	376	EP	$185-$285	$185-$285	$300-$500	$25	B,P	EXCELLENT	220	N/A	N/A	282/75
SHERATON PRINCEVILLE (2)	1986	252	EP	$240-$375	$240-$375	$450-$750	$25	B,P,G,T	FAIR	650	65/35	477	270/80
STOUFFER WAILEA	1978	348	EP	$210-$380	$210-$380	$330-$1300	$35	B,P,G,T	VERY GOOD	340	60/40	500	246/76
TOTAL PRIMARY		4,996											
SECONDARY LUXURY													
GRAND HYATT WAILEA	1991	787	EP	$250-$500	$250-$500	$700+	$25	B,P,G,T	VERY GOOD	2400	50/50	650	787/100
HYATT REGENCY KAUAI	1990	605	EP	$175-$390	$175-$390	$425-$1800	$25	B,P,G,T	GOOD	1875	50/50	405	454/75
HYATT REGENCY MAUI	1980	815	EP	$220-$390	$220-$390	$550-$2500	$25	B,P,G,T	VERY GOOD	1400	60/40	437	563/69
HYATT REGENCY WAIKIKI	1976	1,234	EP	$170-$345	$170-$345	$475-$2500	$25	B,P	VERY GOOD	1250	68/32	432	827/67
HYATT REGENCY WAIKOLOA	1988	1,241	EP	$215-$380	$215-$380	$550-$2700	$25	B,P,G,T	FAIR	2800	60/40	485	680/50
STOUFFER WAIOHAI	1981	434	EP	$195-$340	$195-$340	$445-$1400	$30	B,P,T	GOOD	600	60/40	365	325/75
WESTIN KAUAI	1987	847	EP	$195-$395	$195-$395	$400-$1700	$25	B,P,G,T	GOOD	1450	55/45	360	465/55
WESTIN MAUI	1987	762	EP	$195-$395	$195-$395	$500-$1900	$25	B,P,G,T	VERY GOOD	862	70/30	442	570/50
SECONDARY TOTAL		6,725											
GRAND TOTAL		11,721											

LEGEND: MEAL PLANS
AP - AMERICAN PLAN
MAP - MODIFIED AMERICAN PLAN
EP - EUROPEAN PLAN

AMENITIES
B - BEACH
P - POOL
G - GOLF
T - TENNIS

NOTES: (1) 1989 REOPENED AFTER MAJOR RENOVATIONS
(2) 1991 REOPENED AFTER MAJOR RENOVATION

SOURCE: [illegible]

In 1990, three primary and one secondary luxury hotels added 1,635 rooms to the luxury market inventory. During the first ten months of 1991, two primary and one secondary luxury hotels, (including the Princeville Hotel with 252 rooms which just re-opened after major renovations) totaling 1,303 rooms, were added to the luxury market inventory. Therefore, the luxury market inventory increased by 2,938 rooms in 1990 and 1991.

Hotels currently under construction or proposed for development include those with affiliations with hotel management companies not presently represented in Hawaii. New names associated with luxury properties nationally and internationally that will soon be represented in Hawaii include Princess Hotels and Regent International Hotels. Hyatt Hotels, which has been extremely successful in penetrating the Hawaii market is continuing to expand its presence in the State with the recently opened Hyatt Regency Kauai (605 rooms) and the Grand Hyatt Wailea (801 rooms).

Another trend in hotel development has been the creation of resort destinations that encompass several hotels. In addition to their individual marketing plans, these hotels pool their resources to market the entire resort as a single destination. In some cases, such as the well known Kaanapali Beach Resort, facilities are available to all resort guests including golf and a centrally located retail center. Other resorts that are in the process of expansion or development are the Wailea Resort on Maui, Mauna Lani and Waikoloa Resorts on the Island of Hawaii, Lodge at Koele and Manele Bay Resort on Lanai, Kauai Lagoons, and Ko Olina Resort currently under construction on Oahu. Other major resort destinations proposed for development include Kukio Beach, South Kohala, Kaupulehu and Kohanaiki Resorts on the Island of Hawaii; Kaanapali North Beach on Maui and Kawela Bay on Oahu. All of these resorts will offer beach front luxury accommodations and facilities as well as access to a variety of recreational amenities.

Many of the new hotels will be implementing marketing plans with a greater emphasis on group markets, particularly the incentive and corporate markets. These markets have proved to be quite lucrative, especially the incentive group market. Further, these markets frequently provide room night demand during the "off-seasons" helping to boost occupancies during those periods. To attract group business, hotels currently under construction have incorporated extensive meeting facilities into their design including ballrooms, breakout rooms, and pre-function areas.

Table VII-2 lists future additions to the luxury market which are either currently under construction or have the most likelihood for development. All estimated completion dates are based on the best information available as of the date of this report. All hotels slated for development are scheduled for completion by the end of 1995. Development plans for luxury hotels beyond 1995 are indefinite at this time and will probably be nominal as the market attempts to absorb the additional inventory.

HISTORICAL ROOM OCCUPANCIES

During the second half of the 1970s, luxury hotels in Hawaii enjoyed healthy occupancies in the mid-80 percentage range. With the advent of the recession in the United States in the early 1980s, however, occupancies began to decline, as illustrated in Table VII-3 reaching a low of 70.9 percent in 1982. In spite of the recovery of the U.S. economy beginning in 1982, the luxury market has not been able to achieve pre-recession occupancies. Another setback occurred in 1985 when employees of United Airlines, then the largest airlines serving Hawaii, went on strike during the high summer visitor season. Fortunately, the Hawaii visitor market, including the luxury market, was able to recover from the 1985 strike the following year. Helping that recovery was the diversion of Europe-bound travelers

TABLE VII-2

ADDITIONS TO THE LUXURY MARKET INVENTORY
STATE OF HAWAII

PROPERTY	LOCATION	LUXURY TYPE	NUMBER OF ROOMS	ESTIMATED DATE OF COMPLETION
Hapuna Beach Prince	Hawaii	P	350	1993
Ritz-Carlton Kapalua	Maui	P	550	1993
Hotel Ihilani	Oahu	P	394	1993
Regent at Kohanaiki	Hawaii	P	100	1994
Four Seasons Kaupulehu	Hawaii	P	350	1994
Four Seasons Ko Olina	Oahu	P	335	1994
Kawela Bay Hotel - II	Oahu	P	383	1994
Kohanaiki Resort	Hawaii	S	788	1995
Kauai Lagoons #2	Kauai	S	750	1995
Kawela Bay Hotel - I	Oahu	S	650	1995
TOTAL:			4,650	

YEAR	1993	1994	1995
TOTAL:	1,294	1,168	2,188

NOTE: P - Primary luxury
S - Secondary Luxury

SOURCE: Hawaii Visitors Bureau and Pannell Kerr Forster

TABLE VII-3

HISTORICAL ANALYSIS OF THE LUXURY HOTEL MARKET IN HAWAII

	NUMBER OF HOTELS			OCCUPANCY			AVERAGE ROOM RATE			ESTIMATED LUXURY VISITORS			
YEAR	PRIMARY LUXURY	SECONDARY LUXURY	TOTAL LUXURY	PRIMARY LUXURY	SECONDARY LUXURY	TOTAL LUXURY	PRIMARY LUXURY	SECONDARY LUXURY	TOTAL LUXURY	PRIMARY LUXURY	SECONDARY LUXURY	TOTAL LUXURY	PERCENT OF TOTAL STATE VISITORS
1980	8	2	10	74.33%	73.08%	73.50%	$102.79	$66.45	$78.84	240,000	221,000	461,000	11.72%
1981	8	3	11	76.22%	71.21%	72.46%	$130.69	$81.11	$94.12	302,000	316,000	638,000	16.71%
1982	8	3	11	71.35%	70.83%	70.95%	$150.67	$89.45	$103.44	259,000	318,000	577,000	13.61%
1983	10	3	13	68.24%	73.22%	72.06%	$162.90	$95.98	$110.75	370,000	338,000	708,000	16.71%
1984	10	3	13	62.01%	84.82%	76.43%	$157.62	$98.18	$115.91	345,000	375,000	720,000	14.85%
1985	10	3	13	68.00%	80.69%	75.20%	$161.10	$121.02	$136.71	387,000	383,000	770,000	15.74%
1986	12	3	15	78.08%	85.39%	81.35%	$162.37	$141.16	$152.42	557,000	426,000	983,000	17.53%
1987	12	5	17	72.08%	67.37%	69.25%	$184.96	$146.63	$162.57	476,000	499,000	975,000	16.81%
1988	12	6	18	67.46%	74.18%	72.10%	$195.99	$148.03	$161.92	445,000	709,000	1,154,000	18.79%
1989	12	6	18	67.38%	76.16%	72.86%	$214.12	$177.68	$190.38	475,000	769,000	1,244,000	18.71%
1990	15	7	22	67.41%	74.35%	71.74%	$229.96	$193.11	$206.11	597,000	872,000	1,419,000	20.36%
1991	16	8	24	62.12%	61.21%	61.61%	$229.57	$163.55	$199.78	579,000	729,000	1,308,000	20.04%

SOURCE: PANNELL KERR FORSTER

to Hawaii as the result of increased terroristic activity and retaliatory actions against American citizens in Europe and the Middle East.

The increase in the number of hotel rooms and the relatively low increases in the westbound visitor market are additional reasons why the overall luxury market occupancies have not been able to reach pre-recession levels. The westbound market comprises the major market for luxury properties and is the largest visitor group to the neighbor islands. Annual growth in the westbound market, for the period shown on Table V-14, has been largely reflective of economic conditions and events occurring in the U.S. and Hawaii. Although occupancies are still relatively healthy, the growth in visitors has not kept pace with the steady growth in the supply of rooms.

The composite occupancy for the total luxury market, fluctuated in the low to mid-70 percentage range during the first half of the 1980's and peaked at 81.4 percent in 1986. With the opening of the Westin Maui and Westin Kauai in 1987, a total of 1,609 rooms were added to the room supply and caused occupancy to drop to a 1980's low of 69.3 percent. From 1988 through 1990, occupancies rebounded to approximately 72 percent. It should be noted, however, that these statistics do not reflect the performance of the properties open less than one year, such as the Four Seasons Wailea Resort, Hyatt Regency Kauai, Lodge at Koele, and the Ritz-Carlton Mauna Lani, which all opened in 1990.

In 1991, occupancy for the luxury market dropped over 10 percentage points from 1990 to 61.6 percent, representing a 14.1 percent decline. The effects of the Persian Gulf War, national recession, economic tightening in Japan and glut of luxury hotel rooms all contributed to this decline. The opening of the 787 room Grand Hyatt Wailea in 1991, further added to the excess supply over demand situation in Hawaii's luxury hotel market.

HISTORICAL AVERAGE ROOM RATES

As shown previously in Table VII-3 in 1980 the average room rate for the composite luxury market was $79 compared to $103 for the primary luxury market. In 1990, room rates increased to an average of $206 and $230 for the total luxury and primary markets, respectively. Over the ten years, 1981-1990, room rates increased at an annual average of 10.1 percent for the composite market, 8.4 percent for the primary market and 11.3 percent for the secondary luxury market. Although the primary luxury ADR remained stable at $230 in 1991, the secondary luxury ADR dropped $29.56 from 1990 to $164. The composite ADR for 1991, consequently declined to $200. During the last five years (1987-1991), rate increases reflected an average annual compounded growth of 4.4 percent for the primary market, 2.2 percent for the secondary market and 4.2 percent for the composite market.

HAWAII OUTLOOK

A significant number of new luxury hotel projects point toward an increase in luxury visitors to Hawaii. In 1990, the State of Hawaii received approximately 6.8 million visitors, of which 20 percent were estimated to be luxury visitors. In spite of the factors suggesting positive trends for the travel industry, if all currently proposed luxury class hotels are built, the addition of future inventory may exceed future demand for luxury accommodations for the next decade. Although industry officials anticipate visitors to Hawaii will continue to increase, the limiting factor will not be the number of hotel accommodations, but rather the class of accommodations to be offered. Product differentiation therefore will take on greater significance in light of the increased competitive market in Hawaii and worldwide.

The statistics presented in the remaining sections of this chapter were compiled based on data obtained from PKF's monthly Trends survey. It is difficult to project hotel occupancies by individual markets because the markets are not mutually

exclusive, but rather are interrelated. Further, proposed luxury developments over the next eight years will be a combination of primary and secondary luxury properties.

Estimates of occupancies in the luxury market are derived from an analysis of proposed additions to the competitive supply, natural growth in the luxury visitor FIT and group markets as well as induced demand.

THE LUXURY MARKET

Existing Demand

The 24 properties that currently comprise the competitive luxury market experienced an estimated total demand for accommodations of 2,444,200 room nights during 1991. The existing (demonstrated) demand, segregated by market segment, is presented below.

Market Mix of Hawaii's Luxury Market
1991

Market Segment	Occupied Rooms	Ratio to Total
FIT	1,520,292	62.2%
Group	923,908	37.8
Total	2,444,200	100.0%

Source: Pannell Kerr Forster

Induced Demand

Our analysis of the luxury hotel market indicates there exists potential induced demand in addition to the demonstrated demand discussed above. Induced demand can be defined as demand that could be attracted to the area through the opening of a new property, specifically through the marketing efforts of a hotel operator with strong marketing resources.

The majority of the proposed additions to the luxury inventory are properties that will offer extensive meeting facilities and amenities. As these properties come to fruition, they will be able to induce additional demand to the area, but with diminishing strength as new properties are added to the continuously increasing inventory.

ESTIMATE OF GROWTH IN DEMAND

Table VII-4 summarizes our projections of growth in room demand in the luxury market through 2003. We have considered several factors in our analysis, including trends in historical visitor growth, the state and national economy, related industry growth trends, competitive market historical demand growth, and interviews with the management of competitive hotels, area officials, and demand generators. The chart reflects our estimates of existing demonstrated demand.

TABLE VII-4

PROJECTED LUXURY MARKET ROOM NIGHT DEMAND

	FIT		GROUP		TOTAL	
YEAR	BASE GROWTH RATE	BASE DEMAND	BASE GROWTH RATE	BASE DEMAND	TOTAL GROWTH RATE	BASE DEMAND
1991		1,315,000		798,900		2,113,900
1992	10.0%	1,446,500	10.0%	878,800	10.0%	2,325,300
1993	9.0%	1,576,700	9.0%	957,900	9.0%	2,534,600
1994	8.0%	1,702,800	8.0%	1,034,500	8.0%	2,737,300
1995	6.0%	1,805,000	6.0%	1,096,600	6.0%	2,901,600
1996	5.0%	1,895,300	5.0%	1,151,400	5.0%	3,046,700
1997	5.0%	1,990,100	5.0%	1,209,000	5.0%	3,199,100
1998	4.8%	2,085,600	4.8%	1,267,000	4.8%	3,352,600
1999	4.6%	2,181,500	4.6%	1,325,300	4.6%	3,506,800
2000	4.4%	2,277,500	4.4%	1,383,600	4.4%	3,661,100
2001	4.2%	2,373,200	4.2%	1,441,700	4.2%	3,814,900
2002	4.0%	2,468,100	4.0%	1,499,400	4.0%	3,967,500
2003	3.8%	2,561,900	3.8%	1,556,400	3.8%	4,118,300
AVERAGE:	5.7%		5.7%		5.7%	

NOTE: INDUCED DEMAND FROM NEW ADDITIONS TO SUPPLY IS NOT INCLUDED IN THESE ESTIMATES OF FUTURE LUXURY MARKET ROOMNIGHT DEMAND

SOURCE: PANNELL KERR FORSTER

FIT Demand

Demand from the FIT market remains a major source of demand for hotels in Hawaii. On the basis of our fieldwork and analysis, we estimate that the average compound annual growth rate for the base FIT market demand from 1991 to 2003, will be 5.7 percent. These growth rates will be spurred by the extensive promotional efforts of the Hawaii Visitors Bureau, destination resort marketing associations, and individual properties.

Group Demand

Group demand in the luxury market area is comprised of corporate, association, and incentive group demand. The total compound annual growth in this market is estimated to be 5.7 percent from 1991 to 2003. This growth rate, combined with the the FIT growth rate results in a combined annual base growth rate of 5.7 percent. When we consider induced demand from both segments, the annual growth for total demand in the luxury market increases to 7.5 percent.

In view of our analysis of the group market to Hawaii, historical trends, and anticipated hotel development in Hawaii, we believe that the group market will experience a large amount of growth during the next five- to ten-year period due to the following factors:

- The extensive meeting facilities of the hotels recently opened, under construction and proposed for construction;
- The promotional efforts of the Hawaii Visitors Bureau; and
- The increasing desire of groups to hold meetings in resort settings.

As many of the new resorts are expected to open during the period 1992 to 1996, only minimal growth in occupancies are expected through 1996 as the new supply of hotels offsets demand growth. Thereafter, occupancies should steadily rise as new additions to supply are expected to be minimal and demand begins to absorb the excess rooms inventory. By the year 2000, occupancies should approximate 72 percent. Table VII-5 summarizes the projected occupancy and ADR levels for the luxury market.

Although the luxury market has been experiencing room inflation rates of approximately 10.2 percent during the past ten years, our projected ADR inflation rates are somewhat lower reflecting discounting during years of heavy new additions to supply. We expect average daily rates in the luxury market will increase at approximately the rate of inflation from 1992 through 2003. We have estimated inflation at 5 percent annually for the duration of our projection period.

TABLE VII-5

STATE OF HAWAII TOTAL LUXURY HOTEL MARKET
PROJECTED ROOM OCCUPANCY AND AVERAGE DAILY RATE

	Year	Total Daily Rooms	Total Annual Rooms	Projected Captured Demand	Projected Room Occupancy	Estimated Average Daily Rate
Actual	1991	10,849	3,967,200	2,444,200	61.6%	$200.00
Projected	1992	11,721	4,278,200	2,609,700	61.0%	210.00
	1993	12,585	4,593,500	2,848,000	62.0%	221.00
	1994	13,942	5,088,800	3,200,900	62.9%	232.00
	1995	15,090	5,507,900	3,552,600	64.5%	244.00
	1996	16,371	5,975,400	3,872,100	64.8%	256.00
	1997	16,671	6,084,900	4,125,600	67.8%	269.00
	1998	16,871	6,157,900	4,279,700	69.5%	282.00
	1999	17,171	6,267,400	4,437,300	70.8%	296.00
	2000	17,371	6,340,400	4,590,400	72.4%	311.00
	2001	17,671	6,449,900	4,740,700	73.5%	327.00
	2002	17,871	6,522,900	4,898,700	75.1%	343.00
	2003	18,171	6,632,400	5,047,300	76.1%	360.00

NOTES: Additions to projected supply for 1992 - 1996 are based on hotels recently opened, under construction or planned. Additions to supply after 1996 are based on estimates and market trends.

Source: Pannell Kerr Forster

Table VII-6 presents the projected occupancy and ADR levels for the primary luxury market. The indicated trends generally reflect those of the overall luxury market.

TABLE VII-6

STATE OF HAWAII PRIMARY LUXURY HOTEL MARKET
PROJECTED ROOM OCCUPANCY AND AVERAGE DAILY RATE

	Year	Total Daily Rooms	Total Annual Rooms	Projected Captured Demand	Projected Room Occupancy	Estimated Average Daily Rate
Actual	1991	4,743	1,731,200	1,075,400	62.1%	$230.00
Projected	1992	4,994	1,822,800	1,212,200	66.5%	242.00
	1993	5,858	2,138,200	1,265,800	59.2%	254.00
	1994	7,165	2,615,200	1,501,100	57.4%	267.00
	1995	7,356	2,684,900	1,704,900	63.5%	280.00
	1996	7,356	2,684,900	1,820,400	67.8%	294.00
	1997	7,456	2,721,400	1,885,900	69.3%	309.00
	1998	7,556	2,757,900	1,952,600	70.8%	324.00
	1999	7,656	2,794,400	2,020,400	72.3%	340.00
	2000	7,756	2,830,900	2,086,600	73.7%	357.00
	2001	7,856	2,867,400	2,153,400	75.1%	375.00
	2002	7,956	2,903,900	2,218,600	76.4%	394.00
	2003	8,056	2,940,400	2,284,700	77.7%	416.00

NOTES: Additions to projected supply for 1992 - 1994 are based on hotels recently opened, under construction or planned. Additions to supply after 1994 are based on estimates and market trends.

Source: Pannell Kerr Forster

SECTION VIII

PERFORMANCE ANALYSIS OF THE HOTEL HANA MAUI

PERFORMANCE ANALYSIS OF THE HOTEL HANA MAUI

INTRODUCTION

This section analyzes the current and potential demand for hotel accommodations in the market area, and the assessment of the existing and potential future competitive supply of lodging facilities together with the share of the market that could reasonably be attained by the Hotel Hana Maui with the addition of an 18-hole golf course. This section is organized into three main sections: Competitive Supply Analysis, Demand Analysis, and Market Position of the subject property.

SUMMARY HIGHLIGHTS & CONCLUSIONS

While the Hotel Hana Maui will compete to a certain extent with all luxury hotels throughout Hawaii, the hotel will have a special competitive relationship with the primary luxury properties. Like the Hotel Hana Maui, these properties are high-end luxury properties with well-established reputations. These hotels include the Four Seasons Wailea Resort (380 rooms), Halekulani Hotel (456 rooms), Kahala Hilton Hotel (369 rooms), Kapalua Bay Hotel (194 rooms), Kona Village (125 rooms), Lodge at Koele (102 rooms), Maui Prince Hotel (310 rooms), Mauna Kea Beach Hotel (310 rooms), Mauna Lani Bay Hotel (351 rooms), Ritz-Carlton Mauna Lani (550 rooms), Royal Hawaiian Hotel (526 rooms), Sheraton Moana Hotel (376 rooms), and Stouffer Wailea Beach Resort (348 rooms). Together these thirteen primary luxury hotels total 4,397 rooms, and represent 1,604,905 room nights annually.

There are two additional new primary luxury hotels that opened during 1991, bringing the total primary luxury hotels, excluding the subject hotel, to 15 properties totaling 4,899 rooms. These hotels are the Manele Bay Hotel (250 rooms) and the

Sheraton Princeville Hotel (252 rooms), which reopened after being completely rebuilt. Because these two hotels have yet to operate for a full year, they are not included in our discussions of historical operating statistics for the primary luxury market.

COMPETITIVE SUPPLY ANALYSIS

In 1991 the total primary luxury market achieved an average occupancy of 62.1 percent and an average daily rate of $230. Occupancy at individual properties ranged from 35 percent to 83 percent, while individual property average rates ranged from a low of $126 to a high of $315. These properties were deemed most competitive on the basis of target markets, product positioning, reputation as resort properties, rate structures, number of rooms, and the facilities and amenities offered. The competitive supply of 4,899 rooms represents 1,788,135 annual room nights.

Primary Comparables

Four Seasons Wailea - 380 Rooms: Opened in March 1990, the Four Seasons Wailea is located in the 1,450 acre master-planned resort area of Wailea, Maui. This hotel represents Four Seasons' first resort hotel and its first venture in Hawaii. The guest rooms are luxurious and spacious, averaging 600 square feet per guest room. The hotel offers its guests all of the components expected of a luxury resort, including extensive food and beverage, meeting, and recreational facilities, with an atmosphere of understated elegance and refinement.

Halekulani Hotel - 456 Rooms: One of the original hotels along Waikiki Beach, the Halekulani Hotel was rebuilt from 1981 through mid-1983. Once a 166-room low-rise, the hotel reopened in September 1983 as a 456-room twin-tower high-rise luxury

complex. Its facilities and services make it the Kahala Hilton's primary competitor for the luxury visitor to the Island of Oahu. Hotel facilities include three restaurants, two lounges, 8,400 square feet of meeting and banquet space, eight retail shops, and a swimming pool.

Kahala Hilton Hotel - 369 Rooms: Located three miles east of Waikiki on the sandy shoreline of Maunalua Bay, the 369-room Kahala Hilton offers its guests a secluded, yet convenient location. The hotel opened in 1964 and has since become one of the most exclusive lodging facilities on the Island of Oahu. Its high level of personal service and location outside bustling Waikiki in an exclusive residential neighborhood has earned it the repeat business of dignitaries, celebrities, and the very rich. Facilities include three restaurants, a lounge, 5,500 square feet of meeting and banquet space, seven retail shops, a swimming pool, and a salt water lagoon with dolphins.

Kapalua Bay Hotel - 194 Rooms: The Kapalua Bay Hotel, a 194-room luxury class property that opened in 1978, is located in the Kapalua Resort, a 750-acre master-planned destination resort on the northwestern shore of Maui. Hotel facilities include three restaurants, 8,500 square feet of meeting and banquet space, gift shops, and a swimming pool. Adjacent to the hotel is The Shops, 22,000 square feet of commercial space, and The Bay Club, a 3,000-square foot freestanding restaurant and bar. Hotel guests have preferred access to the resort complex's three 18-hole championship golf courses and 10-court tennis facility.

Kona Village Resort - 125 Rooms: Opened in 1962, Kona Village is a unique resort of 125 thatched bungalows. With no phones, televisions, or radios in the bungalows, the resort was designed to provide a luxurious sanctuary from the stresses of everyday life. Facilities include two restaurants, two lounges, 5,000 square feet of meeting facilities, three lighted tennis courts, numerous ocean activities, a 15-acre petroglyph site, and access to nearby championship golf courses.

Lodge at Koele - 102 Rooms: The Lodge, located in Lanai Highlands near Lanai City opened in April 1990 and marked Rockresorts' re-emergence into the Hawaii market. This exclusive resort combines the warmth and style of an English country manor with the natural beauty of Lanai, in a mountain retreat setting. Facilities include two restaurants, horseback riding, swimming pool, tennis, an 18-hole executive putting golf course and the Greg Norman and Ted Robinson designed Experience at Koele Golf Course. Meeting facilities can accommodate up to 30 persons.

Maui Prince Hotel - 310 Rooms: Opened in August 1986, the V-shaped Maui Prince is the flagship hotel of Makena Resort, an 1,800 acre resort on Maui. Dining facilities include three restaurants, a lounge and poolside snack bar. For recreation, the hotel offers access to the 18-hole Makena Golf Course, six tennis courts, two swimming pools, and a white sand beach. For business group travelers, there is a conference room, multi-purpose pavilion, and an outdoor landscaped garden for larger functions.

Mauna Kea Beach Hotel - 310 Rooms: The 310-room Mauna Kea Beach Hotel opened in 1965, the realization of a dream by its original developer, Laurance S. Rockefeller. It is situated on Kaunaoa Bay at one of the finest beaches in the State of Hawaii. The hotel has since become one of Hawaii's premier resort hotels. Facilities include four restaurants, 3,000 square feet of meeting space, gift shops, an 18-hole championship golf course and thirteen oceanside Plexipave tennis courts. The resort, together with upscale single and multi-family residential units, projects an atmosphere of secluded elegance and is sought after by those wanting to escape for a period of complete privacy.

Mauna Lani Bay Hotel - 351 Rooms: The Mauna Lani Bay Hotel commenced operation in 1983 as the first hotel of the master-planned Mauna Lani Resort. The facilities include three restaurants, a lounge, 4,800 square feet of meeting and banquet space, gift shops, fitness center, 10-court Tennis Garden with pro shop, pool snack bar and swimming pool. The hotel also includes five luxurious bungalows, each of which contain two master bedrooms, two master baths with steam baths, a half bath, kitchen, private swimming pool and whirlpool bath and feature 24-hour butler service. The resort complex currently consists of two hotels; two luxury condominiums (the 80-unit Mauna Lani Terrace and the 116-unit Mauna Lani Point); the 36-hole Francis H. I'i Brown Golf Course; a 10-court tennis club with an additional grass court, tournament stadium court, pro shop, fitness center and restaurant; and a beach club and restaurant.

Ritz-Carlton Mauna Lani - 550 Rooms: Located within Mauna Lani Resort, the Ritz-Carlton Mauna Lani opened in December 1990 and is the first of two Hawaii hotels for Ritz-Carlton Hotels. Facilities include five restaurants, a 14,000 square foot ballroom and several smaller conference facilities, an exclusive beach and protected lagoon, outdoor jacuzzi, fitness center, and a tennis center consisting of 15 courts. The hotel guests also have access to all of the resort's facilities, including the 36-hole Francis H. I'i Brown Golf Course.

Royal Hawaiian Hotel - 526 Rooms: The Royal Hawaiian Hotel opened on Waikiki Beach in 1927, making it Hawaii's second oldest hotel. Once "the" luxury property of the Islands, it has since been surpassed by others in terms of facilities, services, and degree of seclusion offered. Still emanating a timeless elegance, it remains the favorite of many longtime visitors to the Islands, and has a high percentage of repeat clientele. The hotel's pink interior and exterior has earned it the nickname

"The Pink Palace". Facilities include three restaurants and lounges, 12,280 square feet of indoor meeting and banquet space, 66,000 square feet of outdoor meeting and banquet space, retail shops, and a swimming pool.

Sheraton Moana Hotel - 376 Rooms: Originally opened in 1901, the Moana is a Waikiki landmark. Recently reopened after a sixteen month $50 million restoration and renovation, the Moana has been returned to its original colonial elegance with all of the modern conveniences. The hotel offers its guests three restaurants and lounges, 24,000 square feet of indoor and outdoor function space, designer boutiques, and a swimming pool.

Stouffer Wailea Beach Resort - 348 Rooms: Opened in 1978, the Stouffer Wailea Beach Resort is located on the southwest shore of Maui. The hotel has four restaurants, a lounge, shopping arcade, large game room, a 1,400 square foot outdoor swimming pool and jacuzzi, and extensive indoor and outdoor meeting and banquet facilities.

ADDITIONS TO SUPPLY

In addition to the existing primary luxury supply, there are a number of lodging facilities recently completed, currently under construction, or proposed for development in the competitive market area. In our supply analysis, we have included only luxury, full-service hotel properties recently completed, under construction, or which have a good probability of being built as outlined below.

Manele Bay Hotel - 250 Rooms: This beachfront luxury hotel operated by Rockresorts opened on May 1, 1991. It is the second luxury hotel on the Island of Lanai.

Princeville Hotel - 252 Rooms: After closing its doors in March 1989 for a $120 million upgrade, the Princeville Hotel, previously known as the Sheraton Mirage Princeville, had its grand opening on September 20, 1991. Interiors were completely redesigned and rebuilt to take advantage of some of the best scenic views on Kauai.

Hotel Ihilani Resort and Spa - 394 Rooms: Located in the master-planned Ko Olina Resort on Oahu, this hotel is owned and will be operated by Pan-Pacific Hoteliers, Inc. a subsidiary of Japan Airlines. Scheduled opening is September 1993.

Hapuna Beach Prince - 350 Rooms: Located on the South Kohala Coast near the existing Mauna Kea Beach Hotel, this hotel is expected to be completed in 1993.

Ritz-Carlton Kapalua - 550 Rooms: Expected to open in 1993, this second Hawaii venture for Ritz-Carlton Hotels is planned at the Kapalua Resort on Maui. The discovery of an ancient Hawaiian burial ground on the site stopped excavation and led to the relocation of the hotel site.

Four Seasons Kaupulehu - 350 Rooms: Scheduled to open in late 1994, this Big Island resort will be Four Seasons' second in the State of Hawaii.

Four Seasons Ko Olina - 335 Rooms: One of seven luxury hotels planned for the Ko Olina Resort on Oahu, the Four Seasons Ko Olina is expected to maintain the same high level of quality and sophistication that Four Seasons Resorts are known for. Completion is tentatively set for 1994.

Kawela Bay Hotel II - 383 Rooms: This will be the first hotel on Kawela Bay which is in Kahuku on the Island of Oahu adjacent to Turtle Bay. Completion is tentatively scheduled for 1994.

Regent at Kohanaiki - 100 Rooms: Originally scheduled to open in 1994, this Big Island hotel marks Regent International Hotel's re-entry in to Hawaii.

New luxury hotels with estimated completion dates in 1995, include the Kohanaiki Resort (788 rooms on Hawaii), Kauai Lagoons #2 (750 rooms on Kauai), and Kawela Bay Hotel-I (650 rooms on Oahu). However, due to the current supply of luxury hotel rooms in Hawaii and the difficulty in obtaining development financing, completion dates are subject to change at any time.

The recently opened luxury hotels have not been included in our analysis of primary competition to the Hotel Hana Maui because these hotels are new and have yet to establish themselves in the market place.

In addition to the listed hotels, there are several other properties in the preliminary stages of planning. The probability is that some of these projects will come to fruition. To account for these tentative projects, we have included several "projected additions" in our supply and demand analysis in addition to the properties previously discussed, with 100 rooms per year for 1997 through 2005.

DEMAND ANALYSIS

Most of the elements of demand generation for luxury and business travel were discussed in previous chapters of this study. To briefly reiterate, the underlying generators of demand for luxury and business travel depict a favorable trend for this market in the future. With the population growing older, having fewer children, and more families with both spouses working, the funds available for luxury travel should continue to increase. Visitors from international markets with substantially appreciated currencies will be a prime market for luxury accommodations. Furthermore, the lucrative meetings and incentive travel market is expected to continue to increase substantially through the 1990s, thus creating additional demand for luxury meeting facilities.

Demonstrated Demand

Demand for hotel guest rooms is categorized as "demonstrated" demand, or that demand which can be quantified by examining occupancies at existing hotels; "unsatisfied" demand, or that demand which is being turned away or denied at existing hotels and finding accommodations outside the primary market area; and "induced" demand, defined as that demand which does not now seek accommodations in the market area, but which could be persuaded to do so through proper sales efforts and the availability of additional rooms supply. Demand for hotel facilities in any given area is measured by occupancy percentage and average daily room rates. These statistics vary among properties due to age, condition, location, marketing efforts and seasonality of the market area. Illustrated on the following page is the demonstrated demand based on 1990 performance of the primary luxury hotels.

Market Mix of Primary Luxury Supply
1991

Market Segment	Occupied Rooms	Ratio to Total
FIT	717,988	78.7%
Group	194,322	21.3
Total	912,310	100.0%

Source: Pannell Kerr Forster

Induced Demand

Induced demand is defined as demand that does not now seek accommodations in the area but could be persuaded to do so through proper sales and marketing efforts and the availability of appropriate facilities. In other words, individuals and groups that otherwise would not have considered visiting Hawaii, may now be potential guests because of the extensive sales, marketing and publicity campaign currently under way and/or the availability of the proposed Hana Ranch Golf Course at the Hotel Hana Maui.

While it is difficult to identify induced demand when evaluating historical demand, Table VIII-1 below illustrates the growth in the supply of and demand for the overall luxury market in Hawaii.

TABLE VIII-1
HAWAII LUXURY MARKET
HISTORICAL GROWTH IN DEMAND
1977 - 1991

YEAR	TOTAL DAILY ROOMS	TOTAL ANNUAL ROOMS	TOTAL PERCENT CHANGE	MARKET OCCUPANCY	CAPTURED DEMAND	PERCENT CHANGE
1977	2,620	956,300	---	85.5%	817,637	---
1978	2,965	1,082,225	13.2%	87.1%	942,726	15.3%
1979	3,153	1,150,845	6.3%	82.7%	951,634	0.9%
1980	4,116	1,501,610	30.5%	73.5%	1,103,683	16.0%
1981	4,540	1,657,100	10.4%	72.5%	1,200,735	8.8%
1982	4,540	1,657,100	0.0%	71.0%	1,175,712	-2.1%
1983	4,891	1,785,215	7.7%	72.1%	1,286,426	9.4%
1984	5,181	1,891,065	5.9%	76.4%	1,445,341	12.4%
1985	5,181	1,891,065	0.0%	75.2%	1,422,081	-1.6%
1986	5,729	2,091,085	10.6%	81.4%	1,701,098	19.6%
1987	7,339	2,678,735	28.1%	69.3%	1,855,026	9.0%
1988	8,613	3,143,745	17.4%	72.1%	2,266,640	22.2%
1989	9,036	3,297,410	4.9%	72.9%	2,402,493	6.0%
1990	9,516	3,473,340	5.3%	71.7%	2,491,776	3.7%
1991	10,869	3,967,185	14.2%	62.5%	2,479,491	-0.5%

SOURCE: PANNELL KERR FORSTER

As shown in the preceding table, the luxury hotel room supply increased in twelve of the past fourteen years. In all twelve of those years, demand also increased, with the percentage increases in demand equal to or exceeding the percentage increases in supply in six out of the twelve years. From 1977 to 1991, supply has increased a total of 315 percent for an average annual increase of 10.70 percent, in comparison to demand which increased a total of 203 percent for an average annual increase of 8.25 percent. Demand has grown substantially during this period despite outside influences disrupting the normal growth process (i.e., the United Airlines' strike and the DC-10 grounding in 1979; the economic recession in 1980 and 1981; Hurricane Iwa in November, 1982; the United Airlines' pilot strike in 1985). A significant portion of this growth was a result of induced demand.

Projected Total Demand

With respect to the projected demand for rooms in the competitive primary luxury market, we have assumed that future additions to the luxury supply will be well sited, have properly planned and well-executed facilities, and have the benefit of good management and marketing expertise. Our analysis of the competitive lodging market indicates that there exists potential induced demand in addition to the demonstrated demand. Induced demand can be particularly significant in the group meetings market.

Table VII-6 shows the projected supply of available rooms, the estimate of captured demand, and the resulting market occupancy for the primary luxury hotel market. The base year room supply includes all of the primary luxury hotels open at the end of 1991. The total number of rooms, however, has been adjusted down from 4,996 to 4,743. This is to allow for two hotels that were only open for a portion of the year.

It is our opinion that the aggregate of additions to supply used in the calculation of the total primary luxury market occupancy presented in that table represents the most probable level of future development. If a greater number of rooms than projected were to be constructed, these additional rooms may have a negative impact on the projected market performance. Conversely, should any of the projected additions be completed later than the date projected in this report, or should some be abandoned, the total competitive market occupancy may be higher.

MARKET POSITION OF THE HOTEL HANA MAUI

Introduction

From its opening in 1948 through the mid-1980's, the Hotel Hana Maui experienced occupancy and average daily rates equal to if not greater than those achieved by the Hawaiian luxury market as a whole. During these years, the Hotel Hana Maui established itself as a premier destination resort for wealthy travelers who wanted a secluded and luxurious resort environment.

The mid-1980's, however, brought the addition of several new luxury hotels which increased the State's inventory of primary luxury hotel units by 45 percent from 2,069 units in 1982 to 3,006 units in 1986. With a full complement of recreational facilities, these new hotels were well-positioned to satisfy the younger, more action-oriented luxury traveler. Of particular importance is the fact that each of these new resorts had either its own golf course, or had preferred privileges at a nearby resort course. Several of these resorts have more than one golf course for its guests' use.

Market Share

In analyzing the Hotel Hana Maui's market position, we calculated the hotel's "market share index", which represents the ratio of market demand that the Hotel

Hana Maui captured as a percentage of its "fair market share". Fair market share assumes that a hotel will receive the same percentage of the competitive demand as is represented by its percentage of available supply in the competitive market. A hotel with competitive advantages will achieve a market penetration in excess of 100 percent of fair share, while competitive weaknesses will be reflected in penetrations of less than 100 percent of fair share.

Prior to 1986, the Hotel Hana Maui consistently garnered more than its fair share of room night demand, achieving market penetration rates well over 100 percent. The significant additions to supply in the mid-1980's, however, resulted in decreased occupancy rates for both the primary luxury market as a whole and the Hotel Hana Maui individually. While subsequent years saw a rebound for the luxury market to pre-1984 occupancy levels, the hotel never fully regained its market share. In fact, since 1986, the hotel's market penetration has dropped below the 100 percent, fair share mark. In 1991, the hotel captured only 74 percent of its fair share of the available room night demand in the primary luxury market.

These marginal penetration rates correspond to occupancy rates five to twenty percentage points below the primary luxury market average. The Hotel Hana Maui is now experiencing its lowest occupancy rates in over twenty years because of its inability to compete with other luxury resorts due primarily to its lack of significant recreational facilities, meeting space and limited number of rooms.

The following table summarizes the historical occupancy and average daily room rates for the Hotel Hana Maui and the primary luxury market since 1977.

TABLE VIII-2

HISTORICAL OCCUPANCY AND AVERAGE DAILY RATES
FOR THE HOTEL HANA MAUI AND THE PRIMARY LUXURY MARKET

YEAR	NUMBER OF HOTELS	OCCUPANCY LUXURY MARKET	AVERAGE RATE LUXURY MARKET	OCCUPANCY HOTEL HANA	AVERAGE RATE HOTEL HANA
1977	6	87.0%	$74.90	87.0%	$68.50
1978	8	89.3%	$83.70	89.3%	$73.70
1979	8	82.8%	$99.30	82.8%	$82.40
1980	8	74.3%	$102.80	80.4%	$85.50
1981	8	76.2%	$130.70	78.7%	$91.30
1982	8	71.4%	$150.70	76.5%	$102.30
1983	10	68.2%	$162.90	65.7%	$107.70
1984	10	62.0%	$157.60	58.3%	$116.60
1985	10	68.0%	$161.10	56.5%	$108.30
1986	12	78.1%	$162.40	68.5%	$167.70
1987	12	72.1%	$184.90	70.3%	$202.60
1988	12	67.5%	$196.00	62.4%	$255.40
1989	12	67.4%	$214.10	54.3%	$258.40
1990	15	67.4%	$229.90	43.8%	$253.50
1991	16	62.1%	$229.60	46.0%	$254.00

NOTE: AVERAGE RATES ROUNDED TO THE NEAREST $0.10.

SOURCE: PANNELL KERR FORSTER

In 1991, the primary luxury market experienced an occupancy rate of 62.1 percent with individual properties achieving occupancies between 35 and 83 percent. In comparison, the hotel achieved only a 46 percent occupancy rate in 1991. The addition of a golf course will help the hotel offer a significantly more competitive product which will generate new room night demand.

Because of the hotel's relative seclusion and lower number of available rooms compared to competitive hotels, we feel that a 75 percent stabilized occupancy is appropriate for the Hotel Hana Maui as a golf resort. Although several of the luxury hotels that possess their own golf courses perform at higher occupancies, these properties have a comparatively higher number of available rooms or are in a resort destination that offers multiple hotel facilities, and consequently enjoy the advantage of a greater critical mass of visitor accommodation and recreation facilities.

Historically, the Hotel Hana Maui has catered almost exclusively to the FIT market. It is possible the hotel could attract small corporate retreats or incentive groups, however, without plans to add more extensive group and meeting facilities, we expect the market orientation to remain relatively unchanged in the future.

With a projected stabilized occupancy of 75 percent and an anticipated market mix of 98 percent FIT and 2 percent group business, the Hotel Hana Maui is expected to regain and maintain its fair market share of room night demand. Market penetration rates for the Hotel Hana Maui should rise from 74 percent of fair share in 1991 to 91 percent in 1992. As the golf course comes on-line, the hotel is expected to see its competitive advantage reflected in penetration rates over 100 percent. Through the year 2000, the Hotel Hana Maui is expected to capture, at the least, its fair share of room night demand in the primary luxury market, with penetration rates fluctuating between 100 and 105 percent.

Room Revenue Per Available Room (RevPar)

In analyzing historical occupancy and average daily rate (ADR), we have calculated room revenue per available room. Room revenue per available room (ADR times occupancy percentage) illustrates the combined effect of both ADR and occupancy. Presented below on Table VIII-3 are the RevPar comparisons for the years 1987 through 1991. Also presented are the RevPar penetration rates which is one of the most revealing and significant factors in analyzing the hotel's overall performance in comparison to the primary luxury market and the total luxury market.

TABLE VIII-3

HOTEL HANA MAUI

ROOM REVENUE PER AVAILABLE ROOM (REVPAR) COMPARISON

1987-1991

YEAR	HOTEL HANA MAUI REVPAR	PRIMARY LUXURY REVPAR	REVPAR PENETRATION RATE	TOTAL LUXURY REVPAR	REVPAR PENETRATION RATE
1987	$142.89	$133.12	107.33%	$112.33	127.20%
1988	$159.34	$131.44	121.22%	$116.38	136.92%
1989	$140.29	$144.45	97.11%	$138.68	101.16%
1990	$110.97	$156.83	70.76%	$148.43	74.76%
1991	$119.63	$143.32	83.47%	$123.10	97.17%

Due to the hotel's decreasing occupancy rates, which are substantially lower than the primary luxury and total luxury markets, the hotel's RevPar penetration rates have decreased over the past five years. In comparing the penetration to the primary luxury market, Hotel Hana Maui successfully penetrated this market in 1987 and 1988 with rates of 107 and 121 percent, respectively. Since 1988, however, the hotel has not penetrated the market at its fair share with 1991 reflecting a RevPar penetration rate of only 83 percent.

In comparison to the total luxury market, Hotel Hana Maui successfully penetrated the market for the period 1987 through 1989 with penetrations ranging from 127 percent to 101 percent. In 1990 and 1991, however, the hotel decreased its penetration to 75 and 97 percent, respectively. These lower penetration rates signify that the hotel is not successfully penetrating the market when looking at the combined effect of occupancy and ADR. Based on this analysis, since the hotel's ADR has remained consistently above the primary and total luxury market ADR, the hotel will need to increase its occupancy in order to once again fairly penetrate the market.

FIT Demand

With such a pronounced orientation to the FIT market, the Hotel Hana Maui should naturally penetrate this demand segment to a greater degree than the group demand segment which represents only 2 percent of the hotel's market mix. The FIT visitor is highly sought after by all luxury properties as this traveler normally pays near rack rates, contributes socially towards the property's appearance of being exclusive, and tends to be a repeat visitor. The most effective promotion for these visitors are word-of-mouth referrals, personal selling campaigns directed at travel agents with this class of clientele and advertising campaigns by way of media and direct mailings targeted at such consumers.

Over the course of our projection period, the Hotel Hana Maui's penetration rate in the FIT market should increase from 95 percent in 1991 to 139 percent in 1998, the first year of stabilized occupancy. On a stabilized basis the hotel is expected to capture more than its fair share of FIT demand. The greater-than-fair-share FIT market penetration rates reflect the fact that the property will have a higher percentage of FIT visitors than the competitive market in which it will be operating (i.e. 98 percent at the Hotel Hana Maui versus 82 percent for the competitive primary luxury market). We feel this is appropriate for the property considering its small size, secluded location, level of service, and recreational facilities.

Group Demand

While many luxury hotels target the group market to help fill rooms and expose the maximum number of guests to the property, the Hotel Hana Maui has catered almost exclusively to the FIT guest since its opening. Group demand currently comprises 2 to 3 percent of the hotel's market mix. The hotel's small number of rooms, limited access and lack of large meeting and banquet facilities obviously dictate this

orientation to the FIT market. We do, however, expect the hotel to continue gathering a small percentage of its room night demand from the group market. Through our projection period, group market penetration should remain relatively stable at approximately 8 percent of fair share.

Total Captured Demand

Based on the preceding discussion and our understanding of the market, we anticipate that the Hotel Hana Maui will achieve a 52 percent occupancy rate in 1992 and gradually increase, with the development of the golf course, to an occupancy rate of 75 percent in 1998. The market mix is assumed to remain relatively stable at 98 percent FIT, 2 percent group business throughout the projection period. Table VIII-4 presents our projections of capturable demand and market performance for the hotel.

Average Daily Rate

The primary luxury market has been selected as the Hotel Hana's competition based on similarities in character as resort properties, rate structure, size, extent of facilities offered, markets served and the level of service provided. Each hotel, however, remains a unique property which appeals to a specific niche within the luxury visitor market. This is reflected by the average room rates of the competitive market, which ranged from $126 to $315 in 1991. The five properties achieving the highest rates had a combined average daily rate of $280 in 1991. Together, the fifteen primary luxury hotels achieved an average daily rate of $230 in 1991. Those properties with a dedicated resort golf course consistently obtained average daily rates at the top end of the range.

TABLE VIII-4

PROJECTED MARKET PERFORMANCE
OF THE 97-ROOM HOTEL HANA MAUI
1992 - 2003

	FIT				GROUP				PROJECTED MARKET PERFORMANCE				
YEAR	COMPETITIVE ROOM NIGHTS	RATIO TO SUPPLY	MARKET SHARE	CAPTURED ROOM NIGHTS	COMPETITIVE ROOM NIGHTS	RATIO TO SUPPLY	MARKET SHARE	CAPTURED ROOM NIGHTS	TOTAL COMPETITIVE ROOM NIGHTS	RATIO TO SUPPLY	TOTAL CAPTURED MARKET SHARE	TOTAL CAPTURED ROOM NIGHTS	PROJECTED OCCUPANCY
1992	833,600	1.9%	114.0%	18,040	228,800	1.9%	9.0%	370	1,062,400	1.9%	91.0%	18,410	52.0%
1993	982,000	1.7%	114.0%	19,080	284,400	1.7%	8.0%	390	1,266,400	1.7%	90.0%	19,470	55.0%
1994	1,132,000	1.4%	131.0%	20,730	369,000	1.4%	8.0%	420	1,501,000	1.4%	101.0%	21,240	60.0%
1995	1,258,900	1.3%	134.0%	21,860	445,200	1.3%	8.0%	450	1,704,100	1.3%	101.0%	22,310	63.0%
1996	1,334,600	1.3%	134.0%	23,250	486,700	1.3%	7.0%	470	1,821,300	1.3%	100.0%	23,720	67.0%
1997	1,386,300	1.3%	137.0%	24,640	500,700	1.3%	8.0%	500	1,887,000	1.3%	102.0%	25,140	71.0%
1998	1,438,400	1.3%	139.0%	26,020	514,800	1.3%	8.0%	530	1,953,200	1.3%	105.0%	26,550	75.0%
1999	1,490,800	1.3%	134.0%	26,020	529,000	1.3%	8.0%	530	2,019,800	1.3%	101.0%	26,550	75.0%
2000	1,543,200	1.3%	135.0%	26,020	543,200	1.3%	8.0%	530	2,086,400	1.3%	102.0%	26,550	75.0%
2001	1,595,400	1.2%	132.0%	26,020	557,400	1.2%	8.0%	530	2,152,800	1.2%	100.0%	26,550	75.0%
2002	1,647,200	1.2%	130.0%	26,020	571,500	1.2%	8.0%	530	2,218,700	1.2%	98.0%	26,550	75.0%
2003	1,698,400	1.2%	127.0%	26,020	585,400	1.2%	8.0%	530	2,283,800	1.2%	97.0%	26,550	75.0%

NOTE: MARKET SHARE IS DEFINED AS THE SHARE OF DEMAND CAPTURED BY THE SUBJECT HOTEL IN RELATION TO ITS SHARE OF THE COMPETITIVE SUPPLY.

SOURCE: PANNELL KERR FORSTER

While average daily rates in the primary luxury market have increased at a compound annual average rate of over 7 percent between 1986 and 1991, increased competition in the luxury market has weakened the supply and demand relationship and the ability for luxury hotels to increase rates year after year. We are consequently projecting annual growth in the Hotel Hana Maui's rate of 5 percent, beginning with an average daily rate of $254 (1991 dollars). However, with the expected opening of the golf course in 1994, a premium 15 percent increase in the average daily room rate has been projected for that one year. Table VIII-5 presents the projected average room rates for the hotel.

TABLE VIII-5

HOTEL HANA MAUI
PROJECTED AVERAGE DAILY ROOM RATES
(1991 - 2003)

YEAR	BASE RATE	ROOM RATE INFLATION FACTOR	ADJUSTED RATE
1991	$254.00		$254.00
1992	$254.00	1.05	266.70
1993	$254.00	1.05	280.00
1994	$254.00	1.15	322.00
1995	$254.00	1.05	338.10
1996	$254.00	1.05	355.00
1997	$254.00	1.05	372.80
1998	$254.00	1.05	391.40
1999	$254.00	1.05	411.00
2000	$254.00	1.05	431.60
2001	$254.00	1.05	453.20
2002	$254.00	1.05	475.90
2003	$254.00	1.05	499.70

SOURCE: PANNELL KERR FORSTER

SECTION IX

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HOTEL HANA MAUI WITH A GOLF COURSE

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HOTEL HANA MAUI WITH A GOLF COURSE

INTRODUCTION

The estimates of future operating results for the Hotel Hana Maui with the proposed Hana Ranch Country Club were derived through evaluation of current and historical operating results of the hotel and comparable resorts in the market area. These results are dependent on the following assumptions:

- 75 percent stabilized occupancy and $254 (1991 dollars) average daily rate with a 5 percent annual inflation, except for a 15 percent room rate premium in 1994 due to the opening of the golf course.
- Sheraton management will continue to apply its management expertise to hotel operations for the duration of the projection period so that departmental and undistributed operating expenses will be reasonable and comparable to competitive hotels and industry standards.
- Revenues from the Hana Ranch Store and Hana Maui Trading Company have not been included in our analysis of hotel performance.
- The golf course is designed by an internationally recognized golf course designer, is well maintained, and suitable for tournament play.
- An extensive marketing campaign will be initiated and maintained to introduce and market the golf course and will include a hotel room and golf package.

The Statement of Estimated Annual Operating Results for the twelve year period 1992-2003 is presented in Tables IX-6, IX-7, and IX-8. As is the case in all estimates of this sort, we are not in a position to guarantee the results, nor is any warranty intended that they can be achieved.

The Uniform System of Accounts for Hotels, recommended by the American Hotel and Motel Association and in general use throughout the industry, has been used in the classification of income and expenses in this report. In conformity with this system of account classification, only direct operating expenses are charged to

operating departments of the hotel. The general overhead items which are applicable to operations as a whole are classified as deductions from income and include administrative and general expenses, management fees, marketing, property operations and maintenance, and energy costs.

We have also referenced Trends in the Hotel Industry - Hawaii (Trends), a database maintained by Pannell Kerr Forster in Honolulu, which is a compilation of annual operating statistics for participating hotels in Hawaii. The data is accumulated by geographic location and hotel size, and provides operating ratios to total revenues, departmental cost ratios to revenues, and dollars per available room. It should be noted that Trends is used only as a reference in consideration of the specific facilities and amenities available at the Hotel Hana Maui.

INFLATION

While we cannot be certain about future inflationary trends for Hawaii, we have estimated inflation to remain relatively stable at 5 percent throughout our projection period.

MANAGEMENT

We assume the Hotel Hana Maui will continue to be operated under a Sheraton management agreement. It is evident that since Sheraton assumed management of the Hotel Hana from the Rosewood Corporation in July 1990, they have already been able to decrease several of the key departmental and undistributed operating expenses. Sheraton's continued success in bringing these operating ratios in line with those at competitive luxury hotels is a critical assumption in our projections. We further assume that the quality of facilities and excellence of service will not diminish over time to any significant degree.

OCCUPANCY RATES

The occupancy rates for the Hotel Hana Maui were estimated in the Performance Analysis Section based on an analysis of historical hotel occupancy trends and our knowledge of existing and proposed competitive resorts in the market area. The market analysis concluded that the hotel, with the addition of the proposed golf course, can be expected to achieve a stabilized occupancy rate of 75 percent. The projected occupancy rates for the years 1992 through 2003, were estimated as follows:

TABLE IX-1
Hotel Hana Maui
Estimated Occupancy Rates
With A Golf Course
1992 - 2003

Year	Occupancy
1992	52%
1993	55%
1994	60%
1995	63%
1996	67%
1997	71%
1998	75%
1999	75%
2000	75%
2001	75%
2002	75%
2003	75%

Source: Pannell Kerr Forster

AVERAGE DAILY ROOM RATES

The average daily room rates for the Hotel Hana Maui were estimated in the Performance Analysis Section based on an analysis of historical rates for the hotel, trends in the primary luxury market, shifts in the demographic profile of visitors to Hawaii, and the expected competitive position of the hotel with the addition of the golf course relative to other luxury resorts.

The average daily room rate for each year of the forecast period is estimated based on the hotel's actual rate attained in 1991 and adjusting it for general inflation, real growth and a premium resulting from the golf course. Reflected in Table IX-2 is an analysis of the historical average daily room rate and occupancy percentages for the primary luxury market and the industry averages reported in Trends for the State of Hawaii. This table shows that the average daily rate for the primary luxury market has increased at an annual rate of 5.6 percent whereas the State of Hawaii has increased at an annual rate of 6.3 percent. The Hotel Hana Maui has increased its rates at an average annual rate of 5.2 percent.

TABLE IX-2
HISTORICAL AVERAGE ROOM RATE AND OCCUPANCY
1987 - 1991

YEAR	HOTEL HANA MAUI ADR	HOTEL HANA MAUI OCCUPANCY	PRIMARY LUXURY MARKET ADR	PRIMARY LUXURY MARKET OCCUPANCY	STATE OF HAWAII ADR	STATE OF HAWAII OCCUPANCY
1987	$207.00	69.1%	$185.00	72.1%	$80.00	81.1%
1988	255.00	61.3%	196.00	67.6%	87.00	78.5%
1989	258.00	54.3%	214.00	67.4%	96.00	78.8%
1990	253.00	43.8%	230.00	67.4%	102.00	78.8%
1991	254.00	46.0%	230.00	62.1%	102.00	72.4%
AVERAGE ANNUAL GROWTH RATE	5.2%		5.59%		6.26%	

SOURCE: PANNELL KERR FORSTER

While these growth rates reflect considerable strength in the underlying market supply and demand relationship, significant additions to supply in the last two years have increased the competition in the primary luxury market and moderated the annual growth in room rates. The additions to supply, combined with rate increases, made an obvious negative impact on occupancy as shown in the above table.

Our projections assume significant increases in occupied room nights and a stable increase in average daily rate with a 5 percent annual inflation factor, except for a 15 percent increase in 1994 to reflect an estimated room rate premium due to the opening of the golf course. Average daily room rates that we project for the hotel are shown on Table IX-3.

TABLE IX-3
HOTEL HANA MAUI
PROJECTED AVERAGE DAILY ROOM RATES
(1991 - 2003)

YEAR	BASE RATE	ROOM RATE INFLATION FACTOR	ADJUSTED RATE
1991	$254.00		$254.00
1992	$254.00	1.05	266.70
1993	$254.00	1.05	280.00
1994	$254.00	1.15	322.00
1995	$254.00	1.05	338.10
1996	$254.00	1.05	355.00
1997	$254.00	1.05	372.80
1998	$254.00	1.05	391.40
1999	$254.00	1.05	411.00
2000	$254.00	1.05	431.60
2001	$254.00	1.05	453.20
2002	$254.00	1.05	475.90
2003	$254.00	1.05	499.70

SOURCE: PANNELL KERR FORSTER

STAFFING ANALYSIS

Industry staffing averages for primary luxury hotels approximate 2.0 employees per occupied room. However, current staffing levels at the hotel, as shown on Table IX-4 indicates 190 full-time employees or 1.96 employees per available room and 4.22 per occupied room based on the average room occupancy in 1991 of 46 percent or 45 rooms per day. Additionally, there are 52 part-time employees which converts to 26 equivalent full-time employees using the formula of two part-time to one full-time employee. Consequently, there are 216 equivalent full-time employees or 2.33 and 4.80 employees per available and occupied rooms, respectively.

This apparent over staffing situation may be caused to a large degree by the small number of rooms in relation to the size of the property and its common areas which require maintenance regardless of the occupancy level. If the above is true, then the industry staffing guide ratio would tend to be less valid.

Nevertheless, it is anticipated that the present staffing level will be more than adequate to service the increased number of guests resulting from the projected increase in room occupancy. An increase in staffing, therefore, does not appear necessary.

TABLE IX-4
HOTEL HANA MAUI
EMPLOYEE COUNT AND DISTRIBUTION
DECEMBER 1991

Department	Number of Full-time Employees	Number of Part-time Employees	Total Number of Employees
Rooms	44	12	56
Food & Beverage	52	31	83
Hana Ranch Restaurant	19	5	24
Guest Activities/Wellness Transportation/Phone	11	4	15
Gift Shop	3	0	3
Hamoa Beach	3	0	3
Accounting/Purchasing	21	0	21
Property Operations & Maintenance	37	0	37
Total	190	52	242

Source: Hotel Hana Maui

ESTIMATED OPERATING RESULTS

Estimates of future operating results were based primarily on an analysis of historical operating results of the Hotel Hana Maui. Since assuming management of the hotel in July of 1990, Sheraton has improved the efficiency of the hotel as reflected by decreases in several departmental and undistributed operating expenses. Consequently, assuming continued Sheraton management, we believe the hotel should be able to achieve considerably better operating statistics as occupancy increases and the operation stabilizes. It is highly unlikely, however, that the hotel will ever achieve operating statistics comparable to its competitors due to the unfavorable relationship of the size of its infrastructure to the small number of guest rooms.

DEPARTMENTAL REVENUES

Rooms

The occupancy and average daily rates previously derived are used to calculate the projected room revenue for each year of our projection.

Food and Beverage

Estimates of food and beverage revenue include revenue from the Hana Ranch Restaurant as well as the Hotel Hana Maui's dining room and lounge. Food and beverage revenues were estimated at $188 and $42 per occupied room, respectively, based on actual performance in 1991.

Telephone

Telephone revenues were estimated at $3 per occupied room per day.

Other Operated Departments

Other operated departments include guest activities and transportation, wellness activities and Hamoa Beach. Revenue from these activities are estimated at $4.50 per occupied room per day.

Rentals and Other Income

Net revenues from rentals and other sources of income were estimated at $15 per occupied room.

DEPARTMENTAL EXPENSES

Rooms Department

The hotel showed a rooms department expense of 43 percent of room revenues in 1991. On a stabilized basis, rooms department expense has been estimated to be approximately 36 percent of rooms department revenue. This figure is considered to be reasonable based on the operating statistics of comparable luxury hotels, which report an average rooms expense of 30.4 percent of room revenues. Furthermore, the 1990 Trends indicates a rooms expense average for the State of 29.4 percent of rooms revenue.

Food and Beverage Department Expense

Hotel Hana Maui finished 1991 with food and beverage expenses totaling 108 percent of food and beverage revenue and has not shown an operating profit for over five years. Hawaii's primary luxury hotels and hotels overall reported average food and beverage expenses of 95 and 90 percent of departmental revenues, respectively. With the projected higher room occupancy, we believe a profitable department is possible and have estimated food and beverage expenses at 97 percent of departmental revenues.

Telephone

Expenses in 1991 approximated 165 percent of telephone revenue. This high expense ratio is due in part to the small number of rooms and low occupancy from which to generate revenue, compared to the fixed costs of the department. Comparable primary luxury resorts and hotels in Hawaii experienced an average telephone department expense of 83.7 and 74.5 percent of telephone revenue, respectively, which is due to these properties in Hawaii having more rooms and higher occupancies. Assuming further operational refinements, combined with the projected higher occupancy, we estimated telephone expense at 100 percent of telephone revenue.

Other Operated Departments

Based on the historical trends of the subject property and comparable hotels, we estimated operated departments expense of 98 percent of department revenue on a stabilized basis.

UNDISTRIBUTED OPERATING EXPENSES

Operating expenses that are not chargeable to a particular operating department are presented as undistributed operating expenses in accordance with the Uniform System of Accounts for Hotels. These expenses were estimated after examination of actual and budgeted operating statistics for the Hotel Hana Maui and comparable luxury hotels. On a stabilized basis, we projected these expenses for the Hotel Hana Maui to approach the averages being achieved by the primary luxury market.

Administrative and General

This category includes expenses such as salaries and wages of the hotel's administrative staff, cash overages and shortages, credit card commissions, bad debt expense, data processing, executive office expenses, liability and general business insurance, professional fees and travel. This expense has historically ranged between 21 and 28 percent of total revenues for the hotel as compared to an average of 7.6 percent for primary luxury and overall Hawaii hotels. We project a progressively decreasing administrative and general expense that stabilizes at 12 percent of total revenue.

Management Fee

The management fee has been projected based on the actual management agreement dated June 26, 1990, with ITT Sheraton Corporation which specifies a basic management fee of $250,000 per full fiscal year for the term of the agreement which began on

July 1, 1990 and ends on December 31, 2010, or until the first full fiscal year in which the hotel achieves positive gross operating profit, at which time the basic fee shall be an amount equal to two percent of total revenue.

For purposes of the management agreement, the basic management fee is not deemed an operating expense and therefore not deductible in computing gross operating profit. It should be noted that although the above is not an exact literal interpretation of the provision in the Agreement, it represents the intent of the Agreement according to a responsible Sheraton executive.

Marketing

In order to achieve the estimated occupancies at the projected room rates, we estimate a marketing expense of 10 percent of total revenue in 1992 and 1993. This expense gradually decreases after the opening of the golf course to stabilize at 8 percent of total revenues in 1998. This compares to 13.5 percent actual expense for the hotel in 1990, 4.0 percent for Hawaii hotels and 5.6 percent for primary luxury hotels. The expense includes advertising, costs associated with sales promotion programs, and the cost for professional sales staff.

Property Operations and Maintenance

For the last two years this expense has been 24.5 percent of total revenues, including energy costs. Primary luxury hotels and hotels in the State, however, show an average property operations and maintenance expense excluding energy costs of 5.2 percent and 4.9 percent of total revenues, respectively. Considering the hotel's extensive grounds, design and construction and assuming further efficiency gains, we have estimated property operations and maintenance expense excluding energy at 15 percent of total revenues on a stabilized basis.

Energy

Energy expense was estimated at 3.0 percent of total revenues on a stabilized basis. This estimate is in line with energy expenses at comparable luxury resorts which average 2.9 percent, and at all hotels in Hawaii which average 2.8 percent.

FIXED CHARGES

As per the Uniform System of Accounts for Hotels, fixed charges include real estate and property taxes, ground rents, incentive management fees, and insurance on building and contents.

Real Estate Taxes

Based on historical tax assessments for the Hotel Hana Maui, we have estimated tax expenses at 0.8 percent of total revenues on a stabilized basis.

Insurance

Building and contents insurance is expected to run 0.7 percent of total revenues on a stabilized basis, which reflects the hotel's historical costs. Comparable luxury resorts report an average insurance expense of 0.8 percent of total revenues.

Incentive Management Fees

Incentive management fees have been projected based on the terms of the management agreement which specifies that commencing with the third full fiscal year and when the hotel achieves positive gross operating profit (GOP), the fee shall be equal to 10 percent of the excess GOP of such year over the preceding year. Commencing with the first full fiscal year thereafter, the fee shall be equal to 10 percent of GOP each year. It should be noted that although the above is not an exact literal interpretation of the provision in the Agreement, it represents the intent of the Agreement according to a responsible Sheraton executive.

Reserve for Replacements

This reserve fund covers the replacement of furniture, fixtures, and equipment. As specified in the management agreement, a reserve for replacement has been estimated based on a percentage of total revenue, beginning July 1990 as shown on Table IX-5.

TABLE IX-5
Reserve for Replacements

Year	Percent
1--3	2
4--6	3
7--8	3
9-11	4
12-13	3
14-16	4
17-18	3
18-Thereafter	4

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS

Table IX-6 shows comparable 1990 operating statistics for all classes of hotels and primary luxury hotels in Hawaii on a composite basis, actual operating statistics for the hotel for 1991, and estimated operating results for the hotel, without and with the proposed Hana Ranch Golf Course, in a stabilized representative year. Our estimates of the annual operating results for the Hotel Hana Maui with the proposed Hana Ranch Golf Course, for the twelve year period 1992-2003, is presented on Table IX-7 See Section XII for estimates of the annual operating results for the hotel without the proposed golf course.

TABLE IX-6

HAWAII HOTELS
COMPARABLE ANNUAL OPERATING RESULTS
RATIO TO REVENUE

	HAWAII TRENDS 1990	PRIMARY LUXURY 1990	HOTEL HANA MAUI 1991		HOTEL HANA MAUI PROJECTED IN STABILIZED YEAR WITH GOLF COURSE	HOTEL HANA MAUI PROJECTED IN STABILIZED YEAR WITHOUT GOLF COURSE
REVENUES						
ROOMS	64.73%	59.30%	50.52%		52.40%	50.10%
FOOD	21.42%	21.80%	37.43%		35.40%	37.10%
BEVERAGE	4.67%	8.00%	8.26%		7.90%	8.30%
TELEPHONE	1.11%	1.50%	-	(A)	0.60%	0.60%
OTHER OPERATED	3.03%	4.70%	1.73%		0.80%	0.90%
RENTALS AND OTHER	5.00%	4.70%	2.06%		2.80%	3.00%
TOTAL REVENUE	100.00%	100.00%	100.00%		100.00%	100.00%
DEPARTMENTAL EXPENSES						
ROOMS	29.38%	30.40%	42.73%		36.00%	38.00%
FOOD AND BEVERAGE	89.94%	95.40%	107.69%		97.00%	100.00%
TELEPHONE	74.47%	83.70%	-	(A)	120.00%	130.00%
OTHER OPERATED	57.21%	94.40%	322.86%		98.00%	100.00%
TOTAL DEPARTMENTAL EXPENSES	45.06%	52.20%	78.99%		62.40%	66.10%
TOTAL OPERATING PROFIT	54.94%	47.80%	21.01%		37.60%	33.90%
UNDISTRIBUTED OPERATING EXPENSES						
ADMIN AND GENERAL	7.61%	7.60%	17.12%		12.00%	14.00%
TOTAL MANAGEMENT FEE	4.32%	1.80%	3.05%		1.30%	1.80%
MARKETING	4.90%	5.60%	10.77%		8.00%	8.00%
PROPERTY OPERATION & MAINT	4.89%	5.20%	24.52%		15.00%	18.00%
ENERGY	2.84%	2.90%	-	(B)	3.00%	3.00%
OTHER	0.36%	0.80%	-		-	-
TOTAL UNDISTRIBUTED EXPENSES	24.92%	23.90%	55.46%		39.30%	44.80%
INCOME BEFORE FIXED CHARGES	30.02%	23.90%	-34.45%		-1.70%	-10.90%
FIXED CHARGES						
PROPERTY TAXES	2.36%	1.70%	-	(C)	1.10%	1.50%
INSURANCE ON BUILDING	0.21%	0.80%	-	(C)	0.80%	1.00%
RENT	2.84%	1.30%	-		-	-
TOTAL FIXED CHARGES	5.41%	3.80%	-		1.90%	2.50%
INCOME BEFORE RESERVE	24.61%	20.10%	ERR		-3.60%	-13.40%

SOURCE: PANNELL KERR FORSTER

NOTE (A): Telephone income and pense combined with other operated department.
(B): Energy expense combin with property operation and maintenance expense.
(C): Sheraton's internal fancial statements did not disclose fixed charges.

TABLE IX-7

HOTEL HANA MAUI
HANA, MAUI, HAWAII
STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS WITH GOLF COURSE
STATED IN INFLATED DOLLARS; 97 AVAILABLE ROOMS

	1992 (4)			1993			1994			1995			1996			1997		
	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM
OCCUPANCY LEVEL / AVERAGE DAILY ROOM RATE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OPERATING DEPARTMENTS REVENUE:																		
Rooms	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Food	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Beverage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Telephone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other Operated Departments	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rentals and Other Income	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Operating Departments	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DEPARTMENTAL EXPENSES (1)																		
Rooms	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Food and Beverage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Telephone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other Operated Departments	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Departmental Expenses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL OPERATING PROFIT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UNDISTRIBUTED OPERATING EXPENSES																		
Administrative and general	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Management Fees	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Marketing	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Energy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Property Operation and Maintenance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Undistributed Operating Expenses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INCOME BEFORE FIXED CHARGES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FIXED CHARGES (2)																		
Incentive Management Fees	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Insurance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Fixed Charges	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INCOME BEFORE RESERVE (3)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RESERVE FOR REPLACEMENT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INCOME AFTER RESERVE BUT BEFORE OTHER CHARGES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Notes: (1) Each departmental expense ratio is based on the department's estimated revenue.
(2) Fixed charges do not include interest expense, depreciation, amortization, or income taxes.
(3) Income before reserve for replacement, interest, depreciation, amortization and income tax.
(4) 12 months in operation the opening year.

TABLE IX-7
(Continued)

IX-15

SECTION X

ESTIMATED ADDITIONAL TAX REVENUES
TO THE COUNTY OF MAUI

ESTIMATED ADDITIONAL TAX REVENUES TO THE COUNTY OF MAUI

INTRODUCTION

The increased activity resulting from development of the proposed golf course in Hana will also benefit Maui County and ultimately the Hana district through additional tax revenues. This section analyzes the source of these additional tax revenues. While additional tax sources can be far reaching given the economic multiplier effects of additional payroll, etc. to the area, this analysis will examine primary additional tax revenue only. Furthermore, the potential tax implication resulting from the shift of business from other Maui resorts to Hotel Hana Maui, has not been deducted in the computation of additional tax revenue since there is no basis upon which to make a reasonable estimate and the amount of any shift in business should be immaterial. Based on our review of the proposed Hana Ranch Country Club concept, additional tax revenue will arise from the following major sources:

- Individual state income tax
- General excise tax
- Real property tax
- Transient accommodations tax

State corporate income tax was not included in the analysis due to the hotel's anticipated loss position projected in Section IX. Tax revenues raised through the general excise tax and income tax are collected at the State level and reallocated back to the counties during the annual legislative session based on submitted county budgets. Real property taxes are collected at the county level and are available to support public county expenditures. The transient accommodations tax is collected at the State level and reallocated back to the counties.

The basis for each tax is discussed individually on the following pages and the summary computation of the estimated tax revenues are presented in Table X-1.

INDIVIDUAL STATE INCOME TAX

This tax represents the income tax that individuals would have to pay on earnings resulting from employment on construction of the golf course and in its operation. For purposes of this calculation, we used payroll estimates provided by the golf course engineers and developers. We further assumed that total payroll was earned evenly by all employees, with each filing as single with one exemption and using the standard deduction.

Estimated individual State income tax resulting from golf course construction employment, assumed to take place in 1992 and 1993, is computed as follows:

	Tax on Construction Payroll		
	1992 (8 Months)	1993 (12 Months)	Total (20 Months)
Construction payroll	$3,060,000	$4,590,000	$7,650,000
Average number of employees	90	90	90
Average construction payroll	34,000	51,000	85,000
Standard deduction	(1,500)	(1,500)	(3,000)
Exemption	(1,040)	(1,040)	(2,080)
Taxable income	31,460	48,460	79,920
State tax liability (per Hawaii 1991 tax tables)	2,685	4,385	7,070
Number of employees	90	90	90
Total State income tax revenue (rounded)	$ 241,600	$ 394,600	$ 636,200

State income taxes are initially put into the State General Fund and subsequently allocated to the Counties as a result of legislative negotiations. Thus, it is difficult to estimate with any precision how much State tax revenue collected in Maui is reallocated back. However, for the purposes of this study, we will assume that all individual State income tax raised in Maui will be allocated back to the County in total.

State individual income tax generated by golf course operations employment is presented in Table X-1 and totals $784,100 for the ten year period 1994-2003. Total income tax generated, including the 1993 construction period aggregates $1,420,300.

GENERAL EXCISE TAX

General excise tax is imposed on the sale of virtually all goods and services in the State of Hawaii. The tax, currently 4 percent, is based on gross revenues and is applicable to the Hotel Hana Maui and the proposed Hana Ranch Country Club. The total impact from the general excise tax is based on the incremental revenues derived from the hotel operations with a golf course, as developed in Section IX, which exceeds the hotel operations without the golf course, as developed in Section XII, plus the gross revenues from the golf course operation.

General excise taxes are also put into the State General Fund and subsequently allocated to the Counties as a result of legislative negotiations. However, for the purposes of this study, we will again assume that all general excise taxes raised in Maui will be allocated to the County in total.

Estimated general excise tax is presented in Table X-1 and totals $3,210,600 over the ten year projection period 1994-2003.

REAL PROPERTY TAX

Real property tax is levied at the county level and is used to support public programs in each respective county. Current plans for the golf course estimate that it will occupy 201 acres. Although the specific tax assessment rate is not yet available, resort courses are currently assessed at $70,000 per acre, with the tax rate at $4.75 per $1,000 of assessment, according to the County of Maui Real Property Tax Department. Based on the current assessment amounts and assuming a 5 percent annual valuation increase, real property tax revenues to the County of Maui are estimated on Table X-1. Estimated real property taxes for the ten year period 1994-2003 total $841,600.

TRANSIENT ACCOMMODATIONS TAX

The State of Hawaii allocates back to the counties 95 percent of the transient accommodations tax collected by the State. It will allocate 22.8 percent of the total to Maui, 44.1 percent to Honolulu, 18.6 percent to Hawaii and 14.5 percent to Kauai. In calendar year 1989, which is the most recent year available, the following transient accommodations tax revenues were collected from the four counties.

1989 Transient Accommodations Tax
Collected by County

County	Amount	Percentage
Maui	$18.8 million	23.2%
Honolulu	7.8 million	59.0
Hawaii	7.8 million	9.6
Kauai	6.6 million	8.2
	$81.0 million	100.0%

The analysis above reveals that in 1989 the County of Maui collected 23.2 percent of the total transient accommodations tax; however, the State will be allocating back to the County 22.8 percent. Assuming the percentage of 1989 tax collections remains static and applicable to the projection period under study, this infers that 98.3 percent of all transient taxes raised in the county will subsequently be allocated back.

In calculating the impact on the transient accommodations tax for the Hotel Hana Maui, the impact is calculated on the incremental difference in hotel revenues with and without the golf course. The estimated transient accommodations tax impact for the projection period totals $1,216,000 and is shown on Table X-1.

OTHER TAX IMPACTS

The above analyses presented the tax impacts from primary sources due to the development of the Hana Ranch Country Club. Other tax impacts would also be incurred from secondary sources due to the economic multiplier effect of an expanded economic base. Such impacts would include sources such as retail and wholesale operations that support the golf course and hotel and the spending by additional guests coming to the resort. The increased incomes of hotel and golf course employees would also increase income levels of other sectors in the Hana community as more spending would spread throughout the local economy. However, because the analysis of secondary impacts is beyond the scope of this study, the analyses performed were focused on primary impacts.

TABLE X-1

HOTEL HANA MAUI AND HANA RANCH COUNTRY CLUB
VARIOUS ESTIMATED ADDITIONAL TAX REVENUES TO THE COUNTY OF MAUI

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
INDIVIDUAL STATE INCOME TAX											
Average golf course payroll	$23,000	$24,200	$25,400	$26,700	$28,000	$29,400	$30,900	$32,400	$34,000	$35,700	
Standard Deduction	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	
Exemption	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	(1,040)	
Taxable Income	20,460	21,660	22,860	24,160	25,460	26,860	28,360	29,860	31,460	33,160	
State tax liability	1,586	1,698	1,812	1,934	2,084	2,224	2,374	2,524	2,684	2,854	
Number of employees	36	36	36	36	36	36	36	36	36	36	
Total State Income Tax Revenue	$57,000	$61,100	$65,200	$70,300	$75,000	$80,000	$85,400	$90,800	$96,600	$102,700	$784,100
GENERAL EXCISE TAX											
Revenues											
Hotel Operations, incremental only	$1,217,000	$1,529,000	$2,332,000	$3,456,000	$4,685,000	$4,919,000	$5,168,000	$5,424,000	$5,697,000	$5,983,000	
Golf Course	2,650,000	2,921,000	3,264,000	3,631,000	4,026,000	4,228,000	4,439,000	4,662,000	4,895,000	5,140,000	
	3,867,000	4,450,000	5,596,000	7,087,000	8,711,000	9,147,000	9,607,000	10,086,000	10,592,000	11,123,000	
General excise tax rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Total General excise tax revenue	$154,700	$178,000	$223,800	$283,500	$348,400	$365,900	$384,300	$403,400	$423,700	$444,900	$3,210,600
REAL PROPERTY TAX											
Assessed value per acre	$70,000	$73,500	$77,200	$81,100	$85,200	$89,500	$94,000	$98,700	$103,600	$108,800	
Number of acres	201	201	201	201	201	201	201	201	201	201	
Total assessed value	14,070,000	14,773,500	15,517,200	16,301,100	17,125,200	17,989,500	18,894,000	19,838,700	20,823,600	21,868,800	
Divide by $1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
	14,070	14,774	15,517	16,301	17,125	17,990	18,894	19,839	20,824	21,869	
Tax rate	4.75	4.75	4.75	4.75	4.75	4.75	4.75	4.75	4.75	4.75	
Real property tax revenue	$66,800	$70,200	$73,700	$77,400	$81,300	$85,500	$89,700	$94,200	$98,900	$103,900	$841,600
TRANSIENT ACCOMMODATIONS TAX											
Incremental hotel room revenue	$907,000	$1,093,000	$1,534,000	$2,140,000	$2,801,000	$2,942,000	$3,091,000	$3,244,000	$3,406,000	$3,577,000	
Transient accommodations tax rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	
	45,400	54,700	76,700	107,000	140,100	147,100	154,600	162,200	170,300	178,900	
County allocation	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	98.3%	
County of Maui Transient accommodations tax revenue	$44,600	$53,800	$75,400	$105,200	$137,700	$144,600	$152,000	$159,400	$167,400	$175,900	$1,216,000

SECTION XI

OTHER IMPACTS

OTHER IMPACTS

INTRODUCTION

This study is focused on the primary impacts directly attributable to the proposed golf course development. However, secondary impacts will also occur due to the effects of the economic multiplier throughout the Hana economy. The economic multiplier includes effects of secondary spending levels from golf course employees, expenditures to support increased operations at the resort, and increased business for non-hotel retail and wholesale vendors due to spending by the increased number of guests at the resort.

OTHER PRIMARY IMPACTS

Impact from Golf Course and Clubhouse Construction

The improvements made to the land as a result of the golf course and clubhouse construction will also add value to the real property. The economic value added to real property is assumed to be the cost of the improvements made. Based on estimates provided by Keola, as detailed in Section II, total project costs should approximate $43,000,000.

Impact from Construction Employment

The Hana area would also benefit from construction payroll and employment during the build-out phase of the golf course. Based on discussions with golf course engineers and architects, the build-out phase would span approximately twenty months and require a total of 146 employees during the peak construction period or an average of 90 employees throughout the build-out phase. Engineers estimate that 10 percent of the construction workforce will come from the Hana area. Construction payroll is estimated to be $7,650,000.

Impact from Golf Course and Clubhouse Employment

In addition to the economic impact from golf course operations, the golf course will create jobs and infuse additional payroll expenditures into the Hana district. Based on a survey conducted by Community Resources, Inc. and included in Hawaii Golf Course: Impacts and Benefit Assessment by Decision Analysts Hawaii, Inc., Table XI-1 presents the estimated employment and payroll impact of the Hana Ranch Country Club in 1988 dollars.

Assuming each employee creates a demand for one residential housing unit, we would anticipate increased demand for thirty-six additional housing units in the Hana area. This demand represents the upper limit of demand and would be lower to the extent that jobs are filled by Hana residents who already have housing, commuters from other Maui communities, or golf course employees that enter into shared housing arrangements.

SECONDARY IMPACTS

As the scope of the study was limited to primary impacts, the quantification of secondary impacts would require a more complex economic and market forecast model. Consequently, the following is a general overview of the major secondary impacts.

Housing Construction

We have previously indicated that there would be a need for a maximum of 36 long-term residential units to house golf course employees, reduced by those employees that already reside in Hana, are willing to commute from other Maui communities, or are willing to share residential facilities with others. Regardless, however, construction of additional housing would create a substantial number of construction jobs and the infusion of investment capital for the

TABLE XI-1

ESTIMATED GOLF COURSE AND CLUBHOUSE EMPLOYMENT
(1988 DOLLARS)

JOB TITLE	NUMBER OF EMPLOYEES	AVE. ANNUAL SALARY	TOTAL GOLF SALARY
GROUNDS MAINTENANCE:			
SUPERVISOR	1	$30,000	$30,000
ASSISTANT SUPERVISOR	1	$21,000	$21,000
MAINTENANCE SUPERVISOR	1	$16,000	$16,000
MECHANICS	1	$20,000	$20,000
EQUIPMENT OPERATORS	4	$16,000	$64,000
GROUNDSKEEPERS	4	$16,000	$64,000
LABORERS	4	$16,000	$64,000
GOLF OPERATIONS:			
GOLF PROFESSIONAL	1	$30,000	$30,000
ASSISTANT GOLF PROFESSIONALS	1	$21,000	$21,000
CART MECHANIC	1	$19,000	$19,000
CART WASHERS, ATTENDANTS	2	$12,000	$24,000
COURSE MARSHAL, CASHIERS/STARTERS & SALES ASSISTANT	2	$12,000	$24,000
ADMINISTRATION & CLUBHOUSE SUPPORT:			
CLUBHOUSE MANAGER	1	$30,000	$30,000
ASSISTANT MANAGER	1	$21,000	$21,000
ACCOUNTANT	1	$27,000	$27,000
SECRETARY	1	$18,000	$18,000
JANITORS	1	$11,000	$11,000
SECURITY	1	$18,000	$18,000
FOOD AND BEVERAGE			
SPECIALIST COOK/SUPERVISOR	1	$19,000	$19,000
GENERAL COOKS	1	$11,000	$11,000
CASHIERS	1	$17,000	$17,000
WAITERS AND WAITRESSES	2	$14,000	$28,000
BUSBOYS AND KITCHEN HELP	1	$11,000	$11,000
BARTENDERS	1	$11,000	$11,000
TOTAL GOLF PAYROLL	36		$619,000

SOURCE: COMMUNITY RESOURCES, INC.
HAWAII GOLF COURSES: IMPACTS AND BENEFIT ASSESSMENT, DECISION ANALYSTS HAWAII, INC.

development of real property. Such developments could also expand infrastructure and support services that may benefit the community as a whole.

Expanded Employment in Other Sectors

In addition to jobs created in housing construction, increased demand for other goods and services could also lead to employment opportunities in other fields. Employment in supporting industries may develop in the retail and wholesale areas, as well as in other service fields such as education, social services, etc. In addition to possible new employment opportunities, there may also be the possibility of an overall rise in the level of income in the Hana district.

Development of New Business

With the increase in economic activity, opportunities for new businesses may develop either to support the growing local economy or the expanded tourism base at the resort. As the Hana district is serviced primarily by two general stores, there may be opportunity for new businesses in the retail area.

Preservation of Open Space

The development of a golf course is also viewed favorably by many as a means to ensure open space rather than construction of commercial and residential developments. Golf courses provide artistically landscaped and well-maintained open areas that compliment the surrounding terrain and natural environment. They may also provide needed buffer zones between commercial and residential areas.

HOTEL WITHOUT GOLF

SECTION XII

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HOTEL HANA MAUI WITHOUT A GOLF COURSE

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS OF THE HOTEL HANA MAUI WITHOUT A GOLF COURSE

INTRODUCTION

The estimates of future operating results for the Hotel Hana Maui without the proposed Hana Ranch Country Club were based on the same criteria and rationale as discussed in Section IX, except for the differences presented in this section and the following changes in assumptions:

- 60 percent stabilized occupancy and $254 (1991 dollars) average daily rate.
- The proposed golf course will not be constructed.
- An aggressive marketing campaign will be maintained.

The Statement of Estimated Annual Operating Results for the twelve year period 1992-2003 is presented in Tables XII-2 and XII-3. As is the case in all estimates of this sort, we are not in a position to guarantee the results, nor is any warranty intended that they can be achieved.

SUMMARY HIGHLIGHTS AND CONCLUSIONS

Without the proposed Hana Ranch Country Club, the survival of the Hotel Hana Maui becomes very difficult. Estimated annual net operating losses beginning at $2,711,000 in 1992, progressively worsens each year to an estimated aggregate loss of $32,364,000, by the year 2003, not taking into account the current accumulated deficit, debt service and other non-operating expenses. This results from the combination of the Hotel's inability to effectively compete with other primary luxury hotels providing a full complement of amenities and golf, the over staffing of approximately 71 employees and the unfavorable relationship of its large infrastructure to its small number of guest rooms.

OCCUPANCY RATES

The occupancy rates for the Hotel Hana Maui were estimated based on an analysis of historical hotel occupancy trends and our knowledge of existing and proposed competitive resorts in the market area. The analysis indicates that without the golf course and with the extremely high competition in the primary luxury market, which includes newer facilities, more amenities, less isolated locations and discounted pricing, it is highly unlikely that the hotel will attain the high occupancy levels that it achieved through 1982. Although occupancy can probably be increased over current levels, we estimate that it most likely will not exceed a stabilized occupancy rate of 60 percent. The projected occupancy rates for the years 1992 through 2003, are as follows:

TABLE XII-1
HOTEL HANA MAUI
PROJECTED OCCUPANCY
WITHOUT GOLF COURSE
(1992 - 2003)

YEAR	PROJECTED OCCUPANCY
1992	52.0%
1993	55.0%
1994	57.0%
1995	59.0%
1996	60.0%
1997	60.0%
1998	60.0%
1999	60.0%
2000	60.0%
2001	60.0%
2002	60.0%
2003	60.0%

SOURCE: PANNELL KERR FORSTER

AVERAGE DAILY ROOM RATES

The average daily room rates for the Hotel Hana Maui were estimated based on the same factors that were used in Section IX, but with the realization that without the golf course the hotel will be at a significant competitive disadvantage. That situation will most likely force the hotel to a pricing level below that of its primary competitors that do have golf and other competitive advantages. Consequently, average daily room rates have been projected at $254 in 1991 dollars with a 5 percent annual inflation factor and are presented on Table XII-2.

TABLE XII-2
HOTEL HANA MAUI
PROJECTED AVERAGE DAILY ROOM RATES
(1991 - 2003)

YEAR	BASE RATE	ROOM RATE INFLATION FACTOR	ADJUSTED RATE
1991	$254.00		$254.00
1992	$254.00	1.05	266.70
1993	$254.00	1.05	280.00
1994	$254.00	1.05	294.00
1995	$254.00	1.05	308.70
1996	$254.00	1.05	324.10
1997	$254.00	1.05	340.30
1998	$254.00	1.05	357.30
1999	$254.00	1.05	375.20
2000	$254.00	1.05	394.00
2001	$254.00	1.05	413.70
2002	$254.00	1.05	434.40
2003	$254.00	1.05	456.10

SOURCE: PANNELL KERR FORSTER

STAFFING ANALYSIS

As previously discussed in Section IX and as presented on Table IX-4, the existing staffing level appears high in relationship to the number of hotel rooms. If the golf course were not built and the hotel were to continue at a weak performance level, the excess staffing situation would eventually have to be addressed.

Based on the projected 60 percent occupancy of the hotel without the golf course, an average of 58 rooms per day would be occupied. Although the industry guideline is approximately 2.0 employees per occupied room, we will use 2.5 due to the small number of rooms in relation to the size of the grounds. This would equate to 145 full-time employees as compared to the existing 216 equivalent fulltime employees. The implication is an over staffing of 71 personnel.

Needless to say, the social and economic impact to the employees and Hana Community from such a large lay off would be significant and very far reaching. Furthermore, such a reduction could negatively impact the class of operation and affect the hotel's market position and image.

ESTIMATED OPERATING RESULTS

The estimates of future operating results of the Hotel Hana Maui without a golf course are the aggregate of all of the related assumptions and rationale presented. The operating ratios of these projected results are presented on Table IX-6, in comparison to the projected hotel results with a golf course and other statistics. Although Sheraton has, and will probably continue to improve the operating efficiency of the hotel, it will soon reach a point of diminishing returns because of the projected low occupancy level, the low average daily rate compared to its primary competitors, and the unfavorable relationship of the size of the hotel's infrastructure to the small number of guest rooms. Management will undoubtedly have to address its overstaffing situation and class of operation in order to bring operating statistics more into line with industry standards. Under these physical constraints, however, even with reasonable operating statistics, it is very unlikely that the operation will ever generate a volume of business great enough to allow Keola to breakeven.

DEPARTMENTAL REVENUES

Room revenue is computed based on the occupancy and average daily rates previously provided. The assumptions and estimates for all other revenue items remain unchanged as we do not believe they will be significantly affected by the lack of a golf course. Their respective total revenue, however, will be lower as they are based on occupied rooms.

DEPARTMENTAL EXPENSES

Departmental expenses for this projection have been estimated at a relatively higher level than in our projection with a golf course, based on the assumption that the same expense ratios cannot be attained with a lower volume of business. Such expense estimates assume that the hotel is operating on a stabilized basis.

Rooms Department

Rooms department expense is estimated at 38 percent of room revenue compared to 36 percent for our projection with golf.

Food and Beverage Department Expense

Based on Hawaii's primary luxury hotels and past performance, food and beverage expense has been estimated at 100 percent of departmental revenues compared to 97 percent with golf.

Telephone

Telephone department expense has been projected at 130 percent of telephone revenue as compared to historical, which approximates 165 percent. This high percentage is due in part to the small number of rooms and low occupancy from which to generate revenue, compared to the fixed costs of the department.

Other Operated Departments

Based on historical performance, this expense has been projected at 100 percent of departmental revenue, compared to an estimated 98 percent with golf.

UNDISTRIBUTED OPERATING EXPENSES

Administrative and General

We estimated this expense at 14 percent of total revenue compared to 12 percent with golf.

Marketing

We projected this expense with golf to be 10 percent of total revenue in 1992, decreasing to 8 percent in 1997. Although there will probably be less expenses without the golf course, it is anticipated that the lower level of revenue will result in a similar ratio. Consequently, our estimate is the same as the with golf projection.

Property Operation and Maintenance

Projected at 18 percent of total revenue compared to 15 percent with golf.

Energy

Projected at 3 percent of total revenue, the same as project with golf.

FIXED CHARGES

Real Estate Taxes

Estimated at 1.1 percent of total revenues, compared to 0.8 with golf.

Insurance

Same as projection with golf.

Incentive Management Fee

Same as projection with golf.

Reserve for Replacements

Same as projection with golf.

STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS

Our estimates of the annual operating results for the Hotel Hana Maui without the proposed Hana Ranch Country Club, for the twelve year period 1992-2003, are presented on Table XII-3. See Section IX for estimates of the annual operating results for the hotel with the proposed golf course.

TABLE XII-3

HOTEL [illegible]
[illegible], MAUI, HAWAII
STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS WITHOUT GOLF COURSE
STATED IN INFLATED DOLLARS; 97 AVAILABLE ROOMS

OCCUPANCY LEVEL / AVERAGE DAILY ROOM RATE	1992 (4) 52.0% AT $266.70			1993 55.0% AT $280.00			1994 57.0% AT $294.00		
	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM
OPERATING DEPARTMENTS REVENUES									
Rooms	4,910,000	50.1%	50,619	5,432,000	50.1%	56,206	5,931,000	50.1%	61,165
Food	3,636,000	37.1%	37,484	4,020,000	37.1%	41,400	4,392,000	37.1%	45,278
Beverage	812,000	8.3%	8,371	902,000	8.3%	9,299	982,000	8.3%	10,124
Telephone	58,000	0.6%	598	64,000	0.6%	660	71,000	0.6%	732
Other Operated Departments	87,000	0.9%	897	97,000	0.9%	1,000	105,000	0.9%	1,082
Rentals and Other Income	290,000	3.0%	2,990	322,000	3.0%	3,320	351,000	3.0%	3,619
Total Operating Departments	9,793,000	100.0%	100,959	10,873,000	100.0%	112,091	11,834,000	100.0%	122,000
DEPARTMENTAL EXPENSES (1)									
Rooms	2,011,000	41.0%	20,753	2,200,000	40.5%	22,761	2,373,000	40.0%	24,464
Food and Beverage	4,668,000	105.0%	48,124	5,086,000	103.0%	52,433	5,441,000	102.0%	56,505
Telephone	78,000	134.5%	804	85,000	133.0%	876	94,000	132.0%	969
Other Operated Departments	104,000	120.0%	1,072	112,000	115.0%	1,155	116,000	110.0%	1,196
Total Departmental Expenses	6,861,000	70.1%	70,753	7,491,000	68.9%	77,227	8,064,000	68.1%	83,134
TOTAL OPERATING PROFIT	2,932,000	29.9%	30,186	3,382,000	31.1%	34,866	3,770,000	31.9%	38,866
UNDISTRIBUTED OPERATING EXPENSES									
Administrative and general	1,567,000	16.0%	16,155	1,685,000	15.5%	17,371	1,775,000	15.0%	18,299
Management fees	250,000	2.6%	2,577	250,000	2.3%	2,577	250,000	2.1%	2,577
Marketing	979,000	10.0%	10,093	1,087,000	10.0%	11,206	1,124,000	9.5%	11,588
Energy	411,000	4.2%	4,237	435,000	4.0%	4,485	438,000	3.7%	4,515
Property Operation and Maintenance	1,958,000	20.0%	20,186	2,120,000	19.5%	21,856	2,248,000	19.0%	23,175
Total Undistributed Operating Expenses	5,165,000	52.8%	53,248	5,577,000	51.5%	57,495	5,835,000	49.3%	60,154
INCOME BEFORE FIXED CHARGES	(2,233,000)	-22.8%	(23,062)	(2,195,000)	-20.2%	(22,629)	(2,065,000)	-17.4%	(21,289)
FIXED CHARGES (2)									
Incentive Management Fees									
Taxes	166,000	1.7%	1,711	174,000	1.6%	1,794	181,000	1.5%	1,867
Insurance	112,000	1.1%	1,155	118,000	1.1%	1,216	124,000	1.0%	1,278
Total Fixed Charges	278,000	2.8%	2,866	292,000	2.7%	3,010	307,000	2.6%	3,165
INCOME BEFORE RESERVE (3)	($2,515,000)	-25.7%	($25,929)	($2,487,000)	-22.9%	($25,639)	($2,372,000)	-20.0%	($24,454)
RESERVE FOR REPLACEMENT	196,000	2.0%	2,021	326,000	3.0%	3,361	355,000	3.0%	3,660
INCOME AFTER RESERVE BUT BEFORE OTHER CHARGES	($2,711,000)	-27.7%	($27,949)	($2,813,000)	-25.9%	($29,000)	($2,727,000)	-23.0%	($28,113)

OCCUPANCY LEVEL / AVERAGE DAILY ROOM RATE	1995 59.0% AT $308.70			1996 60.0% AT $324.10			1997 60.0% AT $340.40		
	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM
OPERATING DEPARTMENTS REVENUES									
Rooms	6,448,000	50.1%	66,476	6,887,000	50.1%	71,004	7,231,000	50.1%	74,546
Food	4,773,000	37.1%	49,206	5,097,000	37.1%	52,546	5,352,000	37.1%	55,175
Beverage	1,066,000	8.3%	10,990	1,138,000	8.3%	11,732	1,195,000	8.3%	12,320
Telephone	77,000	0.6%	794	82,000	0.6%	845	86,000	0.6%	887
Other Operated Departments	114,000	0.9%	1,175	121,000	0.9%	1,248	127,000	0.9%	1,309
Rentals and Other Income	380,000	3.0%	3,918	407,000	3.0%	4,196	427,000	3.0%	4,402
Total Operating Departments	12,858,000	100.0%	132,557	13,734,000	100.0%	141,567	14,420,000	100.0%	148,660
DEPARTMENTAL EXPENSES (1)									
Rooms	2,515,000	39.0%	25,928	2,617,000	38.0%	26,979	2,748,000	38.0%	28,330
Food and Beverage	5,897,000	101.0%	60,794	6,235,000	100.0%	64,278	6,547,000	100.0%	67,495
Telephone	101,000	131.0%	1,041	107,000	130.0%	1,103	112,000	130.0%	1,155
Other Operated Departments	120,000	105.0%	1,237	121,000	100.0%	1,248	127,000	100.0%	1,309
Total Departmental Expenses	8,633,000	67.1%	89,000	9,082,000	66.1%	93,629	9,536,000	66.1%	98,310
TOTAL OPERATING PROFIT	4,225,000	32.9%	43,557	4,652,000	33.9%	47,959	4,884,000	33.9%	50,350
UNDISTRIBUTED OPERATING EXPENSES									
Administrative and general	1,864,000	14.5%	19,216	1,923,000	14.0%	19,825	2,019,000	14.0%	20,814
Management fees	250,000	1.9%	2,577	250,000	1.8%	2,577	250,000	1.7%	2,577
Marketing	1,157,000	9.0%	11,928	1,099,000	8.0%	11,330	1,154,000	8.0%	11,897
Energy	424,000	3.3%	4,371	412,000	3.0%	4,247	433,000	3.0%	4,464
Property Operation and Maintenance	2,379,000	18.5%	24,526	2,472,000	18.0%	25,485	2,596,000	18.0%	26,763
Total Undistributed Operating Expenses	6,074,000	47.2%	62,619	6,156,000	44.8%	63,464	6,452,000	44.7%	66,515
INCOME BEFORE FIXED CHARGES	(1,849,000)	-14.4%	(19,062)	(1,504,000)	-11.0%	(15,505)	(1,568,000)	-10.9%	(16,165)
FIXED CHARGES (2)									
Incentive Management Fees									
Taxes	192,000	1.5%	1,979	202,000	1.5%	2,082	212,000	1.5%	2,186
Insurance	130,000	1.0%	1,340	137,000	1.0%	1,412	143,000	1.0%	1,474
Total Fixed Charges	322,000	2.5%	3,319	339,000	2.5%	3,494	355,000	2.5%	3,660
INCOME BEFORE RESERVE (3)	($2,171,000)	-16.9%	($22,380)	($1,843,000)	-13.4%	($19,000)	($1,923,000)	-13.3%	($19,825)
RESERVE FOR REPLACEMENT	386,000	3.0%	3,979	412,000	3.0%	4,247	433,000	3.0%	4,464
INCOME AFTER RESERVE BUT BEFORE OTHER CHARGES	($2,557,000)	-19.9%	($26,359)	($2,255,000)	-16.4%	($23,246)	($2,356,000)	-16.3%	($24,289)

Notes: (1) Each departmental expense ratio is based on the department's estimated revenues.
(2) Fixed charges do not include interest expense, depreciation, amortization, or income taxes.
(3) Income before reserve for replacement, interest, depreciation, amortization and income tax.
(4) 12 months in operation the opening year.

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TABLE XII-3
(Continued)

HOTEL [illegible]
[illegible], MAUI, HAWAII
STATEMENT OF ESTIMATED ANNUAL OPERATING RESULTS WITHOUT GOLF COURSE
STATED IN INFLATED DOLLARS; 97 AVAILABLE ROOMS

OCCUPANCY LEVEL / AVERAGE DAILY ROOM RATE	1998 60.0% AT $357.40			1999 60.0% AT $375.30			2000 60.0% AT $394.00		
	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM
OPERATING DEPARTMENTS REVENUES									
Rooms	7,592,000	50.1%	78,268	7,972,000	50.1%	82,186	8,370,000	50.1%	86,289
Food	5,620,000	37.1%	57,938	5,901,000	37.1%	60,835	6,196,000	37.1%	63,876
Beverage	1,255,000	8.3%	12,938	1,318,000	8.3%	13,588	1,384,000	8.3%	14,268
Telephone	90,000	0.6%	928	95,000	0.6%	979	99,000	0.6%	1,021
Other Operated Departments	135,000	0.9%	1,392	142,000	0.9%	1,464	149,000	0.9%	1,536
Rentals and Other Income	449,000	3.0%	4,629	471,000	3.0%	4,856	495,000	3.0%	5,103
Total Operating Departments	15,141,000	100.0%	156,093	15,899,000	100.0%	163,908	16,691,000	100.0%	172,093
DEPARTMENTAL EXPENSES (1)									
Rooms	2,885,000	38.0%	29,742	3,029,000	38.0%	31,227	3,181,000	38.0%	32,794
Food and Beverage	6,875,000	100.0%	70,876	7,219,000	100.0%	74,423	7,580,000	100.0%	78,144
Telephone	117,000	130.0%	1,206	124,000	130.0%	1,278	129,000	130.0%	1,330
Other Operated Departments	135,000	100.0%	1,392	142,000	100.0%	1,464	149,000	100.0%	1,536
Total Departmental Expenses	10,012,000	66.1%	103,216	10,514,000	66.1%	108,392	11,039,000	66.1%	113,804
TOTAL OPERATING PROFIT	5,129,000	33.9%	52,877	5,385,000	33.9%	55,516	5,654,000	33.9%	58,289
UNDISTRIBUTED OPERATING EXPENSES									
Administrative and general	2,120,000	14.0%	21,856	2,226,000	14.0%	22,948	2,337,000	14.0%	24,093
Management fees	250,000	1.7%	2,577	250,000	1.6%	2,577	250,000	1.5%	2,577
Marketing	1,211,000	8.0%	12,485	1,272,000	8.0%	13,113	1,335,000	8.0%	13,763
Energy	454,000	3.0%	4,680	477,000	3.0%	4,918	501,000	3.0%	5,165
Property Operation and Maintenance	2,725,000	18.0%	28,093	2,862,000	18.0%	29,505	3,005,000	18.0%	30,979
Total Undistributed Operating Expenses	6,760,000	44.6%	69,691	7,087,000	44.6%	73,061	7,428,000	44.5%	76,577
INCOME BEFORE FIXED CHARGES	(1,631,000)	-10.8%	(16,814)	(1,702,000)	-10.7%	(17,545)	(1,774,000)	-10.6%	(18,289)
FIXED CHARGES (2)									
Incentive Management Fees									
Taxes	222,000	1.5%	2,289	233,000	1.5%	2,402	245,000	1.5%	2,526
Insurance	151,000	1.0%	1,557	158,000	1.0%	1,629	166,000	1.0%	1,711
Total Fixed Charges	373,000	2.5%	3,846	391,000	2.5%	4,031	411,000	2.5%	4,237
INCOME BEFORE RESERVE (3)	($2,004,000)	-13.2%	($20,660)	($2,093,000)	-13.2%	($21,576)	($2,185,000)	-13.1%	($22,525)
RESERVE FOR REPLACEMENT	606,000	4.0%	6,247	636,000	4.0%	6,557	668,000	4.0%	6,887
INCOME AFTER RESERVE BUT BEFORE OTHER CHARGES	($2,610,000)	-17.2%	($26,907)	($2,729,000)	-17.2%	($28,133)	($2,853,000)	-17.1%	($29,412)

OCCUPANCY LEVEL / AVERAGE DAILY ROOM RATE	2001 60.0% AT $413.70			2002 60.0% AT $434.40			2003 60.0% AT $456.10		
	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM	AMOUNT	%	AMOUNT /ROOM
OPERATING DEPARTMENTS REVENUES									
Rooms	8,788,000	50.1%	90,598	9,228,000	50.1%	95,134	9,689,000	50.1%	99,887
Food	6,506,000	37.1%	67,072	6,831,000	37.1%	70,423	7,173,000	37.1%	73,948
Beverage	1,453,000	8.3%	14,979	1,526,000	8.3%	15,732	1,602,000	8.3%	16,515
Telephone	104,000	0.6%	1,072	109,000	0.6%	1,124	114,000	0.6%	1,175
Other Operated Departments	156,000	0.9%	1,608	164,000	0.9%	1,691	172,000	0.9%	1,773
Rentals and Other Income	520,000	3.0%	5,361	546,000	3.0%	5,629	573,000	3.0%	5,907
Total Operating Departments	17,527,000	100.0%	180,690	18,404,000	100.0%	189,733	19,323,000	100.0%	199,205
DEPARTMENTAL EXPENSES (1)									
Rooms	3,339,000	38.0%	34,423	3,507,000	38.0%	36,155	3,682,000	38.0%	37,959
Food and Beverage	7,959,000	100.0%	82,052	8,357,000	100.0%	86,155	8,775,000	100.0%	90,464
Telephone	135,000	130.0%	1,392	142,000	130.0%	1,464	148,000	130.0%	1,526
Other Operated Departments	156,000	100.0%	1,608	164,000	100.0%	1,691	172,000	100.0%	1,773
Total Departmental Expenses	11,589,000	66.1%	119,475	12,170,000	66.1%	125,464	12,777,000	66.1%	131,722
TOTAL OPERATING PROFIT	5,938,000	33.9%	61,215	6,234,000	33.9%	64,268	6,546,000	33.9%	67,485
UNDISTRIBUTED OPERATING EXPENSES									
Administrative and general	2,454,000	14.0%	25,299	2,577,000	14.0%	26,567	2,705,000	14.0%	27,887
Management fees	250,000	1.4%	2,577	250,000	1.4%	2,577	250,000	1.3%	2,577
Marketing	1,402,000	8.0%	14,454	1,472,000	8.0%	15,175	1,546,000	8.0%	15,938
Energy	526,000	3.0%	5,423	552,000	3.0%	5,691	580,000	3.0%	5,979
Property Operation and Maintenance	3,155,000	18.0%	32,526	3,313,000	18.0%	34,155	3,478,000	18.0%	35,856
Total Undistributed Operating Expenses	7,787,000	44.4%	80,279	8,164,000	44.4%	84,165	8,559,000	44.3%	88,237
INCOME BEFORE FIXED CHARGES	(1,849,000)	-10.5%	(19,064)	(1,930,000)	-10.5%	(19,897)	(2,013,000)	-10.4%	(20,754)
FIXED CHARGES (2)									
Incentive Management Fees									
Taxes	257,000	1.5%	2,649	270,000	1.5%	2,784	284,000	1.5%	2,928
Insurance	174,000	1.0%	1,794	183,000	1.0%	1,887	135,000	0.7%	1,392
Total Fixed Charges	431,000	2.5%	4,443	453,000	2.5%	4,671	419,000	2.2%	4,320
INCOME BEFORE RESERVE (3)	($2,280,000)	-13.0%	($23,507)	($2,383,000)	-12.9%	($24,566)	($2,432,000)	-12.6%	($25,074)
RESERVE FOR REPLACEMENT	526,000	3.0%	5,423	552,000	3.0%	5,691	580,000	3.0%	5,979
INCOME AFTER RESERVE BUT BEFORE OTHER CHARGES	($2,806,000)	-16.0%	($28,930)	($2,935,000)	-15.9%	($30,259)	($3,012,000)	-15.6%	($31,053)

Notes: (1) Each departmental expense ratio is based on the department's estimated revenues.
(2) Fixed charges do not include interest expense, depreciation, amortization, or income taxes.
(3) Income before reserve for replacement, interest, depreciation, amortization and income tax.
(4) 12 months in operation the opening year.

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APPENDIX C

AGRICULTURAL FEASIBILITY OF HANA RANCH COUNTRY CLUB LANDS AND EFFECTS OF CONVERSION ON AGRICULTURE

Prepared By Frank S. Scott, Jr., Agricultural Economist, May 1992

AGRICULTURAL FEASIBILITY OF HANA RANCH COUNTRY CLUB LANDS AND EFFECTS OF CONVERSION ON AGRICULTURE

Prepared For

PACIFIC PLANNING AND ENGINEERING, INC.

By

Frank S. Scott, Jr., Agricultural Economist

May 1992

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SUMMARY AND CONCLUSIONS

This report addresses the feasibility of alternative types of agricultural production at the proposed Hana Ranch Country Club site and the probable effects on the economic viability of Hana Ranch cattle production and on Hawaii agriculture in general if the lands are withdrawn from agriculture.

Soil capability classifications for agricultural production are based on SCS and LSB crop productivity ratings, supplemented by on-site observations. The site contains no prime agricultural lands (SCS I & II and LSB A & B). SCS classifies 102 acres as marginal and the remaining 100 acres as submarginal and not suitable for cultivated crop production. LSB classifies 142 acres as marginal and 59 acres as unsuitable for cultivated crop production. SCS classifies most of the land area as well suited to grazing and LSB classifies it as marginal. On-site observations indicate a good carrying capacity under the current management system, which maximizes pasture output and prevents destructive over-grazing.

Rainfall, which is estimated to average about 80 inches annually for the mean of the project site, is uniformly distributed and is considered adequate, except for occasional dry spells for pasture and cultivated crop production. A minimal amount of supplemental irrigation could be effectively utilized for some crops, but the cost for that purpose would be prohibitive unless acreage converted to crops requiring irrigation is sufficient to provide adequate economics of scale in irrigation development.

Several truck and orchard crops were investigated as alternatives to cattle grazing. These crops could provide much higher gross returns per acre than grazing, but would be subject to more serious ecological problems than in many competing areas where the crops are currently grown and would likely have some disadvantages in competing in the marketplace because of lower yields and higher costs. Some varieties of floriculture and nursery crops are potentially viable at Hana Ranch, but these crops would require very limited land areas and would probably best be located in the more accesible lower areas of the ranch rather than in the project area. Cattle grazing, although economically viable during only one year out of three during the past three decades, is the only proven enterprise on the ranch and may have the potential to become more viable through increased efficiency.

Conversion of 201 acres of Hana Ranch land out of cattle grazing

to provide a site for the Hana Ranch Country Club would reduce grazing capacity of the 3,316-acre total grazing area by 5.9 percent, assuming comparable land capability. However, management has a plan for compensating for this decrease in grazing area by clearing an equivalent amount of woodland in terms of number of cattle units carried. The location of the golf course would have the effect, however, of causing some reduction in operating efficiency in transferring cattle from paddock to paddock in the rotation system. Nevertheless, the overall effect on the cattle operation would be expected to be minimal.

There is no indication that conversion of the 196 acres in the project area would have any effect on the availability of land for agricultual production. The acreage in cultivated crop production in Maui county declined a very substantial 24 percent during the most recent 10-year period for which data are available, from 83,600 acres in 1981 to 63,200 acres in 1990. Whereas some of this land has been converted to other uses, most of it is still available for agriculture. Further, the 63,200 acres in crop production compares to a total of 408,000 acres zoned agricultural for the county. Cattle production has also decreased, from 15,300 head in 1981 to 12,700 head in 1990 for the island of Maui, alone, indicating a decreased need for grazing land in relation to that available. Similar trends have taken place in other Hawaii counties.

AGRICULTURAL FEASIBILITY OF LAND TO BE UTILIZED FOR HANA RANCH COUNTRY CLUB AND THE EFFECTS OF CONVERSION ON AGRICULTURE

By

Frank S. Scott, Jr., Agricultual Economist

INTRODUCTION

This report investigates the agricultural feasibility of the 201 acres of grazing land to be displaced by the proposed Hana Ranch Country Club and the effects of its displacement on the economic viability of Hana Ranch and the agricultural potential for Maui and for the State of Hawaii. Determination of agricultural feasibility is based on criteria specified below. The agricultural need for the land area to be displaced considers the economic effects on Hana Ranch and the availability of land in relation to existing and projected agricultual production. The property as identified by Tax Map Keys 1-4-02: 5, 7, 9 and 10 and portions 4 and 8; 1-4-03: 6 and portion 9; and 1-4-07; portion 4, is shown in Figure 1.

PROCEDURE

The rationale of the investigation is to evaluate the economic feasibility of retaining the project site in agricultural production, including existing uses and alternative uses that may or may not be more intensive and more economically viable than existing uses. Conversion of the land to golf course use, in effect, precludes not only its existing agricultural use, but alternative agricultural uses. This requires an in-depth investigation to identify feasible agricultural alternatives for the site and the effects that the conversion would have on these alternatives. The analysis then requires an assessment of the land area needed to produce crops adaptable to the site in relation to total land area in Hawaii available for such production. Determination can then be made as to whether the site, considering its comparative advantages or disadvantages in relation to alternative production areas, is essential for sustaining Hawaii agriculture.

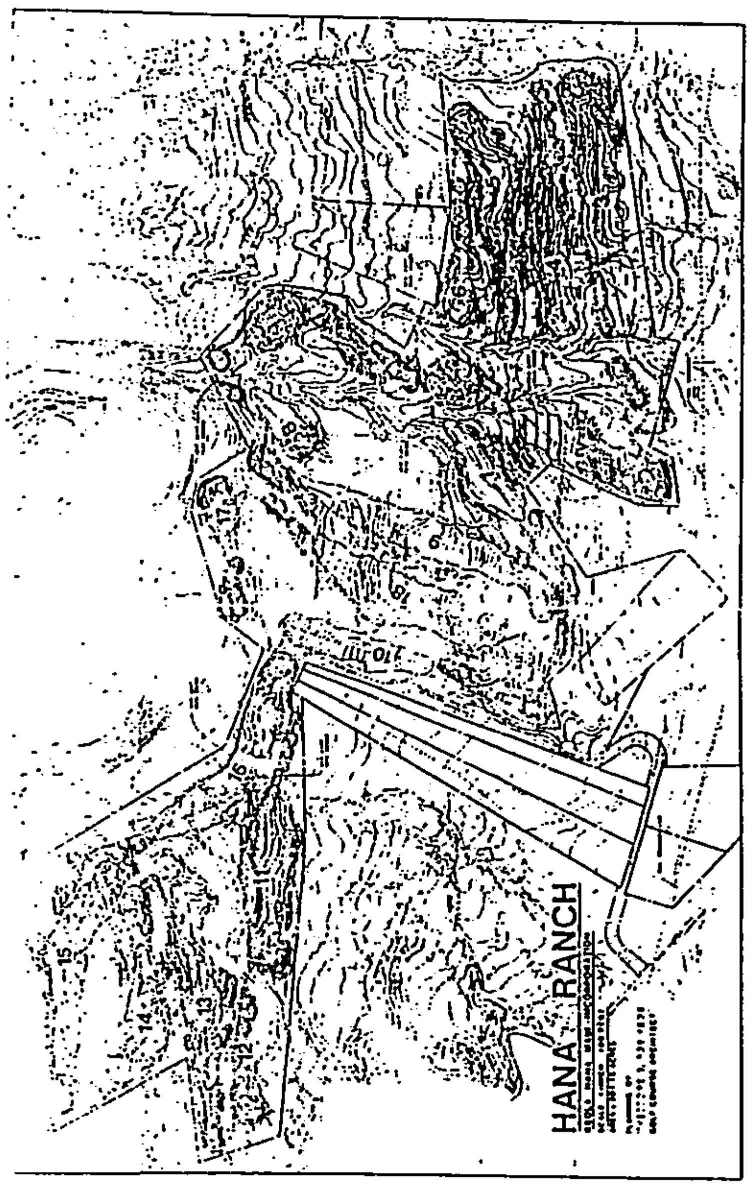

Figure 1. Hana Ranch Country Club

PRIOR AND EXISTING USES

The Hana Plantation, which was established in 1864, utilized a major portion of the project site for sugarcane production, which was processed at the nearby Ka-uiki mill (Earthplan). The sugarcane operation on what is now Hana Ranch (Kaeluku Plantation) apparently became uneconomic and was closed down in 1946 and the cattle grazing operation was established. Since that time, Hana Ranch has been used exclusively for cattle grazing. A map of the ranch is shown in Figure 2.

AGRICULTURAL FEASIBILITY CRITERIA

Determination of agricultural feasibility of lands to be displaced by Hana Ranch Golf Course is based on the following criteria:

1. Ecological Adapatation, consisting of soil type, configuration, topography, accessibility, rainfall, need for potential availabillity of irrigation water, temperature, wind, light intensity and environmentally related disease and insect problems.

2. Sales Potentials, consisting of market potentials for ecologically adaptable crops and the comparative advantage of crops in the project area to compete in the marketplace.

3. Economic Viability, including profitability and comparative advantage in relation to competing areas.

4. Intensity of Production, consisting of gross and net returns per acre as indicators of use value of the land.

ALISH CLASSIFICATIONS

ALISH classifications (Agricultural Lands of Importance to the State of Hawaii) of the Hawaii State Department of Agriculture are shown in Figure 3. Approximately 137 acres or 70 percent of the project area is classified as Other Important Agricultural Land and the remaining 30 percent is unclassified. Other Important Agricultural Land is considered of importance to the state or the local community for the production of food, feed, fiber and/or forage crops, but is not prime agricultural land. Golf courses are permitted activities in the Agricultural District provided that they are not located within lands classified as A or B by the University of Hawaii Land Study Bureau.

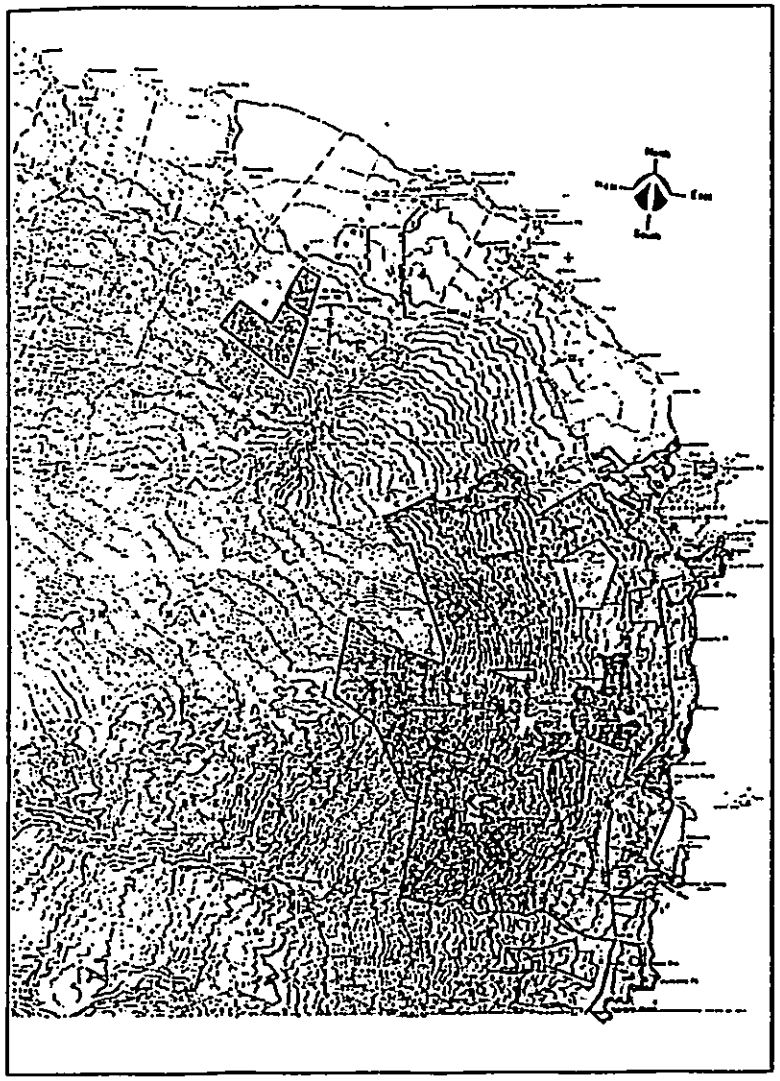

Figure 2. Hana Ranch

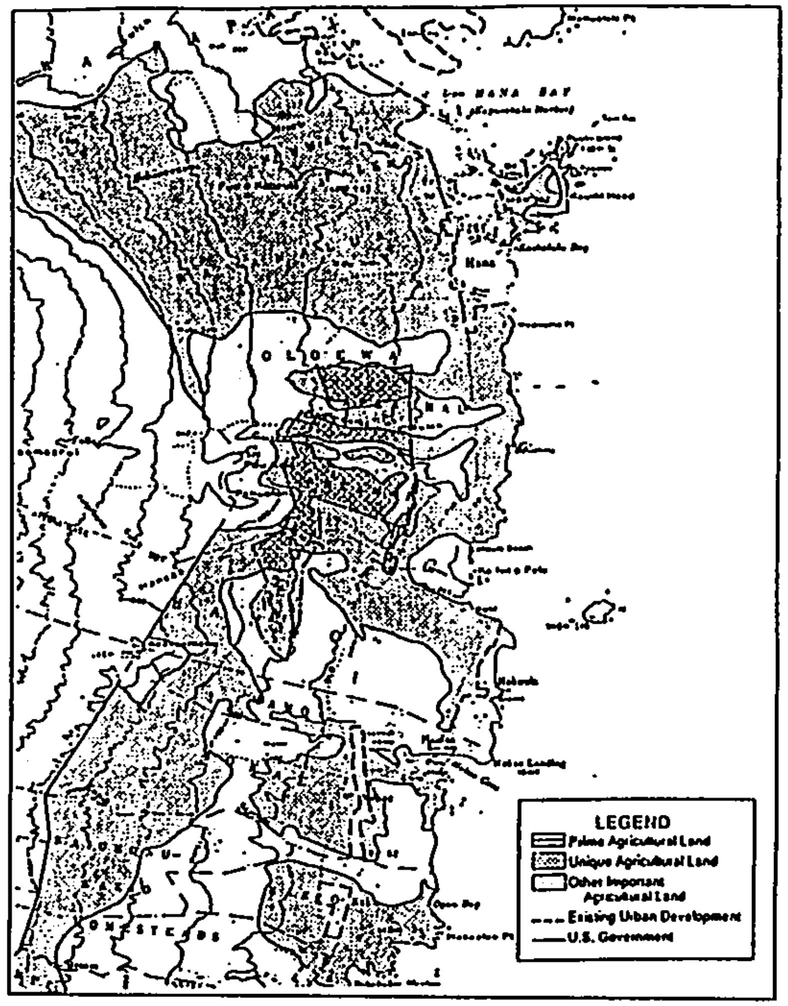

Figure 3. Agricultural Lands of Importance to the State of Hawaii, Hana Ranch Country Club

MAUI COUNTY HANA COMMUNITY PLAN DESIGNATIONS

The project site is designated agricultural by Maui County's Hana Community Plan. Under this plan, a PK-4 zoning designation is required for golf course development.

LAND CAPABILITY CLASSIFICATIONS

Land capability classifications for determing agricultural production feasibility in the report utilize soil capability classifications by the USDA Soil Conservation Service (SCS) and the University of Hawaii Land Study Bureau (LSB) plus on-site observations by the author. The Land Evaluation and Site Assessment System (LESA) established at the request of the Hawaii State Legislature in 1983 is not utilized in this report since the system has not been approved by the State Legislature and has not been formally established in either statutory or administrative form.

SOIL CONSERVATION SERVICE CLASSIFICATIONS (SCS)

SCS soil capability classifications are based on soil profile, topography, water holding capability, drainage, erosion hazard, pH, workability and depth of root penetration. SCS soil capability classifications range from I to VIII, with I being the best. Class I soils have no more than minimal limitations that restrict crop production. Class II have moderate limitations, Class III are marginal and Classes IV to VIII are unsuitable for cultivated crop production, with Class VIII having the most severe limitations. SCS classifications also provide capability groups for sugarcane, pineapple, truck crops, pasture, woodland and wildlife. SCS classifications for the project site are shown in Figure 4 and are described as follows:

Hana Series

The Hana series consists of well-drained soil on upland slopes on Maui. The soils developed in volcanic ash. They are gently sloping to moderately steep, with elevations ranging from nearly sea level to 1,200 feet. Annual rainfall is estimated at about 80 inches for the mean of the project area and is reasonably well distributed throughout the year. The mean annual soil temperature is a moderate 73 degrees F.

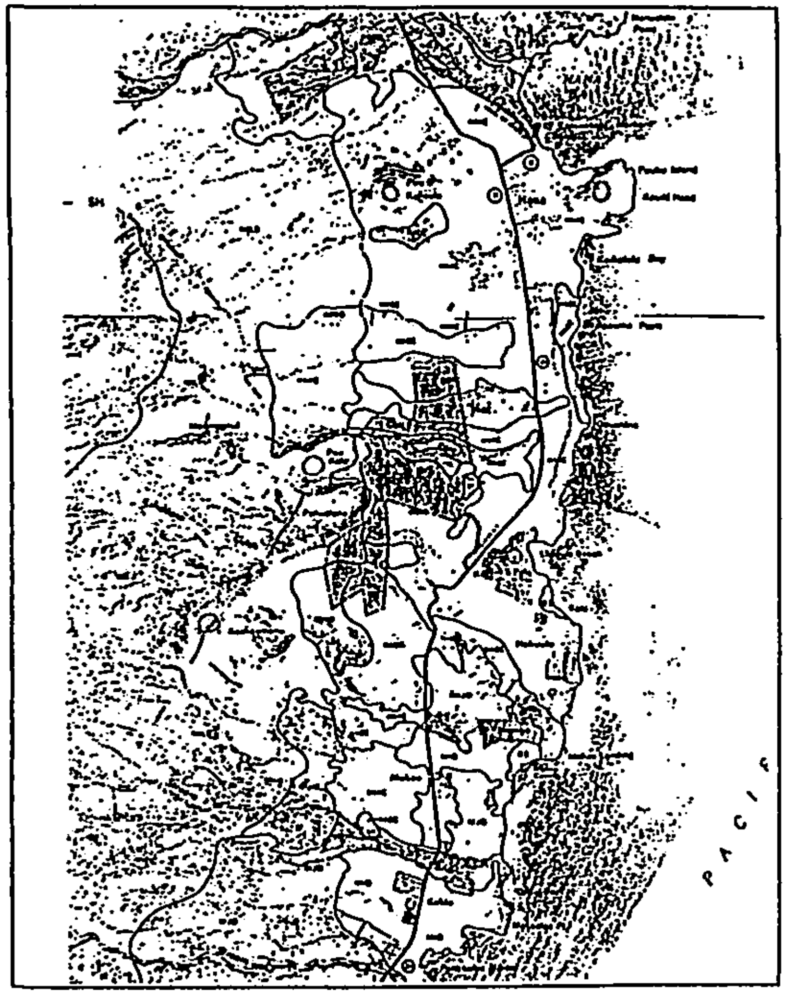

Figure 4. USDA Soil Conservation Service Land Classifications, Hana Ranch Country Club

Hana Silty Clay Loam, Moderately Deep Variant, 3 to 15 Percent Slopes (HKNC).

This subseries encompasses approximately 102 acres or 51 percent of the land area in the project site. It is divided into three separate parcels by two makai-mauka strips of HKOC soil and is cut short by HKOC and HKMD soils on the panhandle of the project area that extends to the South (see Figure 4). On-site assessment indicates that most of the land in the project site has moderate slopes. The topsoil is dark-brown silty clay loam, containing 10 to 15 percent gravel and cobblestones, but no large stones. At present, gravel and cobblestones appear minimal on the surface of the soil, indicating that the texture may have been improved when it was under sugarcane cultivation. The subsoil is indicated to be reddish-brown, very friable silty clay loam, 6 to 14 inches thick, with a subangular blocky structure containing 20 to 30 percent gravel and cobblestones. Some of the subsoil was undoubtedly mixed with the topsoil during cultivation for sugarcane and the two layers could be expected to be more homogeneous at present. The substratum is fragmented aa lava at a depth of 20 to 30 inches.

Runoff is reported to be slow to medium, with a slight to moderate erosion hazard. This was verified during the on-site inspection, which took place during a heavy rainstorm. Very little erosion appeared to be taking place. The soils are moderately steep near cinder cones as indicated by SCS. SCS also indicates some rock outcrops, but very few were evident. The available water holding capacity is indicated to be a low 1.2 inches per foot in the topsoil and 1.4 inches per foot in the subsoil, which would be expected to pose a problem during occasional dry periods.

The soil is classified as IIIe, nonirrigated, which indicates severe erosion problems if cultivated and not protected. The pasture capability if the soils are well managed is indicated to be 8,400 to 14,000 pounds of air-dry forage per acre per year, which is very good. Actual annual carrying capacity is indicated by ranch management to be a very high 1.65 acres per animal unit, without fertilizing. SCS indicates that pasture on this land type is difficult to improve through seeding, fertilization and weed and brush control, but actual conditions indicated less serious problems of weed and brush control. The ranch uses an advanced method of paddock rotation, with minimum time of grazing on each paddock, which is indicated to maximize carrying capacity and minimize problems of brush encroachment.

Capability classifications for this soil, other than for pasture and woodland are not provided by SCS. The IIIs capability classification indicates, however, that the soils are marginal

for cultivated crop production. Sugarcane, although grown on the project site for many years was probably a marginal crop and thus became uneconomic in 1946 during movement into an era requiring higher yields and greater efficiency of production for economic viability. A combination of factors, including difficulty in plowing and fertilizing and difficulty of harvesting during periods of high rainfall probably contributed to the demise of sugar production.

The cobblestones and gravelly conditions of these soils would not be conducive to the production of most vegetable crops and the fairly high and uniform rainfall might be expected to promote disease. Production of bananas in comparable areas suggests that bananas could be grown on the project site, but various problems would limit comparative advantage in relation to competing areas. Continuing rainfall and high humidity would contribute to disease. Extensive fertilizing and continual harvesting would be highly labor intensive. The area is conducive to some types of orchard production. However, commercial orchard production is limited in Hawaii, because of costs, quality and limited market opportunities. On-site observation indicated that macadamia orchards located east of Hana appear to be experiencing some disease problems because of ecologcial conditions.

Hana Extremely Stony Silty Clay Loam, Moderately Deep Variant, 3 to 15 Percent Slopes (HKOC)

This soil includes about 72 acres or 36 percent of the project site. Its conformation at the site consists mainly of strips of land running in a makai-mauka direction that separate parcels of the better HKNC soils. The soil has a profile like that of Hana Silty Clay Loam (HKNC), a moderately deep variant and 3 to 15 percent slopes. It is inferior to HKNC because of stones that cover 3 to 15 percent of the surface and workability is very difficult. There are also some rock outcrops. It includes steep areas near cinder cones. On-site inspection clearly indicate the difference between this soil and HKNC. However, this soil was also used for sugarcane production since it intersperses with HKNC and it appears that some of the stones may have been removed and the texture has been improved. It is given a capability classification of VIs, nonirrigated, which indicates severe limitations because of the erosion hazard and is generally unsuited to cultivation. For grazing, however, it is almost equal to HKNC, except for the more serious erosion problems and the existence of stones, which make pasture improvement difficult. The same problems that apply to vegetable and orchard crop production on HKNC soil also apply to this soil, but are somewhat more serious. The soil can be considered extremely submarginal for these crops.

Hana Very Stony Silty Clay Loam, 3 to 25 Percent Slopes (HKLD).

This subseries contains 12 acres or 6 percent of the project area, located in the South-Makai panhandle of the site. It is situated on the slope of a cinder cone (Puu Kolo) and ranges from moderately steep to steep.

The topsoil is very dark brown and very dark grayish-brown about 12 inches deep. The subsoil is dark brown silty clay loam about 22 inches thick, with a subangular blocky structure. The substratum consists of moderately weathered, pebble-size cinders overlying Aa lava. The topsoil is medium to strongly acid and the subsoil is slightly acid. Permeability is moderately rapid and the runoff is slow to medium, with a slight to moderate erosion hazard. The waterholding capacity is only about 1.2 inches per foot in the topsoil and 1.4 inches per foot in the subsoil. Roots penetrate to a depth of 3 to 4 feet in the better areas. The SCS capability classification is VIs, nonirrigated. This soil is generally unsuited to cultivated crop production, because of the erosion hazard, but has a pasture carrying capacity comparable to the HKNC subseries, except that pasture improvement is more difficult. Some orchard crops could be grown on these soils, but may be subject to disease because of comparatively high rainfall and humidity. Orchard crops may be subject to stress during occasional periods of low rainfall, without irrigation.

Hana Extremely Stony Silty Clay Loam 3 to 25 Percent Slopes (HKMD).

This soil consists of a pocket of 15 acres or 7 percent of the land area in the project site. It has a profile similar to HKLD, except that stones cover 3 to 15 percent of the surface. The subseries includes small, steep areas near cinder cones. The soil is classified as VIs, nonirrigated. It is not adaptable to cultivated crop production, but is used for pasture.

LAND STUDY BUREAU CLASSIFICATIONS (LSB)

LSB classifies soils by land type in which classifications are provided for overall crop productivity ratings, with and without irrigation, and for selected crop productivity ratings for 7 crops; namely, pineapple, vegetables, sugarcane, forage, grazing, orchards and timber.

LSB overall ratings for cultivated crop production and grazing range from A to E, with A being the best. The overall productivity ratings evaluate each land type in its general productive capacity for agricultural use and not for specific crops. The ratings interpret the interacting complex influence of climate, surface relief, drainage, wind velocities and soil under modal cultural practices. Selected ratings for individual crop categories range from a to e, with a being the best. Ratings are generally comparable to those of SCS, but differ somewhat because of fewer categories (A to E for LSB as compared to I to VIII for SCS) and some differences in capability classifications in specific areas. Differences also result from slightly different soil capability criteria. Because of minor differences, the use of both methods provides a more comprehensive evaluation than obtained by the use of one system alone. LSB land capability classifications are shown in Figure 5.

C14

This series is the major soil type in the project site and encompasses about 80 acres or 40 percent of the total. It is located in the central part of the site and is separated by D15 to North and C17 to the South. It is also interspersed with Makai-Mauka strips of D15. Much of this series is the same as SCS HKNC. The overall crop productivity rating is C, nonirrigated. Selected crop productivity ratings are d for pineapple, b for vegetables, c for sugarcane, b for orchards, c for grazing and a for forage. Most of this area is rated IIIs by SCS, which gives a somewhat better rating for grazing and does not classify the land for other individual crops, except for woodland. The unit is nonstony to slighly stony and is moderately well suited to cultivation.

C17

This series includes about 62 acres or 31 percent of the project area. It consists of two parcels; one on the North boundary of the project and the other in the panhandle in the South. The Northern parcel is the same as SCS HKNC, but the Southern parcel is given a lower classification of HKLD by SCS. The overall crop productivity rating is C, nonirrigated, the same as for C14, but some of the individual crop productivity ratings are lower. The selected ratings are d for pineapple, d for vegetables, c for sugarcane, b or orchards, c for grazing and d for forage. The area is stony and poorly suited to cultivation.

D15

This capability classification contains about 57 acres or 28 percent of the project site. It divides the better soils of C14 and C17 in the north section of the project, snakes through C14 and the southern parcel of C17 and includes the southern half of the panhandle in the south of the project. It is given an overall overall crop productivty rating of D, which is not suited to

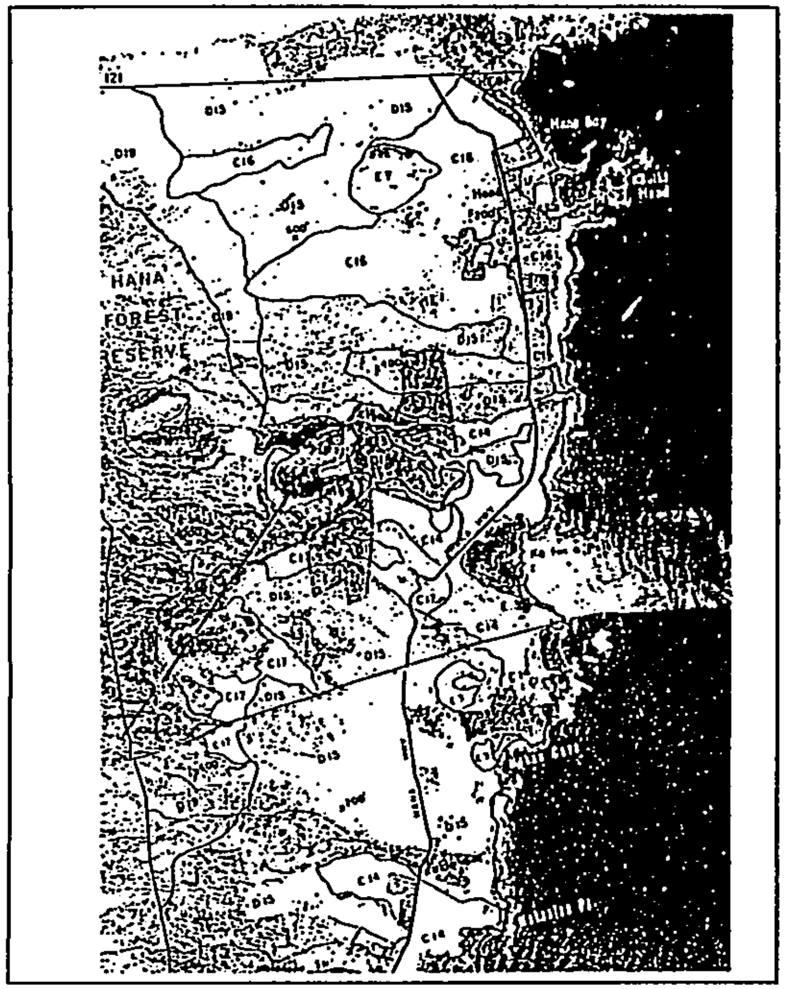

Figure 5. University of Hawaii Land Study Bureau Land Classifications, Hana Ranch Country Club

cultivated crop production, because of stony and rocky conditions. It is rated e for selected crops, except for orchards and grazing for which it is rated c. It includes a major part of the land area classified as HKOC (IVs) by SCS.

E7

This series consists of a 2-acre parcel of land on the slopes of the South mauka cinder cone (Puu Kolo). The soil is given an overall rating of E and is also rated e for all selected crop productivity classifications. The area is very steep and moderately to imperfectly drained. It is not adaptable to cultivation and is marginal for grazing.

SUMMARY - SOILS AND TOPOGRAPHY

SCS and LSB overall land classifications are summarized in Table 1. This table serves the purpose of developing a simple perspective of the detailed foregoing analyses. Both SCS and LSB classifications consider the top two capability classifications, I and II for SCS and A and B for LSB as prime agricultural lands. The Hana Golf Course project has no soils in these top two categories. The third classification, III for SCS and C for LSB applies to soil types that are marginally adaptable to cultivated crop production. Based on SCS land capability classifications, 51 percent of project soils are marginal for crop production and 49 percent are not adaptable to cultivated crop production. LSB classifies 71 percent in the marginal category and 29 percent as not adaptable. But there are exceptions to the overall ratings for certain crops. Both SCS and LSB provide selected crop productivity ratings for important individual crops. LSB provides this information for all soils classified, but SCS generally provides it only for crops that are adaptable to particular soils. SCS provides capability ratings only for grazing and woodland in the project area, whereas LSB provides it for all crop categories.

Table 2 summarizes LSB selected crop productivity ratings for the project site. For vegetables, LSB rates 80 acres in the project as b, which is better than average for vegetable production and 118 acres as d and e, which are not adaptable to truck crop production. SCS doesn't consider vegetables for this area and on-site observation indicates that none of the soils in the project are better than marginal (C) for vegetable production because of the texture of the soil that would make machinery use difficult. Also, the moderately heavy rainfall and cloudy conditions could

Table 1. SCS and LSB Land Capability Classifications, Hana Ranch Country Club

Agency	Soil Type	Capability Classification	Acreage	Percent
SCS	HKNC	IIIs	102	51
	HKOC	IVs	72	36
	HKLD	VIs	12	6
	HKMD	VIs	15	7
LSB	C14	C	80	40
	C17	C	62	31
	D15	D	57	28
	E7	E	2	1
SUMMARY SCS		I & II	0	0
		III	192	51
		IV-VIII	99	49
LSB		A & B	0	0
		C	142	71
		D & E	59	29

Table 2. LSB Selected Crop Productivity Ratings

a. Selected Productivity Ratings by Soil Type

Soil Type	Acreage	Vegetables	Sugarcane	Orchards	Grazing
C14	80	b	c	b	c
C17	62	d	c	b	c
D15	57	e	e	c	c
E7	2	e	e	e	e

b. Acreage of Each Crop in Each Soil Capability Classification

Crop	Soil Capability Classification a	b	c	d & e
Vegetables	0	80	0	121
Sugarcane	0	0	142	59
Orchards	0	142	57	2
Grazing	0	0	199	2

impact adversely on the production of some environmentally sensitive vegetables, such as staked tomatoes.

LSB classifies 142 acres as c (marginal) and 59 acres as d & e (not adaptable) to sugarcane production. These classifications are consistent with the termination of sugarcane production in 1946. For orchard production, 138 acres are classified as b and 56 acres as c. These classifications seem realistic insofar as soil type, topography, drainage and erosion hazard are concerned, since orchard crops would not require annual plowing and rainfall is generally adequate as will be indicated later. But the feasibility of orchard production in the area is also dependent upon other factors, such as the market, which are discussed in other sections of the report.

Adaptability of flowers and foliage to different ecological conditions in Hawaii is highly individual plant specific. Shade houses for potted plant production and stock plant fields are found throughout the state. Some are located in heavy rainfall areas, such as Hilo, and others are located in dry areas, such as the lower elevations in Kona or Molokai. According to University of Hawaii horticulturists, floral and foliage producers in different rainfall and humidity zones select adaptable plants and modify environmental conditions where possible. Where rainfall is excessive, fibre glass roofs can be used to divert rainfall and irrigation is used in dry areas. Heavy rainfall areas promote certain diseases, such as baterial blight of anthuriums and grey mold in dendrobium orchids. Ground production of flowers and foliage is more subject to disease in heavy clay soil areas than on aa lava soils. A critical consideration for the production of potted flowers and foliage is a steady supply of near potable water of 3,000 gallons per acre per day. Obviously, the quality of the ground soil is not a consideration for the production of potted plants.

The foregoing analysis would indicate that certain species of flowers and foliage could be grown on the project site. The production of potted flowers and foliage would require an adequate source of water for daily application. Specifically, certain varieties of stock plants, ginger and anthuriums could be grown at the project site. Various potted foliage plants and some varieties of orchids could also adapt.

Nearly all of the land area is considered by LSB to be marginal for grazing, whereas SCS considers most of the land well adapted to grazing, with a relatively high carrying capacity, except in the rocky areas. On-site inspection confirms the SCS capability classifications for Hana Ranch pastureland under good management. Cattle grazing is one of the best agricultural use of Hana Ranch lands considering, with respect to soil type and ecological

conditions. This must , of course, be considered in conjunction with the other criteria for agricultural feasibility.

CLIMATE

Temperature, Wind and Microclimatic Conditions

The average annual temperature recorded at Hana Airport is approximately 75 degrees, with highest and lowest temperatures amounting to 91 degrees and 50 degrees, respectively. Based on other areas in the state with similar climates, mean monthly temperatures could be expected to range from about 70 degrees in February to 77 degrees in August. Temperatures are near optimal for subtropical crops, but slightly higher than optimal for beef cattle production.

Prevailing winds as recorded at Hana Airport and Hana Ranch and reported by Hana Ranch personnel are mild at 10 to 15 miles per hour. The conformation of the land area in relation to Haleakala Crater is indicated to cause the winds to be lighter than in most other windward areas in the state. Winds are typically northeasterly during the day and downslope from the west during

the evenings. Thus prevailing winds are favorable to truck crop, orchard and flower and foliage production. Farmers in surrounding areas report, however, that occasional Kona storms from the South may cause severe damage to vine plants, bananas and orchard crops.

Rainfall in Relation to Plant Requirements

There are no rainfall records for the specific area of the proposed Hana Ranch Golf Course. However, recordings at Hana Ranch headquarters at an elevation of 130 feet provide a close approximation of rainfall at the makai boundaries of the project site. Recordings at Hana airport are comparable, but slightly higher than those at Hana Ranch. The only available data for estimating rainfall at the higher elevations of the project site consist of recordings at the former Kaeleku Sugar Company at an elevation of 300 feet Mauka of Hana Airport. But the Kaeleku recordings overestimate rainfall at the higher elevations on the project site because rainfall decreases from North to South in the Hana area. Hana Ranch recordings (SKN 354.00) are shown in Table 3 and Kaeleku Sugar recordings (SKN 355.10) are shown in Table 4.

Truck crops and orchards require a gross water delivery of about 5 acre-inches per month or 60 acre-inches annually, if evenly

Table 3. Rainfall Recorded at SKN 354.00, Hana Ranch, 1907-1978

Month	Maximum	75% a/	Median	Mean	25% b/	Minimum
			(inches)			
Jan	27.6	9.6	5.6	7.4	4.4	0.3
Feb	33.1	7.3	4.7	5.9	3.1	0.5
Mar	24.1	10.5	6.6	7.8	3.6	0.8
Apr	35.8	9.0	5.6	7.6	3.4	1.5
May	14.1	4.8	3.9	4.5	2.6	1.3
Jun	8.7	3.9	3.1	3.4	2.5	1.2
Jul	9.5	5.1	4.0	4.3	3.1	1.8
Aug	17.8	6.0	4.4	4.9	2.7	0.6
Sep	26.8	5.3	3.8	4.5	3.1	1.5
Oct	18.5	9.0	6.1	6.9	3.8	2.5
Nov	20.1	7.9	5.4	6.4	3.5	1.6
Dec	31.8	10.1	6.1	7.5	4.1	1.5
Ann	125.9	76.9	65.5	69.2	57.4	38.7

a/ 75% of recordings did not exceed amounts indicated.

b/ 25% of recordings were below amounts indicated.

Source: Department of Land and Natural Resources, Water and Land Development Division, State of Hawaii

Table 4. Rainfall Recorded at SKN 355.10, Kaeleku Sugar, 1927-1945

Month	Maximum	75% a/	Median	Mean	25% b/	Minimum
Jan	16.7	11.4	7.5	8.1	5.4	1.4
Feb	37.9	11.8	7.2	10.0	4.6	1.8
Mar	31.6	15.7	9.4	11.5	6.8	3.4
Apr	27.7	13.4	11.7	11.1	4.5	3.5
May	18.1	10.4	7.3	8.1	5.1	2.9
Jun	10.0	6.9	5.3	5.7	4.4	2.6
Jul	12.6	9.1	7.3	7.6	5.9	4.5
Aug	12.5	9.4	7.8	7.8	6.3	3.3
Sep	14.1	9.4	7.2	7.8	5.1	3.2
Oct	30.2	9.5	5.9	8.2	5.5	3.3
Nov	22.1	10.8	9.0	9.1	5.1	3.1
Dec	21.3	13.1	9.4	10.0	5.8	3.1
Ann	140.3	114.4	102.7	104.8	93.3	73.8

a/ 75% of recordings did not exceed amounts indicated.

b/ 25% of recordings were below amounts indicated.

Source: Department of Land and Natural Resources, Water and Land Development Division, State of Hawaii distributed. Bananas require a gross delivery of 6.7 acre-inches per month or 80 acre-inches annually, if evenly distributed. Pasture will survive under varying amounts of water delivery, but high yielding pasture in the area under good management could be expected to effectively utilize at least 7 acre-inches per month or 84 acre-inches annually, assuming even distribution by months. Sugarcane is a heavy water user and requires an even distribution of at least 8-acre inches per month for maximum yields under Hana climatic conditions.

Median annual rainfall is 65.5 inches at Hana Ranch and 102.7 inches at Kaeleku. The actual mean for the project site could be expected to be somewhat less than midway between the two recordings because of the tendency for less rainfall from North to South in the area. Eighty inches would seen to be a meaningful estimate. Mean monthly distribution within the year is reasonably uniform. Hana Ranch recordings are somewhat low during the warm months, but since rainfall increases by elevation in the area, expected higher medians for these months are probably adequate.

Whereas median annual and monthly rainfall are indicated to be adequate for the crops considered, occasional periods of inadquate rainfall occur. During 25 percent of the time, rainfall may be less than adquate for any month of the year (Table 3). This overemphasizes the problem, however, since low rainfall months would appear in different years and may be interspersed with adequate or heavy rainfall months. Also, under very rare occasions, rainfall for any one month may be negligible. Pastures and orchard crops could survive during occasional negligible rainfall months, but this could pose a serious problem for truck crop production. Shade or greenhouse floral production is a special case that requires a daily uniform delivery of 3,000 gallons of water per acre and thus would require irrigation. Rainfall would be generally adequate for such plants as ginger and foliage stock plants, although supplemental irrigation would be necessary during dry periods for opitimal production.

Uniform seasonal distribution of rainfall does not meet the requirements of all crops. Coffee, for example, requires a unique climate with heavy rains prior to flowering and a dry period during harvesting, such as in the major production areas in Kona. This climate can be simulated through proper seasonal adjustment of irrigation water in lower rainfall areas. The fairly high and uniform rainfall in Hana does not provide the required climatic conditions for coffee production.

In summary, rainfall is indicated to be adequate at the project site for pasture and and some orchard crops, but is occasionally inadequate for truck crops. Development of supplemental irrigation for occasional truck crop needs would very likely be

prohibitive in cost unless there is sufficient acreage to allow economies of scale, which is not likely because of market limitations.

SALES POTENTIALS AND COMPARATIVE ADVANTAGE

A major criterion and often the most crucial one in determining agricultural economic feasibility of a parcel of land is the sales potential for crops that are ecologically adaptable. This involves determining the market potential for specified crops plus the comparative advantage of these crops in the marketplace. Sales potentials for those crops that are adaptable to soils in the project site are discussed below.

Beef

The market for Hana Ranch cattle under the current production system is firmly established and became marginally economically viable in 1991, not considering opportunity costs for the land. This is in contrast to previous years, when the ranch was economically viable only about one-third of the time. Under the current system, eight-month old weaner calves are shipped by surface transportation to California buyers who in turn market them for further development in areas where various feeding alternatives are less costly and more readily available than in Hawaii. The limited numbers of old cows and bulls in the operation are marketed on Maui. It is implied that this system is more economic than growing the calves to a sufficient range weight for sale as grass fed beef or as feeder cattle to Hawaii feedlots, which are disadvantaged by high costs of grains and supplements, which must be imported from the U.S. mainland. The Hana Ranch cattle production and marketing system thus counters the decreasing comparative advantage of cattle feedlot operations in Hawaii.

Ironically, although many beef producers in Hawaii face serious economic problems, the market for beef in Hawaii far exceeds the ability of Hawaii producers to supply it. The market supply of beef and veal in Hawaii during the most recent 10-year period increased from a carcass weight of 94.8 million pounds in 1981 to 111.5 million pounds in 1990, but Hawaii producer's share of this market decreased from 30 percent (28.7 million pounds) in 1981 to 26 percent (29.1 million pounds) in 1990. In 1990 the market share of beef marketings in Hawaii was 56 percent for the U.S. mainland, 26 percent for Hawaii and 18 percent for foreign suppliers. The marginally profitable Hana Ranch cattle operation is an exception to the feasibility of beef production in Hawaii in general.

Truck Crops

LSB classifications indicate that an area of 78 acres or 40 percent of the project site is ecologically adaptable to vegetable (truck crop) production, which would provide a considerably more intensive use of the land than cattle grazing. But the variety and acreage of vegetable crops that can be grown in Hawaii is extremely limited. Most major vegetables, such as irish potatoes, onions, asparagus and carrots, are better adpated to more temperate climates. Even Kula onions and cabbage are grown in cooler areas at higher elvevations than at the project site.

For vegetables that are adapted to production in Hawaii, the sales potentials are essentially the quantities required to displace imports and the acreage required to produce these quantities is minimal. Table 5 indicates the acruages of selected vegetables that might be grown on the project site. Displacement of imports for all crops considered would only require 761 acres.

Maui county produces 83 percent of snap beans grown in Hawaii, but the opportunity for expansion is limited (Table 5). Only 35 acres would be required to displace the 422,000 pounds of imports at an expected yield of 12,000 per acre.

Maui county (primarily Molokai) is also the primary producer of sweet corn in the state, with 79 percent of state production in 1990. Imports are limited and would require only 29 acres of additional Hawaii production for displacement.

Maui is a minor producer of cucumbers and produced only 22 percent of 3,550 pounds of state production in 1990. Displacement of imports would require only 98 additional acres of Hawaii production.

Eggplant for the Hawaii market is produced primarily in the state, but not in Maui county. Only 12 acres would be required to displace imports. Maui county is the primary producer of green peppers in the state, but the bulk of the supply of green peppers is imported. Displacement of imports would require and additional 133 acres of Hawaii production.

Most sweetpotatoes for the Hawaii market are produced in the state, with Maui county (probably mostly Molokai) being the primary producer. Only 54 acres would be required to displace 1990 imports.

Tomatoes offer the best opportunity for expansion in Hawaii vegetable production and 400 acres would be required to displace imports. Maui produces about half of the state crop, but state

Table 5. State of Hawaii and Maui County Market Supplies and Acreage Required to Displace Imports of Selected Vegetables Which Might Be Grown on Hana Ranch

Crop	Market Supply Hawaii	Market Supply Maui	Market Supply Imports	Yield Per Acre	Acreage Required to Displace Imports
	(1,000 pounds)			(pounds)	(acres)
Beans, snap	990	820	422	12,000	35
Corn, sweet	2400	1900	152	8,000	19
Cucumbers	3550	790	1968	20,000	98
Eggplant	1060	25	351	30,000	12
Peppers, green	1560	1390	2652	20,000	133
Sweetpotatoes	1600	1360	1080	20,000	54
Tomatoes	4600	2250	13996	35,000	400
Total					751

Source: Statistics of Hawaiian Agriculture, Hawaii Agricultural Statistics Service, Hawaii State Department of Agriculture, 1990.

production constitutes only 25 percent of Hawaii consumption. Most Hawaii production is in greehouses, where irrigation water and reasonable access to the market are required. It is obviously not a crop to be considered for Hana Ranch, where this crop, alone, could not justify the development of an irrigation system.

Not only is the opportunity for vegetable production in Hawaii limited, but most of the crops considered are better adapted to other areas in Hawaii than to Hana Ranch. Thus truck crops are not indicated to be a viable commercial agricultural alternative for the project site, although certain varieties are ecologically adaptable. This does not preclude some production of these crops for use in Hana and nearby areas.

Orchard Crops

A limited number of orchard crops, such as citrus and macadamias are marginally ecologically adaptable to the project area which justifies an investigation of the market potential and the ability to compete with other production areas in the market place. Coffee and commerical varieties of mangoes are not well adapted ecologically to the project site and consideration of the sales potential is not called for.

Hawaii produced citrus crops have generally not been able to compete favorably with imports and the market for them is extremely limited. In 1990, the Hawaii market utilized 16 million pounds of oranges from the U.S. mainland and only 1.3 million pounds of of Hawaii produced oranges. About 2 million pounds of grapefruit were imported from the U.S. mainland and Hawaii production was negligible. There may be some opportunity of increasing Hawaii's market share of citrus fruit through quality control, but no meaningful breakthrough is evident at present. Most temperate climate fruits come from the U.S. mainland or from foreign countries.

Hawaii is the major world producer of macadamia nuts, but this situation is changing rapidly as production expands in foreign countries. The Hawaii industry has reached a point where production exceeds demand under the existing level of market development. Prices have dropped below commercial costs of production and many farmers are unable to market their nuts. Marketing problems will become more serious as more of the 22,000 acres in plantings reach maturity and yields per acre increase. The U.S. International Trade Commission has indicated that there is almost no possibility that stronger trade restrictions will be imposed to protect the Hawaii macadamia industry. Research by the author of this report indicates that the market will expand somewhat through further development, but that expansion may benefit foreign suppliers.

Bananas

Hawaii was self sufficient in banana production until 1967, after which time imports from Central and South America attained an important share of the market. Out of a total market supply of 13.9 million pounds of bananas in 1981, the market share of Hawaii producers was 43 percent. Some progress was made in displacing imports during the past 10 years and in 1990 Hawaii supplied 54 percent of the 19.1 million pounds marketed in the state. At an expected yield under good management of 30,000 pounds per acre, 377 acres of additional Hawaii production would be required to displace 1990 imports of 11.3 million pounds.

With improved production and marketing practices, there is a reasonably good possibility that Hawaii producers could displace a major portion of banana imports. Trends indicate, however, that there is little likelihood of a major expansion in banana production on Maui. The Puna area on the island of Hawaii has been the most successful in expanding production during recent years. Output from Hawaii county increased from 2.1 million pounds from 130 acres harvested in 1981 to 7.0 million pounds from 355 acres harvested in 1990. Oahu production, which is predominantly Brazilian (apple) bananas, increased from 2.7 million pounds from 425 acres in 1981 to 3.4 million pounds from 485 acres in 1990. During the same period the small Maui-Molokai banana industry increased from 0.2 million pounds from 35 acres harvested in 1981 to 0.5 million pounds from 50 acres harvested in 1989, but fell back to 0.25 million pounds from 35 acres in 1990.

Whereas bananas would be fairly well adapted to the project site ecologically, some disadvantage in relation to high production competing areas could be expected. The site would also have a transportation disadvantage. These conditions could impact adversely on the ability to compete in the marketplace.

Floriculture and Nursery Products

The Hawaii floriculture and nursery products industry has undergone a marked expansion for several years. During the past 10 years, gross sales value at the farm level increased from $29.5 million in 1981 to $70.3 million in 1990. Most of the production in 1990 was on the islands of Hawaii and Oahu, with market shares amounting to 48 percent and 37 percent, respectively, for a combined total of 85 percent. Maui and Molokai combined produced $9.1 million in floriculture and nursery products or 12.8 percent of the state total in 1990. Production has continued to expand and its value increased from $4.0 million in 1981 to $9.1 million in 1990.

Floriculture and nursery production in Hawaii is highly concentrated and thus requires only a small land area. Land devoted to the production of flowers and foliage increased by only 688 acres during the past 10 years, from 1,610 acres in 1981 to 2,298 acres in 1990.

Since open field and greenhouse-shadehouse operations are distinctly different in land requirements, a breakdown of acreage devoted to each type of production is useful. For the state, open field production increased from 895 acres in 1981 to 1,595 acres in 1990, for a total increase of 700 acres or 70 acres per year. The acreage occupied by greenhouse-shadehouse production, on the other hand, decreased slightly from 715 acres in 1981 to 703 acres in 1990. Maui-Molokai open field production increased by 240 acres or 24 acres per year during the 10-year period, from 255 acres in 1981 to 495 acres in 1990. But greenhouse-shadehouse production increased by only 11 acres or 1.1 acres per year, from 23 acres in 1981 to 34 acres in 1990.

The foregoing analysis indicates that although the Hawaii floriculture and nursery products industry has contributed substantially to diversifed agricultural income, the land area required for this industry is minimal and new acreage requirements based on past trends are very small. The analysis, based on past trends, indicates that new acreage requirements annually amount to only 24 acres for field production and essentially no additional land for greenhouse-shadehouse production. The opportunity to share in part of the indicated need for expansion depends in part on transportation advantage. In this respect Hana Ranch would be at an apparent disadvantage.

The market analysis indicates that the sales potential for the production of flowers and foliage on Hana Ranch is extremely limited. This does not preclude some production, however. There would, for example, be compatability between a limited floral and foliage enterprise and the Hana Hotel visitor operation. This possibility deserves investigation and such a development could lead to additional production for other markets.

Sugarcane

Under current conditions, with import barriers protecting the U.S. sugar industry, the sales potential itself is not a limiting factor to Hawaii sales of sucrose. But the fact that sugarcane became uneconomic and discontinued in the area in 1946, with the related demise of the sugar mill, there is no possibility of a revival of the industry in Hana. Particularly crucial are marginality of production, high labor costs, prohibitive transportation costs and inadequate acreage of adaptable land to permit necessary economies of scale.

ECONOMIC VIABILITY AND INTENSITY OF PRODUCTION

This section provides mean estimates of expected gross and net returns and employment for enterprises that are at least marginally adaptable to the priect area.

Beef

Beef production is the least intensive alternative for the project area, with estimated gross returns of about $84 per acre for 1991. It is not possible to determine historical profitability of ranching for the project area alone, since data are available only for the entire ranch operation. The ranch provided positive net returns to land and risk, before land cost, in 1991, but was profitable for only 11 of the past 29 years (Keola Hana Maui). The agricultural opportunity cost for land might be considered minimal for much of the land area of the ranch, since it is ecologically adaptable only to grazing or forestry, but this does not apply to the project site. Based on comparative soil quality, prorated cattle grazing returns per acre for the site could be expected to be higher than for the ranch as a whole and there are potentially viable alternative uses of the land. The grazing operation uses a minimal amount of labor compared to most agricultural enterprises. A prorating of employment to the 201 acres in the project area is estimated at less than 1 man-unit.

Bananas

Modification of a study on costs and returns for bananas by Scott suggests a yield of 20,000 pounds per acre for Williams bananas, which provides a gross value per acre of $7,500 per acre at 35 cents per pound. The crop requires a high level of labor and fertilizer input and annual costs are estimated at $7,000, allowing a net return to land & risk (before charging for land cost) of $500 per acre, assuming no major losses from disease or Kona winds, which is unlikely. This highly labor intensive crop would provide employment for an estimated 24 man-units in the 196-acre golf course area.

Macadamias

Estimates for the economic viability and intensity of macadamia production are derived from a study by Scott, Sisson, Kanda and Yeap. The projected maximum yield at orchard maturity for the project site is 5,000 pounds per acre in-shell. At an expected price of 90 cents per pound, gross returns would amount to $4,500 per acre and, costs, not including land, are estimated at $4,050, providing a net return to land and risk of $450 per acre, assuming no serious losses from disease or insects. The Hawaii macadamia industry currently has a surplus of nuts in relation to demand, partly because of cheaper imports, and the price recently dropped to 65 cents per pound in-shell, which is below costs of production for many producers. Even at a price revival to 75 cents per pound, returns would drop to $3,700 per acre, with a net loss of $300 per acre to land and risk for the project area. The long run outlook for developing new macadamia orchards is not promising. Macadamias require a very long term investment and the risk associated with such an investment is major. There is no income until the first commercial crop at year 7 and full production does not occur until years 13-15. The crop is labor intensive and would provide employment for an estimated 17 man-units (full time equivalent on the 196 acres).

Truck Crops

Since several truck crops are marginally adaptable to the project area, a composite budget analysis is utilized for estimating costs and returns and employment requirements. This composite includes snap beans, cucumbers, green peppers, and sweet potatoes. Staked, field produced tomatoes are not included, because most tomatoes are produced in green houses in Hawaii. These crops are highly intensive and could be expected to provide a mean gross of $7,000 per acre and a net of $3,000, not considering land costs. This, again, assumes no serious losses from disease, insects and other environmental problems. Although these crops could be grown in the project area, they are better adapted ecologically to other areas in the state and thus would not likely be able to compete in the marketplace even if though they could be grown in the project area.

Floriculture and Nursery Products

Flowers and foliage plants are the most intensive major agricultural crops produced in Hawaii. The average gross return for all types of production amounted to $30,600 per acre in 1990. Because of the huge variety of flowers and foliage produced, estimates of net returns are beyond the scrope of this report. Potted flowers and foliage are much more intensive than the average for all types of floricultue and nursery production. An updating of a study of costs of production of potted flowers and foliage by the author indicates a gross return of $80,00 per acre and a net return of $10,000 per acre. The operation is also labor intensive and requires one to 1 1/2 man units per acre. The analysis assumes efficient management and optimal production conditions and provides a guide as to what could be expected. Actual gross and net returns could be expected to vary considerably from this economic model, since both input and output values differ for each individual situation. Less than

optimal conditions would readily result in a loss for this sensitive type of enterprise.

Based on the various feasibility criteria used in the report, there is justification for at least limited production of flowers and foliage on Hana Ranch, particularly since such production would be compatible with the hotel visitor operation. With this start, the possiblity of expansion into a larger market should be researched. Further expansion may not be feasible because of transportation disadvantages and the need for developing potable or near potable water at the rate of 3,000 gallons per acre per day. In any event, the production of flowers and foliage would require only a very limited amount of land area, which would probably be best located near the highway, rather than on lands at the project site.

Summary, Economic Viability and Land Use Intensity

Of the various agricultual enterprises considered, floriculture and nursery crop production is by far the most intensive, both in gross and net returns and in labor requirements. Livestock grazing is by far the least intensive insofar as gross returns per acre are concerned. But some of the more intensive agricultural enterprises are estimated to provide negative net returns because of ecological problems and related high costs of production. Other crops, although at least marginally adaptable ecologically, would not be able to compete with other production areas with greater comparative advantage in the markeplace. Thus the potential for physical production of these crops, alone, will not contribute to economic viability. Cattle production under the existing production plan is a proven, profitable enterprise. The foregoing analysis suggests that continuation of livestock production may provide the least uncertainty of agricultural alternatives considered.

IMPACT OF CONVERSION OF LANDS TO HANA RANCH GOLF COURSE ON THE ECONOMIC VIABILITY OF HANA RANCH

Withdrawal of 201 acres of grazing land for the Hana Ranch Golf Course would reduce grazing capacity by approximately 6.1 percent (based on an estimated 3,316 acres currently used for pasture). The particular location of the golf course would also have the effect of dividing the grazing area and cause some reduction in operating efficiency in transferring cattle from paddock to paddock in the rotation system. This would necessitate driving the cattle around the gold course or modifying grazing procedures to avoid transferring cattle from one side of the golf course barrier to the other. These changes would be expected to cause some increase in labor per animal unit and possibly some reduction in cattle weight gains per time unit of grazing. But the overall effect on ranching operations because of this inconvenience could be expected to be minimal.

The 6.1 percent reduction in carrying capacity in itself would reduce maximum utilization of a fixed number of employees. Because of the small work force required for ranch operations, reduction in employment to compensate for the 6.1 percent loss in acreage would not be possible.

The ranch proposes to offset the problem of reduced carrying capacity and reduced efficiency by clearing a sufficient amount of land areas for grazing to offset any land loss to golf course use. Intensifying grazing capacity for given land areas through soil improvement is also under consideration. The proposed area for clearing consists mostly of SCS IVs (LSB D) soils, which have a somewhat lower carrying capacity than the average for lands displaced. Thus an area of new pasture development somewhat larger than that displaced would be required.

As indicated, the loss of efficiency in the ranch operation as a result of golf course development can be compensated for by additional pasture development. But the additional pasture could be used to increase the size of the operation and perhaps increase efficiency if it were not designated to compensate for acreage lost to the golf course, although this is a minor consideration in total ranch operations.

To summarize, there is indication that the Hana Ranch Golf Course would have some adverse impacts on ranch operations, but these impacts would be expected to be relatively minimal. The proposed golf course would provide much more intensive use of the 196 acres, including both revenue and employment opportunities.

LAND REQUIREMENTS IN RELATION TO AVAILABILITY OF AGRICULTURAL LAND ON MAUI

Trends in acreage in crop production provide is a meaningful indicator of the need for agricultural land in a given area. For Maui, it is necessary to use the trend data for the county, since Maui, Molokai and Lanai data are combined for most categories in Statistics of Hawaiian Agriculture (1). Based on historical data on agricultural production on the three islands, it is possible to obtain a rough determination of county trends in acreage that relate specifically to the Island of Maui. The following comparisons are based on changes during the most recent 10-year period.

Acreage in cultivated crop production for Maui county decreased by a very substantial 24 percent from 83,600 acres in 1981 to 63,200 acres in 1990. Most of this decrease was in sugarcane and pineapple acreage. The indicated decline of 4,700 acres in sugarcane occurred on Maui, which was the only one of the three islands with commercial sugarcane production. Land in pineapple declined by 11,900 acres or 40 percent during the 10-year period. Most of this decline was on Maui and Lanai, since the bulk of Molokai acreage had been phased out earlier. The comparatively small area devoted to the production of vegetables, melons and miscellaneous crops declined from 6,400 acres in 1981 to 4,100 acres in 1990, despite an increase in vegetable and melon production on Molokai.

Trends in livestock production can be restricted to beef cattle, since other livestock alternatives are not indicated to be feasible for Hana Ranch. Cattle statistics, which are reported

separately for the island of Maui, indicate a decrease in the number of beef cows from 15,300 head in 1981 to 12,700 head in 1990. Marketings of all cattle and calves decreased from 10,300 head in 1981 to 8,600 head in 1990.

The 63,200 acres in crop production in Maui county in 1990 compare to a total land area of 408,000 acres zoned Agricultural by the Hawaii State Land Use Commission (249,064 acres on Maui, 111,657 acres on Molokai and 47,280 acres on Lanai). According to Land Study Bureau classifications, the land acreage zoned Agricultural includes large areas of land that are submarginal or infeasible for crop production. This is based on the standard that only lands classified as A, B and C are adaptable to cultivated crop production, although some D lands are marginal for grazing and are usable in some instances for crop production if surrounded by better lands or modified to permit agricultual use.

The Land Study Bureau in 1967 classified 32,678 acres as A, 20,045 acres as B and 38,425 acres as C for a total of 91,148 acres adaptable to cultivated crop production. As of January, 1991, the Hawaii State Land Use Commission classified 19,337 acres as Urban and 3,747 acres as Rural. These classifications include all uses other than Agricultural or Conservation. An undetermined amount of lands classified as Urban and Rural would include LSB capability classifications of A, B and C, but probably limited amounts of A and B, thus reducing lands adaptable to cultivated crop production to somewhat less than the 91,148-acre total, but still considerably in excess of the 63,200 acres in cultivated crop production. The fact that some areas of crop production include D soils would further widen the gap between lands in crop production and lands adaptable to crop production.

Another indication of land availability for crop production or grazing is the change in acreage zoned agricultural. During the subject 10-year period, land zoned agricultural on the island of Maui decreased by only 3,744 acres, from 411,744 acres in 1981 to 408,000 acres in 1990 and land zoned Urban and Rural increased by only 3,674 acres, from 19,410 acres in 1981 to 23,084 acres in 1990. This compares with the decrease of 20,400 acres in cultivated crop production during the same period.

In summary, the decline in crop production during the most recent 10-year period far exceeded both the acreage reclassified out of the Agricultural zone and the increase in the acreage zoned Urban. Based on these trends, there is not indication that the 196 acres to be converted from agriculture to golf course use would have a significant negative impact on acreage needed for crop production and grazing on Maui.

SELECTED REFERENCES

1. Department of Agriculture, State of Hawaii, State Agriculture Plan, October, 1982, 31 pp.
2. Department of Planning and Economic Development, State of Hawaii, The Hawaii State Plan - The Economy, 1977, pp. 6-1 to 10-13.
3. Department of Business, Economic Development and Tourism, The State of Hawaii Data Book - A Statistical Abstract, Various Issues through 1991.
4. Division of Land and Water Development, Rainfall Atlas of Hawaii, Report R76, Department of Land and Natural Resources, State of Hawaii, June, 1986, 267 pp.
5. Division of Land and Water Development, Median Rainfall - State of Hawaii, Circular C88, Department of Land and Natural Resources, State of Hawaii, June, 1982.
6. Earthplan, Social Impact Assessment for Hana Ranch Country Club, Prepared for Keola Hana, Inc. (included in Hana Ranch Golf Course Environmental Assessment by Pacific Planning and Engineering, Inc.), January, 1991.
7. Hawaii Agricultual Reproting Service, Statistics of Hawaiian Agriculture, Hawaii State Department of Agriculture in Cooperation with USDA, Various Issues Through 1990.
8. Hawaii Soil and Water Conservation Districts, State of Hawaii Soil and Water Conservation Program, Report No. R 67, Department of Land and Natural Resources, State of Hawaii, November, 1980, 26 pp. (plus maps).
9. Hawaiian Sugar Planters Association, Hawaiian Sugar Manual, 1991.
10. Keola Hana Maui, Inc., Unpublished data on Hana Ranch Operations
11. Land Study Burea, Detailed Land Classification - Island of Maui, Land Study Bureau, University of Hawaii, LSB Bulletin No. 7, May, 1967.
12. Mogi, H. Planning and Research, Inc., Statewide Agricultual Park Action Plan - Phase II - Implementation Program, Hawaii State Department of Agriculture, February, 1984, 249 pp.
13. Pannel Kerr Foster, Economic Impact of Proposed Hotel Hana Maui Golf Course, January, 1991.

14. Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai - State of Hawaii, SCS, USDA, in Cooperation with the University of Hawaii Agricultural Experiment Station, August, 1972, 232 pp.

15. Scott, Frank S. Jr., John S. Sisson, Maurice Kanda, and Teck C. Yeap, Economics of Macadamia Nut Production in Hawaii, Research Series 59, HITAHR, College of Tropical Agriculture and Human Resources, University of Hawaii, December, 1989, 79 pp.

16. Scott, Frank S. Jr., Economic Viability of Banana Production in Hawaii, 18th Annual Hawaii Banana Industry Association Conference, August, 1986, pp.33-50.

17. U.S. Department of Agriculture, Economic Research Service, Food Consumption, Prices, and Expenditures, 1968-89, Statistical Bulletin No. 825, May, 1991, 148 pp.

APPENDIX D

WATER RESOURCES AND SUPPLY FOR PROPOSED HANA RANCH COUNTRY CLUB

Prepared by Water Resource Associates, July 1992

WATER RESOURCES AND SUPPLY
For
PROPOSED HANA RANCH COUNTRY CLUB

Hana, Maui

Prepared for

Pacific Planning & Engineering, Inc.

Water Resource Associates

July 1992

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WATER RESOURCES AND SUPPLY
For
PROPOSED HANA RANCH COUNTRY CLUB

INTRODUCTION

Keola Hana Maui, Inc. is proposing to develop an 18-hole golf course with related facilities on sloping pasture lands located approximately one and a half miles south of Hana town.

This report assesses the water resources and availability of water in the Hana area, and relates them to the project's water requirements and potential impacts. The water resources, sustainable yield of the area, existing sources of supply, and the project's water requirements and proposed water supply are discussed.

PROPOSED PROJECT

The proposed project site is located on the mauka side of coastal Highway 31 (Hana Highway) between two cinder cones, Puu Kolo and Ka Iwi o Pele (Figure 1). The project will utilize approximately 210 acres for an 18-hole golf course which will include water features, a clubhouse, a driving range, and a parking area. A lake will be included among the water features. The clubhouse will include men's and women's locker facilities, pro shop, restaurant, snack shop, administrative offices, and community meeting rooms.

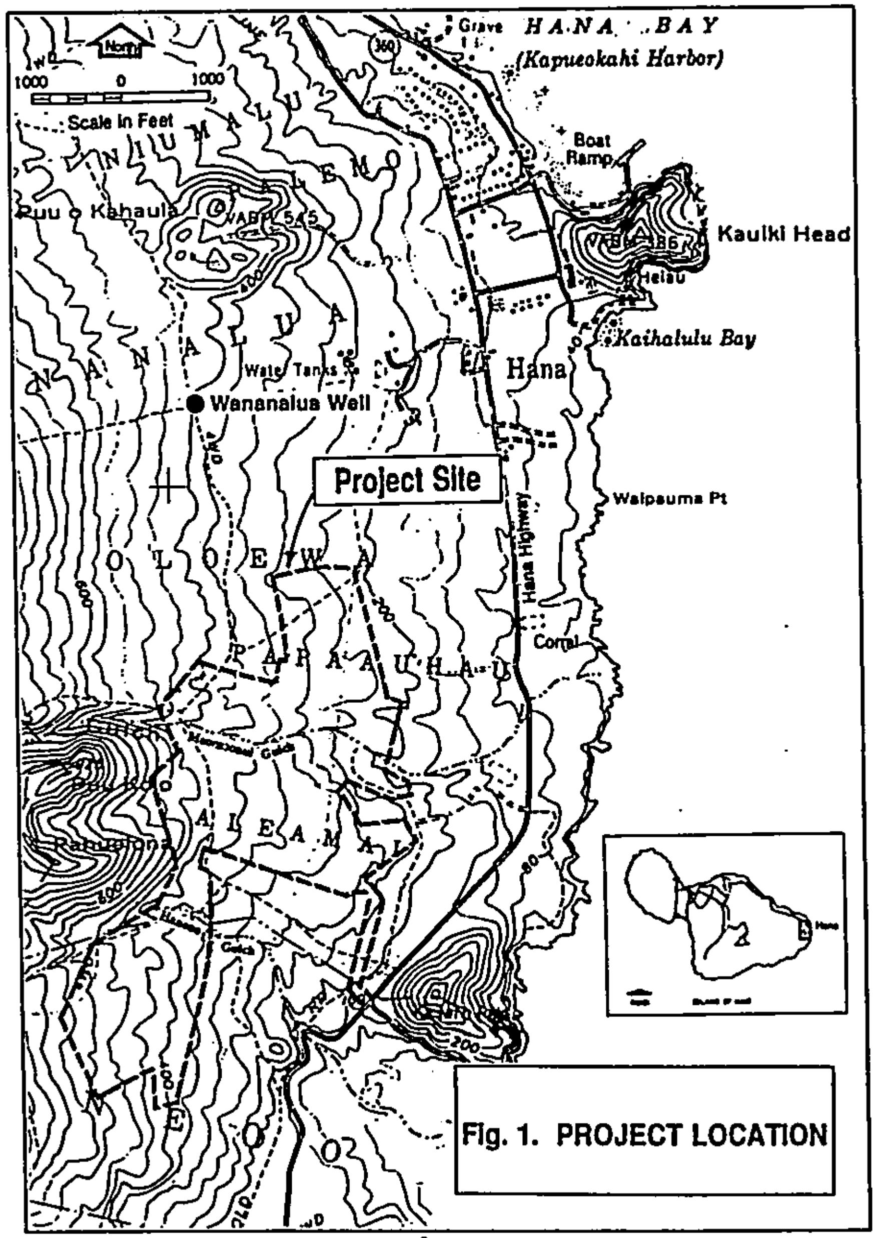


Fig. 1. PROJECT LOCATION

PHYSICAL ENVIRONMENT

Climate

The climate of Hana is typical of Hawaii's climate; namely, mild and equable temperatures throughout the year, moderate humidities, and persistence of northeasterly tradewinds. The average temperature is approximately 75°F. The maximum temperatures average in the 80's and the minimum temperatures average in the low 60's. Prevailing tradewinds blow steadily from the northeast with greater persistence during the summer months than during the winter months.

The Hana area receives an average annual rainfall of 75 inches in the coastal area to over 200 inches on the high volcanic slopes four miles inland (see Map 1). The project site lies roughly between elevations 200 and 500 ft. and receives an average annual rainfall of approximately 70 inches.

Soils

The soils in the Hana area belong to the Hana-Makaalae-Kailua association which consists of moderately deep, well-drained soils underlain by a moderately fine-textured subsoil. These soils are derived from weathered volcanic ash and cinders. The natural vegetative cover includes Christmas berry, guava, guineagrass, hilograss, kaimi clover, and kikuyugrass.

Thirty percent of the Hana-Makaalae-Kailua association consists of Hana soils, a dark brown to grayish-brown, friable silty clay loam. In general the substratum consists of moderately weathered cinders. Fragmented aa can be found at depths of three to four feet.

As mapped by the Soil Conservation Service (1972), the project site is underlain principally by Hana silty clay loam (HKNC), one of two similar types of soil occurrence. The less dominant is generally described as Hana extremely silty clay loam (HKOC). Both types occur on 3 to 15 percent slopes. The Hana soils are moderately deep and range from non-stony to extremely stony (1.5 to 8.5 ft. in the project site, based upon seismic refraction survey by Pacific Geotechnical Engineers). The surface layer generally consists of dark-brown silty clay loam that contains 10 to 15 percent gravel- and cobble-sized stones. The subsoil, 6 to 14 inches thick, consists of reddish-brown, very friable silty clay loam that has a weak, subangular blocky structure. It contains 20 to 30 percent gravel- and cobble-sized stones. Runoff is slow to medium and erosion hazard is slight to moderate. In places, roots penetrate to a depth of two to three feet. A more detailed description of subsurface conditions is given in the consultant report by Pacific Geotechnical Engineers.

Topography

Hana lies mostly within Haleakala's northeast rift zone which is evident from the numerous cinder cones which dominate the area. Hana town lies close to its axis. The project site lies among several cinder cones associated with a southeast branch of the main northeast rift zone (Map 1). The gentle grass-covered slopes of the site range from 3 to 15 percent which is typical of the Hana coast. Currently, the land is used for cattle grazing. Above an elevation of approximately 600 feet, the volcanic slopes are steeper and rise at a more or less uniform 20 percent.

Geology

Three major periods of eruptions of Haleakala Volcano created East Maui and produced the three volcanic series of formations known as Honomanu, Kula, and Hana. The Honomanu series (the oldest) forms the basal core and bulk of East Maui. Covering this series of typically permeable basalts are the more massive and less permeable basaltic andesite and basalt lava flows of the Kula series. Following the Kula activity, eruptions ceased for a long while during which time erosion carved out the remarkably deep canyons of Keanae, Waihoi, Kipahulu, and Kaupo.

Following this long period of quiescence, volcanic activity resumed along Haleakala's southwest and northeast rift zones producing the Hana series of basalts, andesitic basalts, and andesites, which partially filled the deep canyons and blanketed much of the eastern part of East Maui, including the Hana area. This Hana volcanic series also produced a line of spatter and cinder cones which are very evident in the Hana area. Numerous lava flows eventually covered the slopes of Hana and numerous

cinder cones were produced with blankets of ash and cinder deposited around them. Consequently, the subsurface presumably consists of numerous lava flows intercalated with buried ash and cinder deposits. The Hana series of lava flows are mostly permeable.

Situated among a number of eruptive vents (cinder cones), the project site is underlain by numerous lava flows and intercalated ash and cinder deposits (see Appendix, Driller's Log, Wananalua Well).

SURFACE WATER RESOURCES

The steep slopes above Hana receive over 200 inches of rainfall a year, yet there is no runoff to the sea from any of the gulches during normal weather. Only during periods of heavy rainfall (usually cyclonic storms occurring during the winter months) do the normally dry gulches in the area have intermittent flows that reach the sea. Kawaipapa, a major gulch, which lies approximately two miles north of the project site and empties into Hana Bay, Moomoonui and Haneoo gulches which pass through the project site, and Kapia stream which lies approximately a mile south of the project site are all normally dry in their coastal reaches. However, these gulches and stream do have perennial flows at elevations above 1000 feet where rainfall averages 100 to 200 inches a year.

In addition to surveys by other project consultants, the gulches and stream were surveyed from a helicopter by Water Resource Associates on October 31, 1990, and observations clearly showed that the perennial flows in their upper reaches are "losing streams". That is to say, the perennial flows gradually decrease downstream as surface waters are lost to deep percolation in the streambeds. Typically, the flows entering a plunge pool were observed to be greater than the flows leaving it. The flow in Moomoonui gulch disappeared at about the 1000-foot elevation, or about 1.5 miles inland from the coast. The flow in Kapia stream gradually diminishes downstream and finally disappeared into a plunge pool at about the 400-foot elevation, or about a mile inland from the coast. Kawaipapa gulch also was observed to be dry in its lower reaches.

The stream channels were observed to have shallow to moderate depth, cutting across alternately dense and permeable lava flows which account for the losing character of the surface water flows and the formation of a series of plunge pools.

Because of the infrequent and flashy nature of the flows and the ruggedness of the terrain, these surface water resources do not offer a reliable source of water supply.

GROUNDWATER RESOURCES

Kawaipapa Aquifer System

The island of Maui has been divided into six groundwater sectors, one of which is the Hana Sector which includes the eastern part of East Maui from Nahiku on the northeast coast, around Hana, and on to Kipahulu on the southeast coast (State Commission on Water Resource Management, 1990). In turn, the Hana Sector is subdivided into four aquifer systems, one of which is the *Kawaipapa Aquifer System* which comprises the eastern tip of East Maui extending along the coast from Honomaele Gulch (located 1½ miles west of Hana Airport) southward to Kapaia stream located near Hamoa (see Figure 2). The Kawaipapa Aquifer System consists principally of high-level, dike confined groundwater aquifers in the mountainous interior areas and basal aquifers in the coastal areas. According to the Commission's 1990 report, the Kawaipapa Aquifer System has an estimated groundwater recharge of 109 mgd and an estimated sustainable yield of 48 mgd (million gallons per day). The proposed project is located within this system.

High-Level, Dike Confined Water

Hana's abundant rainfall occurs on the high slopes of the northeast rift zone and is the source of groundwater recharge to the high-level and basal aquifers within the

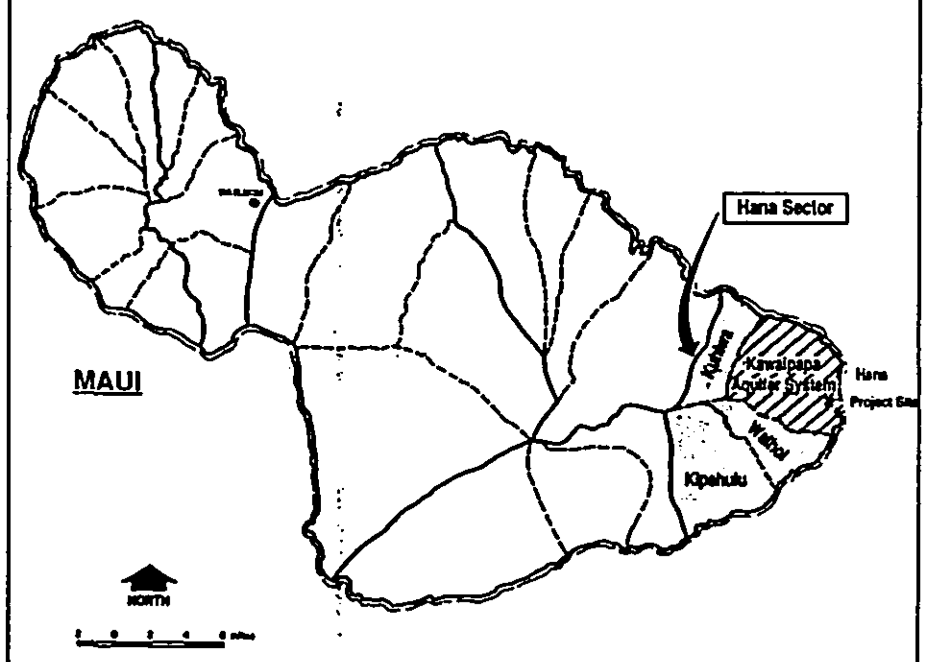


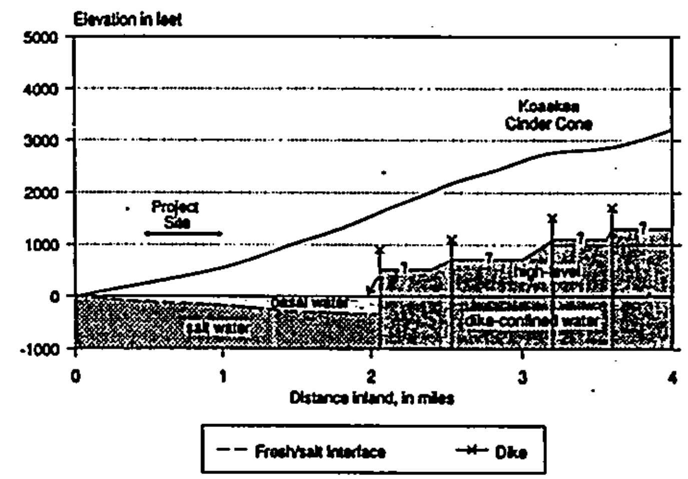
Fig. 2. KAWAIPAPA AQUIFER SYSTEM

aquifer system. As shown in Map 1, rainfall averages 100 inches a year approximately two miles inland from the coast and rapidly increases to over 200 inches a year two miles further inland at an elevation of 3000 feet. Rainfall percolates quickly into the permeable basaltic lava flows of the Hana volcanic series. Within the rift zone, numerous water-tight dikes create compartments of high-level ground water beneath the rugged interior slopes of Hana. Such high-level ground water probably lies too deep below the surface to be economically developable.

Basal Water

Ground water moves from the interior high-rainfall areas more or less directly toward the coast. In the vicinity of the project site, groundwater movement is assumed to be directly toward the coast. As rainfall and the number of dikes decrease toward the coast, bodies of high-level ground water become lower in step-like fashion and eventually spill into the basal aquifers along the coast. An interpretive hydrogeologic cross section of the Hana area is shown in Figure 3.

Figure 3. INTERPRETIVE HYDROGEOLOGIC CROSS SECTION



A total of seven wells have been drilled in the Kawaipapa Aquifer System, from Kaeleku near the Hana Airport to Mokae just south of Hamoa (see Table 1 and Map 1). All of the wells are located approximately one mile inland from the coast and produce potable water from basal aquifers. The results of these wells indicate that there are different basal aquifers in the Hana area which have different heads and chloride contents.

Table 1. WELLS IN THE KAWAIPAPA AQUIFER SYSTEM

Well Name	State Well No.	Owner	Year Drilled	Ground Elev. (ft.)	Csg Dia. (in.)	Csg Depth (ft.)	Well Depth (ft.)	Basal Head (ft.)	Pump Cap. (mgd)	Initial Chloride (ppm)
Hamoa	4300-02	Maui DWS	1985	357	11	405	406	7.8	0.30	10
Helani	4600-01	Keola Hana	1949	250	8	271	280	3.0	0.17	35
Kaeleku	4701-01	Keola Hana	1959	403	10	426	426	6.5	0.36	9
Mokae	4300-01	Keaka-Wai	1981	213	4	195	223	5.0	--	15
Wakiu A	4600-02	Maui DWS	1972	266	10	285	288	1.5	0.10	133
Wakiu B	4600-03	Maui DWS	1976	306	10	320	323	2.0	0.10	180
Wananalua	4539-01	Keola Hana	1988	410	12	440	440	5.3	0.43	70

Outside of the rift zone in the Kaeleku and Hamoa areas, the basal aquifers are thicker (6.5 to 7.8 ft. heads) and fresher (9 and 10 ppm initial chlorides) than those within the rift zone. The Kaeleku and Hamoa wells were sampled and tested on February 4, 1992 by Water Resource Associates and found to have a chloride content of 7 ppm, slightly lower than their initial reported values. A chloride content of less than 10 ppm suggest ground water that is uncontaminated by salt water intrusion. The head in the Hamoa well was initially reported as 6.5 ft., based upon uncalibrated measurements. However, a head of 7.8 ft. was subsequently determined from accurate measurements made with a surveyor's steel tape (Mitchell Ohye, Division of Water and Land Development, personal communication, March 1992).

Within the rift zone, data from four wells show three different basal aquifers with lower heads and higher chloride contents, reflecting some salt water intrusion. In the Wakiu area, the basal aquifer has a head of 1.5 to 2.0 ft. and, consequently, is more prone to salt water intrusion under pumping conditions. Chlorides in the Wakiu wells have reportedly ranged upwards of 200 ppm (250 ppm is the arbitrary potable water limit). In the Helani area, the basal aquifer is slightly thicker with a head of 3.0 ft. and slightly fresher with chlorides reported as high as 112 ppm. The thin, sensitive basal groundwater conditions encountered in the Wakiu-Helani area probably are due primarily to restricted recharge resulting from dike structures in the rift zone and to the absence of impermeable coastal caprock formations which would inhibit salt water intrusion. Tidal fluctuations in the Wakiu wells suggest permeable lavas occur between the wells and coast.

A mile south of the Helani well, the basal aquifer tapped by the Wananalua well is thicker with a head of 5.3 ft. and a fresher chloride content of 60 ppm.

Groundwater Recharge and Sustainable Yield

As mentioned earlier in this report, the State Commission on Water Resource Management (1990) has estimated the groundwater recharge and sustainable yield of the Kawaipapa Aquifer System to be 109 mgd and 48 mgd, respectively. However, to confirm that there is ample groundwater resources in the project area, the recharge and sustainable yield in the two-mile coastal section between Hana and Hamoa has been roughly estimated by the water budget method. Assuming a four-square-mile recharge area between the 75-inch and 250-inch mean annual isohyets for the two-mile coastal stretch between Hana and Hamoa, the calculated volume of rainfall amounts to an average 58 mgd. The net rainfall that infiltrates into the ground and becomes groundwater recharge is estimated at 24 mgd, or 42 percent of total rainfall, based upon evapotranspiration losses calculated for other similar areas in the State and negligible runoff.

However, of the 24 mgd recharge, only a fraction can be developed on a sustained or long-term basis. This fractional amount is called the sustainable yield of an aquifer and the term is commonly used to describe the amount of ground water that can be developed from a basal aquifer without adversely affecting the long-term ability

of the aquifer to produce acceptable quality water. Adverse effects may relate to localized upconing of salt water caused by drilling wells too deep, by excessive pumping rates, or by shrinkage of the basal lens due to excessive total pumpage over the long term. Sustainable yield is always less than recharge. It also refers to total withdrawal from the aquifer and does not take into account well spacing, well depth, or pumping capacities of individual wells. The sustainable yield of the basal aquifer in the Hana-Hamoa coastal area was calculated using the following equation:

where, I = recharge, h_e = equilibrium head, and h_o = original head

$$\textit{Sustainable Yield} = I\left[1 - \left(\frac{h_e}{h_o}\right)^2\right]$$

Based upon experience with well-studied basal aquifers, it is assumed that a basal aquifer can be safely drawn down to an equilibrium head which equals 75 percent of the original head. Thus, the sustainable yield in the above equation reduces to 44 percent of the estimated 24 mgd recharge, or 10.5 mgd.

EXISTING WATER SYSTEMS

Keola Hana Maui Water System

Keola Hana Maui, Inc., through its subsidiary Hana Water Resources, Inc., operates its own water system to supply the water needs of its residential subdivision, Hotel Hana Maui, Sea Ranch Cottage, Ranch Restaurant, and commercial center. This privately owned system (see Figure 4) has two deep well sources--the Wananalua well, drilled in 1988, and the Helani well, drilled in 1949. The installed pump capacity of these two sources totals 600,000 gallons per day.

Wananalua Well Source. Keola Hana's Wananalua well (State Well No. 4559-01) is located about a half mile from the boundary of the project site, at an

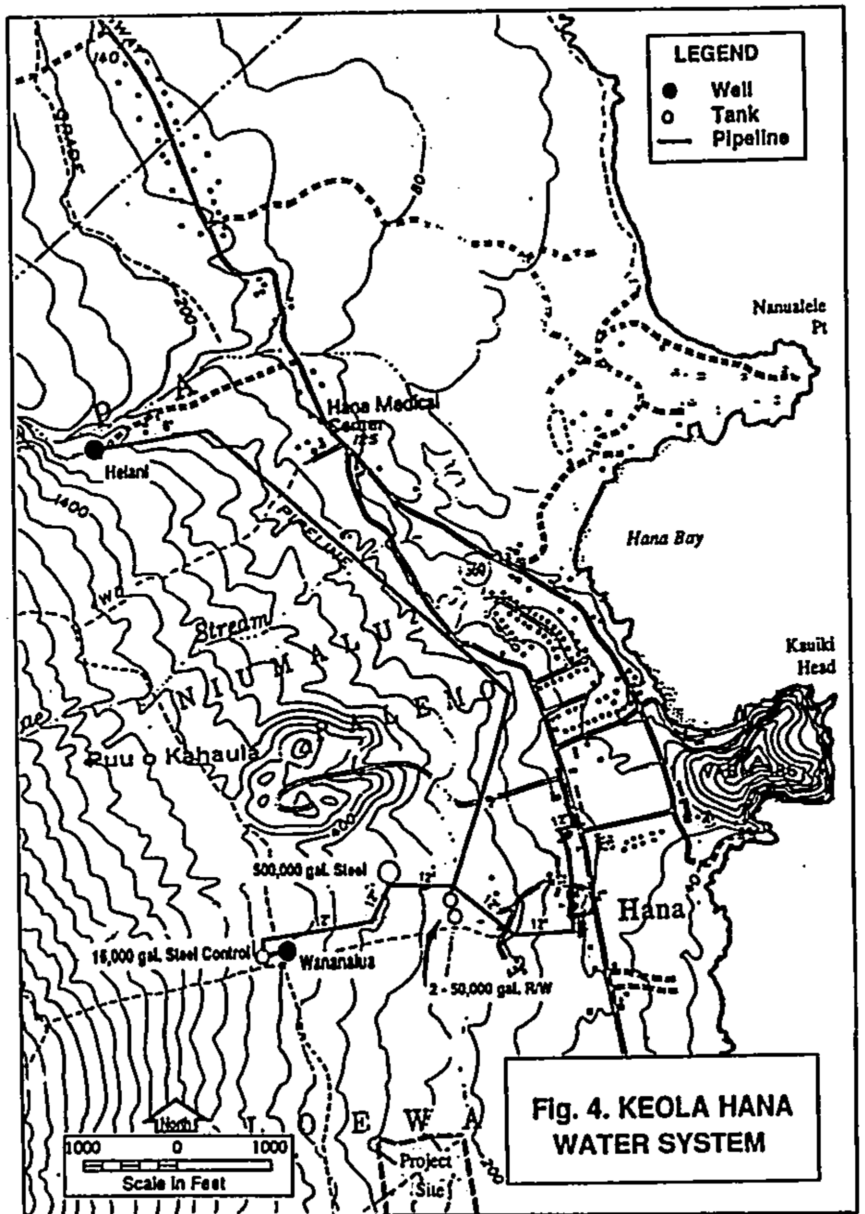


Fig. 4. KEOLA HANA WATER SYSTEM

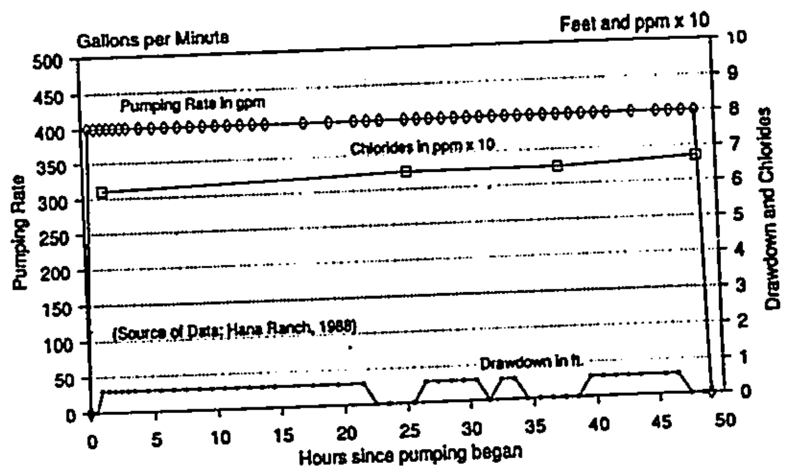
elevation of 410 feet. The well has a 12-inch diameter casing which extends to 30 feet below sea level (see Appendix, As-built Section). The well has an installed lineshaft pump capacity of 300 gpm (gallons per minute), or 430,000 gpd (gallons per day), rated at a head of 430 feet and is equipped with a Pennwalt chlorination system, which operates automatically with the pump. The well pumps into a 15,000 gallon glass-lined steel control tank located at an elevation of 426 feet. From this control tank, water flows by gravity through a 12-inch pipeline to a 500,000 gallon glass-lined steel storage tank located at an elevation of 314 feet. Water flow from the control tank to the 500,000 gallon storage tank is controlled by a pressure-sustaining valve. Additional storage is provided by two 50,000 gallon redwood tanks located at approximately the 250-foot elevation.

The pump is outfitted with an emergency generator to supply electric power during power outages. The generator operates automatically, starting up when line voltage drops and stopping when power is restored. A hydropneumatic system is also installed at this well to provide water pressure for operating the control valves and chlorinator.

Although the presently installed pump capacity is 300 gpm, the Wananalua well has a tested capacity of 400 gpm (576,000 gpd). A 48-hour pump test resulted in a drawdown of 0.58 feet and a chloride content range of 62 to 67 ppm (see Figure 5). On December 19, 1991, the chloride content tested at 81 ppm, reflecting the salinity of the well at an average annual draft of 0.28 mgd (see Appendix, Laboratory Analysis Report, Wananalua Well).

Helani Well Source. Helani well (State Well No. 4600-01) is located a mile north of the Wananalua well and serves as a standby source for the Keola Hana water system. It is situated in Kawaipapa gulch mauka of Helani Gardens and lies approximately one mile inland from the coastline at an elevation of 250 feet. It is cased with an 8-inch diameter casing to a depth of 271 feet, or 21 ft. below sea level, and its total depth of 280 feet extends 30 ft. below sea level. The well has an installed lineshaft pump capacity of 120 gpm, or 173,000 gpd, rated at a head of 360 ft. The pump is operated and flushed each Thursday for a short period of

Figure 5. PUMPING TEST RECORD
Wananalua Well (4559-01), Hana, Maui
Date of Test: August 1-3, 1988



maintenance. The well has an automatic chlorination system and is connected to the 500,000-gallon Wananalua storage tank by 7,500 feet of 6-inch transmission pipeline installed in 1950 (Figure 4).

The capacity of the Helani well is estimated to be roughly 200,000 gpd based upon limited information. No information on drawdown is available. According to State records, the well had an initial chloride of 35 ppm, a minimum chloride of 28 ppm in 1970, and a maximum chloride of 112 ppm in 1974. On February 18, 1987, the chloride content was tested at 120 ppm by the Department of Health. In 1987, the well had a pump capacity of 216,000 gpd and was pumped continuously for 3½ months during the Summer. Concern was expressed at that time about salt water intrusion, although no chloride data was reported. The present pump capacity is 120 gpm (173,000 gpd).

Water Quality. The Wananalua and Helani wells both produce good quality potable water. The Wananalua well taps a slightly thicker and fresher basal aquifer

than the Helani well. Their chloride contents are 60 ppm and 110± ppm, respectively, compared to the arbitrary limit of 250 ppm for potable water. The chemical analyses report for the Wananalua well is included in the Appendix.

Current Water Use. Based upon information provided by the engineering department of Hotel Hana Maui (Roland Torres), the water system currently meets all of its water needs from the Wananalua well and provides metered service to 69 customers (68 residential users in the Hana subdivision and the Hasegawa store) and unmetered service to Hotel Hana Maui, Hana Store, Hana Ranch, and Chevron station (plans are to install water meters in the near future). Monthly records of pumpage from the Wananalua well averaged 0.134 mgd for 1990 and 0.285 mgd for 1991.

County Water System

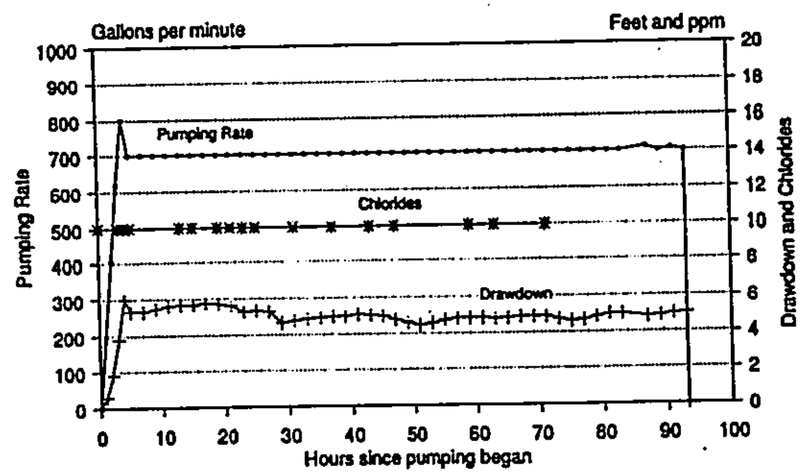
The municipal water needs of a portion of Hana town and of Hamoa (2½ miles south of Hana) are provided by the Maui Department of Water Supply's Hana water system. The system is supplied by three deep wells, two at Wakiu and one at Hamoa, located at the north and south ends of the system, respectively. A series of 12, 4, and 3-inch pipelines connect the Wakiu source to Hana and a 4-inch pipeline, which passes through a portion of the project site, connects the Hamoa well to a storage tank above Hana town (see Map 2). The Hamoa well (4300-02) primarily serves Hamoa and Hana. Besides the Hana tank, major storage for the system is provided by a 500,000 gallon concrete tank next to the Wakiu wells and a 190,000 gallon concrete tank next to the Hamoa well.

The County system also incudes a surface water source located on Wailua stream (6.5 miles south of Hana) at the 1,000-foot elevation, which serves the Wailua area outside of the study area. The estimated available yield of surface water is 0.1 mgd based upon an average metered flow of 0.12 mgd in the 4-inch Wailua transmission pipeline (Hirota, 1983).

The total capacity of the Hana water system is 0.6 mgd (Wakiu wells, 0.2 mgd; Wailua surface water source, 0.1 mgd; and Hamoa well, 0.3 mgd) (Source: Maui Water Use and Development Plan, 1990). According to the 1990 report, these sources are expected to meet the water needs of the Hana-Hamoa-Wailua area to the year 2010. However, the Hamoa well is capable of producing 1.0 mgd. By installing a larger capacity pump, the Hamoa well would be capable of meeting water needs beyond the year 2010. The Hamoa well was tested for 93 hours at a constant rate of 700 gpm (1.0 mgd) with a stable drawdown of 4.9 ft. and chloride content of 10 ppm (see Figure 6).

Water Quality. The Hamoa well lies outside of the rift zone and produces ground water from a basal aquifer that is thicker and fresher than the aquifers in the rift zone. The Hamoa well has a head of 7.8 ft., based upon reliable measurements made with a surveyor's steel tape (Mitchell Ohye, Division of Water and Land Development, 1992). The well's chloride content is only 10 ppm, which is much lower than the Wananalua (60 ppm), Helani (112 ppm), and Wakiu (180 ppm) wells located within the rift zone. The excellent quality of the Hamoa well is evident from the chemical analyses report which is included in the Appendix.

Figure 6. PUMPING TEST RECORD
Hamoa Well (4300-02), Hana, Maui
Date of Test: November 4-8, 1985



Current Water Use. Based upon pumpage records for 1990 and 1991, the current water use by the County's Hana Water System is less than 0.148 mgd, as shown in Table 2.

Table 2. AVERAGE ANNUAL PUMPAGE, HANA WATER SYSTEM

Source	1990	1991
Hamoa Well	0.048	0.042
Wakiu Wells	0.100	0.054
Total	0.148 mgd	0.096 mgd

Source of Data: Maui County Department of Water Supply

PROJECT WATER REQUIREMENTS

Potable Water

The estimated potable water requirement for the proposed golf course is between 20,000 and 30,000 gallons per day, based upon typical usage for a clubhouse.

Nonpotable Irrigation Water

The amount of irrigation water required by a golf course varies, depending on the amount of rainfall that occurs. Based upon general guidelines for irrigation of turfgrass presented in the 1989 report on Golf Course Development on Oahu (page 12, Exhibit 5), a golf course located in an area that receives 70 inches of rainfall a year would not require any irrigation because 70 inches of rainfall a year amounts to 5,200/gpd/ac (gallons per day per acre), which is greater than the estimated turfgrass water requirement of 4000 gpd/ac. The proposed Hana golf course is located in an area with an average rainfall of 70 inches a year. However, in practice, irrigation will be required because the estimate does not take into account the uneven distribution of rainfall throughout the year.

The irrigation requirement for the proposed golf course is estimated to average 70,000 gpd, with a maximum month requirement of 100,000 gpd. This estimate is based upon a comparison with the Oahu Country Club and Pali Golf courses located on Oahu. Both of these golf courses use municipal water and are located in areas with about 75 inches of rainfall, similar to the project site. According to Honolulu Board of Water Supply records, the monthly water use for the year 1990 averaged approximately 65,000 gpd for the Oahu Country Club and 47,000 gpd for the Pali Golf Course. The maximum-month usage occurred during the period mid-August to mid-September and amounted to 97,200 gpd for the Oahu Country Club and 81,400 gpd for the Pali Golf Course. The greens are irrigated and the fairways are largely sustained by rainfall.

Fire Protection

Based upon Maui Department of Water Supply standards, fire protection for the proposed clubhouse facility will require a flow rate of 2,000 gallons per minute for a duration of two hours, or a reserve storage capacity of 240,000 gallons.

PROPOSED WATER SUPPLY

Potable Water

The most readily available potable water supply for the proposed project is the County's existing 4-inch transmission pipeline, which passes through the project site and connects the Hamoa well source to Hana town. The proposed clubhouse will be located near this pipeline. Therefore, to meet the estimated 20,000 to 30,000 gpd of potable water needed for the clubhouse and maintenance facility, Keola Hana Maui will request water service from the Maui Department of Water Supply. However, if

request for County service is not approved, Keola Hana Maui proposes to construct the necessary water supply improvements to provide potable water from the Wananalua well source located north of the project site. Such improvements will meet State Department of Health and Maui Department of Water Supply requirements.

Nonpotable Water

The estimated average 70,000 gpd (maximum summer month, 100,000 gpd) of nonpotable water required for irrigation of the golf course will be provided by restoring and utilizing an existing 5-acre catchment reservoir with a natural hillside rain catchment area of approximately 30 acres. This formerly used reservoir, referred to herein as the Puu Kolo reservoir, lies at an elevation of 800 feet in a natural saddle-shaped depression on the mauka side of Puu Kolo cinder cone which lies just mauka of the project site (see Map 1 and Appendix, Photograph of Puu Kolo Catchment Reservoir). The reservoir is in good condition, as can be seen in the photographs in the Appendix. A similar rain catchment reservoir above the Wananalua well has been successfully utilized for many years to supply stock water for Hana Ranch (see Appendix, Photograph of Keola Hana Maui Catchment Reservoir). The reservoir at Wananalua has a storage capacity of 3.2 million gallons and a catchment area of 1.7 acres.

When the Puu Kolo catchment reservoir is restored, it will have a storage capacity of 13 million gallons (40 acre-feet). Preliminary calculations indicate that the catchment reservoir will supply an estimated average 91,000 gpd, based upon a catchment area of 30 acres, a reservoir area of 5 acres, an average annual rainfall of 80 inches, and an average annual evaporation of 45 inches (net rainfall = 2.917 ft. x 35 acres x 43,560 ft.^{2} x 7.48 ÷ 365 days = 91,300 gpd). The reservoir will have a depth of 8 feet.

Nonpotable water from the Puu Kolo reservoir will be gravity-fed to the golf course irrigation system via a new pipeline.

Fire Protection

Water supply for fire flow protection for the clubhouse and maintenance facilities will be provided by a lake that will be created near the clubhouse for the golf course. The lake will have a storage capacity of approximately 2.1 million gallons, which easily exceeds the minimum fire flow storage requirement of 240,000 gallons. The lake will be about an acre in size and have a depth of 8 feet. All requirements for fire protection will conform to Maui Department of Water Supply standards.

POTENTIAL IMPACTS ON WATER RESOURCES AND MITIGATIVE MEASURES

Water Supply Alternatives

Groundwater resources, although plentiful in the Hana area, will not be used for irrigation of the proposed golf course. Instead, nonpotable hillside rain catchment water will be used to meet the irrigation needs of the proposed project. An adequate source of supply will be provided by the currently unused Puu Kolo catchment reservoir located above the project site on the mauka side of Puu Kolo cinder cone. As described earlier in this report, the Puu Kolo reservoir will provide an estimated average water supply of 91,000 gallons per day. Keola Hana Maui has two other similar catchment reservoirs. One is located about 3000 feet north of Puu Kolo and is currently being used to provide stock water for its cattle operations. The other is located about 4000 feet south of Puu Kolo and is unused. However, these two reservoirs will not be needed for the proposed project.

Two existing sources of supply are available to meet the 20,000 to 30,000 gpd of potable water requirement of the proposed project. The most readily available source of supply is the County Department of Water Supply's 4-inch transmission pipeline which traverses the project site and connects the Hamoa well to Hana town. Keola Hana Maui will request potable water service from this 4-inch pipeline for the proposed golf course. However, if the Department does not approve the request,

Keola Hana Maui proposes to meet the potable water needs of the project from its nearby Wananalua well source by installing the necessary delivery system.

Impact on Sustainable Yield

The withdrawal of 0.03 mgd of potable ground water for the proposed project will have no adverse impact on the Kawaipapa Aquifer System which has an estimated sustainable yield of 48 mgd (State Water Resources Protection Plan, 1990). Seven wells have been drilled in this aquifer system and altogether they have an installed pump capacity of 1.5 mgd and currently use less than 1.0 mgd, or 2 percent, of the sustainable yield.

Impact on Underlying Basal Aquifer

The proposed golf course is geologically located between the main northeast rift zone centered more or less along an axis through Hana and a southeast spur centered more or less along an axis through Hamoa (see Map 1). This spur off the rift zone is evidenced on the surface by eight closely spaced eruptive vents (mostly cinder cones) which surround the project site. Dikes associated with these eruptive vents have undoubtedly intruded the subsurface formations, creating basal aquifers in dike-intruded lavas having moderate to low permeability and limited groundwater recharge, similar to other rift zone areas where the hydrology is known.

Due to its partial isolation between the rift zone and its spur, the basal aquifer underlying the project site is anticipated to be thin (3 to 4 feet of head) and have less recharge than the basal aquifers at Hamoa and Wananalua. No groundwater wells have been drilled in the project site to indicate the basal groundwater conditions beneath the project site, but rift zone geology precludes the project site as a prime area for any potable groundwater development.

Fertilizers, pesticides, and herbicides are the major chemicals used on golf courses which may have potential impact on the basal aquifer. Their use is regulated by the State Department of Agriculture and State Department of Health. All chemicals used must be biodegradable and approved by the U.S. Environmental Protection Agency. These chemicals may be subject to movement from the point of application due to runoff and infiltration during rain storms or by infiltration due to excess irrigation. An assessment of the use of these chemicals is discussed below and in great detail in other consultant reports.

Fertilizers are normally applied only to the greens, tees, fairways, and parts of the roughs of a golf course; and consist of nitrogen (N), phosphorus (P), and potassium (K). Nitrogen and phosphorus are the elements of concern regarding contamination of surface and ground waters. However, phosphorus attaches tightly to clay soils and exhibits little movement from the point of application. Consequently, phosphorus is not expected to be a problem with regard to contamination of ground water or surface water runoff. Nitrogen, in the form of nitrate, is not bound by clays and moves easily with water and is the only element of fertilizers which might contaminate runoff or ground water. However, nitrogen is assimilated by turfgrasses at a high rate immediately after application which results in complete use of nitrogen under normal conditions of application and weather.

Only when over irrigation or heavy rainfall occurs soon after application of nitrogen would there be potential movement of nitrogen from the point of application by runoff or percolation below the root zone. With regard to contamination of runoff, since the project site is part of a much larger watershed, any movement of nitrogen by runoff from the golf course will likely be diluted by waters from the mauka watershed areas. The potential impact of nitrogen movement, by runoff or by percolation below the root zone, can be mitigated by: (1) using a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied, and (2) avoiding nitrogen applications immediately prior to and during periods of anticipated heavy rainfall, which usually occur in the winter months. From a surface runoff and groundwater quality standpoint, the potential impact of the proposed golf course with respect to nitrogen movement probably would be less than the current use of the land for cattle grazing. The potential for nitrogen contamination is discussed in detail by other project consultants (Environmental Turf Services).

Pesticides are normally applied on an as-needed basis in response to an outbreak of pests on the greens, tees and fairways. The pesticides used are of low toxicity and are rapidly degradable in soil and/or become attached to clayey soils and organic matter. Therefore, movement of pesticides from the point of application is not expected to be a problem.

The use of fertilizers and pesticides on the proposed golf course is not expected to have any adverse effect on underlying potable groundwater resources. It is unlikely that any leached contaminants will reach the fresh water portion of the basal aquifer in sufficient concentration, if at all, to adversely impact water quality or pose a threat to human health. Any leached contaminant within the project site will tend to migrate seaward toward the brackish water zone of the aquifer as it moves downward through 200 to 500 ft. of dipping lava flows and buried ash deposits to the basal groundwater table. Any contaminants which might reach the basal aquifer can be expected to be diluted by the mauka to makai groundwater flux. The potential for pesticide contamination is discussed in detail by other project consultants (Environmental Turf Services).

Although the coastal slopes between Hana and Hamoa have been used for cattle grazing (a source of nitrate) for over 25 years, the nitrate concentration in the Hamoa and Wananalua wells indicate no nitrate contamination of the basal aquifers. In general, pristine groundwater has a concentration of one ppm nitrate, or less. Consequently, the 0.16 and 0.12 ppm nitrate concentrations in the Hamoa and Wananalua wells, respectively, is evidence that the basal aquifers tapped by these wells are uncontaminated.

Impact on Existing Groundwater Sources

The withdrawal of an additional 0.03 mgd (30,000 gallons per day) of potable ground water from either the Hamoa well or, the Wananalua well will not have any adverse long-term effect on either of the two sources or any of the other existing sources in the Kawaipapa Aquifer System. The Hamoa well has an installed pump capacity of 0.30 mgd which is more than adequate to meet current water use of

0.05 mgd. Also, the well has a tested potential yield of 1.0 mgd, which far exceeds current and probable future water needs (see Figure 6). The Wananalua well has an existing pump capacity of 0.43 mgd and a tested potential yield of 0.57 mgd (see Figure 5), which is more than adequate to meet Keola Hana's current and projected water needs. The adequacy of these two well sources is summarized below.

	Hamoa Well	Wananalua Well
Potential Yield (mgd)	1.00	0.57
Existing Pump Capacity (mgd)	0.30	0.43
Current (1990-91) Use (mgd)	0.05	0.28
Net Available Capacity (mgd)	0.25	0.15
Net Available Yield (mgd)	0.95	0.29

The Hamoa well taps a separate basal aquifer from that of the Wananalua well. Not only does the Hamoa well lie outside (south) of the rift zone, but it is also separated from Wananalua by dike-intruded lavas associated with the intervening southeast spur of the rift zone (see Map 1). Hydrologic data from the two wells also confirms separate aquifers. The Hamoa basal aquifer is relatively thick with a high head of 7.8 feet (highest basal head so far encountered in the Kawaipapa Aquifer System) and a pristine chloride content of 7 ppm (measured February 4, 1992). Furthermore, the Hamoa aquifer showed no evidence of salt water intrusion during a 4-day pumping test at a rate of 1.0 mgd.

The Wananalua well, on the other hand, is located in the rift zone and taps a basal aquifer with a lower head of 5.3 feet and a higher chloride content that ranges between 60 and 80 ppm.

Ground water in the Hana-Hamoa section of the Kawaipapa Aquifer System flows mauka to makai from the broad interior recharge areas toward the coast. Consequently, the direction of groundwater flow in the basal aquifer underlying the project site is also mauka to makai (eastward) to the coast rather than laterally to the south or north toward the basal aquifers tapped by the Hamoa and Wananalua wells, resulting in no expected or potential threat of contamination from fertilizer and chemical use on the proposed project site.

To further assess the potential for contamination of the Hamoa and Wananalua well sources, the maximum width of the zone of groundwater contribution to each well was estimated from the following equations:

$$r = \frac{Qw \ x \ 5280}{2\pi \ (b/41h) \ (Q/L)}$$

where,

r = Distance of influence downgradient from well in ft.
b = Active length of well in ft.
h = Head in ft.
Qw = Pumping rate in mgd
Q/L = Groundwater flux in mgd/mile

W = $2\pi r$ = Maximum width of zone of groundwater contribution to the well.

For the Hamoa Well,

$$r = \frac{0.3 \ x \ 5280}{2\pi \ (50/41 \ x \ 7.8) \ (12)} = 134 \ ft.$$

$$W = 2\pi \ x \ 134 = 842 \ ft.$$

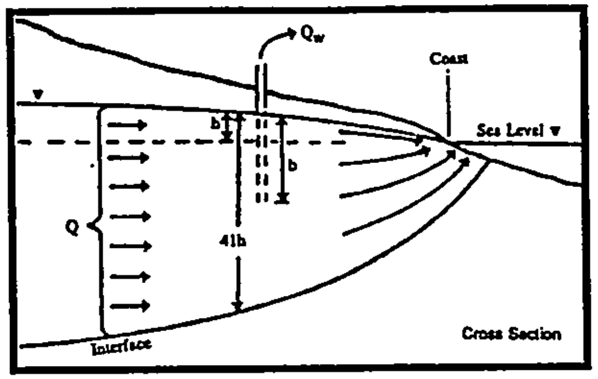
For the Wananalua Well,

$$r = \frac{0.43 \ x \ 5280}{2\pi \ (35/41 \ x \ 5.3) \ (12)} = 187 \ ft.$$

$$W = 2\pi \ x \ 187 = 1175 \ ft.$$

The shape of the zone of groundwater contribution, or influence, is a parabola with the centerline coincident with the direction of groundwater flux or flow (see Fig. 7). The maximum lateral extent to either side of the well is therefore equal to one-half of W. For the Hamoa well, the maximum lateral extent on a side is equal to 421 ft. and for the Wananalua well, 588 ft.

Thus, based upon their respective 2500 ft. and 2700 ft. distances from the nearest boundary of the project site, it is concluded that the proposed golf course should pose no potential threat of contamination to the Hamoa and Wananalua well sources.



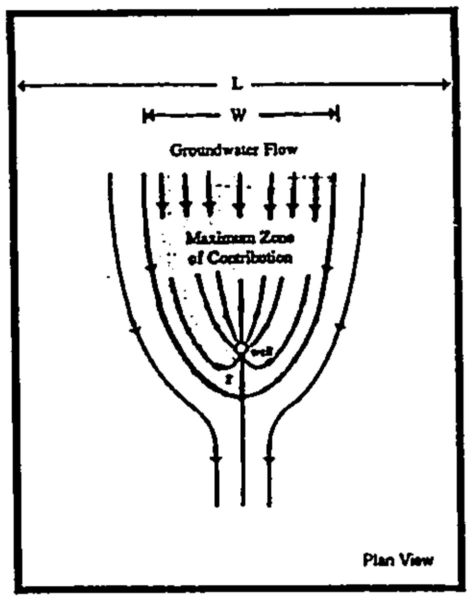


Figure 7. Pumping Well and Groundwater Flow in a Ghyben-Herzberg Lens.

Waste Water Disposal

The project site lies mauka of the State Department of Health's "UIC" line established for the protection of potential sources of potable ground water. Consequently, disposal of wastewater by injection wells or cesspools is not permitted.

The proposed clubhouse facility is expected to generate approximately 20,000 gpd of domestic wastewater effluent. A septic tank and leach field system should be an acceptable method of wastewater disposal.

Storm Runoff and Stream Channels

The major drainage from the project site consists of two dry gulches--Haneoo and Moomoonui--which extend from the upper slopes mauka of the site to the coast (see Map 2). Based upon an October 31, 1990 helicopter survey, these gulches have small perennial flows in their upper reaches above approximately 1,000 feet in elevation in the high rainfall areas, but are dry within the project site, during normal weather conditions. During their course down the mountain slopes, they lose their flows to permeable lavas in the streambed. It is anticipated that the existing vegetation, natural slopes, and drainage patterns will be retained wherever possible. Therefore, no increase in runoff or sedimentation from the project site is expected. After establishment of the golf course, runoff should be no greater than under the current pasture use of the land. Small vegetated retention basins will be constructed as necessary to control runoff and sedimentation. Consequently, no long-term, adverse impact related to surface runoff or sediment transport into the gulches are expected. Short-term impacts resulting from construction activities such as clearing and grubbing will be controlled by county grading permit requirements and mitigated by the implementation of acceptable and appropriate soil management and construction practices.

No alteration of the two major stream channels, Haneoo and Moomoonui gulches, is contemplated. Any necessary bridges will span these channels without instream support structures. However, if any alteration work is required, Keola Hana Maui will apply for and comply with any permit requirements of the State Department of Land and Natural Resources and U.S. Corps of Engineers. Most of the other channels in the project site are smaller and normally dry and probably do not require channel alteration permits. However, the above two agencies will be consulted before any alteration work is considered.

REFERENCES

City and County of Honolulu, July 1989, Golf Course Development on Oahu.

County of Maui, Department of Water Supply, September 1983, Environmental Impact Statement for the Wailua-Hana Water System Improvements, Hana, Maui. Prepared by Sam O. Hirota, Inc.

_________, _________, March 1983, A Study to Develop Design Criteria for Providing Drinking Water in Conformance with the Safe Drinking Water Act for the Wailua-Hana Public Water System. Prepared by Sam O. Hirota, Inc.

Hana Ranch, September 1988, Hana Ranch Wananalua Well, State No. 4559-01. Prepared by John F. Mink.

Hawaii Commission on Water Resource Management, Department of Land and Natural Resources, 1990, Maui County Water Use and Development Plan. Prepared by Maui County Department of Water Supply and Department of Planning.

_________, 1990, State Water Resources Protection Plan, Volume I and II. Prepared by George A.L. Yuen and Associates, Inc.

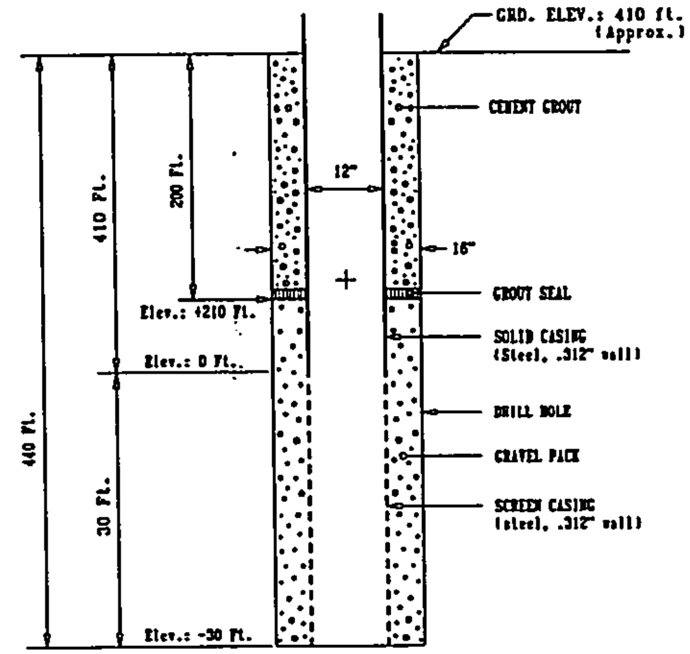
U.S. Geological Survey, Salwyn S. Chin, Grace A. Tateishi, and Johnson J.S. Yee, 1982, Water Resources Data, Hawaii and Other Pacific Areas, Water Year 1982, Volume I, Hawaii.

U.S. Soil Conservation Service, in cooperation with The University of Hawaii Agricultural Experiment Station, August 1972, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.

APPENDIX

Wananalua Well (4559-01), Hana, Maui

As-built Section



Not to Scale

Source of Data: Driller's Report, Roscoe Moss Co.

Water Resource Associates

BREWER ANALYTICAL LABORATORY
A Department of Brewer Chemical Corporation
Papaikou, Hawaii 96781 Phone: 964-1271

Job No. 5875
Date: 08-15-88
Page: 1 of 2

LABORATORY ANALYSIS REPORT - Wananalua Well, Maui, 4559-01

To: Warren Unemori Engineering, Inc. Attn: Mr. Warren Unemori
2145 Wells Street
Wailuku, Hawaii 96793

Samples of: Potable Water from Hana Ranch Water System, Phase 3
Sampled by: Eric Yamashige Sampling Date: 08-03-88 Time: 1115
Receipt Date: 08-04-88 Time: 0715

Date Sample Analyzed			08/04-12/88			
Time Sample Analyzed						
Sample Type						
Sample Description	Units		New Well			Maximum Contaminant Levels mg/L
Arsenic	mg/L		<0.002			0.05
Barium	mg/L		0.09			1.0
Cadmium	mg/L		0.004			0.010
Chromium	mg/L		<0.01			0.05
Lead	mg/L		<0.02			0.05
Mercury	mg/L		<0.0001			0.002
Selenium	mg/L		<0.002			0.01
Silver	mg/L		<0.005			0.05
Fluoride	mg/L		0.30			1.9+0.5
Nitrogen, Nitrate	mg/L		0.14			10.0
Turbidity	NTU		0.31			1.0
Endrin	mg/L		<0.00002			0.0002
Lindane	mg/L		<0.0002			0.004
Methoxychlor	mg/L		<0.0001			0.1
Toxaphene	mjg/l		<0.0005			0.005
2,4-D	mg/L		<0.005			0.1
2,4,5-T	mg/L		<0.001			0.01
Total Coliform	Col/100		TNTC (Too numerous to count)			<1

Laboratory Remarks: Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency, March, 1976 and/or "Microbiological Methods for Monitoring the Environment", U.S. Environmental Protection Agency, August 1978 and "Methods for Organochloric Pesticides and Chlorophenoxy Acid Herbicides in Drinking and Raw Source Water", U.S. Environmental Protection Agency, July 1978.

BREWER ANALYTICAL LABORATORY
A Department of Brewer Chemical Corporation
Papaikou, Hawaii 96781 Phone: 964-1271

Job No. 5875
Date: 08-15-88
Page: 2 of 2

LABORATORY ANALYSIS REPORT

To: Warren Unemori Engineering, Inc. Attn: Mr. Warren Unemori
2145 Wells Street
Wailuku, Hawaii 96793

Samples of: Potable Water from Hana Ranch Water System, Phase 3
Sampled by: Eric Yamashige Sampling Date: 08-03-88 Time: 1115
Receipt Date: 08-04-88 Time: 0715

Date Sample Analyzed		08/11/88	08/11/88	08/11/88	08/11/88	
Time Sample Analyzed						
Sample Type						
Sample Description	Units	08/01/88 12 Noon	08/02/88 12 Noon	08/02/88 12 Noon	08/03/88 12 Mid	
Chlorides	mg/L	.62	65	65	67	

Laboratory Remarks: Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency, March, 1976 and/or "Microbiological Methods for Monitoring the Environment", U.S. Environmental Protection Agency, August 1978.

AECOS
970 N. Kalaheo Avenue, Suite C311 • Kailua, Hawaii 96734
Telephone: (808) 254-5884

Job #: 457
Log #: 5420
Date: 1/29/92
Page: 1 of 4

TO: Keola Hana Maui
Sample Site: Hana, Maui
Date Sampled: 12/19/91
Time Sampled: 0930
Sampled by: Hiro

Attn: Jenny Decler
Receipt Date: 12/19/91

Log #: 5420

Wananalua Well, Maui - State Well No. 4559-01
LABORATORY ANALYSIS REPORT - Primary Drinking Water Standards

	Amount Detected	Detection Limit	Date Analyst
Arsenic (mg/l)	BDL	0.002	1/2 mka
Barium (mg/l)	BDL	0.050	1/2 mka
Cadmium (mg/l)	BDL	0.001	1/2 mka
Chromium (mg/l)	BDL	0.01	1/2 BAL
Lead (mg/l)	BDL	0.001	1/2 mka
Mercury (mg/l)	BDL	0.0002	1/2 BAL
Selenium (mg/l)	BDL	0.005	1/2 mka
Silver (mg/l)	BDL	0.001	1/2 mka
Fluoride (mg/l)	BDL	0.1	1/3 er
Nitrate (mg N/l)	0.117	0.03	12/20 er/dh
Turbidity (NTU)	0.23	0.1	12/19 cl
Total Coliform (col/100 mls)	<1	1	12/20 BAL
Gross Alpha (pCi/l)	0.0 ± 1.4	2	1/22 BL
Gross Beta (pCi/l)	3.5 ± 1.5	3	1/22 BL
Endrin (mg/l)	BDL	0.0002	1/2 er
Lindane (mg/l)	BDL	0.0001	1/2 er
Methoxychlor (mg/l)	BDL	0.0005	1/2 er
Toxaphene (mg/l)	BDL	0.005	1/2 er
2, 4-D (mg/l)	BDL	0.002	12/30 mka
2,4,5-TP (mg/l)	BDL	0.001	12/30 mka

BDL = Below Detection Limit
Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, March 1979 and/or "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water," U.S. EPA, July 1978.

Job #: 457
Log #: 5420
Date: 1/29/92
Page: 2 of 4

Secondary Drinking Water Standards

	Amount Detected	Detection Limit	Date Analyst
Alkalinity (mg CaCO3/l)	44	5	12/26 cl
Calcium Hardness (mg CaCO3/l)	56.4	0.5	1/6 mka
Chloride (mg/l)	81.0	5	12/23 cl
Color (APCU)	BDL	5	12/19 er
Copper (mg/l)	0.02	0.02	1/6 mka
Total Dissolved Solids (mg/l)	212	10	12/26 sm
Foaming Agents (mg LAS/l)	BDL	0.025	12/20 mka
Iron (mg/l)	BDL	0.1	1/6 mka
Manganese (mg/l)	BDL	0.05	12/19 cl
pH	8.40	0.1	12/19 cl
Sulfate (mg/l)	11/8	2	1/7 klm
Zinc (mg/l)	0.01	0.01	1/6 mka
Calcium (mg/l)	7.6	0.05	1/6 mka
Magnesium (mg/l)	9.1	0.005	1/6 mka

BDL = Below Detection Limit
Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, March 1979 and/or "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water," U.S. EPA, July 1978.

	Amount Detected	Detection Limit	Date Analyst
Benzene	BDL	0.5	1/2 AL
Bromobenzene	BDL	0.5	1/2 AL
Bromochloromethane	BDL	0.5	1/2 AL
Bromodichloromethane	BDL	0.5	1/2 AL
Bromoform	BDL	0.5	1/2 AL
Bromomethane	BDL	0.5	1/2 AL
n-Butylbenzene	BDL	0.5	1/2 AL
sec-Butylbenzene	BDL	0.5	1/2 AL
tert-Butylbenzene	BDL	0.5	1/2 AL
Carbon Tetrachloride	BDL	0.5	1/2 AL
Chlorobenzene	BDL	0.5	1/2 AL
Chloroethane	BDL	0.5	1/2 AL
Chloroform	BDL	0.5	1/2 AL
Chloromethane	BDL	0.5	1/2 AL
2-Chlorotoluene	BDL	0.5	1/2 AL
4-Chlorotoluene	BDL	0.5	1/2 AL
Dibromochloromethane	BDL	0.5	1/2 AL
1,2-Dibromo-3-chloropropane	BDL	0.5	1/2 AL
1,2-Dibromoethane	BDL	0.5	1/2 AL
Dibromomethane	BDL	0.5	1/2 AL
1,2-Dichlorobenzene	BDL	0.5	1/2 AL
1,3-dichlorobenzene	BDL	0.5	1/2 AL
1,4-Dichlorobenzene	BDL	0.5	1/2 AL
Diochlorodifluoromethane	BDL	0.5	1/2 AL
1,1-Dichloroethane	BDL	0.5	1/2 AL
1,2-Dichloroethane	BDL	0.5	1/2 AL
1,1-Dichloroethene	BDL	0.5	1/2 AL
cis-1,2-Dicloroethene	BDL	0.5	1/2 AL
trans-1,2-Dichloroethene	BDL	0.5	1/2 AL
1,2-Dichloropropane	BDL	0.5	1/2 AL
1,3-Dichloropropane	BDL	0.5	1/2 AL
2,2-Dichloropropane	BDL	0.5	1/2 AL
1,1-Dichloropropane	BDL	0.5	1/2 AL
1,3-Dichloropropene	BDL	0.5	1/2 AL
Ethylbenzene	BDL	0.5	1/2 AL
Hexachlorobutadiene	BDL	0.5	1/2 AL
Isopropylbenzene	BDL	0.5	1/2 AL
4-Isopropyltoluene	BDL	0.5	1/2 AL
Methylene Chloride	BDL	0.5	1/2 AL

BDL = Below Detection Limit
Samples analyzed according to Method EPA 524.2.

	Amount Detected	Detection Limit	Date Analyst
Methylene Chloride	BDL	0.5	1/2 AL
Naphthalene	BDL	0.5	1/2 AL
n-Propylbenzene	BDL	0.5	1/2 AL
Styrene	BDL	0.5	1/2 AL
1,2,1,2-Tetrachloroethane	BDL	0.5	1/2 AL
1,1,2,3-Tetrachloroethane	BDL	0.5	1/2 AL
Tetrachloroethene	BDL	0.5	1/2 AL
Toluene	BDL	0.5	1/2 AL
1,2,3-Trichlorobenzene	BDL	0.5	1/2 AL
1,2,4-Trichlorobenzene	BDL	0.5	1/2 AL
1,1,1-Trichloroethane	BDL	0.5	1/2 AL
1,1,2-Trichloroethane	BDL	0.5	1/2 AL
Trichloroethene	BDL	0.5	1/2 AL
Trichlorofluoromethane	BDL	0.5	1/2 AL
1,2,3-Trichloropropane	BDL	0.5	1/2 AL
1,2,4-Trimethylbenzene	BDL	0.5	1/2 AL
1,3,5-Trimethylbenzene	BDL	0.5	1/2 AL
Vinyl Chloride	BDL	0.5	1/2 AL
Zylenes, Total	BDL	0.5	1/2 AL

BDL = Below Detection Limit

Samples analyzed according to Method EPA 524.2.
"Method for the Determination of Organic Compounds in Drinking Water,"
U.S. EPA, December 1988.

CHEMICAL ANALYSES OF WATER

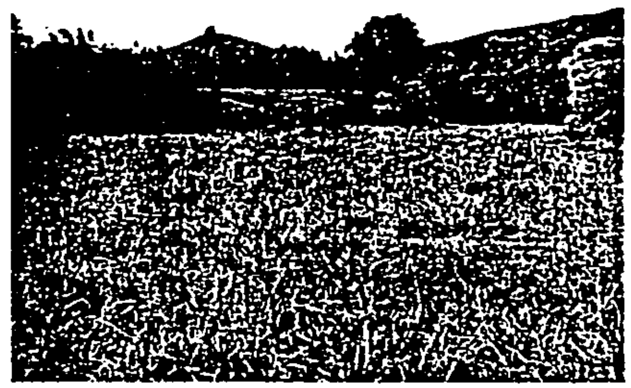
Hamoa Well, Hana, Maui
State Well No. 4300-02

Sample Taken: November 8, 1985, 8:30 a.m.
Analyses by: U.S. Geological Survey, February 6, 1986

Nitrogen (mg/L)	0.16
Carbonate Hardness (mg/L)	16
Calcium (mg/L)	3.8
Magnesium (mg/L)	1.6
Sodium (mg/L)	8.6
Potassium (mg/L)	1.6
Chloride (mg/L)	6.9
Sulfate (mg/L)	2.3
Fluoride (mg/L)	<0.10
Silica (mg/L)	17
Iron (mg/L)	0.009
Manganese (mg/L)	<0.001
Total Dissolved Solids (mg/L)	56
Alkalinity (mg/L)	24
Arsenic (mg/L)	<0.001
Barium (mg/L)	<0.1
Beryllium (mg/L)	<0.01
Cadmium (mg/L)	<0.001
Chromium (mg/L)	<0.01
Cobalt (mg/L)	<0.001
Copper (mg/L)	0.002
Iron (mgj/L)	0.070
Lead (mg/L)	0.001
Molybdenum (mg/L)	0.001
Nickel (mg/L)	0.002
Silver (mg/L)	<0.001
Zinc (mg/L)	<0.01
Aluminum (mg/L)	0.07
Lithium (mg/L)	<0.01
Selenium (mg/L)	<0.001

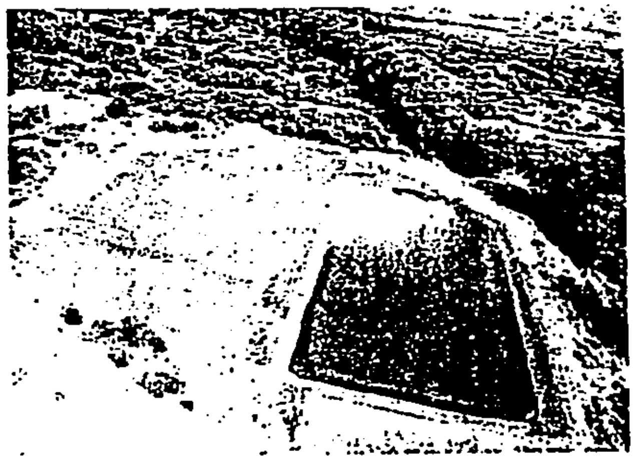
PUU KOLO RAIN CATCHMENT RESERVOIR

Aerial view of unused Puu Kolo Reservoir, looking south. Puu Kolo is barely visible on left and low arcuate dam is left of center.



Ground view of reservoir floor and arcuate dam, looking south-southwest.

KEOLA HANA MAUI RAIN CATCHMENT RESERVOIR

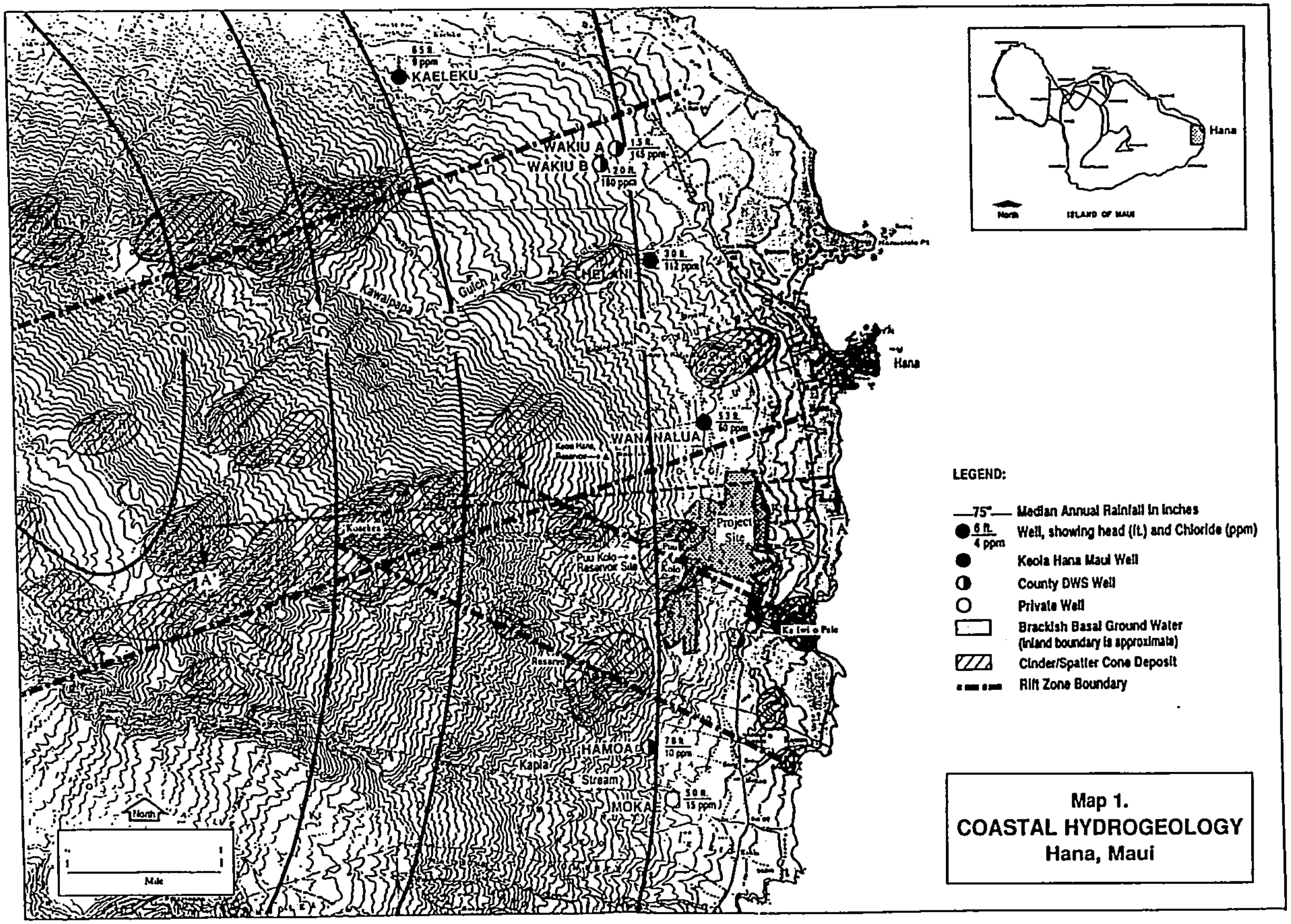


Aerial view of Keola Hana's butyl rubber-lined rain catchment reservoir, located at an elevation of 1000 ft. just inside the forest reserve boundary. View is to the north.

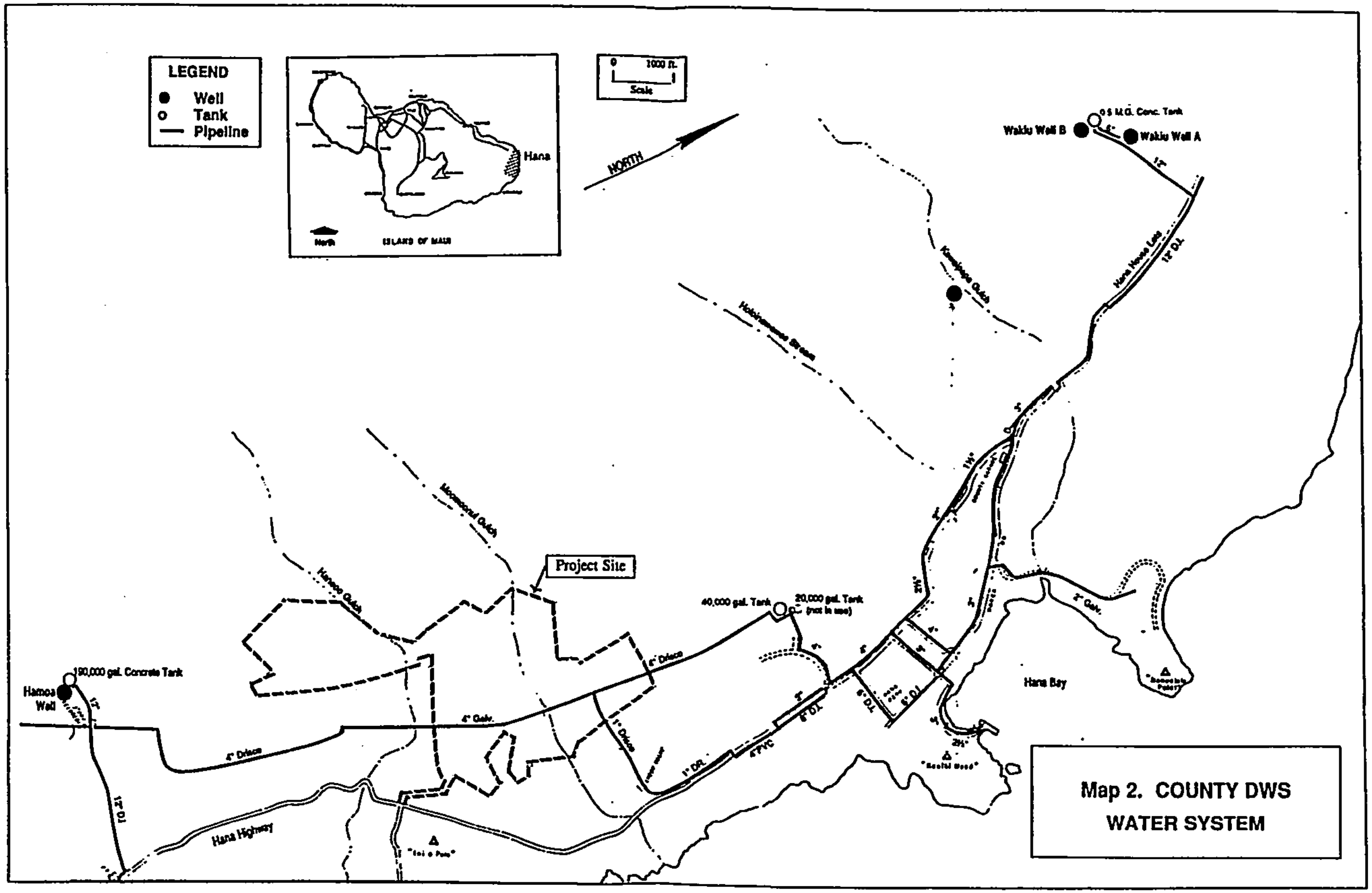
DRILLER'S LOG

Wananalua Well (State Well No. 4559-01)

Depth (ft.) From	To	Description
0	33	Gravel Cinder
33	46	Blue Rock
46	63	Boulder Cinder
63	107	Blue Rock
107	123	Red Grey Rock
123	165	Blue Rock
165	174	Red Rock
174	197	Gray and Blue Rock
197	200	Brown Rock
200	222	Brown Rock Soft
222	241	Gray Hard Rock
241	258	Gray Rock
258	273	Brown Rock Hard
273	287	Gray Rock Hard
287	290	Red Cinders and Clay
290	376	Brown Lava and Cinders
376	406	Brown Broken Rock
406	437	Red and Gray Cinders
437	440	Gray Rock Hard



Map 1.
COASTAL HYDROGEOLOGY
Hana, Maui



Map 2. COUNTY DWS WATER SYSTEM

APPENDIX E

ENVIRONMENTAL RISK ASSESSMENT AND INTEGRATED GOLF COURSE MANAGEMENT PLAN FOR THE PROPOSED GOLF COURSE AT HANA, MAUI

Prepared by Environmental & Turf Services, Inc., July 1992

ENVIRONMENTAL RISK ASSESSMENT AND INTEGRATED GOLF COURSE MANAGEMENT PLAN FOR THE PROPOSED GOLF COURSE AT HANA, MAUI

for

Keola Hana Maui, Inc.
Honolulu, Hawaii

by

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FINAL
July 13, 1992
(Revised October 27, 1992)

EXECUTIVE SUMMARY

Keola Hana Maui, Inc. is planning to construct an 18-hole golf course in Hana Maui. The 150 acre golf course would be located on 201 acres of land south of the town center, and mauka of Hana Highway. The golf course would be built to help supplement declining occupancy rates of the Hotel Hana Maui.

The project site overlies a potable aquifer. No wells tap into this part of the aquifer, but ground water from the site discharges at the coastline where it could impact water quality. Although there are no perennial streams that flow through or near the property there are three major gulch systems that drain runoff from parts of the site during storm events. The runoff is partly conveyed to the ocean and percolates through the bottom of the gulches to some extent. Preservation of water quality is critical especially in Hana where subsistence and recreation fishing are part of the fabric of life. Therefore Keola Hana Maui requested the preparation of this report that contains an integrated golf course management plan (IGCMP), a ground water risk assessment, and a surface water risk assessment.

Specifically, our task can be described as follows:

- develop an IGCMP based on the philosophy that growth and maintenance of healthy turf minimizes the need for pesticides;
- evaluate the potential for the turf chemicals specified in the IGCMP to impact ground water and surface water;
- summarize field results from other studies; and
- recommend mitigative measures to reduce or eliminate the potential impacts.

The IGCHP is quite extensive and detailed, and is based on the principle of integrated pest management (IPM). IPM practice uses a variety of cultural, mechanical, biological, and chemical methods to control insect, disease, and weed pests. For example, the IPM program contained herein has over four pages of guidance on the use of naturally-occurring beneficial insects, bacteria, etc. to control insect pests. The IGCHP also establishes pest infestation guidelines for pesticide application; i.e., insect and disease density thresholds below which pesticide application may not be necessary. The IGCHP identifies 42 weeds, 15 diseases, and 11 insect pests that may occur on site. Eighteen of these are identified as key pests (12 weeds, five diseases, and one insect). Sixteen pesticides have been identified for use against these 68 pests in a worst case pest infestation scenario. Two of these are considered to be "organic" in common jargon. Actual pesticide usage may be one half what is projected in the IGCHP.

The 16 pesticides include 7 herbicides, 4 insecticides, and 5 fungicides. But no pesticides are recommended for total area coverage, i.e. blanket treatment.

Approximately 70% of the nitrogen fertilizer recommended is in the slow-release form. In this form, nitrate-nitrogen is much less likely to impact ground water and surface water than more conventional quick-release, water soluble forms.

The following bermudagrass turf species should be used due to disease resistance, salt tolerance, weed and insect resistance, low water usage, production of a good playing surface, and other factors:

- Tifdwarf on greens;
- Tifgreen 328 on tees; and
- Tifway II on fairways and roughs.

The IGCHP also provides guidance on safe handling, storage, and disposal of turf chemicals.

The risk assessment process described below is based on principles and techniques developed by the U.S. Environmental Protection Agency, in part by the Study Director (S. Cohen) during his tenure there.

Pesticide Evaluations

Pesticides were thoroughly evaluated as part of the ground water and surface water risk assessments.

The mobility, persistence, human toxicity and aquatic toxicity of all synthetic chemical pesticides were evaluated. Potentially toxic metabolites were considered as well. Computer simulation modeling using hundreds of chemical- and site-specific input parameters was performed on selected pesticides to predict chemical loss in runoff and leachate.

A ranking scheme was developed by ETS and used to select chemicals for modeling. The ranking scheme was modified for specific applications to ground water and surface runoff modeling. It was necessary to identify the highest priority candidates due to the intensive effort required for modeling, i.e., it would be impractical to model all chemicals. The scheme includes considerations for use volume, toxicity, and the ability to migrate offsite. The following pesticides with the highest rank scores were selected for intensive computer modeling of surface runoff: dithiopyr, iprodione, fenarimol, copper hydroxide, and chlorpyrifos. The following pesticides were selected for modeling leaching to ground water: fairways -- oryzalin, metribuzin, and fluvalinate; greens -- iprodione, fluvalinate, and fenarimol. Thus representatives of all pesticide use classes were selected for computer modeling -- herbicides, fungicides, and insecticides.

Modeling

Site-specific input data were used for the modeling. The site was visited by ETS coauthors, and soil was sampled by hand and analyzed. Hydrogeologic data were obtained from on-site geophysical surveys and test borings. Daily weather records were used from a five year period. Data on worst-case storm events were also obtained.

State-of-the-art, data intensive computer simulation models were used to predict offsite migration of turf chemicals.

The field-validated EPA-endorsed SWRRBWQ computer simulation model was used to estimate sediment-sorbed and dissolved concentrations of pesticides and fertilizers in surface runoff. Storm events of 1 year and 100 year return intervals and 24-hour duration were modeled as well as annual averages. Several hundred input parameters had to be entered by ETS staff.

The EPA-supported PRZM-VADOFT modeling system was used to simulate pesticides leaching to ground water. Leachate transport was simulated for five years using daily weather records. Close to 1000 input parameters had to be entered by ETS staff, not including the daily weather records.

As noted above, an extensive amount of site-specific input data was used for all modeling. In some cases, reasonable and conservative assumptions were used. One example is in the use of weather data. Five years were chosen at random from the 20 wettest years of the 37 years for which data are available. Many other conservative assumptions are described in the text.

Conclusions and Mitigation Measures

The Hana Ranch Country Club course can be operated in a manner that would not impact the basal aquifer or nearshore organisms as long as responsible turf management is practiced. Fourteen synthetic and two "organic" pesticides are recommended to help the golf course through the first several years of operation. The pesticide and fertilizer scenario presented in the IGCHP is a reasonable worst case scenario, i.e., it assumes that much of the recommended IPM program fails. Conclusions about environmental impacts follow.

Ground Water. In the reasonable worst case--an approximation of the upper 95% confidence interval--pesticide concentrations at the top of the aquifer would be no greater than 1/76th of the lifetime drinking water Health Advisory Levels and generally much lower. This conclusion applies to the five pesticides most likely to contaminate ground water. These calculations were based on the assumption that the greens would be constructed according to U.S. Golf Association specifications, a reasonable assumption. It was further assumed that the effluent from the greens would be "daylighted" (exposed) onto the surface of a rough, or otherwise conveyed to some other metabolically active environment, such as a pond, irrigation ditch, etc. This too is a reasonable assumption. Therefore, we propose as mitigation measures that the greens be constructed according to USGA specifications, and the greens' drainage be conveyed to some other dissipative environment, such as the surface of a rough area. There would probably be no cause for concern if the IGCHP were followed even without these mitigation measures. However, it would be prudent and not impractical to implement these measures.

The appropriate fertilization program for this site, considering both turf growth and water quality impacts, recommends that approximately 70% of the fertilizer nitrogen (N) be applied in the slow-release form. This minimizes ground water contamination potential relative to quick-release forms of N.

The expected N concentration increase in the top 5 ft of the aquifer, if the maximum amount of N is applied, would be less than 1 ppm. This is at least one order of magnitude less than the 10 ppm drinking water MCL. Increases in N concentrations at the point where ground water discharges to the shoreline would probably be nondetectable.

There were over 3100 head of cattle at the Hana ranch as of January, 1992. It is estimated that the manure from the cattle produces over 37,000 pounds of nitrogen (N) per year, more than 10 times the maximum loading anticipated for the proposed golf course. If Keola Hana Maui, Inc. desires to maintain the current level of N loading to the environment, the herd would have to be reduced by 10%.

Surface Water. There was no cause for runoff concern for the fertilizers or fungicides. There was a marginal concern for the herbicide dithiopyr (Dimension®) and a more significant concern for the insecticide chlorpyrifos (Dursban®). The highly toxic but efficacious insecticide chlorpyrifos raised some concerns for potential impacts on aquatic organisms during 1 year and 100 year return 24 hour storm events. Dissolved concentrations of chlorpyrifos in runoff from 1 year and 100 year storm events are predicted to be 2.2 ppb and 0.2 ppb, respectively. These predicted concentrations compare unfavorably with chlorpyrifos' 1 hour water quality criteria--0.011 ppb for marine organisms. It is highly unlikely that harmful concentrations would occur at the shoreline, due to the strong wave mixing action and the conservative assumptions we made in our modeling. Nonetheless, when in doubt, it is better to err on the side of environmental protection. Consequently, we are tentatively recommending trichlorfon as a near-term mitigative measure. Trichlorfon is less persistent than

chlorpyrifos, it has lower aquatic toxicity, it has a lower HAL, and it is registered for turf use in Hawaii against key insect grub pests. In the longer term, it is hopeful that the beneficial nematodes described in this report will provide an effective, non-chemical solution. The concern about the herbicide dithiopyr was based on predicted concentrations following the one year return storm event only. The predicted concentration at the mouth of the gulches (0.9 ppb) was slightly greater than our calculated water quality criteria (0.56 ppb), but did not consider dilution at the shoreline. As a conservative mitigation measure, we recommend that dithiopyr may be applied to 40 acres of the golf course, but no more than 20 acres at a time, separated by intervals of at least six months.

Other Potential Nearshore Impacts. Ciguatera toxin can accumulate in reef fish under certain circumstances. If the reef fish are consumed by humans, illness and death can result. Nobody knows the reason for outbreaks of ciguatoxin outbreaks, which have been documented as long ago as 1606. But experimental and field data seem to indicate that turf management of golf courses is not the cause.

Spray Drift. Liquid pesticide formulations should not be applied when wind speeds exceed 10 mph. This would prevent pesticides from drifting more than 50 ft. This should not be an overly burdensome restriction, since winds in the area are less than 11 knots (12.6 mph) 90.3% of the time. A tractor boom spray shroud may also be used to further reduce drift.

Considerations of Public Comments

The concerns of the public were carefully considered during the development of this risk assessment and turf management program. This can be seen in the focus of our risk assessment (Section VI (B), "Potentially Significant Exposure Pathways").

In 1991 and early 1992, various government agencies and citizens of Hawaii provided formal comments on the Environmental Assessment and EIS preparation notice, respectively, for this project. Following is a brief summary of the key comments, some of the commenters, and brief statements about how the comments were addressed.

Comments	Commenters	Resolution
Ground water Impacts	Dept. Water Supply, Dept. Health, Hana Community Negot'ns Cmte., Others	A key focus of this risk assessment. No potential problems noted.
Nearshore Impacts	Hana Community Negot'ns Cmte., Others	A key focus of this risk assessment. Marginal concerns for 2 pesticides. Mitigation measures provided.
Need for an integrated golf course management plan	O.S.P., Dept. Ag, D.L.N.R., Others	Provided in this report along with reasonable worst case assumptions about pesticide use.

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I. Introduction and Purpose

Keola Hana Maui Inc. is planning to construct an 18-hole golf course in Hana Maui. The 150 acre golf course (including roughs and areas with native grasses) would be located on 201 acres of land located south of the Hana town center, mauka of Hana Highway. The golf course would be built to help increase occupancy rates of the Hotel Hana Maui.

The project site overlies the Kawaipapa Aquifer System. The Kawaipap Aquifer System is potable over the project site. No wells tap into this part of the aquifer, but ground water from the site discharges at the coastline where it could impact water quality. Although there are no perennial streams that flow through or near the property, there are two major gulch systems that drain runoff from parts of the site during storm events. The runoff is partly conveyed to the ocean and percolates through the bottom of the gulches to some extent. The preparation of this report is intended to evaluate the potential impacts of the golf course, and therefore, contains an integrated golf course management plan, a ground water and a surface water risk assessment.

Specifically, our task can be described as follows:

- develop an integrated golf course management plan (IGCMP) based on the philosophy that growth and maintenance of healthy turf minimizes the need for pesticides;
- evaluate the potential for the turf chemicals specified in the IGCMP to impact ground water and surface water;
- summarize field results from other studies; and
- recommend mitigative measures to reduce or eliminate the potential impacts.

II. DESCRIPTION AND PROJECT OVERVIEW

A. Site Description

The project site consists of approximately 201 acres of gently rolling pasture land located about 1.8 miles from the Hotel Hana-Maui (Figure 1). It is located on the lower eastern slopes of Haleakala which rises to more than 10,000 feet a few miles to the west.

The Hana region is located on the windward coast of Maui at the eastern extremity of the island. Accessibility to Hana is limited to vehicles traveling from Kahului on Hana Highway or by air service.

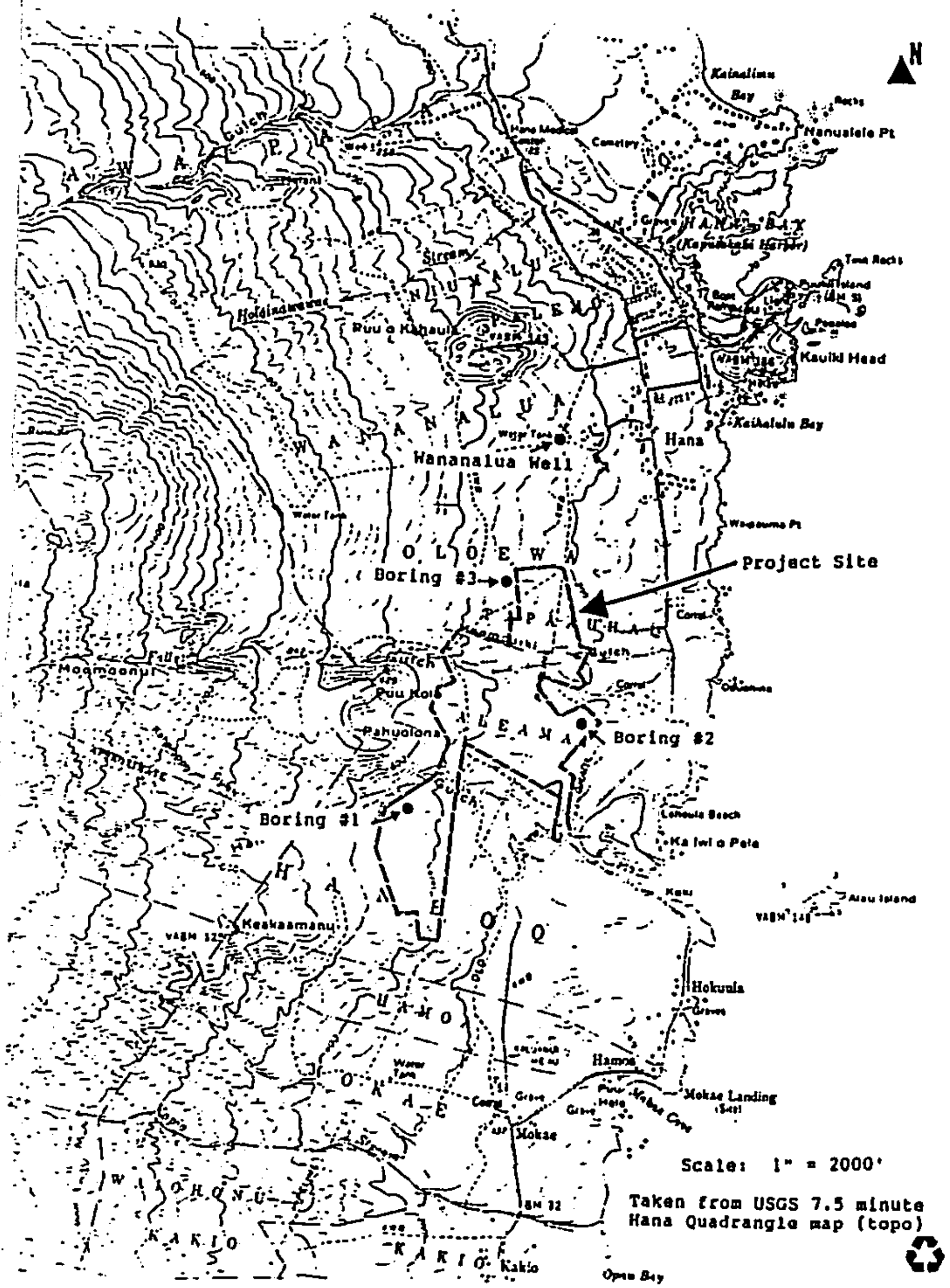
Temperatures range between 60° and 80° F throughout the year with light tradewinds. The Hana area receives an average of 69 inches of rain annually. This environment is conducive to tourist and Kama'aina activities relating to enjoyment of the natural lifestyle this tropical island offers.

Specific site description of soils and hydrogeology can be found in section VI (A) below.

B. Project Overview

The Hana Ranch Country Club will be an 18 hole championship golf course. It will include a clubhouse and driving range and is meant to upgrade the resort to a competitive level and provide an extension of services not currently provided by the Hotel Hana-Maui. Keola Hana Maui, Inc. does not plan to develop or sell any land, houses or condominiums around the golf course.

Figure 1. Site Location Map



III. INTEGRATED PEST MANAGEMENT

A. Introduction

This report is intended to serve five basic functions:

1. To educate the reader on the basic concepts of Integrated Pest Management (IPM) and to explain how these concepts can be translated into an Integrated Golf Course Management Plan (IGCMP).

2. To create, in sufficient detail, a plan for operating the proposed Hana Ranch Country Club in a safe, effective and environmentally responsible manner.

3. To act as a source for current pest prevention control and to provide information for the golf course superintendent on the process of managing the Hana Ranch Country Club with baseline IPM principals.

4. To provide site specific recommendations to the owner on methods of designing and building the golf course to lower the need for pesticide use and to minimize or eliminate the impact of management.

5. For the purpose of providing a conservative risk management assessment, develop a worst case scenario for pesticide use on the project site and allow an adequate environmental safety cushion if pest pressure reaches an unusual high point.

In accordance with this policy, Keola Hana Maui, Inc. will employ a professional turfgrass manager with the capability to implement the integrated golf course management plan and demonstrate sensitivity as it relates to environmental issues.

This will include consistent compliance with Federal, State and County environmental regulations, water quality monitoring of ground and surface water resources, the protection of wildlife and environmentally sensitive areas, and continued leadership in environmental concerns as it relates to public safety and awareness.

The goals of the Hana Ranch Country Club are as follows:

1) To be leaders in environmental management and environmental monitoring.

2) To be protective of the physical and environmental resources of the site.

3) To develop pest management strategies with an emphasis towards reducing the use of pesticides.

4) Provide water conservation equipment, materials and methods, to maximize usage of water efficiently.

5) To hire and maintain qualified personnel sensitive to the environmental issues of the project site.

The strategy for minimizing pesticide use on the Hana Ranch Country Club:

1) Plant turf species adaptable to climatic conditions found on the lower slopes of Haleakala and on the eastern windward coast of Maui.

2) Use sound Cultural Management to minimize pesticide use.

3) Utilize best management practices and sound environmental technology to gain knowledge on acceptable levels of pest impact. Include this knowledge in the Integrated Golf Course Program.

4) Provide the golf course superintendent the necessary assistance, support, and technology that will be needed to provide the very best in turf management.

B. <u>Goals of IPM</u>

To economically and ecologically manage pest populations in a sound pest management program, one must utilize reasonable approaches for turfgrass quality and provide an acceptable safeguard for human health and the environment.

Integrated Pest Management is an interdisciplinary program that manages all known pest control tactics into a single system to prevent unacceptable levels of pest damage. The control methods are designed not to eradicate pest populations, but to manage turfgrass in the most economical way with the least possible effect on people, property, and the environment.

Integrated Pest Management is a decision making process for pest prevention and control. IPM does not eliminate the use of pesticides, but does allow for their use only after all other measure of control have been considered. Flexibility must be provided within the system. IPM will provide the environmental and economic benefits of applying pesticides only when needed and reduce the reliance on chemicals as the only method available for control.

The successful use of IPM on turfgrass removes the conventional spray approach to pest management and is likely to reduce pesticide usage 30% or greater. According to a recent National Golf Course Superintendent's Association of America survey, greater than 70% of superintendents who responded said they are currently employing IPM practices. Successful demonstration of Integrated Pest Management programs have been implemented at the Pine Ridge golf course near Baltimore, MD; the Johns Island Club in Vero Beach, FL; the Sagamore Resort north of Albany, NY; and the Applewood golf course in Golden, CO. These projects have helped demonstrate and illustrate how important the role of a qualified golf course superintendent is for adoption of reasonable alternative IPM methods for control. This reduction in conventional levels of management by the golf course superintendent places conservation of the biocoenosis at the forefront of turfgrass maintenance.

There are no single pest control methods available that will give complete control of turfgrass pathogens. Golf courses like other agricultural commodities, are susceptible to occasional attacks from a rather complex list of pests. Warm season turfgrass does not have the acute disease problems of cool season turf varieties, but is prone to repeated attacks from different kinds of mites, insects, weeds, and disease. These pests and casual agents may be observed during various climatic conditions and life cycles. They may be controlled by a variety of pest control methods.

The IPM system requires the monitoring of pest populations so that when pest pressure exceeds the action level, an appropriate treatment may be implemented. A threshold is the point at which the pest, may exceed a defined tolerance level of damage to turf, and an appropriate method for control is to be considered. The treatment may be one of variety of measures. This system will work on every defined management area but must be tailored for each tee, green,

fairway and rough. This concept of pest management provides a form of risk reduction and environmental control.

IPM will incorporate preventative control measures and will define specific effective pest management strategies. The system will work towards the suppression of pest populations and provide for the judicious selective use of pesticides. By managing pest populations and choosing the most ecologically acceptable method available for control, an IPM program will reduce the potential for pollution to the environment.

C. Objectives of IPM

The following are interrelated guidelines that will assist the golf course superintendent in achieving the goals of IPM:

- To develop healthy turf and ornamentals that can withstand pest pressure.
- To keep damaging insects, weeds and diseases at or below an acceptable threshold level.
- To utilize natural control methods (biological, cultural, mechanical, and physical) that will maximize beneficial organisms rather than destroying them.
- To use chemicals more wisely, less often and/or in lower quantities.
- To develop a strategic approach for the continued presence of harmful species that will remain as host for aerobic fungi, bacteria, parasites and predators.

- To time chemical treatments more precisely at vulnerable pest stages and thereby more effectively and economically control pests.

- To accept a certain level of loss or damage to the turf areas.

D. <u>Developing an IPM Business Plan</u>

The golf course superintendent and project IPM consultant must develop a time plan with a step by step approach that identifies the type of resources that will need to be available. The plan should include a statement and purpose on the level of maintenance that must be provided. There should be a sufficient level of technically trained staff available to carry out the plan.

The plan should include the following resources:

1) Knowledgeable staff trained to implement an effective Integrated Pest Management Program.

2) Sufficient staff time to consistently monitor each management unit (tee, green, fairway and rough).

3) Proper equipment for ease of transportation and identification.

4) Availability of a diagnostic laboratory or the assistance of an advisory firm responsive to proper pest identification and control.

A calendar should be developed that includes a list of all tournament play and normal play functions. This will assist in the proper timing of cultural practices and allow

for control methods to be planned in advance. Once a calendar has been developed, it should include a schedule for monitoring and provide documentation that a site analysis has occurred.

The golf course superintendent should delegate a proper chain of command and appoint key personnel who will be trained as part of a monitoring team. To perform detection of pest infestation it is recommended that at least three individuals be designated as scouts. These individuals will report directly to the golf course superintendent and will be responsible for daily monitoring of each playing unit within the golf course agricultural management system.

E. <u>Monitoring Control Systems</u>

Monitoring control systems will provide the basis for developing economic thresholds and to determine if action will be necessary for control. It is anticipated that a maximum of two hours per day will be needed in order to implement an effective monitoring control program. The system should be simple, accurate and part of the daily regiment for turfgrass management.

A thorough understanding of potential pest species will be needed for each member of the monitoring team. An understanding of the role that beneficial organisms provide will be needed before any organism is identified as a pest. A secondary pathogen may be a pest under certain conditions but may also provide a balanced beneficial role in other turfgrass situations. The observation team should note any visual reduction in turfgrass quality and accurately secure the proper information regarding the phenology or life cycle of the pest.

Pests may be defined as bacteria, deleterious fungi, insects, nematodes, rodents, viruses, weeds etc. The information obtained through monitoring will provide site specific educational knowledge and limit the levels of predictable loss to turfgrass.

Documentation will be needed to identify where outbreaks are most likely to appear. The importance of the pest should be noted on a scouting form and also include the biological, cultural, environmental, and physical factors that affect the presence of the species. For example, an excellent time to observe mycelium is prior to poling the dew from the playing surfaces. The visible detection of sclerotia will provide a good indication of the potential movement of the pathogen into the host biotic tissue. In the early stages of development, active disease is easier to identify, when dew is present on the turfgrass. This can be performed prior to mowing without interruption of the playing public.

The golf course superintendent should document the location and the environmental condition of the casual agent affecting the plant species. The level at which the pest population or its damage endangers crop quality is often called the economic threshold (Bohmont, 1990). Detailed point sampling (i.e. number of insects), should measure the density of the pest population relative to their damage on the area of turfgrass. This information will be used to determine the site specific threshold levels for each agricultural management unit located on the Hana Ranch Country Club. Actual field observations can be used to fine tune the limits of the pre-determined threshold action levels. Pest occupance is so weather dependent that it is necessary to observe pest populations for several years to have a good idea as to the range of pest problems. It will likely require at

least three years to develop a comprehensive data base to establish site specific base line pest occupance.

Additional samples should be taken to determine the level of infestation (high and low). Random sampling will provide additional documentation on the potential impact to the entire acreage. Accurate field data will allow the golf course superintendent to make reasonable and timely decisions on when to apply the appropriate method for control. The monitoring process will gain confidence and experience in all levels of the management personnel.

The experience of utilizing IPM will produce effective control and tolerance of pest population outbreaks. It will be through this knowledge, that the golf course superintendent will be able to realize, the fallacy of relying solely on chemicals for control. The value of turfgrass as a playing medium for golf is very important. Golf course superintendents have become increasingly more aware and knowledgeable concerning the protection of environmental resources. The use of a pesticide is becoming increasingly more controversial and expensive. New technology is continually being introduced and products are being packaged and formulated safer. Chemical companies are actively involved in new areas of chemical research to seek out replacement products for existing pesticides. Their goal is to create chemicals with reduced animal and human toxicity that would degrade to innoxious compounds.

The golf course superintendent will develop a tracking procedure to evaluate and predict when conditions exist that would encourage damaging pest populations. The skills obtained will allow the superintendent to be a leader in pest management control. This will also generate information on the success of his applied control measures against the pest.

The following page provides a sample on the necessary information which is needed for inclusion in the monitoring and scouting report.

F. Obstacles to IPM

There are many obstacles to the acceptance of Integrated Pest Management. Programs that are designed to assist golf course superintendents in agreed IPM approaches have only recently begun to surface. The lack of understanding in the concept and benefit of implementing a control procedure program, and the failure to establish and accept reasonable action thresholds, may prohibit an otherwise sound management program from accomplishing the main goal of IPM principles. The biggest roadblock to an integrated pest management program is that the golf course superintendent must not be held to a damage free and weed free standard to maintain his employment position (Petrovic, 1991).

Golf course superintendents who manage existing golf courses, need a commitment by the ownership that adequate funding will be available for an IPM program. Management wants assurances that failure of turfgrass will be kept to a minimum and that additional costs usually incurred during the first year will result in an over-all improvement to the facility.

These two concepts can be accomplished if both parties enter into an agreement. Additional levels of trained personnel for the sole purpose of maintaining quality turfgrass with IPM practices will be needed. The quality of maintenance standards may in fact be enhanced if this heightened level of concern by the golf course superintendent

MONITORING AND SCOUTING SUMMARY REPORT

Name (Scout/IPM Specialist)____________________ Company____________________
Date______ Time In______ Time Out______
Pest: Disease________ Weed________ Insect________ Other________
Host Site: Tee_____ Fairway_____ Green_____ Rough_____ Ornamental_____ Other_____
Hole Number:________
Observations & Comments____________________

IDENTIFY AND CHARACTERIZE PEST POPULATION:

Macro Environment
*Key Pests*____________________
*Occasional Pests*____________________
*Migrant Pests*____________________

Micro Environment
*Non Pests*____________________
*Potential Pests*____________________

Qualitative Assessment
Pest Pressure: *# Pest/Sq.Yd.*_____ *Low*_____ *Medium*_____ *High*_____
Action Limit: *# Pest/Sq.Yd.*_____ *Ranking 1(low)-5(high)*_____
*Turfgrass Quality*____________________ Color____________________
*Quantity*____________________
Are beneficial organisms present? YES NO *Identify*____________________
*Disease Immunoassay Kit Used*____________________ *Positive ID?* YES NO

*Mechanical Damage Observed*____________________

Weather Information____________________

Computer Weather Station Information Attached? YES NO

RECOMMENDATIONS FOR CONTROL____________________

INCLUDE A SKETCH OF THE SITE WITH PEST LOCATIONS ON THE BACK

*Signature of Golf Superintendent*____________________ is met. With continued training of people in IPM, today's golf courses can minimize the potential risk of managing high quality turf. Lower levels of pesticide use is a benefit to everyone involved in the game of golf. The protection of humans, wildlife, non-target organisms, and ground and surface water only enhances the environmental stewardship of a golf course. Working together, a golf course can accomplish an effective Integrated Pest Management Program without jeopardizing the standards that both parties seek.

Only recently have new products shown the capability to suppress pathogens. Limited data and long term results have delayed registration of new products for turfgrass use. The removal of products that have failed because of unsubstantiated claims have forced manufacturers to be more sensitive about the needs of the turfgrass industry. Superintendents have learned the importance of their role in environmental control and continually ask for assistance in developing better pesticide product management and philosophy. It is through these efforts that new advances in turf management are possible.

G. <u>Turfgrass Manager Concerns</u>

The current membership of the profession known as golf course superintendents, belong to an organization that is recognized throughout the world of golf as the Golf Course Superintendents Association of America (GCSAA). GCSAA has always felt an obligation to properly prepare and engineer the future generation of golf course superintendents and ultimately achieve recognized, professional status. To achieve the professional code of standard known as Certified Golf Course Superintendent (CGCS) an applicant must be currently employed as a golf course superintendent and have a minimum of five years experience as a golf course

superintendent. He must be a class A member of GCSAA during this time and pass a comprehensive examination that consist of the following sections:

Section I - Knowledge of GCSAA and the Certification Program
Section II - The Game and the Rules of Golf
Section III - Turfgrass Management
Section IV - Pest Control Management
Section V - Financial Management
Section VI - Organizational Management

Eligibility for application requires that two Certified Golf Course Superintendents be chosen to provide GCSAA, with an Attesting Visitation Report. This must be completed during the one year application process. The certification status (CGCS) is valid for a period of five years upon the successful completion of the examination and eligibility requirements.

Renewal of active Certified Golf Course Superintendent status is required every five years. Individuals must obtain 15 continuing education credits (CEUs) prior to the eligible date of certification. GCSAA has established future eligibility status through the year 2004, that will require the minimum of a Bachelor Degree; or completion of Division I and Division II Programs. The implementation of this professional code of standard looks towards the future and sets a standard that is applicable and synonymous with golf course operations throughout the world today.

It is recommended that Keola Hana Maui Inc. seek the assistance of a Certified Golf Course Superintendent to manage the golf facility at the Hotel Hana-Maui. The individual should have a degree in agronomy and be experienced in Integrated Pest Management. He should posses a willingness to be a leader in achieving the goals outlined in the

Integrated Golf Course Management Plan. It will be the golf course superintendent's responsibility to manage the IPM program. He should be knowledgeable in the adaptation and management of warm season turfgrass and provide the necessary leadership for each member of the maintenance staff at the Hana Ranch Country Club.

The Integrated Golf Course Management Plan developed for the Hotel Hana-Maui golf facility has set a goal to establish baseline data on pest occurrence for a period of one year. During the first year of establishment, disease and pest problems generally are less of a problem than in subsequent years. The evaluation of pest occupance for the Hotel Hana-Maui golf facility has been completed. The approximate levels for potential pest outbreak have also been established for the turfgrass. Close monitoring of turfgrass during the establishment or grow-in phase will track the existence of potential pathogens. It will be very important to note the baseline information when sufficient crown and thatch layers have developed. It is during this early stage that an evaluation on the quality of turf will be necessary. The evaluation should include a cross check for each Preliminary Threshold Guideline that has been established in the (IGCM) Plan.

Technical training and related land use expertise will be necessary during the first years of operation. Continued agronomic assistance will be needed to assist the golf course superintendent in developing pest management strategies. The development of base line data will be time consuming and expensive. To collate this information into a useful IPM program, continued field assistance will be necessary. Keola Hana Maui, Inc. must understand that some loss of turf may be encountered, but with the addition of a regional expert in turfgrass agronomy this loss can be kept to a minimum.

Technical and agronomic assistance will be particularly useful during the grow-in stage of turfgrass development. The use of local university and extension expertise, will also compliment the ability of the golf course superintendent to implement the Integrated Golf Course Management Plan.

IV. BENEFICIAL EFFECTS OF TURFGRASS

The review of literature clearly shows that there are many benefits derived from turfgrass. The importance of this form of plant life often becomes lost by those who may demonstrate opposing viewpoints.

Environmental groups will typically target the potential health risks associated with the use of synthetic materials to maintain turfgrass. The right of the private sector, to publicly orchestrate an agenda of frustration with the current regulatory process, is usually fueled by perceived notions on the beneficial use of total organic products. Recognition is seldom given to those who are trained as licensed applicators in the use of both synthetic and organic materials, or that a complete environmental evaluation is usually needed prior to any material being considered for use. Industry is regulated by a federal process that closely monitors how each material will be registered for use. A state and county process adopts and regulates who will be allowed to use registered materials. Together these regulations form the technical training necessary for non-commercial applicators to apply a registered product. It is designed to assure that these products will be used in a safe form and matter.

It is the polarization of special interests within the regulatory approval process for the establishment of golf courses, that seemingly neglect to acknowledge the benefits of establishing turfgrass. The reference to grass during Biblical times and the evolution of the science of grasses in today's world, holds the key to what may remain most precious to mankind. "In the United States, turf is probably the most widely grown, talked about and least appreciated commodity" (Hanson and Juska, 1978).

There are approximately 850 plants per square foot or about eight million in each lawn of 10,000 square feet. This array of

green grass plants protect us, pleases us, enhances the environment and is beneficial to our health (Roberts and Roberts, 1988). One single grass plant grown under ideal conditions has a tremendous root system, 387 miles of roots equivalent to the distance between New York and Montreal. Howard Dittmer at the University of New Mexico estimated that a Kentucky bluegrass plant can have 2,000 root branches (Owen, 1980). This intense root mass has the ability to secure and maintain trillions of tons of soil sediment and keeps this from eroding away.

Plants play an important role in controlling climate. All plants, including turfgrasses, release significant amounts of oxygen into the air. Approximately 1,000 - 1,500 cu ft of green plant canopy are required to produce enough oxygen per person. This would equate to a 2" stand of turfgrass 6,000 - 9,000 sq ft in area (Roberts, 1991). On a block of eight average houses, front lawns have the cooling effect of about 70 tons of air conditioning. The average home-size central-air unit has a 3 to 4-ton capacity (Baker, 1987). Turf is one of the best exterior solar radiation control ground covers available. Grasses have a stem or node that develops into a narrow leaf biotic plant capable of converting energy into food for growth. A mat of rhizomes and stolons it accomplishes this process by a mechanism known as photosynthesis.

Environmental groups, concerned about the quality of atmospheric rainfall and the airborne movement of materials, often neglect to mention the beneficial aspects of turfgrass. The degradation of air, soil, and water are often cited in comparison with the production of row crop agriculture. Recognition is seldom provided on the ability for turfgrass to produce thatch, trap pollutants, or work as a buffer to prevent runoff from fallow soil. An acre of flourishing growth will probably absorb hundreds of pounds of sulfur dioxide during a year (Schery, 1976). Grass also "takes in carbon dioxide, ozone, hydrogen fluoride, and peroxyacetyl nitrate - the worst group of atmospheric pollutants" (Baker, 1987).

Grasses provide the balance to harmonize all forms of living organisms. While trees and shrubs provide a vertical orientation of green within the landscape, lawngrasses develop the green carpet upon which other plantings are located. Lawns provide the ideal background for the most pleasing landscape possible. They make and complete an inviting setting. Grassed areas provide visual coherence by pulling together and organizing all of the divergent parts of a scene (Roberts and Roberts, 1988). Turfgrasses are the only plant in the landscape that can recuperate, and in fact thicken, when consistently cut at a 1-2 inch height. This occurs because the growth tissue is located near the base of the leaf or shoot so the plant grows back from the base (Brown, 1979).

The airborne movement of contaminates is often cited by those concerned with atmospheric rainfall and the quality of precipitation that may fall. Particulate matter is continually falling from the atmosphere. Dusty haze over a city can reduce sunlight as much as 15% and ultraviolet radiation 30% or more in winter. "These dust particles in the air act as nuclei for fog, increase rainfall and make for darker days" (Schery, 1976). Grasses trap much of an estimated 12 million tons of dust and dirt released annually into the atmosphere (Daniel and Freeborg, 1979). This dust and smoke is trapped in part by lawngrass leaves so that it does not reenter the atmosphere. The particles are washed away by water condensed on leaf surfaces and by rain. They are deposited on the ground, where they enter a dynamic living soil system. Grassed areas lower atmospheric dust appreciably.

The aesthetic color green provides the visual impact to affect moods in many people. Administering plant life demonstrates how an individual may take responsible action to preserve our natural resources. Turfgrass provides modification to glare and assists

many people in the control of allergies. Grasses, as well as other ornamentals, reduce undesirable noise levels by 20-30% (Robey, 1977). A grass plant provides assistance in soil erosion, water quality and quantity, buffer zones for fire prevention, and an intermediate end product forage, consumed by grazing animals. A specialty crop in the agricultural stable, turf is grown to produce cushions of living carpet with physical and aesthetic appeal for sports and recreation, home lawns, and soil conservation. Turf is an agricultural commodity you will be glad to enjoy underfoot (Grau, 1986).

V. INTEGRATED GOLF COURSE MANAGEMENT PLAN

A. Introduction

The Integrated Golf Course Management Plan is an outline of proposed methods and materials recommended for use in managing the planned 18-hole golf course and driving range for the Hana Ranch Country Club. This program provides the most recent advancements in the establishment of turfgrass, and demonstrates a level of management designed to systematically reduce the probability of major turf pest damage.

This plan was developed around the probable pests which have been observed as potential problems for existing golf courses on the island of Maui. Interviews with golf course superintendents and site visits to golf courses adjacent to the lower slopes of Haleakala do not indicate severe pest potential. The impact environmentally should be less than the 25 years of heavily grazed conditions observed during a site walk of the proposed site. The conversion of pasture land to turf, from soils rich in organic matter, will disperse the numerous dung beetles and reduce defoliation of natural vegetation. The degree to which we project probable pests to impact the proposed Hana Ranch Country Club, will be addressed in the Integrated Golf Course Management Plan.

This plan should be considered as a guideline. Enclosed are recommendations on the use of effective and low impact methods and materials. These are the current industry standards used to successfully build and operate the golf course in an environmentally responsible way. As newer technology becomes available, and these newer methods and materials are proven to be safe and effective, the plan will

adjust and expand to include these new and best technology advancements.

B. Structural Control Program

The design of the Hana Ranch Country Club will seek to minimize unnecessary excavation of soil. The elevation of the proposed site, ranges from 550 feet (mauka) to 200 feet at the lower portion (makai). The 201 gently rolling acres are in a range of 3-15% in slope. Soils belong to the Hana-Makaalae-Kailua association and consist of moderately deep, well-drained soils underlain by a moderately fine-textured subsoil. These soils are derived from weathered volcanic ash and cinders.

Numerous dung beetle activities and the presence of earthworms, indicate that these healthy soils will provide an excellent base for establishing turfgrass. A thorough assessment on the value of manure was performed and illustrated how the completed energy cycle of returning organic matter has enriched native soils and introduced grasses. The concept of using manure to establish an area with suitable topsoil may also provide the means to introduce the practices of composting and rotovating green and tee clippings. A reclamation process for future topsoil availability for use on the golf course, would be very beneficial and minimize the need to supply additional organic amendments to enrich soils. This would also provide a source of material to be used during seed germination or to repair areas with damaged turf. Manure and copost clippings would provide soils for use on ornamental and landscape plantings. A compost area for turfgrass must provide sufficient protection from weed seed contamination. The concept of composting is labor intensive an is usually considered when the availability of topsoil is limited.

By providing replacement quantities of nutrients and controlling the soil's pH, it will be possible to encourage appropriate turf growth while simultaneously discouraging the growth of fungi, weeds, and grubs. To accomplish this during the construction phase, soil testing of the greens mix and fairways topsoil mixtures should occur. This will provide accurate information to identify and correct soil chemical and nutrient related problems.

Vegetation on the project site consists of primarily pasture land. The north half of the project is dominated by Pangolagrass.

The southern half consists of clumps of African dropseed pasture grass. Common sedges (*Fimbristylis dichotoma, Pycreus polystachyos*) and green kyllinga (*Kyllinga brevifolia*) are abundant throughout. The use of existing natural pasture lands will be incorporated in the design of fairways wherever feasible. Evidence of provisions to protect existing trees and shrubbery have been designated by the golf course architect. They have been identified on the Construction Plans for use by the Contractor during construction of the Hana Ranch Country Club.

The storm water runoff patterns that flow in the makai direction will be retained in their natural drainage patterns. Prior to construction, an approved phasing and erosion control plan will be established. A plan using silt fences, hay bales, silt basins, sod, etc. will be used to protect areas along the Kaholopoo, Moomoonui, the two unnamed gulches, and areas prone to potential erosion. A recommended buffer zone of 50 ft has been established along the edges of these gulches

and only the pruning of trees and shrubs within the gulches has been proposed.

Sediment erosion can be a serious problem if not avoided by a rapid, successful grow-in process. During the establishment period (grow-in) of a golf course, increased use of nitrogen, potassium, phosphorous, etc., are needed to get rapid turf cover establishment and therefore secure the soils from erosion.

Below are typical standards used in the golf industry to build a modern golf course.

<u>Fairways and Roughs</u>
<u>Sub-Grading</u>

All cuts and fills shall closely follow the Designer's Contour Plan. Filled areas shall be sufficiently compacted and a choker layer installed as specified to prevent settling, and all grading shall be done in such a manner that no water-holding soil depressions are produced. Natural drainage swales shall be used wherever possible. If certain areas cannot be surface drained properly, they shall then be drained by imbedding perforated drain pipe (4" minimum) in a trench six inches (6") in width by a minimum of 18" in depth filled with 3/8" gravel. Trenches shall extend to non-play areas. Trenches draining into nearby level non-play areas shall surface or end in open swales, and/or lined vegetative or non-vegetative ponds. Swales will be designed as natural areas or be included in reclamation or recirculation ponds. Containment pits can be constructed to a minimum of 12' x 12' x 3' or be of sufficient storage volume to retain and reclaim drainage water. These pits shall be filled with greensmix material and include a blanket of filter fabric and a 4" layer of topsoil.

All stones 2" in diameter and larger shall be removed from untopsoiled areas to be grassed. This removal shall be accomplished with stone pickers, rakes or any other devices that do not disturb the finished sub-grade.

Topsoil Selection

One of the most critical decisions to be made for this project is the selection of topsoil. The selected material must conduct desirable water and gases for airflow. This can be accomplished through proper particle size selection and modification. It shall have a desirable waterholding capacity and allow for proper drainage while providing a medium for adequate physical and nutritional plant support. It is critical to choose materials that are relatively clean of undesirable weed seed. This will greatly reduce the need for chemical weed control (herbicides) materials.

A final soil test should be made for any soils that may be imported off-site if they have been used for agricultural purposes. This test will determine if there is any concern regarding chemicals used in row crop agriculture. Persistent trace levels of products such as atrazine and/or metabolites of other agricultural compounds may be considered to high in residual content. Soil testing will eliminate the concern for the movement of unknown toxic substances and assure the establishment of turfgrass. The proper soil pre-mix will be determined after each soil test has been performed. This material may then be placed onto a properly graded surface.

Fine Grading-Topsoil Cleaning

After topsoil is re-spread, all stones, roots, and debris greater than 3/4" in diameter shall be removed by stone

pickers, rakes, or other devices that do not disturb grade or create water-holding pockets.

Tees

Sub-Grading and Compaction

Tees shall be built to follow the Designer's Contour Plan. To insure that the tee forms blend well into natural terrain, all filled areas shall be compacted to 95% as specified so that no future settling will occur. Fill soil will be tracked or sheepfooted with adequate moisture added throughout the grading process. The last 3 ft will be placed on 6" lifts with necessary tracking, sheepfooting, etc., and moisture to achieve the mandatory compaction of 95%.

Fine Grading and Topsoil

Care shall be exercised that no water will be trapped around the tee. The same soil mixture used for the greens shall be used for the tees. The soil mixture depth should be a minimum of 4" (when settled and floated). The soil mix shall blend into the surface mix in a pleasing manner. To assure proper grading, the contractor will be subject to "stringlining" of all tee surfaces. Sub-grades will be constructed with sufficient pitch (1%) to allow sub-drainage, but finished surface grades will be perfectly level unless otherwise specified by the Designer. Tile will be installed at unit price if necessary to complete sub-drainage. A maximum of 6" and a minimum of 3" of tee mix material is acceptable.

Greens

General

The architectural instructions regarding the design of greens shall be closely followed according to field drawings.

The method of construction will conform to current United States Golf Association's (USGA) "Specifications for a Method of Putting Green Construction." Slope on the pinnable areas of the green shall not exceed 1.5%.

Shaping Procedures

The putting surface should be graded with the green cavity excavated to a depth of 18" (12" if top soil is to be added later); such grade to be approved by the designer. Once such approval is made, the contractor is then responsible for installing the putting surface according to the specifications. The finished grade is to be replaced identically to that of the originally approved sub-grade.

Sub-Grade and Compaction

The contours of the sub-grade should conform to those of the proposed finish grade with a tolerance of plus or minus one inch. The sub-grade should be compacted to 95% as specified to prevent future settling that might create water-holding depressions in the sub-grade surface and corresponding depressions in the putting surface. The last three feet of sub-grade fill material will be placed on 6" lifts, with necessary tracking, sheepfooting, etc., and moisture to achieve the mandatory compaction of 95%.

It will be noted that layers of materials above the sub-grade consist of 4" of gravel, 2" of coarse sand, and 12" of topsoil mixture. Thus, the total depth will be 18".

"Ringing" the Green

The 30-inch wide collar is to be constructed to the exact same specifications as the green.

Drainage

Trenches shall be excavated in a herringbone or semi-herringbone style with no lateral lines spaced more than 20 ft apart. Trenches shall be 8" in width by 12" in depth. The bottom of the trench shall produce a constant grade of not less than 0.5% slope. The trenches and associated drain tile should extend to the surface designated lakes and into non-play areas at least 50 ft. Trenches draining into nearly level non-play areas shall end by surface venting the drains.

Non-play areas may include grassed swales designed to capture leachate that is daylighted into native natural vegetation. These areas shall be designated to contain all associated runoff with aesthetic value that requires little or no maintenance. A reclamation drain system may also be included on sites where 50 ft buffers are not practical. This system would allow for the discharge of leachate into a sealed pond that would be designed to recirculate drainage water for re-application to the golf course. This will provide additional mitigating measures from non-point source discharge and provide additional buffering for the protection of sensitive areas such as streams and wetlands.

Washed gravel of 1/4" to 3/8" diameter (as approved by USGA recommended testing lab) shall be evenly spread 4" deep in the bottom of all trenches. Local soil test engineers and laboratories may be used to verify all USGA recommendations. It is recommended that all material meet compliance standards with USGA specifications and be approved by the golf course architect. The golf course architect will serve on behalf of the clients interest and approve documentation from the soil testing laboratory.

A four inch diameter perforated drain pipe will be placed on the gravel blanket. Pipe shall be either ABS plastic pipe or ADS accordion style coiled plastic pipe with perforations. Otherwise, rigid pipe shall be in 8 ft or 10 ft sections, installed with holes on the bottom side. All pipe joints shall be connected by impervious sleeves.

The trenches shall then be filled with gravel and a 4" gravel blanket shall be spread over the entire putting surface. All 4" pipe beyond the perimeter of the collar ("Conduit Pipe") shall be non-perforated unless an exit pipe is placed in a surface flow swale from the green (particularly in front of greens). In this situation, the conduit pipe will be placed in an 8" wide by 12" deep trench with gravel backfill similar to that used under the putting surface. Gravel is to be brought to the top of the trenches flush with adjacent finish grades.

The upper ends of all main drain tile shall be equipped with a tee joint or elbow to the surface grade beyond the greens cavity. This joint will be brought to the surface and grated at its opening at the time of installation. This arrangement will enable the drain line to be flushed should it become clogged. The grate also will allow air to enter the drain lines to better facilitate drainage release. Exit points of the drains shall be surfaced in designated areas and marked on the greens drainage plan as-built. Drain exit points must be kept away from sensitive areas or streams that flow out of the course property.

Plastic Interface

To prevent capillary water movement between the greensmix and surrounding site soils, a plastic interface shall be installed to "ring" the putting surface. The plastic shall be

1 mm in thickness and 2 ft in width. The plastic shall be placed vertically around the cored sub-grade so that the top coincides with the height of the finished grade. The sheet shall be staked at 10 ft intervals to ensure that it remains in a vertical position.

Gravel Base

The entire sub-grade should be covered with a layer of clean, washed pea gravel or crushed stone to a uniform thickness of 4" inches. The preferred material for this purpose is washed pea gravel (with less than 3% combined silt and clay) of 1/4" to 3/8" diameter (as approved by a USGA recommended testing lab). If particles of any other size are included, they shall be screened out. THIS IS IMPORTANT TO THE PROPER FUNCTIONING OF THE PERCHED WATER TABLE.

Very Coarse Sand Layer

A uniform 2" layer of coarse sand 1-2mm shall be spread over the sub-grade layer. This sand should be within a range of 5-7 diameters of the gravel. Thus, if 1/4" pea gravel (about 6mm) is used, then the particles of the overlying layer of sand should not be less than 1mm in diameter. To prevent movement of the sand into the gravel, the maximum allowable discrepancy shall not exceed 5-7 diameters. THIS LAYER IS ESSENTIAL FOR THE PERCHED WATER TABLE TO WORK.

Greens Mixture

The greensmix shall have particle size distribution with sieve analysis recommendations verified by a soil testing laboratory. Local labs may be used to verify the sieve analysis for USGA Greens. The analysis of the test mixture is to be submitted to the Designer for review and approval. This may be done at the time of submittal for Bid for Contract. The designer and soil testing laboratory agronomist has the right to vary this mixture to meet any special needs of the grass type being utilized.

Percolation rates approved by the Designer must be met with the completed mix. Variations of 10% (± 5% of standard) will be allowed with the percolation rate. All mixing of materials shall be done off-site or by an outside soil blending service (i.e. TransAmerican Soil Blenders). After mixing, samples taken under the supervision of the Owner's representative will be sent to a USGA testing lab to insure that the mix meets the original specifications. This will be done prior to any placement of the materials on the greens. The greens mix shall be spread over the putting surface area to the compacted, uniform, minimum depth of 12".

Recommended Percent of Organic Matter

Organic matter with the ideal characteristic to provide 10-20% of volume as determined by laboratory analysis, shall be used to amend the sand content within the greens and tees root zone mix. To increase water and nutrient retention Spaghnum peatmoss should be uniformly combined into the final greensmix. The material should provide 15% Water Holding Capacity with a percolation rate of ± 15 in/hr. It is understood that not all materials are manufactured the same and that variations in water holding capacity and percolation rates do exist. However, the use of Spaghnum peatmoss 10-20% by volume in conjunction with 80% sub angular silica sand (in the .25-.75 particle size distribution) will provide the appropriate root zone mix for use in putting green surface establishment.

Soil Covering Placement, Smoothing and Firming

When soil has been thoroughly mixed it shall be transported to the green site and dumped at various points around the perimeter. The soil can then be moved more easily from the edges to the center. Many techniques are acceptable for spreading the soil, including shovels, boards, and small equipment. For example, a small crawler-type tractor suitably equipped with a blade is useful for pushing the soil mixture out onto the prepared base. If the tractor is operated with its weight on the greens mixture that has been moved on the site, the base of the green will not be disturbed. Under no circumstances will loaded rubber-tired vehicles or dump trucks in excess of one ton be allowed on the gravel base before or during the spreading of the topmix. Existing tile drains must be clearly marked so that they are not crushed by sand trucks or other equipment. Grade stakes spaced at frequent intervals on the green site will be helpful in indicating the finished depth of the soil mixture. Finish grade will require the use of a level or transit.

When the soil has been spread over the surface of the putting green, it should be compacted or firmed uniformly. A roller is not satisfactory because it "bridges" the soft spots. "Footing" or trampling the surface will best eliminate the soft spots. Raking the surface and repeating the footing operation will result in having the seedbed uniformly firm. The raking and footing must be repeated until uniform firmness is obtained. Sufficient and repeated watering must be included in the settling process.

Fine Grading

The entire green area shall be fine graded and floated so all contours blend into fairways, bunkers and mounds as shown on the greens plans or as directed by the designer. No water-holding pockets shall remain.

[Note: If the Designer's Final Specifications for construction differ from the text above, the Designer's Specifications must be considered as alternatives from those provided.]

Physical Barriers

A complete archaeological reconnaissance survey has been completed on the project site by Cultural Surveys Hawaii. Fourhundred total acres were included in the scope of the project although only 201 acres are proposed for the golf course. Sites located on the golf course have been mapped and results of the study reported to the State Department of Land and Natural Resources. Probable ages, site significance ratings, historic and cultural significance and preservation measures have also been adopted. A program of data recovery has been established and measures to avoid and preserve additional located sites have been incorporated into the final design of the golf course. There are no endemic plants native to the Hawaiian Islands on the site nor are there any wetlands as defined by the Federal Interagency Committee for Wetland Delineation.

C. Turfgrass Selection

Selection of Turfgrass

The intensity of the management of a golf course is far greater than any supposedly similar situation that may be encountered in agriculture or forestry. This is due to the intensity of the intended use and the need for the turfgrass

to resist and recover from damage incurred during play and maintenance.

The following criteria was used for deciding the appropriate turfgrass species for use on the Hana Ranch Country Club:

1. Resistance to disease
2. Resistance to weeds and insects
3. Low water usage
4. Tolerant to moderate salt conditions
5. Climatological conditions of the site
6. Efficient in soil stabilization
7. Desirable for golf in the intended playing situation
8. Quality nursery sprigs and sod available for course planting
9. Stock material that is clean of harmful pests and grown in accordance with good turf growing practices

The grasses which are proposed for use on the project are:

Greens	Tifdwarf Bermudagrass
Fairways	Tifway II Bermudagrass
Tees	Tifgreen 328 Bermudagrass
Roughs	Tifway II Bermudagrass

D. Integrated Golf Course Management

1. Introduction

As a program, Integrated Golf Course Management combines the use of physical, structural, mechanical, cultural and chemical controls of numerous pests that may attack a golf course. The goal of the IGCM program is to produce high quality turf. The objectives are to provide a turfgrassed, landscaped biological community with wildlife habitat that is suitable for recreation. The balance of the ecological community will be integrated in the management of the Hana Ranch Country Club in order to balance turfgrass needs and preserve existing natural resources and site features.

The design and construction of the Hana Ranch Country Club will allow for structural elimination of many potential problems that would typically limit the effectiveness of an IGCM plan. The major drainage from the project site consists of two dry gulches Haneoo and Moomoonui. These gulches have only small perennial flows in the upper reaches where rainfall is high, and are normally dry within the project site except during heavy rains. The protection of this natural storm runoff and the installation of turfgrass as a soil stabilizer, will reduce the potential for soil erosion around the perimeters leading into these gulches. The shaping of land features to blend with the intermittent gulches will assist in prevention of soil erosion and slow the movement of surface runoff. In the design of the golf course, retaining portions of natural grazed areas will provide feeding grounds for doves, lowland songbirds, and migratory shorebirds. Dead trees and snag trees will provide roosting, nesting, look-out, and perch sites for native and exotic birds. The conversion of pasture to managed turf impacts the environment less than allowing grazing of animals on pasture land. The ability to provide turfgrass as a managed crop while retaining portions of the meadow as fallow land would provide a more diverse set of living space for plant and animal life. The implementation of the Integrated Golf Course Management program in coexistence with pasture will provide a wonderful opportunity for biodiversity.

2. Components of Integrated Golf Course Management (IGCM)

A golf course playing surface is a living filter that adsorbs, utilizes, absorbs, degrades, and/or volatilizes most inputs from nutrient and properly applied pesticide products. An important step in Integrated Golf Course Management is to determine the acceptable levels of degradation that can occur. The lack of a significant quantity of undesirable fungi, for example, will prevent the future loss of the grass plants due to its degenerative effect (disease). The amount of thatch build-up and predictable levels of parasitic nematodes along with the physiological control of necrosis will be the measure of a successful Integrated Golf Course Management Plan.

The Hana Ranch Country Club will maintain the greens as a consistent, virtually weed-free turf. They will be of desirable playing quality, aesthetically appealing, and not impacted by the presence of deleterious pests. Insect damage to the greens must also be at an absolute minimum but the greens need not be totally free of insects. "Allowing limited damage (weeds or insect damage) does carry a risk that the above pathogen may spread which would force the use of a broader control" (Vittum, 1986). To produce high quality turf, it is not necessary to have absolute control over insects and weeds. For example, healthy turf can be sustained with as many as five white grubs per square foot if traffic (wear) is not excessive (Brandenburg, 1989).

As for the tees, a similar level of quality will be required. A limited amount of turf damage is acceptable in the apron areas of the tees provided that it does not interfere with aesthetic quality or function of the tee complex. As a routine operation, tee markers are rotated over the entire tee surface to create a uniform wear pattern across the tees. Rotation is necessary to maintain turf recovery. Therefore, the entire tee must be in a playable condition.

Fairways may have a slightly greater amount of pest damage than tees. Weed control will be used in most play areas. In the rough and natural areas outside the fairways, a lower level of maintenance activity is proposed for insects and fungi.

Once the level of acceptable impairment is defined, and the corresponding level of management is instituted, a regular program of inspection is required. To maintain turf effectively for the Hana Ranch Country Club, it will be necessary for the golf course superintendent and management team to make daily inspections of the course. This process is essential to identify the type and presence of pests early, keep damage to an insignificant level, and to initiate the lowest level of response.

3. <u>Use of the Concepts of Integrated Golf Course Management (IGCM)</u>

The implementation of an IGCM program requires that all methods of control be available to the manager. Appropriate controls may then be selected for any circumstances that might cause specific turf pests. Maintaining healthy turf by the prudent use of fertilizers, soil amendments, pesticides, and cultural practices will prevent environmental degradation (Harrison, 1989).

The goal of the Integrated Golf Course Management Program at the golf course, is to prevent the opportunity for the growth of pests by using biological, cultural, mechanical, and structural means. If a pest causes damage beyond acceptable limits and all other measures have not reduced the amount of

noticeable damage, then chemical treatments may be necessary to reduce the pest density. It shall be noted that this method of control will only be used as a last resort. Judicious use of pesticides along with spot treatment applications will be designed to control and not eradicate invading turf pest organisms.

Following the construction of the golf course, other situations detrimental to pests will take place by the institution of specific cultural or mechanical practices. This opportunity to introduce a negative environment for pests is provided by the proposed comprehensive cultural control program for the Hana Ranch Country Club. The Integrated Golf Course Management program will function by reducing the potential occurrence of pests and make the host plant resistent by the modification of the turf grass environment.

4. <u>The Integration of Pest Managing Concepts</u>

Elements of the IPM plan:

- Pest may be defined as plant damaging disease, insects or weeds.
- Prevention will include monitoring, forecasting, scouting, and visually searching for positive identification.
- Control will include the use of physical, cultural, biological, mechanical and chemical management.

Goals of the IPM:

- To establish site specific base line data on pest occurrence for a period of one year.

- To educate and develop a staff whose knowledge will be instrumental in implementing an effective and integrated golf course management plan.

- To perform experimental work regarding the testing of the effects of non-chemical practices to control pests and minimize pesticide use.

- To establish a field testing procedure to monitor the impact of the IGCM plan.

5. <u>The Use of Pest Managing (IPM) Techniques</u>

- Daily documentation with inspection of each golf hole to include weekly monitoring reports.

- Monthly reports to build a calendar identifying potential hot spots.

- Quantitative and qualitative assessments of turf areas to establish a proper mode of action.

- Adjustment of mowing heights to reduce, weeds, fungus, and insect damage.

- Rotation of routine cutting patterns to prevent excessive wear.

- Avoidance of mowing during high temperature stress.

- Use of syringing or misting during high temperature stress.

- A balanced water and nutrient program.

- Set action thresholds: A point when pest populations or environmental conditions indicate a need to take action.

- Look towards alternative and innovative approaches to control pests. If their effectiveness is field proven, seek appropriate approval for use.

- Apply pesticides only when the pest is most vulnerable and where it presents the least hazard to people, property, and the environment.

6. <u>Pest Monitoring Practices</u>

Proper detection and identification of insects and mites in turf is the key to using proper controls. In an IPM program, the mere presence of a bug in turf is not a valid reason for taking steps for control. Therefore, a thorough knowledge of the techniques and methods of detecting pest populations is needed. An evaluation of the site has suggested that certain potential pests will be more important than others. These are rated in a <u>Pest Infestation Index</u>. Also key to the IPM program are <u>Threshold Guidelines</u>. These are used to help select the appropriate control action needed, if any.

a. <u>Sampling Guidelines</u>

The golf course superintendent will monitor each golf hole for any indication in a reduction in turf quality. He will be responsible for the proper identification of any fungi, insects, or weeds and will be responsible for the documentation that each has been identified correctly. He will look for environmental factors that would make the site incompatible with the needs of the pest. Improving ventilation, selective removal of vegetative growth, and physical removing of small pest populations are examples of steps to be taken as a first-step approach.

The following techniques are presented as standard methods to assess insect and mite pests of turfgrass. Refer to the individual fact sheets in Appendix A for appropriate sampling techniques for insect pests. Samples of unidentified insects; weeds, nematodes, or pathogens will be forwarded to a reputable laboratory for assistance in proper identification and procedure for control. If the need arises to obtain and determine the best control option, the assistance of an appropriate environmental firm, state agency, or university specialist will be used.

i. Visual Inspection

The old-fashioned technique of looking closely at the turf is probably still the most valuable. Use spot inspection of damaged areas or spots which do not look right. Proper inspections requires getting down on your hands and knees. Spread the turf and look at the base of the stems for insects or discoloration. Grab hold of the turf and pull up. If the turf breaks off easily, look for the sawdust of billbugs. If grass (insect fecal pellets) are present, use a disclosing solution to determine if turf caterpillars are present.

If a pest is detected, you will need to know the extent of the problem. The transect method is merely walking in a line across the affected turf counting the number of damage areas observed. Square foot samples are often useful if billbugs, mites or scales are suspected. Simply cut back a square foot flap of turf and count the number of grubs visible in the soil. Or use a standard golf course cup cutter to take turf and soil samples. Multiply the cup cutter by 10 in order to get the number of insects per ft^2.

ii. Disclosing Solutions

Many of the turf insects and mites seem to defy easy detection by simple looking. Therefore, a disclosing solution of pyrethrum or soap will do. A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known not to cause turf damage) in two gallons of water should be used. With a common garden sprinkling can, apply the two gallons of soapy water to a one square yard (1.0 yd^2) area. Within 3-5 minutes the caterpillars will come to the surfaceand can be easily counted. Occasionally, billbug adults and other insects are also flushed out.

iii. Flotation

Scientists studying chinch bugs often use the technique of flotation. Flotation is merely inserting a large metal cylinder, a one gallon can with the top and bottom cut off is satisfactory, into the turf to the soil level and filling it up with water. Chinch bugs and other turf inhabiting insects and mites float to the surface for easy counting. Taking flotation counts on golf courses probably would take more time than necessary to determine if an infestation is present.

iv. Trapping

Some of the turf infesting insects are attracted to lights or chemical attractants (pheromones) and can be easily monitored. Most of the cutworms, sod webworms and many of the night flying white grub adults can be collected in a light trap. Pheromone traps have been developed for the cutworms, sod webworms and armyworms. Other insects such as billbugs can be monitored by using simple pitfall traps placed along the side of turf areas.

- Light traps generally use an ultraviolet (UV) bulb which is more attractive to most night flying insects. By running a trap several nights a week and counting the numbers of cutworms, sod webworms or armyworm adults, estimations of when turf damage could occur can be made. As an example, black cutworm adults are easily captured in a light trap and larvae can be expected on greens and tees about two weeks after peak adult catches.

- Pheromone traps are even more precise than light traps because single species can be monitored. Pheromones exist for black cutworms and most of the armyworm complex. The numbers captured can be used like light trap counts.

- Pitfall trap used for monitoring billbugs is a 16 oz. cup buried in or next to turf with its rim level with the soil. Billbug adults fall into the trap and can be counted to monitor when activity begins. After two weeks of steady captures, it is time to sample for the larvae in the turf.

v. Disease Immunoassay Kits

Disease immunoassay kits will be used to aid in the identification of turfgrass disease. They will be used to detect and/or rule out through positive indication that the disease pathogen is present. Currently, the kits are available for the following diseases: Brown patch, Dollar spot, and Pythium. The kits will be used in accordance with the manufacturer's recommendation and suggested mode of action regarding pesticide usage.

b. Environmental Monitoring

Turfgrass scientists are always attempting to find better ways of predicting pest activity. Since most pest activity is regulated by weather conditions, several methods have been developed which use weather monitoring to predict pest development. These methods (or models) suggest when activity will occur but not how much activity. In other words, you will still have to look to see if pests are actually in sufficient numbers to cause damage to the turf.

i. Degree-day Models

Degree-days are a method of measuring the amount of development that an organism has been exposed to by weather conditions. Its basis rests on the idea that insects and mites develop more rapidly as they get warmer. It also assumes that below a certain temperature, called the threshold temperature, no development takes place. There are no degree-day models available for the insects and mites on the current site.

ii. Plant Phenology Models

Plant phenology models are essentially nature's degree-day models. Since plant development is also dependent on temperature, associating plant activity with insect activity can improve timing of controls. An example is: spring egg laying by the black turfgrass ataenius is at the same time as horse chestnut is in full bloom. There are no phenology models available for the insects and mites on the current site.

7. Pest Identification

A list of known and probable weeds, fungus, and insect problems that will most likely affect turfgrass at the Hana Ranch Country Club has been compiled. These pests were based on a site review of turfgrass established at the Hotel Hana-Maui, observations on the physical features of the proposed agricultural pasture land, and input received from our related work and experience on the island of Maui. Due to the inherently variable nature of the environment, it must be understood that this list is not, and never will be a complete list. The extent of the pest injuries suggested will greatly depend on the disease, host pressure, weed and seed contaminations, and the weather conditions affecting the turfgrass species at the Hana Ranch Country Club.

Turfgrass Weeds

Weed problems associated with golf course turf are divided into two categories; grassy weeds (monocotyledons) and broadleaf weeds (dicotyledons). The identification of these weeds are listed in Tables 1 and 2. The use of on site topsoil as a final topmix with desirable structure and void of foreign pests or pathogens will be used as part of an attempt to minimize the use of herbicides.

Turfgrass Disease

Anticipated turfgrass diseases for the Hana Ranch Country Club are listed in Table 3. Each disease varies in their potential to infect and injure turfgrass. Occurrence and the severity vary, depending on the time of year, weather conditions, and fertility levels. The diagnostic features most prevalent when identifying a particular disease are listed in Table 4. A comparative list of both cultural and

Table 1. Pest Identification - Grasses (monocotyledons) Weeds-Annual*

Annual bluegrass	*Poa annua*
Bahiagrass	*Paspalum notatum*
Cyperus sedge	*Cyperus hypochlorus*
Dallisgrass	*Paspalum dilatatum*
Goosegrass	*Eleusine indica*
Green kyllinga	*Kyllinga monocephata*
Henry's crabgrass	*Digitaria adscendens*
Hilograss	*Paspalum conjugatum*
Kikuyugrass	*Pennisetum clandestinum*
Lovegrass	*Eragrostis spp.*
Molasses grass	*Melinis minutiflora*
Purple nutsedge	*Cyperus rotundus*
Sandbur	*Cenchrus ecininatus*
Smutgrass	*Sporobolus poirettii*
Stargrass	*Chloris divaricata*
Swollen finger grass	*Chloris inflata*
Vaseygrass	*Paspalum urvillei*
Wainaku grass	*Panicum repens*
White kyllinga	*Kyllinga kyllingia*
Yellow nutsedge	*Cyperus esculentus L.*

* The above species of weeds are those that are found on annual basis. Small amounts of weeds left to mature may be detrimental to turfgrass management.

Table 2. Pest Identification - Broadleaves (dicotyledon) Weeds-Perennial

Ageratum	*Ageratum conyzoides*
Alternanthra	*Alternanthera repens*
Asiatic pennywort	*Centella asiatica*
Broad-leaved plantain	*Plantago major*
Buttonweed	*Borreria laevis*
Creeping indigo	*Indigofera endecaphylla*
Dandelion	*Taraxacum officinale*
Drymaria	*Drymaria cordata*
Garden spurge	*Euphorbia hirta*
Kaimi clover	*Desmodium canum*
Marsh pennywort	*Hydrocoytle sibthorpioides*
Milkwort	*Polygala paniculata*
Pigweed prostrate	*Amarunthus graecizans*
Pigweed spiny	*Amarunthus spinosus*
Pink wood sorrel	*Oxalis martiana*
Prostrate spurge	*Euphorbia prostrata*
Purslane	*Portulaca oleracea*
Sensitive plant	*Mimosa pudica*
Sow thistle	*Sonchus oleraceus*
Spotted spurge	*Euphorbia supina*
Synedrella	*Synedrella nodiflora*
Yellow wood sorrel	*Oxalis corniculata*

Table 3. Pest Identification - Turfgrass Disease

Algae	*Thallophyta* Freshwater algae
Anthracnose	*Colletotrichum graminicola*
Bacterial stripe	*Xanthomonas spp.*
Brown patch	*Rhizoctonia solani*
Dollar spot	*Schlerotinia solani*
Dreschlera leaf spot	*Dreschlera* leaf spot
Fading out	*Curvularia spp.*
Fairy ring	*Marasmius oreades*
Fusarium blight	*Fusarium spp.*
Grease spot	*Pythium spp.*
Leaf rust	*Puccinia spp.*
Melting out	*Bipolaris spp.*
Moss	*Bryophyta spp.*
Nematodes	*Criconemoides, Meloidogyne, Helicotylenchus, Pratylenchus, spp.*
Take all patch	*Gaeumannomyces graminis*

Table 4. Diagnostic Features: Common Warm-Season Turfgrass Diseases

DISEASE	CAUSAL AGENT(S)	SYMPTOMS/SIGNS	SUSCEPTIBLE GRASSES
ANTHRACNOSE	*Colletotrichum graminicola*	Brown lesion with yellow halo expands to cause yellowing of entire leaf blade. Either infection results in stem girding. Fruiting bodies are dark cushion-like bodies with small black spines and can be seen with a hand lens.	Bahiagrass, bermudagrass, and centipedegrass*.
BERMUDAGRASS DECLINE	*Gaeumannomyces* spp. or similar fungi as yet undetermined	Begins as small, irregular, yellow patches which expand and thin out as grass dies. Roots are short, thin and rotted. Usually observed first at edges of putting greens.	Bermudagrass*.
BROWN PATCH (Rhizoctonia Blight); RHIZOCTONIA LEAF AND SHEATH SPOT	*Rhizoctonia solani, R. zeae, R. oryzae*	Begins as small circular light green patches that turn yellow and then brown or straw-colored. Patches expand to several feet in diameter. Turf at outer margin may appear dark & wilted (smoke ring). Whole leaf facsimiles pull up easily due to basal rot of leaf sheath. Aerial blight common with centipedegrass & St Augustinegrass. During warm summer months, may also observe distinct light brown foliar lesions.	Bahiagrass, bermudagrass, centipedegrass*, St Augustinegrass*, zoysiagrass*.
DOLLAR SPOT	*Lanzia* spp. and *Moellerodiscus* spp. (*Sclerotinia homoeocarpa*)	Small, bleached patches of dead grass that do not expand but do coalesce with other spots to form large patches, irregular, light tan lesions with distinct brown borders. White, cottony mycelium may be observed in early morning when dew is present.	Bahiagrass*, bermudagrass*, centipedegrass, St Augustinegrass, zoysiagrass*.
CERCOSPORA LEAF SPOT	*Cercospora fusimaculans*	Small, dark brown or purple lesions on leaf blade and sheath that become tan color with age. High disease severity results in leaf death and turf areas that thin out.	St Augustinegrass*, bitter-blue cultivars are less susceptible than yellow-green cultivars.
FAIRY RING	*Chlorophyllum*, *Marasmius*, *Lepiota*, and other basidiomycete fungi	Circular to semi-circular bands of dark green turf with or without mushrooms present in band. Some rings are bands of dead turf. Rings expand each year.	All warm-season turfgrasses.
GRAY LEAF SPOT	*Pyricularia grisea*	Lesions begin as small, brown spots that expand into oval areas with tan centers and dark purple or brown margins. Yellow halo may be present. During warm humid weather, lesions covered with gray velvet mat of mycelium. Leaves wither resulting in scorched appearance.	St Augustinegrass*, yellow-green cultivars are less susceptible than blue-green/bitter-blue cultivars. St Augustinegrass treated with atrazine is more susceptible.

Table 4.(cont'd.)

DISEASE	CAUSAL AGENT(S)	SYMPTOMS/SIGNS	SUSCEPTIBLE GRASSES
"HELMINTHOSPORIUM" LEAF SPOT/ MELTING OUT	*Bipolaris*, *Drechslera*, *Exserohilum* spp. (previously Helminthosporium fungi), and *Curvularia* spp.	Leaf spot symptoms vary with specific pathogen and host from small, solid brown to purple lesions to expanded lesions with bleached centers that girdle the leaf blade. Severely infected leaves turn reddish-brown to straw color. "Melting-out" occurs under severe infection as turf areas thin and die. Lesions on stems are dark purple to black. Crown/root rots will also occur.	Bermudagrass*, St Augustine-grass, zoysiagrass.
PYTHIUM BLIGHT	*Pythium* spp.	Small, distinct patches of grass that first appear dark and water-soaked but later turn straw color. No distinct leaf lesions. Patches spread quickly in "streak" pattern. Cottony mycelium may be observed when early morning dew is present.	All warm-season turfgrasses, primarily bermudagrass*.
PYTHIUM ROOT ROT	*Pythium* spp.	General turf browning and thinning. Roots appear thin with few hairs and have a general discoloration. Turf does not respond to N applications.	All warm-season turfgrasses.
RUST	*Puccinia* spp.	Orange to reddish-brown pustules on leaves. Severe infections cause yellowing of leaves and thin turf.	Bermudagrass, St Augustine-grass, and zoysiagrass*.
SPRING DEAD SPOT	*Leptosphaeria korrae*, *Ophiosphaerella herpotricha* and *Gaeumannomyces graminis var. graminis*	Large circular patches of bleached, dead grass that appear as dormant turf resumes growth in spring. Root, crown, and stolon rot evident.	Bermudagrass*.
ST AUGUSTINEGRASS DECLINE	St Augustinegrass decline virus (Panicum mosaic virus)	Initially, observed chlorotic (yellow) mosaic of mottle on leaf blades that gradually becomes more extensive until area appears uniformly yellow and thin. Death may eventually occur.	Centipedegrass and St Augustinegrass* (some cultivars).

* DENOTES MOST SUSCEPTIBLE TURFGRASS SPECIES

chemical methodology is illustrated in Table 5. This table shows the effects and benefits of sound cultural management and lists the typical forms of chemical treatments that have been used in conventional pest management programs. Cultural and curative practices that promote healthy turf will be employed in an effort to minimize the occurrence of outbreaks. These are also introduced in Table 5 and will illustrate ways to reduce the detrimental effects of significant pest damage.

Turfgrass Insects

The following insects (Table 6) are those that have the ability to destroy healthy areas of turfgrass at the Hotel Hana-Maui golf facility. These insects are those deemed important enough to warrant constant monitoring. Tolerable levels below threshold limits should pose no significant threat to the desirable playing quality of the golf course.

8. Pest Problems Associated With Turf at Hana

Table 7 represents the pest problems that might be encountered at the Hana Ranch Country Club. They are listed in the order of insects, weeds, and disease. Each of the pest listed in Table 7 have been given a Pest Index code that determines the probability of impact. A corresponding Frequency Index to determine the degree of likelihood that this pest should be monitored is also provided. The location of probable impact has been identified for each playing surface.

9. Preliminary Threshold Guidelines

Lists of Preliminary Threshold Guidelines have been established for each of the anticipated pests and are presented on the following pages in Tables 8-11. These

Table 5. Methods of Disease Control Warm-Season Turfgrasses

DISEASE	CULTURAL CONTROL	CHEMICAL CONTROL	RESISTANT SPECIES/VARIETIES
ANTHRACNOSE	Avoid fertility imbalances, improve drainage and remove excess thatch. Stress due to insects or nematodes should be eliminated.	Benomyl, chlorothalonil, fenarimol, thiophanate-methyl, triadimefon	No resistant centipedegrass cultivars are available.
BERMUDAGRASS DECLINE	Aerate and topdress greens monthly during late spring, summer, and early fall. Apply NH4-N rather than NO3-N. Balance N with K and apply micronutrients. Raise mower height during disease outbreaks.	Benomyl, fenarimol, propiconazole, thiophanate-methyl, triadimefon	No resistant cultivars are available.
BROWN PATCH	Avoid excess N, especially readily available forms of N. Avoid excessive irrigation.	Anilazine, benomyl, chlorothalonil, iprodione, maneb, mancozeb, PCNB, thiophanate-methyl, thiram. DO NOT use benomyl or thiophanate-methyl if causal agent is R. oryzae or R. zeae. Use fenarimol, propiconazole, and triadimefon as preventative and not curative compounds.	No resistant species are available.
CERCOSPORA LEAF SPOT	Avoid N deficiency. Irrigate deeply and less frequently.	None are currently labeled. Contact fungicides such as chlorothalonil, iprodione, or mancozeb may provide disease suppression.	Bitter-blue varieties are less susceptible.
DOLLAR SPOT	Avoid N deficiency. Irrigate deeply and less frequently.	Anilazine, benomyl, chlorothalonil, fenarimol, iprodione, maneb, mancozeb, propiconazole, thiophanate-methyl, thiram, triadimefon, vinclozolin	No resistant species are available.
FAIRY RING	Mask symptoms with N fertilizers. Remove mushrooms as some are poisonous. Before planting, eliminate large sources of organic matter such as tree stumps, wood building materials, etc.	None are currently registered. To eliminate fungus, fumigate with soil sterilant and replant.	No resistant species are available.
GRAY LEAF SPOT	Avoid excess N. Irrigate deeply and only when necessary.	Chlorothalonil, propiconazole, thiophanate-methyl + mancozeb	Yellow-green cultivars of St Augustinegrass are less susceptible. St Augustinegrass treated with the herbicide atrazine is more susceptible.

Table 5.(cont'd.)

DISEASE	CULTURAL CONTROL	CHEMICAL CONTROL	RESISTANT SPECIES/VARIETIES
"HELMINTHOSPORIUM" LEAF SPOT/ MELTING OUT	Avoid excess N. Balance fertility components. Irrigate deeply an less frequently. Avoid thatch accumulation. Raise mowing height during disease outbreaks.	Anilazine, chlorothalonil, iprodione, maneb, mancozeb, propiconazole, vinclozolin	No resistant species are available.
PYTHIUM BLIGHT	Improve drainage & air circulation, reduce irrigation. Avoid excess N.	Chloroneb, ethazol, metalaxyl, fosetyl-AL, propamocarb	No resistant species are available.
PYTHIUM ROOT ROT	Improve drainage, aerate, and reduce irrigation.	Chloroneb, ethazol, metalaxyl, fosetyl-AL, propamocarb (except for fosetyl-AL, all of these fungicides should be watered into the root zone)	No resistant species are available.
RUST	Avoid N deficiency. Irrigate deeply and less frequently.	Anilazine, maneb, mancozeb, propiconazole, triadimefon	No resistant species are available.
SPRING DEAD SPOT	Avoid low mowing heights, thatch, compaction, and excess N.	Benomyl, fenarimol, propiconazole, thiophanate-methyl	No resistant species are available.
ST AUGUSTINEGRASS DECLINE	Do not plant susceptible cultivars.	None, disease is caused by a virus	St Augustinegrass cultivars: Floratam, Floralawn, Raleigh, and Seville.

Source: Landshoot, June, 1991. Landscape Management. 30:6.

Table 6. Pest Identification - Turfgrass Insects*

Bagworm	Moth	*Brachyctytarus grisseus*	de Joannis
Bermudagrass mite	Mite	*Eglophyes cynodoniensis*	Sayed
Bermudagrass scale	Scale	*Odonaspis ruthae*	Kotinsky
Black cutworm	Moth	*Agrotis ipsilon*	Hufnagel
Fiery Skipper	Butterfly	*Hylephila phyleus*	Drury
Grass webworm	Moth	*Herpetogramma licarsisalis*	Walker
Hunting billbug	Weevil/ beetle	*Sphenophorus venatus vestitus*	Chittenden
Lawn armyworm	Moth	*Spodoptera mauritia*	Boisduval
Rhodegrass mealybug	Mealybug	*Antonina graminis*	Maskell
Southern chinch bug	True bug	*Blissus insularis*	Barber

*Each insect will be monitored for detection and an established threshold level for baseline observations will be set under the Integrated Pest Management Program (Table 8).

Table 7. Location and Extent of Pest Infestation

Pest Infestation Index

a. Insects	Pest Index	Location	Frequency Index
Bagworm	O	R	1
Bermudagrass Mite	P	T F G	3
Bermudagrass Scale	P	T F G	3
Black Cutworm	O	T G	3
Black Turfgrass Ataenius	O	F	1
Fiery Skipper	P	F	1
Grass Webworm	K	T F G R	5
Hunting Billbug	O	F R	3
Lawn Armyworm	P	T F G R	2
Rhodesgrass Mealybug	O	F R	1
Southern Chinch Bug	O	F R	1

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Table 7. (cont'd)

Pest Infestation Index

b. Weeds Monocotyledons	Pest Index	Location	Frequency Index
Annual bluegrass	O	T G	2
Bahiagrass	O	T F R	2
Cyperus sedge	K	T F R	4
Dallisgrass	O	F R	2
Goosegrass	K	T F G R	5
Green kyllinga	K	T F R	4
Henry's crabgrass	K	T F G R	5
Hilograss	K	T F R	4
Kikuyugrass	K	T F R	4
Lovegrass	O	T F R	2
Molasses grass	O	F R	2
Purple Nutsedge	K	T F R	3
Sandbur	P	F R	1
Smutgrass	K	T F R	4
Stargrass	O	T F R	2
Swollen finger grass	O	T F R	2
Vaseygrass	O	T F R	2
Wainaku grass	K	T F G R	4
White kyllinga	O	T F R	1
Yellow Nutsedge	O	T F R	3

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Table 7. (cont'd)

Pest Infestation Index

b. Weeds Dicotyledons	Pest Index	Location	Frequency Index
Ageratum	K	T F R	4
Alternanthra	O	F R	2
Asiatic pennywort	K	T F R	5
Broad-leaved plantain	O	F R	2
Buttonweed	O	F R	2
Creeping indigo	O	F R	2
Dandelion	O	T F R	2
Drymaria	O	F R	2
Garden spurge	O	F R	2
Kaimi clover	O	T F R	3
Marsh pennywort	O	T F R	2
Milkwort	O	F R	2
Pigweed prostrate	O	T F R	3
Pigweed spiny	O	T F R	2
Pink wood sorrel	P	R	1
Prostrate spurge	O	F R	2
Purslane	O	F R	2
Sensitive plant	K	F R	4
Sow thistle	O	F R	2
Spurge spotted	O	T F R	2
Synedrella	O	F R	2
Yellow wood sorrel	O	F R	2

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Table 7. (cont'd)

Pest Infestation Index

c. Disease	Pest Index	Location	Frequency Index
Algae	K	T F R	5
Anthracnose	O	T G	3
Bacterial stripe	P	F	2
Brown patch	K	T F G	4
Dollar spot	O	T G	2
Dreschlera leaf spot	P	T F	2
Fading out	O	F	1
Fairy ring	O	T F G R	2
Fusarium blight	K	T G	4
Grease spot	K	T F G	4
Leaf rust	O	F	3
Melting out	K	T F	4
Moss	P	T G	1
Nematodes	P	T F G R	1
Take all patch	O	T G	3

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Table 8. Preliminary Threshold Guidelines - Turfgrass Insects*

Area	Pest	Insect Density: Cultural Controls	Insect Density: Curative Controls
Greens/Tees Fairways Roughs	Grass Bagworm	$3-5/ft^2$ $5-8/ft^2$ $5-8/ft^2$	$6/ft^2$ $8/ft^2$ $8/ft^2$
Greens/Tees Fairways Roughs	Bermudagrass Mite	$1-2/ft^2$ $3-4/ft^2$ $4-8/ft^2$	$4/ft^2$ $6/ft^2$ $10/ft^2$
Greens/Tees Fairways Roughs	Bermudagrass Scale	$1-2/10ft^2$ $6-8/10ft^2$ $6-8/10ft^2$	$4/10ft^2$ $6/10ft^2$ $10/10ft^2$
Greens/Tees Fairways Roughs	Black Cutworm	$1-2/ft^2$ $2-3/ft^2$ $3-4/ft^2$	$3/ft^2$ $4/ft^2$ $5/ft^2$
Greens/Tees Fairways Roughs	Black Turfgrass Ataenius	$6-9/ft^2$ $12-15/ft^2$ $15-20/ft^2$	$10-12/ft^2$ $15-25/ft^2$ $25-30/ft^2$
Greens/Tees Fairways Roughs	Fiery Skipper	$1-2/ft^2$ $2-3/ft^2$ $3-4/ft^2$	$3/ft^2$ $4/ft^2$ $7/ft^2$
Greens/Tees Fairways Roughs	Grass Webworm	$1-3/ft^2$ $3-5/ft^2$ $5-8/ft^2$	$4/ft^2$ $6/ft^2$ $8/ft^2$
Greens/Tees Fairways Roughs	Hunting Billbug	$3-4/ft^2$ $4-5/ft^2$ $5-8/ft^2$	$4/ft^2$ $6/ft^2$ $8/ft^2$
Greens/Tees Fairways Roughs	Lawn Armyworm	$1-3/ft^2$ $3-5/ft^2$ $6-8/ft^2$	$4/ft^2$ $6/ft^2$ $8/ft^2$
Greens/Tees Fairways Roughs	Rhodesgrass Mealybug	$3-5/ft^2$ $5-8/ft^2$ $8-12/ft^2$	$6/ft^2$ $10/ft^2$ $15/ft^2$
Greens/Tees Fairways Roughs	Southern Chinch Bug	$10-15/ft^2$ $16-25/ft^2$ $26-30/ft^2$	$12-16/ft^2$ $25-30/ft^2$ $30-35/ft^2$

* Currently, there are no established industry standards for insect and mite pest thresholds for the pests found on this site. The following thresholds for insects and mites are established as a preliminary guide to assist the golf course superintendent in deciding when to choose the appropriate form of control. See Appendix A with Fact Sheets for additional information. We fully expect that local experience will result in the refinement of these threshold guidelines.

Table 9. Preliminary Threshold Guidelines - Turfgrass Weeds*

(Monocotyledons)

Pest Control	Area	Cultural Management	Curative Management
Purple Nutsedge	Tees/Greens Fairways Roughs	spot treat spot treat spot treat	post emergence post emergence post emergence
Sandbur	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Smutgrass	Tees/Greens Fairways Roughs	preventative preventative preventative	spot treat spot treat spot treat
Stargrass	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat spot treat spot treat
Swollen finger grass	Tees/Greens Fairways Roughs	preventative preventative preventative	spot treat spot treat spot treat
Vaseygrass	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Wainaku grass	Tees/Greens Fairways Roughs	spot treat spot treat spot treat	post emergence post emergence post emergence
Yellow nutsedge	Tees/Greens Fairways Roughs	spot treat spot treat spot treat	post emergence post emergence post emergence

* Control of annual turfgrass weeds on Bermudagrass greens and tees are best obtained with the use of a pre-emergent herbicide. The use of spot treatment will serve as a guide to those compounds modeled for use under the maximum number of acres treated per year.

Table 10. Preliminary Threshold Guidelines - Turfgrass Weeds*

(Dicotyledons)

Pest	Area	Cultural Management	Chemical Control
Ageratum	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Alternanthra	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Asiatic pennywort	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Broad-leaved plantain	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Buttonweed	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Creeping indigo	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Dandelion	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Drymaria	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Garden spurge	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Kaimi clover	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Marsh pennywort	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence

* Control of annual turfgrass weeds on Bermudagrass greens and tees are best obtained with the use of a pre-emergent herbicide. The use of spot treatment will serve as a guide to those compounds modeled for use under the maximum number of acres treated per year.

Table 10. (cont'd)

(Dicotyledons)

Milkwort	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Pigweed prostrate	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Pigweed spiny	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Pink wood sorrel	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat spot treat spot treat
Prostrate spurge	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Purslane	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Sensitive plant	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Sow thistle	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Spurge spotted	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Synedrella	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence
Yellow wood sorrel	Tees/Greens Fairways Roughs	mechanical removal spot treat spot treat	spot treat post emergence post emergence

* Dicot weeds may be controlled with consistent cutting heights on Greens and Tees. The use of clean treated topsoil or topsoil blended with cinder, organic matter, and ash should result in lower counts of weed infestation. Consistent monitoring and proper timing of spot treatment will result in less need for post emergent applications.

Table 11. Preliminary Threshold Guidelines - Turfgrass Disease

Pest	Area	Cultural Management Threshold	Chemical Control Guidelines
Algae	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 120 hours
Anthracnose	Tees/Greens Fairways Roughs	upon detection 48-72 hours 48-72 hours	spot treat 96 hours 96 hours
Bacterial stripe	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	72 hours 96 hours 120 hours
Brown Patch	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 96 hours
Dollar spot	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 96 hours
Dreschlera leaf spot	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Fading out	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Fairy ring	Tees/Greens Fairways Roughs	24-48 hours 48-72 hours 96 hours	72 hours 96 hours 120 hours

Table 11. (cont'd)

Pest*	Area	Cultural Management Threshold	Chemical Control Guidelines
Fusarium blight	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Grease spot	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 24-48 hours	48 hours 48 hours 48 hours
Leaf rust	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Melting out	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat spot treat
Moss	Tees/Greens Fairways Roughs	upon detection 96 hours 120 hours	spot treat spot treat spot treat
Nematodes	Tees/Greens Fairways Roughs	sample counts sample counts sample counts	spot treat spot treat spot treat
Take all patch	Tees/Greens Fairways Roughs	upon detection upon detection upon detection	spot treat spot treat spot treat

* Currently there are no established industry standards for pest threshold guidelines. The following thresholds for insects, weeds and disease are established as a preliminary guide to assist the golf course superintendent in deciding when to choose the appropriate form of control. We fully expect that local experience will result in the refinement of these threshold guidelines.

thresholds set a period of time for the golf course superintendent to analyze turf pest occupance and establish baseline density for implementing cultural and mechanical control methods. They also have been established for the golf course superintendent to determine when a potential pesticide may be needed for control. See Appendix A of this report with fact sheets for additional information for insects and mites.

Development of economic thresholds in field crops attempts to relate pest populations with the amount of damage caused. This relationship can then be used to decide if the cost of applying a control will actually result in more money being made from the crop. Obviously, turfgrass is mainly used for its ornamental value and is not harvested like a field crop. This ornamental value varies according the turf use and in some cases can not even be determined. Therefore, the traditional use of "economic" threshold should probably be changed to aesthetic threshold. Again, this is a value judgement because each person would value turf in a different way. Some people would not mind a few dandelions or brown spots in their lawn while others demand flawless turf.

Turf specialists have attempted to study the relationship of turf insects to damage observed and, unfortunately, do not seem to be able to come to any set rules. In the past, controls were recommended for annual grubs when populations reached 6-10 per square foot. We now know that skunks or raccoons may consider this number good enough reason to rip up the turf. On the other hand, with good irrigation and fertilizer over 20 grubs per square foot may not be noticeable.

In summary, pest thresholds may be recommended in some of the turfgrass manuals and pamphlets. Be aware that these thresholds are only targets and there are many other factors which will influence the quality of the turf. On the other

hand, remember that in order to follow good pest management practices, the mere presence of a pest is no justification to apply a control product. The turf manager must determine whether there are enough of the pests to actually cause unacceptable damage to the turf.

E. Pest Management Strategies

1. Biological Control Tactics In Turfgrass

The turfgrass environment is actually quite complex and usually contains a large number of beneficial insects, mites and spiders. If these organisms are not destroyed by insecticides or other harsh chemicals, they can often control the insects and mites which damage the turf. In some cases, these beneficial insects look like the pests and inexperienced managers may actually apply a pesticide. Therefore, it is important that you learn to identify the "good" bugs from the "bad" bugs. There are also a few diseases (pathogens) of turf insects which are useful. Remember that these biological controls often take longer to do the job and may provide a reduced level of control. This should be perfectly acceptable because of the reduction in the use of pesticides and lack of harm to non-target insects.

Bacillus thuringiensis (Bio-bit®) is being proposed for use on the Hana Ranch Country Club facility at this time. This and several other biological control agents are described in the following paragraphs. The efficacy and practicality of other biological control products are examined. If a potential product can show significant reduction in both the incidence of pest problems and effective treatment in their control, then use of the product will be field tested.

a. Common Predators and Parasites

These insects actively seek out their prey and attack them. Predators such as bigeyed bugs, earwigs, lacewings, ground beetles, lady beetles and rove beetles are constantly feeding on insect and mite eggs, caterpillars and chinch bugs. Parasites seek out their host and lay an egg(s) on or in them during susceptible stages. Most parasites are wasps or flies. Unfortunately, most of these predators and parasites are very susceptible to most of the commonly used, conventional pesticides. Therefore, caution must be used when applying turf insecticides as "preventive" treatments. These treatments probably will kill most of the predators and may cause outbreaks of other pests. On the current site, earwigs, ground beetles, rove beetles and lady beetles are significant predators. Several parasitic wasps are also present. These are mentioned in each of the insect or mite fact sheets in Appendix A.

Earwigs

Earwigs are occasionally found in the turf and most feed on plant material as well as other insects. Earwig nymphs and adults may attack sod webworms and cutworms as well as a variety of other soft bodied insects. Earwigs are often a nuisance problem when they decide to invade buildings in search of a place to hide.

Ground Beetles and Rove Beetles

These voracious predators feed on any egg or insect which they can subdue. Both adults and larvae are predators and are probably the most common natural control for turf attacking caterpillars.

Lady Beetles

Lady beetles, like green lacewings, are more common on trees and shrubs. They occasionally are found feeding on aphids and mites in turf. Releasing lady beetles in turf is not recommended because the commercially available species do not prefer turf habitat.

b. Common Pathogens

Most turf insect pests have natural diseases which periodically control their populations. Most of these pathogens require some special handling or application technique in order to be fully effective. It is imperative that the instructions for their use are followed carefully.

Milky Disease of White Grubs

There are several bacterial diseases which attack white grubs, causing their blood fluids to turn a milky color. The most famous of these is the Japanese milky disease, *Bacillus popilliae*, which is commercially available. Milky disease strains are known for most of the other white grubs but they are not currently marketed. At present, Japanese beetle milky disease is applied to the turf as tablespoons of powder or as a granule. The bacterial spores work their way into the turf and when a Japanese beetle grub ingests it, they become infected. The grubs turn milky over several weeks or months before dying and releasing more spores. It usually takes 3-5 years for this cycle to continue before enough bacterial spores are in the soil to adequately protect against grub damage. The good part of this control technique is that the spores seem to last indefinitely, once established.

The black turfgrass ataenius is the only white grub pest identified for the Hana Ranch Country Club, therefore the Japanese beetle milky disease would not be required.

Insect Parasitic Nematodes

Tiny microscopic nematodes which attack white grubs have been known since the 1930's. However, no one could figure an easy way to raise these parasites or apply them until recently. The nematodes are now being produced in large quantities and several strains have been identified which will kill sod webworms and cutworms, billbugs, and the white grubs. These nematodes search out insects and enter their bodies through natural openings or by drilling through the cuticle. Once inside the body, the nematodes release a bacterium which kills the pest within hours. The nematodes then complete their development and produce new infective juvenile nematodes. Fortunately, these biological control agents are only infective to insects and will not harm the turf or other larger animals, including humans.

As with all biological controls, some care must be exercised to get the best results with parasitic nematodes. The active juveniles are very susceptible to drying and sunlight. Therefore, they should be applied to the turf with considerable water, preferably in the mourning or evening and should be irrigated in immediately. The correct strains must be selected which are most active against the turf caterpillars, billbugs or white grubs. At present the state government is not allowing the importation of these valuable biological controls. If permits are issued, these can be used on most of the caterpillar and billbug pests on this site.

Bacillus thuringiensis Bacterium

Bacillus thuringiensis or Bt is a common bacterium which has activity against many caterpillars. Certain strains have recently been developed which also have activity against mosquito larvae and leaf beetles. Though there are several products registered for sod webworm control, little efficacy data is available to indicate its usefulness. The soil

dwelling cutworms in turf are apparently not affected by the Bt's once they reach the third instar larval stage.

Strains with activity against the *Spodoptera*, armyworms, seem to have activity on some of the grass webworms and sod webworms. These are recommended for the Hana Ranch Country Club site.

Beauveria Fungus

This fungus disease has many strains which attack a variety of insects. *Beauveria* infections have been recovered from chinch bugs, turf caterpillars and billbugs. Unfortunately, no commercial strains are currently available though some may be on the market in the near future. As with most fungal diseases of insects, considerable moisture and shade are needed for best development.

2. Cultural Control Tactics in Turfgrass

The cultural control tactic involves modifying the environment so that it is less suitable for pests, using, for example, mechanical destruction of pests or selection of resistant grasses. Most of these concepts are easily overlooked since applying a pesticide or releasing a biological control "feels" like something more useful or effective.

Good cultural practices, including thatch control, properly balanced soil chemistry, proper nutrient management, and efficient water management will greatly reduce the need for pesticides. Turf develops better root structure with proper fertilization, water, and mowing. This will help the turf resist pest outbreaks including the ravages of chinch bugs, billbugs, and turf caterpillars.

Turf requires certain nutrients to flourish. The soil chemistry should be analyzed and the proper nutritional values established and maintained.

Probably the major factor which helps insect pests and hinders controls is the accumulation of thatch. Thatch provides a good hiding place for many pests. It helps make a more uniform humidity zone for sod webworms, cutworms and chinch bugs. It is partially used as food by billbug larvae and white grubs. Thatch also hinders the movement of pesticides or biological controls applied to control white grubs. Therefore, using maintenance techniques which will reduce thatch or keep it from developing will reduce pest damage, pest survival, and increase pesticide efficacy.

The right turfgrass for the climatic zone must be planted. Certain species and cultivars of turfgrasses appear to have natural resistance or tolerance to insect, mite, and disease pests. Other turfgrasses seem to be especially attractive to pests or may react badly when pests attack. Turf varieties resistant to insects or mites are included in the fact sheets in Appendix A.

High relative humidity in the turf zone can promote disease and insect pest attacks. However, chinch bugs are very susceptible to naturally occurring fungus infections during cool moist periods. Adequate sun exposure and air circulation must remain high on the list to eliminate turfgrass degradation. This must be balanced with a well-designed and implemented irrigation program to maintain proper moist conditions. A healthier turf environment should prevent or reduce the impact of turf pest outbreaks that could cause severe damage.

Below is an outline of the cultural practices expected for use on the Hana Ranch Country Club:

Cultural Controls Outline

- Proper pH and electrolytic balance of soils will be established and maintained to provide optimum growing conditions.
- Adequate air circulation and exposure to sunlight will be analyzed and improved in areas under stress, if necessary.
- Adequate tee and green size will be provided to accommodate traffic wear and reduce areas of compaction.
- Misting by means of the irrigation system will be used to provide effective control on the rate of evapotranspiration and heat stress.
- Daily inspection by the golf course management team will be necessary to identify any potential pest problems early.
- The basic goal of cultural management is to maintain healthy turf that keeps the incidence of weeds, insects, nematodes and disease at an insignificant level.
- Action threshold levels will be established to limit the unnecessary use of pesticides.

3. Implementation of Cultural Controls

The first step in cultural control is the selection of the correct grass species for each of the playing surfaces. The planned selection of Hybrid Bermudagrass for each playing surface does not have the acute disease problems associated with cool season turfgrass varieties. The climatic conditions found on the windward shores of eastern Maui and the ability for Bermudagrass to withstand a series of host pressures, will assist the golf course superintendent towards a reduction in pesticide usage. Hybrid Bermudagrass varieties are used throughout Hawaii and have shown to be excellent turfgrass choices for golf courses.

Each turf management area must be properly drained and irrigated. The introduction of coarse textured sand and a sub-base of washed pea gravel in the greens and tees will slow the movement of water above the soil interface. Outflow of surface runoff into lined lakes or natural retention areas will provide an additional measure of recirculating water for irrigation.

The Hana Ranch Country Club will install its own weather monitoring station. This station will balance the addition of any irrigation water by monitoring natural precipitation rates. Weather stations also monitor the soils water holding capacity. They have the ability to adjust for allowable irrigation, at precipitation rates, that will eliminate the potential for surface run-off. The use of a computerized state-of-the-art weather station and irrigation control system (Maxi-V Rainbird or Toro-8000) will be utilized. To reduce leaching, the system will supply water to plants, at the replacement values, for turf. This highly advanced system allows the superintendent to adjust flows according to normaland unusual site specific conditions. Continuous underwatering of the turf leads to the establishment of shallow root systems that correspondingly dry out rapidly during periods of hot weather (Lucas, 1984). Irrigation can be used to discourage insect growth and promote turf health. Infrequent deep watering seems to be the best practice, when possible (Daar, 1982).

As stated earlier, cultural methods will be used to control excessive thatch in order to eliminate prime habitat for insects and fungus. Thatch control will be accomplished by vertical mowing and by the collection of grass clippings

from the green and tee management areas. Aeration of the surface soils will be used to relieve compaction. This provides a reduction in thatch and helps in the exchange of gases and fluid to the turf. Vertical mowers and/or groomers will be installed on green and tee mowing equipment allowing the course to be dethatched on a regularly scheduled basis. Control of thatch promotes better water movement to the turfgrass roots. In turn, this allows the turf to proliferate, due to the extension of turf roots from more effective water penetration. The removal of thatch also allows the turf grass plants to dry more effectively which eliminates or reduces the chances for the grass to act as a site for algae and fungi growth (Daar, 1982).

If a nutrient or pesticide is applied, it will be done in a manner that provides an equal balance between the need to continue a cultural practice or apply a pesticide. If for any reason a nutrient or pesticide is applied, no clippings will be removed from the site. In all cases, clippings will be either left to fall in place or be scattered in rough areas adjacent to each golf hole where the mowing practice takes place. No clippings will be scattered within 100 ft of any surface water.

To achieve healthy turf, which is a living filter and erosion stabilizer, one must meet the turfgrass community's biological, chemical, and physical needs. Aeration, thatch control, adequate air circulation, adequate sun exposure, proper irrigation and drainage, proper turfgrass selection, nutrition and soil chemical adjustment, proper mowing height selection and equipment maintenance are all part of the total program. This is called stress management.

4. <u>Biostimulant/Stress Management Materials</u>

In order to provide a holistic approach, for the golf course superintendent and his associated management team, the use of stress management control products shall be considered for use within the Integrated Golf Course Management Plan. There are many materials available for use. Each product generally provides biostimulation and root zone enhancement. They may also be used to provide assistance in the germination of new seedlings or act as a catalyst for desirable plant growth.

The following materials may provide stress specific assistance in the management of turfgrass and assist the golf course superintendent in the reduction of pesticide usage. It should be noted that these alternative materials have a place in the management of fine turfgrass and are particularly useful in the maintenance of high traffic areas such as tees and greens. As time progresses and the soil ages the use of these modification materials may prove to be particularly beneficial for turfgrass hardiness.

Environmental and Turf Services, Inc. is currently reviewing and evaluating the use of these materials as potential soil modification amendments. These products will likely be useful for enhancement of soil microbes and/or drainage. These management steps are necessary to increase the turfgrass plant's ability to resist environmental pressures and stress. Reducing stress and activating beneficial soil microorganisms in turn reduces disease, weeds, and insects.

- **Bovamura** is a liquid organic manure fertilizer that promotes deep root development and encourages tillering. It may be used for root development on newly sodded areas. It supports the development of soil microorganisms and transforms nutrients to usable plant food. It is manufactured by the PBI Gordon Corporation.

- **GroZone** is a calcined clay soil conditioner for the root zone. The material retains moisture to minimize stress

from prolonged droughts and reduces watering requirements. It helps to increase nutrient retention, prevent compaction and creates a strong environment for healthy roots. It is manufactured by the American Colloid Company.

- **Isolite porous ceramic** is a root zone modification material designed to improve water conservation and increase capillary porosity. It provides a low cation exchange capacity will not tie up nutrients and helps to leach salts. It is typically used as a soil amendment during construction or aerification. It is manufactured by the Innova Corporation an affiliate of Suntiomo Corporation of America.

- **Nelton mesh element** may be used to increase macro-pores. The mesh is used to increase shear strength and provide increased stability on slopes. The filaments also open continuous pore space and may be a potential amendment that may be rototilled into the soil. It is manufactured by Nelton, Ltd. England.

- **NoburN** is a new organic wetting agent that loosens compacted soils. It helps to alleviate localized dry spots and hydrophobic conditions but does not have to be watered in unlike synthetic wetting agent materials. It is derived from the desert Yucca plant and is manufactured by Roots Inc.

- **PanaSea and PanaSea Plus** utilize liquified sea plant extract to biostimulate root growth and aid in the reduction of thatch. Natural growth hormones (cytokinin) work to make the turfgrass more resistant to stress. The product works very well to speed release of the lemma during seed germination. It is manufactured by Emerald Isle Ltd.

•P2 is a synthetic polymer which acts as a water absorbent and retention material. This can be used to help raise the waterholding capacity and help lower the bulk density of the soil. It is distributed by Broadleaf Industries.

•Pro^2/Oxygen Plus provides oxygen to control stress encountered with anaerobic soils. There are several groups of anaerobic microorganisms which are pathogenic in plants. These organisms thrive in the absence of oxygen. The release of oxygen into the soil environment is a practical method for control. It is manufactured by Plant Research Laboratories.

•Sand-Aid is a natural organic sea plant soil conditioner. It may be used to decrease nutrient leaching and increase fertilizer efficiency. It may be incorporated into the soil mix of new green construction or applied as a topdressing constituent. It is also manufactured by Emerald Isle Ltd.

•Turftech utilizes nitrogen fixing bacteria (cyanobacteria) and II may contribute as much as one pound of nitrogen per 1,000 square feet over a 60 day period. It may help to suppress disease causing fungi and bacteria and reduce the need to apply additional forms of nitrogen. Normal phosphorous and potassium is still required. It is manufactured by Soil Technologies Corporation.

•Epoleon is an organic deodorizer and neutralizer. This product stabilizes compounds so as not to be re-released into the atmosphere. It is manufactured by the Epoleon Corporation of America.

These are but a few of the many products available for use. Environmental and Turf Services acknowledges the potential benefit of these materials and the need for the golf course superintendent to seek out their appropriate roles.

Complete soil analysis and site specific deficiencies should be documented on scouting forms prior to the use of these materials. The registration of these materials should be acknowledged by the appropriate agency prior to use.

One of the most common sources of stress is soil nutrient and chemical imbalance. Soil and plant tissue, along with water quality testing, must be done at least twice a year. This will provide on going evaluation of the nutrient, electrolytic balance, pH, etc., of the soil. The presence of a pH imbalance can make adequate nutrient supplies unavailable through chemical insolubility or fixation. This can lead to turfgrass disease.

Once the turf has been established, it must be nourished by adequate quantities of nutrients and water. Chemical controls are greatly reduced, and sometimes eliminated, when the use of nutrient management is properly employed. Adequate nitrogen will be needed to sustain enough growth to recover from traffic associated with play. Too much nitrogen can increase thatch, lead to flush growth and create cell wall disease susceptibility of certain fungus. In the spring and fall, higher phosphorous is needed to increase root depth and mass. Higher potassium is needed in the summer to increase cell wall thickness. Too little nitrogen, potassium, phosphorous, etc., can lead to disease.

5. Mechanical Control Program

In order to maintain a healthy and protective stand of turfgrass for the Hana Ranch Country Club the addition of a mechanical control program will be needed in conjunction with preventative cultural control measures.

Suggested mechanical controls include the use of the following types of equipment and practices:

- Core aerification
- Shatter-Core aerification (shallow and deep tine with solid tines)
- High pressure water injection aerification
- Spiking/Slicing
- Dethatching (heavy thatch removal)
- Vertical mowing (light thatch removal)
- Grooming
- Brushing
- Proper mowing heights
- Proper mower blade sharpening
- Proper equipment repair

Aerification is a process of opening passageways from the surface of the soil into the root zone. In turfgrass, it is the equivalent of cultivation (plowing/discing) in agriculture. Because golf courses are subject to traffic (walkers, carts, tractors, etc.) the upper soil profile has a tendency to compress (compaction) and create inadequate soil pore space. Often this will restrict the passageway of air and water into the root zone.

This reduction in growth is due to the imbalance in carbon dioxide and oxygen exchanges. If the timing of this method is performed too late in the summer it can cause a great deal of heat related stress. Exposure of the root zone and soil/mix must be balanced with the effects of elevated temperature. Increased direct sun exposure along with elevated evapotranspiration values must be observed.

Additional aerification will sometimes be used to alleviate a reduction in the root structure profile. Historically, shatter core aerification has been used when persistent compaction problems warranted deeper aerification. With shatter core aerification the presence of soil/sand on the canopy of the leaf surface must be minimized. The recent advent of high pressure water injection provides an increased

safety margin for aerification on greens and tees during summer months. Comparative field testing is currently underway to determine the benefits that are derived when choosing this form of aerification. The machine currently in production is manufactured by the Toro Corporation.

The first four items under the Mechanical Control Program, describes various ways that the process of improving air, soil, and water in turfgrass is accomplished. Aerification should be performed in the late spring (April-June) and again in the early fall (September-October) to manage routine problems. If this method is performed too early in the spring or too late in the fall it can create inactive turf recovery and adverse weed seed competition.

The use of mechanical methods to control the excess build up of thatch is necessary to manage healthy turf. Some thatch on playing surfaces is desirable because of its cushion and filtering effects. Thatch helps to shade and protect the soil. It also helps to contain or filter out fertilizers and chemicals. In addition, the proper amount of thatch will help to enhance the biological active zone. This in turn will help to deactivate undesirable residual chemical and fertilizer products. Dethatching, vertical mowing, grooming and brushingare the primary methods used to control and maintain the desired thatch level.

All turfgrass will be maintained at the highest cutting height possible to produce acceptable playability. The following range of heights listed in Table 12 will be maintained for each surface unit of play. The frequency of cut will provide controlled growth and less impact from stress, both climatic and environmental.

The range of square footage estimates and acreage of grass types for the proposed Hotel Hana-Maui golf facility are listed in Table 13. Areas left in their natural vegetative

Table 12. Turfgrass Maintenance for Hana Ranch Country Club

Area	HEIGHT OF CUT	MOWING FREQUENCY	(X) WEEKLY
TEES	3/8"-1/2"	M W F	(3) with baskets
FAIRWAYS	3/8"-1/2"	M T W TH F	(5)
GREENS	1/8"-3/16"	T W TH F S S	(6) with baskets
ROUGH	1"-1 1/2"	M T TH F	(4)

TABLE 13. Hana Ranch Country Club Total Square Footage Estimate (based on 201 acres)

Area/Use	Grass Type	Acres	Square Footage
Tees, Driving Range Tee and Nursery	Tifgreen 328 Bermudagrass	7.0	304,920
Fairway and Driving Range	Tifway II Bermudagrass	42.0	1,829,520
Greens, Putting Green, and Nursery	Tifdwarf Bermudagrass	5.0	217,800
Intermediate Rough & Green Aprons	Tifway II Bermudagrass	15.0	653,400
Mowed Roughs	Tifway II Bermudagrass	50.0	2,178,000
Native grasses	Native Species	31.0	1,350,360
Total mowed vegetation		119	5,183,640
Total native grasses		31	1,350,360
Total remaining acreage		51	2,221,560
Total proposed acreage		201	8,755,560

state along with proposed acreage for native grasses are also provided.

No more than one third of the leaf blade will be routinely removed in any single mowing. Clippings will be removed from tees and greens and dispersed over the rough adjacent to each hole where they are removed. There will be no compost of removed leaf blades nor will any clippings be permitted to accumulate near the intended use of play. Any clippings used for organic decomposition will be incorporated by rototilling into a defined topsoil mixing area.

Consistent mowing heights and proper bedknife adjustments must be maintained throughout the growing season. Alternate mowing equipment, used during periods of excessive soil wetness, shall be used to maintain these consistent mowing heights. Mowing frequency will increase during the spring and generally following fertilizer applications. During cooler conditions and hot and dry periods mowing frequency may decrease. During inclement weather, the golf course superintendent shall use a reduction in mowing frequency. This will keep potential surface water mechanical damage to a minimum. Each mower will be adjusted, sharpened and inspected according to the manufacturer's specification in order toprovide optimum cutting performance. The use of Wiehle rollers will be included on all equipment used to mow tees, fairways, and greens. This will aid in the control of excessive thatch and promote tillering of planned bermudagrass.

Greens will be maintained utilizing a walk-behind and/or triplex mower manufactured by the Jacobson Textron Company or similar manufacturer. The use of these mowers will provide a precise uniform cut with the least amount of compaction and mechanical damage. Clean up passes around the edge of the green will be altered to allow upright growth and prevent what is known as tracking. It would be suggested, that the predominant mowing equipment used on the greens, be of the walk-behind mower type rather than the triplex mowers. Both are appropriate and effective for Tifdwarf greens. However, it has been proven that the use of the walk-behind mowers cause less compaction, improves the quality of cut, and reduces wear from the continual use of the triplex mowers.

The Smooth Roll from Turf Engineering is now available from Woodbay Enterprises for the purpose of increasing green speed without the need to lower cutting heights. Besides increasing speed, this machine will smooth and true the surface, making greens noticeably firmer and less resistant to ball impact damage. Stimpmeter readings with an increase of one - two feet have been recorded after using the Smooth Roll. It is being recognized as a very valuable tool for use in a mechanical control program. It provides a major achievement in gaining desired green speed, by maintaining higher heights of cut while reducing the stress for golf course putting greens.

Equipment used to mow tees will be low compaction, light-weight hydraulic triplex mowers. They will be provided with optional grooming attachments, have five to eight blade reels, and grass catchers. In areas difficult to access with a triplex mower or prone to stress, a smaller 22" inch walk-behind mower with the above features may be used.

More than one size mower will be used to maintain fairways. The manufacturer whose design features best adapts to the characteristics of each golf hole on Hana Ranch will be chosen for use. Careful consideration and an on-site demonstration should be provided before choosing equipment for the Hana Ranch Country Club. Eight to eleven blade high

frequency hydraulically driven reels will be used to maintain the fairway playing surface. Triplex mowers with optional buckets will be used on smaller fairways. This will provide the option to offset perimeter cuts. Lightweight five-gang mowers with identical features will be used on all fairways. Fairways will be mowed in the opposite direction every time they are cut to prevent matting, compaction and/or frequency marks.

Two types of mowers (reel-type and rotary) will be used to maintain roughs and general use turf. Tractor drawn, ground driven or hydraulic reel mowers will be used to maintain areas adjacent to perimeter roughs. Any areas adjacent to bunkers, greens, and tees may involve the use of a hydraulic rotary or reel driven mower. The mowers selected will be chosen by providing a uniform cut with a minimum of wear and compaction damage. They should assure quality playing conditions and remove no more than a maximum one third of the total leaf blade, during each mowing.

The final and most critical part of the mechanical control section of this IGCM program is proper mowing height adjustment and mower cutting quality. Mowers must be maintained so that leaf blades are cut and not torn off. Lacerated leaf ends will increase the possibility of pathogen invasion. Extensive irregular separation of leaf tissue gradually increases a process known as chlorosis. Mower blades must be sharp. Proper mowing heights are also paramount to the management of healthy turf. Other than for special tournaments, the mowing of Bermuda greens below 1/8" can create undue stress. Mowing Tifgreen tees below 1/4" does not provide for adequate turf recovery or repair. Tifway II fairways should be kept at or above 3/8" to get desirable color and cover.

Summary of Cultural/Mechanical Controls

The following will be used as interrelated cultural practices:

- The use of a mechanical spiker to promote root growth, reduce the incidence of water puddling, and provide beneficial oxygen to the crown area.

- Vertical mowers to control excessive areas of thatch (more than 1" or 2.5 cm on fairways/roughs; more than 1/2" or 1.25 cm on tees; more than 1/4" or 1cm on greens).

- Mechanical brushes will be used to provide upright shoot growth and prevent matting.

- A coring machine or aerifier will be used to eliminate compacted soils and prepare the site for topdressing or overseeding.

- The use of a high pressure water injection aerifier will be used in periods of stress or when the practice may actually help reduce the need to apply a pesticide.

- A mechanical renovator on fairways and roughs will be used to control excessive thatch. Sprigging or sodding will be used as a preventative means to control unwanted species of weeds wherever possible. Any playing area with insufficient vegetative growth will receive the appropriate sod or sprigging as a measure to improve the quality of play. The turf type will be of the same type and quality defined in the architects specification plan for the Hana Ranch Country Club.

- Topdressing will be applied on a week to monthly basis to all tees and greens, depending on the growth and thatch conditions of the respective areas. Wear patterns on tees will be topdressed. Markers will be moved daily to allow sufficient time for the bermudagrass to grow together. This practice will help to eliminate the establishment of weeds that are the result of continual wear.

- Greens will be topdressed as deemed necessary by the golf course superintendent. The rate of top-dressing will be directly proportional on the need to control thatch or achieve smoothness. Topdressing material will be of the same material as specified in the original specification plan for new construction of golf course greens. The use of identical sand as supplied for original construction is preferred. The lack of a organic matter is permissible as long as the material is of the same particle size distribution.

- Topdressing will be used to level playing surfaces, improve root structure when coring, control thatch and protect new seedlings. Spot topdressing will be the practice for those areas in fairways with exposed native soils.

6. Chemical Controls

a. Methods of Selecting Chemicals for the IGCM Plan

The chemical control tactic relies mainly on herbicides, fungicides, insecticides and miticides. However, modern pesticides have changed dramatically in recent years and special care must be taken to get the maximum efficacy out of them. On this site, only the pesticides with short residual activity periods (i.e. those which decompose rapidly) will be recommended. Bt microbial toxins and insecticidal soaps will be the primary insecticides used. However, if stronger measures are warranted, fluvalinate (Havrik®) or chlorpyrifos (Dursban®) may be selected for spot treatments.

Fluvalinate works primarily through contact action. Dried residues of Havrik are non-toxic and non-repellant to honeybees. Treatment is recommended during non-foraging periods to mitigate any adverse effects. The product breaks down rapidly in alkaline water. It is important to use water with a pH of 5-7 in order to prevent rapid breakdown and repeat applications. Chlorpyrifos is much less susceptible to break down but has a high organic carbon binding feature. Over 99% of this pesticide "sticks" to organic matter. When applied to turf, virtually none gets past the thatch layer.

Common turfgrass diseases associated with warm season turfgrass were illustrated in Tables 4 and 5. The location and extent to which additional turfgrass pest may potentially injure turfgrass on the Hana Ranch Country Club were listed in Tables 6 and 7.

Implementation schedules that describe the most likely time for occupance and a guideline for various levels of management are provided on Tables 14 and 15. Table 16 quantifies the specific chemical usage and the probable number of acres to be treated. The chemicals, rates, areas of application, and the pest treated are described as probable worst case applications. The outlined quantities on Table 16 reflect as much as 50% more chemical product than what is actually anticipated during routine maintenance. The application of Integrated Pest Management will help to delay and reduce the need for pesticide usage. This will also

Table 14. Implementation Schedules for Hana Ranch Country Club

LEVEL OF MANAGEMENT: "High Maintenance"

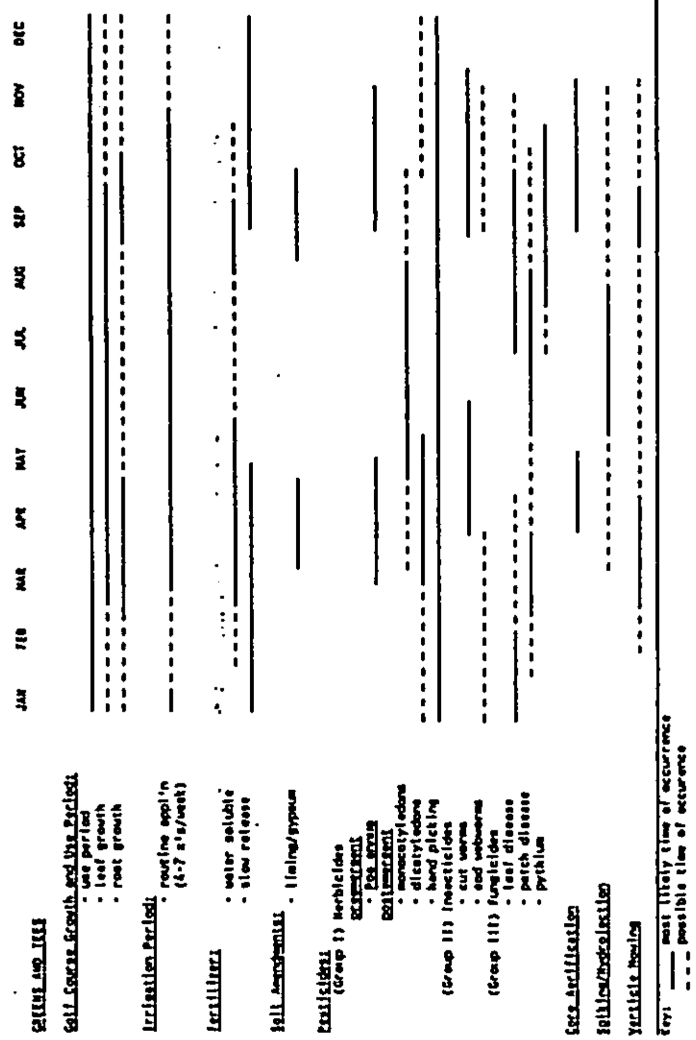


Table 15. Implementation Schedules for Hana Ranch Country Club

LEVEL OF MANAGEMENT: "Medium Maintenance"

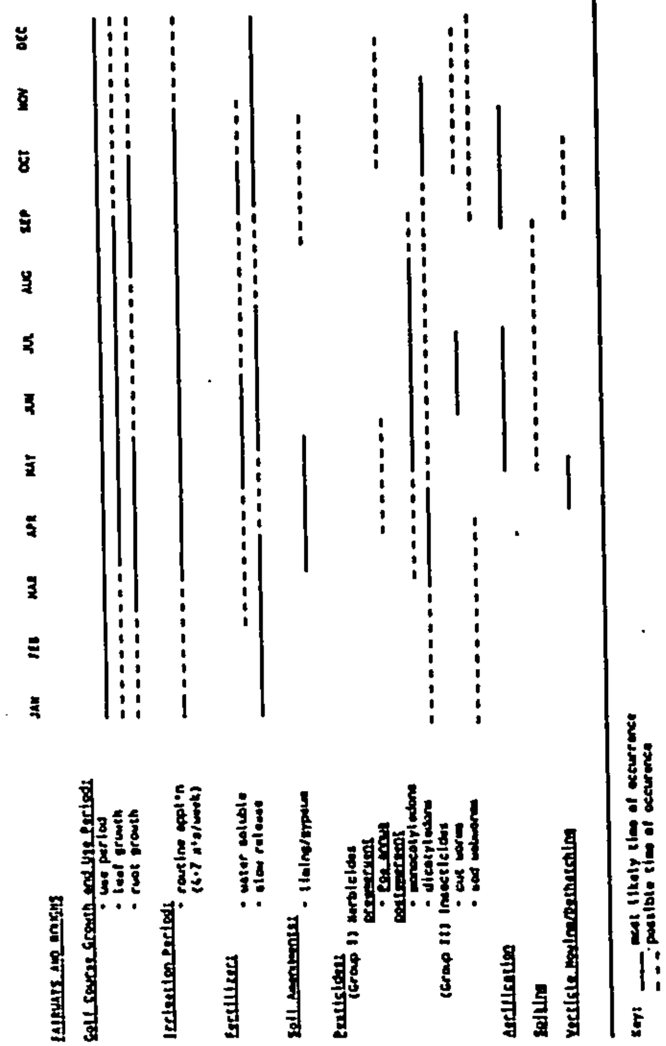


Table 16. Probable Pesticides for Use on Hana Ranch Country Club

I. Herbicides (Tees/Fairways/Roughs)

Common Name	Trade Name	Recommended Rate/App Lb/a.I./Ac	Projected No. of Apps/Yr. (Maximum)	Projected Maximum Annual Total a.I. Lb/a.I./Ac	Max Acres Treated Per/Yr.	Areas Treated
Dithopyr	Dimension	0.5	1 x's/yr	0.5	40 ‡	T F R
Glyphosate	Roundup	5.0	2 x's/yr	10 ea	10.0	F R
Imazaquin	Image	0.51	2 x's/yr	1.02	40.0	T F R
Isoxaben	Gallery	1.0	1 x's/yr	1.0	64.0	T F R
Metribuzin	Sencor	0.75	2 x's/yr	1.5	18.0	T F R
MSMA	Weedhoe	2.0	2 x's/yr	4.0	16.0	T F R
Oryzalin	Surflan	1.50	2 x's/yr	3.0	40.0	T F R

II. Insecticides (Greens/Tees/Fairways/Roughs)

Bacillus thuringiensis	Bio-bit	0.25	3 x's/yr	0.75	30	T G F
Fluvalinate	Mavrik Aquaflow	0.16	2 x's/yr	0.32	10	T G F
Chlorpyrifos	Dursban 50 (wsp)	1.0	2 x's/yr	2.0	10	T G F
Potassium Salts of Fatty Acids	M-Pede	1.35	3 x's/yr	4.05	30	R

III. Fungicides (Greens and Tees Only)

Copper hydroxide	Blueshield	16.77	2 x's/yr	33.54	12.0	T G
Fenarimol	Rubigan	2.72	2 x's/yr	5.44	12.0	T G
Fosetyl-AL	Aliette (wsp)	17.42	3 x's/yr	52.25	12.0	T G
Iprodione	Chipco 26019	2.72	2 x's/yr	5.44	12.0	T G
Thiophanate-methyl	Clearys/3336 (wsp)	2.72	2 x's/yr	5.44	12.0	T G

Note: These products have been selected and are projected at rates consistent with our "worst case philosophy." These rates were computer modeled for simulated maximum impact. Recommendations on these application rates will be addressed in the Environmental Risk Assessment for the Hana Ranch Country Club. WSP = water soluble packets.

‡ Dithopyr may be applied to 4 acres at 0.5 lb/acre each year. However, the applications must be split over all the fairways so that 20 acres are treated once, then the other 20 acres are treated 3 weeks later. This limitation is necessary due to concerns about runoff to the ocean.

reduce the potential for upsetting the microflora and non-target organisms.

The critical selection process for each pesticide was based on local chemical effectiveness, registered product use in Hawaii, and regional experience. Safety considerations were important in selecting chemicals for this plan. Sources used to obtain product information include: scientific literature, environmental fate data, EPA pesticide registration standards, discussions with golf course superintendents, chemical suppliers in Hawaii, manufacturers' literature, (technical reports, material safety data sheets, product labels and communications with manufacturers' representatives) and fact sheets. Pertinent information was first taken from primary and secondary scientific literature. University libraries were used as partial resources to identify other potential literature. Sources obtained through interlibrary loan networks and/or industry periodicals were also used. The data coming from current literature and EPA reports were given preference over data provided by manufacturers.

The term curative is used in the description of control methods expected for use on the Hotel Hana-Maui golf course. The use of the term preventive describes techniques necessary to keep the inherent pest problem from becoming a major turf threat. The need for preventive measures will be determined by actual weather conditions and the use of early detection kits such as "Reveal" (a ten minute diagnostic test kit). Historic records, past experience, and/or visual examinations will also be used. The favorable weather patterns found on the lower slopes of Haleakala volcano and the performance of existing golf courses on the leeward coast of eastern Maui, should demonstrate that optimum growing conditions for turfgrass do exist and that no additional range of turfgrass pest should be encountered.

Wherever possible removal of weeds will be eliminated by hand. An ultra low-volume backpack sprayer will be used to apply spot treatment applications to those areas of disease, insects, and weeds above threshold limits. Ultra low-volume sprayers are very good for many broadleaf herbicides that are applied at low dosage that easily blend in water. Any pesticide applied as a wetable powder and/or at high applications may not work well in this type of sprayer. Pests that are slightly above threshold levels, but not excessive in population, will be treated with a proportioned droplet or a "wick type" spot applicator.

b. <u>Other Factors Relative to Chemical Use</u>

i. <u>Influence of Thatch</u>

Thatch can cause several problems when using insecticides or miticides. Most of these pesticides are rather "sticky" and tend to bind to organic matter. Therefore, thatch may bind the pesticide so that it does not get through (in the case of billbug grubs) or does not come into contact with the target pest. Matted thatch can also become dry and difficult to wet. This mat may actually cause the surface irrigation applied after an application to run off.

ii. <u>Enhanced Degradation</u>

In past years, certain pesticides did not seem to work as well as they originally did. Most people figured that the pests had become resistant. However, when laboratory tests were performed, resistance was not a factor. We now know that most of the modern pesticides are naturally broken down by soil microbes, bacteria and simple fungi. In some cases, these microbes seem to have "learned" how to "eat" these pesticides very rapidly and may actually use the by products as food. This problem is called enhanced degradation.

Enhanced degradation seems to occur most commonly when the same pesticide is used repeatedly, especially during the same season. From current evidence, there may also be the possibility of cross degradation. In other words, the microbes may be able to degrade several pesticides after "learning" how to eat one.

iii. Irrigation

Irrigation after applications of insecticides or miticides to turf is very important to the success or failure of control. Though you must follow the instructions on the current label of the product used, there are some generalizations which can be made. Most surface insecticides for chinch bugs, greenbugs, mites and sod webworms should be on the leaf surface or in the top layers of thatch. Therefore, most applications of insecticides or miticides made to control these pests should not be watered in.

Most soil insecticides for control of white grubs or billbugs need to get as far into the thatch layer as possible. Therefore, a thorough watering as soon after an insecticide application is made is essential for best results. Though most people like to state some exact amount of irrigation, the best rule is to water until the top one inch of soil under the thatch layer has been wetted.

Granular formulations are common in turf management and these must be rained on or irrigated before the pesticide becomes active. Granular formulations are often preferred where irrigation is not possible because the active pesticide will remain longer, or at least, until a rain activates the granule.

iv. pH

Several insecticides and miticides are very sensitive to high or low pH's. Therefore, careful before mixing of a pesticide and adjustment to the pH of the mix may be necessary.

v. Formulation Effects

As with irrigation after an application, the formulation makes important contributions to the efficacy of a pesticide. In general, liquid applications seem to perform better for control of the surface pests. Liquid or granulars seem to be equally suitable for the soil pests.

vi. Timing

As with all pest control attempts, timing is the most critical issue. Most of the modern insecticides and miticides have short residual ability and need to be applied when the pests are in a susceptible stage. Virtually all of the turfgrass insect and mite pests can be controlled well with reactive applications. Preventive pesticide applications are best reserved for some diseases.

vii. Pest Resistance

Resistance to pesticides is always a problem. Several turfgrass insects have been identified with resistance to insecticides. Fortunately, most of this resistance occurred with the use of the older chlorinated hydrocarbon insecticides such as chlordane and dieldrin. Some of the insects have demonstrated some resistance to the organophosphate insecticides. Therefore, attempt to use those techniques which reduce the chances of developing resistance. Specifically, only use a pesticide when needed and try not to use the same product more than once in a season or from season to season.

F. Fertilizer Usage Strategies

It is often assumed that the main reason that a golf course needs to be fertilized is to make it look green. The color of the grass is important, but only secondary to the many other important functions in the plant. The goals of this fertilizer program are to:

- be foremost, environmentally responsible.
- produce a healthy stand of turf that can recuperate from damage caused by diseases, insects and traffic from golfers and by maintenance equipment.
- produce a healthy, visually attractive playing surface, but not at the expense of the root system.
- make the golf course be competitive against the invasion of weeds.
- provide the necessary amount of nutrients so as to not over-fertilize which can increase the need for irrigation and increase the likelihood of leaching; under-fertilize so as to reduce the competitiveness of the turfgrass site from invasion of weeds or to withstand the perils of pests and heavy traffic.

Even though about half of the nitrogen fertilizer applied to turfgrass does end up in the plant, the other half can be found stored in the soil and lost to the atmosphere. Thus, there is limited fertilizer nitrogen remaining that can be leached into ground water, or transported as runoff into surface water (Petrovic, 1990). It has been shown that golf

courses can be managed so nitrates from fertilizers do not contaminate ground water supplies (Petrovic, 1990).

When research does show nitrate leaching from turfgrass areas, it also reveals that leaching fortunately lends itself to being controlled by best management practices (e.g., Cohen, et al., 1990). Excessive leaching most often occurs when one or more of the following conditions exist:

- excessive single amounts of highly water-soluble amounts are used.
- highly water-soluble nitrogen sources (urea, ammonium nitrate, calcium nitrate, ammonium sulfate, or potassium nitrate) are used at inappropriate times.
- when water soluble fertilizers are applied to turf in dormant or semi-dormant states which exhibit lower nutrient uptake and greater water percolation.
- and/or where excessive irrigation or unexpected heavy rains have caused greater amounts of leaching. Research information on sites like golf greens containing high amounts of sand do not support the conclusion that properly managed golf courses are prone to heavy nitrate leaching. This is especially true with today's trend toward lower nitrogen rates and increased use of slow-release nitrogen sources. Slow-release nitrogen sources require microbial activity or hydrolysis to convert the nitrogen to an available plant form. When soluble nitrogen sources are used, the potential for ground water contamination can be reduced essentially to zero by following sound "best management" practices. Frequent applications of lesser amounts of both fertilizers and irrigation water can greatly reduce potential leaching. Applying fertilizers at times of rapid plant growth

enhances plant uptake, thus reducing the amounts which could potentially leach through the soil profile.

For example, a study done by Morton, et al. (1988) addressed the influence of irrigation and fertilization on nitrogen losses from turf. The study was conducted on a sandy loam soil. The authors concluded that normal fertilization and irrigation for these grasses on a mix of cool-season turfgrass resulted in nitrogen losses no different from the unfertilized controls. (Snyder, et al., 1984) also observed that controlling irrigation will reduce the potential for nitrate leaching to essentially zero on sand with Bermudagrass in Florida.

With the implementation of sound management practices, the probability of ground water contamination from nitrate fertilizers for use on the Hana Ranch Country Club can be effectively reduced to insignificant levels. Since irrigation inputs of water will be at a replacement rate only (modified penman calculation from an on-site weather station), overwatering and leaching of plant available soluble nitrogen forms can not readily occur.

When using proper replacement of irrigation water amounts during periods of active plant growth, water soluble nitrogen can be applied at rates of less than 1.0 lb/N/1000 ft^2/month without any significant accumulation or leaching. Timing fertilizer application to coincide with the period of active plant growth and nutrient uptake will optimize nitrate absorption and reduce the amount of soluble nitrogen available for leaching. Slow-release or fertilizers, that do not release excessive nitrogen during heavy rain, will be the fertilizers applied during the wet months.

The proportion of highly soluble and slow-release nitrogen fertilizers used on this golf course will vary with management, area, and time of year (Table 17). Roughly 25 to

50% of fertilizers applied to greens and tees will be in water-soluble forms, while the remaining 50 to 75% will be of the slow-release variety. This is due to the intensive nature of area usage. Typical application rates for tees are approximately 1 lb/N/1000 ft^2 per growing month. Greens are fertilized at approximately 0.75 lbs N/1000 ft^2 per month (Table 17).

A higher proportion (up to 70%) of the nitrogen added to fairways will be slow-release or delayed-release formulations. Total nitrogen added per year on fairways will be approximately 4-6 lb/1000 ft^2.

The use of the terms natural organic or non-synthetic organic, are continually used to imply a more safe benign use of beneficial material. Refined natural organic material suggests a more environmentally sound approach to turfgrass nutrient requirement and disease control. These materials are usually required to be used at a higher rate of application, but less often. In order to maximize the effects of these materials to become fixed for disease suppression, repeated applications may be necessary. This is not to imply that these materials will be used with higher active ingredients than their counterparts to produce the same effects, but it does illustrate the ratio of material often times results in the same percentage of nutrient loading and sustained release.

There is tremendous interest in developing non-chemical alternatives for disease control. One rapidly emerging field of alternatives is the use of disease suppressive "natural organic" fertilizers. In laboratory, greenhouse and field studies it has been shown that the natural organic fertilizers (Ringer, Sustane and All Gro Compost) can suppress disease development from 50% to 100% (Nelson, 1990, 1991). The suppression of the severity was noted on a wide range of diseases including ones important on this site, brown patch,

Table 17. Nitrogen Fertilizer Annual Usage on the Hana Ranch Country Club

	Single Application	Maximum Yearly
I. GROUP (Greens/Tees)		
Water-Solubles[1]		
1. Gro More 27-0-18	.10-.20 lb/N/1000 sq. ft.	Greens and Tees[2] will receive 2-3 lbs/N/1000 sq. ft./yr of water soluble products
2. Gro More 12-62-0	.10-.20 lb/N/1000 sq. ft.	
3. Gro More 20-5-30	.10-.20 lb/N/1000 sq. ft.	
4. Gro More 12-0-45	.10-.20 lb/N/1000 sq. ft.	
5. Urea 45-0-0	.30-.75 lb/N/1000 sq. ft.	
6. Gro-Power 6-2-8	.30-.75 lb/N/1000 sq. ft.	
Slow Release (Primarily)		
1. Scotts 22-0-16	.50-.75 lb/N/1000 sq. ft.	Greens and Tees will receive 3-8 add'l lbs/N/1000 sq ft./yr of water insoluble products
2. Scotts 19-26-5[3]	.50-.75 lb/N/1000 sq. ft.	
3. Scotts 15-0-30	.50-.75 lb/N/1000 sq. ft.	
4. STEP (trace elements)[4]	.50-.75 lb/N/1000 sq. ft.	
5. Par Ex 31-0-0	.50-.75 lb/N/1000 sq. ft.	
6. Par Ex 21-3-16	.50-.75 lb/N/1000 sq. ft.	
7. Par Ex 12-3-34	.50-.75 lb/N/1000 sq. ft.	
8. Alternative Nitrogen Sources	varies, based on product[5]	
II. GROUP (Fairways/Roughs)		
Water-Solubles[1]		
1. Urea 45-0-0	.50-.75 lb/N/1000 sq. ft.	Fairways and Roughs will receive 1-2 lbs/N/1000 sq ft./yr of water-soluble products[6]
2. Calcium Nitrate 15-0-0	.50-.75 lb/N/1000 sq. ft.	
3. Ammonium Nitrate 34-0-0	.50-.75 lb/N/1000 sq. ft.	
4. Turf Royal 21-7-14	.50-.75 lb/N/1000 sq. ft.	
5. Best 16-6-8	.50-.75 lb/N/1000 sq. ft.	
6. Ammonium Sulfate 21-0-0	.50-.75 lb/N/1000 sq. ft.	
Slow Release (Primarily)		
1. Par Ex 31-0-0	.75-2.0 lb N/1000 sq. ft.	Fairways and Roughs will also receive 2-5 lbs N/1000 sq ft./yr of water insoluble products[6]
2. Par Ex 24-4-12	.75-2.0 lb N/1000 sq. ft.	
3. Par Ex 10-18-22[3]	.75-2.0 lb N/1000 sq. ft.	
4. Par Ex 28-3-8	.75-2.0 lb N/1000 sq. ft.	
5. Scott 32-3-10	.75-2.0 lb N/1000 sq. ft.	
6. Scott 22-0-22	.75-2.0 lb N/1000 sq. ft.	
7. Alternative Nitrogen Sources	varies, based on product[5]	

[1] Formulations will be selected in accordance to field inspection, soil and tissue testing.
[2] Tees typically use 20-30% more (N) fertilizer than the greens.
[3] Starter materials will be used during the first year of construction and for establishment of nursery grasses.
[4] Trace elements will be added according to soil tests.
[5] Refer to products on Table 15 for choice in Natural Organic Materials.
[6] Roughs will receive 35-40% less (N) fertilizer than the fairways.
NOTE: Water-soluble products will be used during periods of active plant growth and during periods of less frequent rains.

dollar spot, and pythium root rot. The disease suppressive properties of these materials have not been widely tested on warm-season grasses. However, they should be used and their effectiveness on disease suppression be evaluated on this golf course as a way to reduce the need for fungicide applications. These nitrogen sources have been found not to leach from cool season golf greens.

The following materials listed in Table 18 are alternative products that will be included in the Integrated Golf Course Management Plan.

G. Pesticide Use Recommendations

1. Applications

The following policy will be used when applying pesticides.

- The pest will be properly identified. The use of disease, insect, and weed identification guides will be used. Diagnostic aid kits will be used on pathogens for which they have been developed.
- Extension Service, Commercial and University lab assistance will be used to identify any unknown activity.
- The golf course superintendent will identify and document when the agreed upon threshold limit of pest activity has been exceeded.
- A pesticide application will be made when there is no alternative measure for control.

Table 18. Alternative Nitrogen Sources

Slow Release Synthetic Material

Trade Name	Manufacturer	Analysis	Release	Formulation
Nutralene	Nor-Am	40-0-0	12-16 weeks	Methylene Urea
Once	Grace Sierra	24-6-11	5-6 months	Osmocote Resin
Polyon	Persell Ind.	42-0-0	9-10 weeks	Polymer Osmosis

Natural Organic Material

Resurge	Quad Five	7-7-7	12-16 weeks	Feather meal
Bermuda Green	Ringer	12-2-6	5-7 weeks	Feed grade animal protein
Sustane	Sustane Corp.	5-2-4	12-16 weeks	Turkey waste composted

Recommended Rate of Application

Product	lbs.N/1,000 ft^2	lbs. of Product/ 1,000 sq. ft.	Total lbs./Acre
Nutralene	0.75 - 2.00	1.90 - 5.00	83 - 217
Once	1.00 - 2.00	4.25 - 8.50	185 - 370
Polyon	0.75 - 2.00	1.80 - 4.80	78 - 209
Resurge	1.00 - 2.00	15.0 - 30.0	653 - 1,306
Ringer	1.00 - 2.00	8.50 - 17.0	370 - 740
Sustane	1.00 - 2.00	20.0 - 40.0	871 - 1,742

- The material selected will be applied only after receiving a written recommendation from a certified pesticide advisor.

- The actual application of a pesticide will be made under the direction of a certified, licensed applicator.

- The golf course superintendent will be licensed in the following categories: Aquatic Weeds, Turf and Ornamental.

- All pesticide applications will be made in accordance with label specifications.

- In order to minimize drift to non-target areas the application of pesticides through the golf course irrigation system will be prohibited. The application of a pesticide will be prohibited when wind speeds exceed 10 mph. Documentation will be verified by the Environmental Pestcaster and/or the irrigation system weather station.

- The applicator will adhere to all label specifications for loading, mixing, and applying the compound. All protective clothing as specified by the label will be worn by the applicator.

- Liquid application of a pesticide will be made using a low pressure boom type sprayer or a hydrofoil shrouded sprayer with the boom height no higher than 18" inches high. This will help to further minimize aerosol drift.

- The use of low volume hollow cone nozzles and applicator spray shields will be installed on the spray boom.

- No pesticides will be applied within 50 ft of any stream or wetland.

- Notification of a pesticide application will be made in accordance with the law.

- All pesticide applications will be posted prior to the application and will remain posted for a minimum of 24 hours.

The golf course superintendent will be responsible for the administration of the above policies.

2. Aerosol Drift Control

The potential for pesticide drift to surface waters can be minimized by applying on days when wind is minimal and applying at the times of day (early morning, late evening) when winds are naturally diminished. The use of drift control devices, such as the "windfoil" shrouded sprayer made by the Rogers Innovative Inc., Equipment Company, can essentially eliminate the drift of sprayed pesticides to non-target areas (i.e. lakes, ponds, streams, etc.) to a factor of zero. Verification of wind and environmental conditions will be recorded by the environmental pestcaster or from the irrigation system weather station. The Pestcaster will provide the superintendent with accurate weather information for proper timing of any application.

The use of an on-site weather station will be used to measure wind speed and direction. Consistent with

recommendations of the Department of Agriculture (11/29/91), all tractor boom applications will be made with spray shrouds and no pesticides will be applied when winds exceed 10 mph.

3. Runoff Control

The potential for groundwater contaminated by pesticides and runoff into nearby surface waters on the Hana Ranch country club will be minimized both structurally and biologically. There are no potable water wells or supply sources down gradient from the project site. Drainage patterns on the project site will not be altered and outflows of drainage from the golf course will be contained in lined retention ponds or natural vegetative areas. The drainage system will be designed to recirculate stormwater runoff. A part circle irrigation system will be installed on greens if the salinity content in soils reaches 1,500 ppm. A study conducted at Penn State University illustrated that runoff is insignificant over dense, high quality turfgrass stands. (Harrison, 1989). Experimental applications of pesticides did not result in significantly contaminated runoff over turfgrass plots, even after a simulated six inch rainfall immediately following pesticide applications.

The use of pesticides that are readily bound and held by organic matter in the soil will further reduce the potential for overland movement. Timing applications when rainfall is not predicted will be standard procedure. A 24-hour window is usually necessary unless label requirements require the product to be watered in. Regulating irrigation over this same period, will allow pesticides to be bound by the leaf surface and soil matrix, or taken up by the target pest and degraded by soil microorganisms.

4. Handling and Mixing

It is recommended that Keola Hana Maui, Inc. utilize a state-of-the-art boom sprayer (manufactured by the Toro Corporation or similar manufacturer). Computerized flow meters, independent boom separation, ground tracking speed, calibration for precise liquid applications, and a sonar boom leveler will be provided on this vehicle. The sprayer will be maintained to the highest standards and will immediately cease operation if any failure is noted by the golf course superintendent or operator. This vehicle will be totally self-contained and will only be used to apply pesticides to the designated target areas.

In addition, a Windfoil Driftproof Spray Applicator, by Rogers Innovative will be installed on a dedicated sprayer for use on the Hana Ranch Country Club. The windfoil can eliminate drift and increase environmental and personal safety by containing the spray inside the shroud, away from the wind. Low volume application of mist sized particles reduces the amount of water and pesticide required for control. Spraying with less water reduces both drying and re-entry time. Verification of wind speed by the envirocaster and wind speed direction by the computerized irrigation system, will provide immediate indication of current weather conditions.

5. Spray Solution Guidelines

Applicators will receive the appropriate training and will be knowledgeable in the proper compliance level set forth within the Integrated Golf Course Management Plan. The following standards will be used as procedure for all pesticide applications.

The spray equipment for the Hana Ranch Country Club will be filled with water from a back siphon protected hose outlet. The spray tank should initially be filled to within 75% of its holding capacity. The compound chosen for use is added to the amount of water in the spray tank. All compound packaging is triple rinsed and poured into the spray tank. The use of formulated material in water soluble or water dispersal granules will reduce the amount of hazardous waste for disposal. The products with this type of formulation are listed in Table 18 and are designated by the term wsp (water soluble packets). All packaging is placed inside the storage building along with the original shipping carton for disposal. Any pesticide applied remains at the designated source for initial fill up. This will be either adjacent to or within the pesticide storage building. Upon following the completion of mixing instructions as specified on the label, the spray apparatus may be topped-off to achieve the proper ratio of diluted material. A roof will be provided to cover the loading area and the pad will be excavated to a depth of one foot with poured concrete as a retaining wall. Eight inches below the surface lies an 18 ft x 18 ft piece of filter fabric on top of a eighteen foot 18 ft x 18 ft piece of black polyethylene. Approximately 7" of sand will be compacted over the entire area. The purpose of this area is to guard against any form of rinsate that may accidentally be spilled. A hose outlet with a back siphon, protected by a concrete barrier is located at this site.

In the center of the concrete wash pad, a drain and sump pump is to be installed. This will collect pump spillage or tank rinsate into one of two double-walled, above-ground, 1000 gallon storage tanks. One is to be used to collect herbicides and the other insecticides, fertilizers or fungicides. A manual valve will direct the flow to the appropriate tank. These tanks are to be connected underground to the pesticide and fertilizer storage areas. Drainage flow into the appropriate tank will be provided in the event of a potential fire or when the storage area is cleaned. The area should be covered with adequate roofing to eliminate rainfall collection into the storage tanks. This will constitute a "closed system" for the loading and cleaning of pesticides.

Upon completion of the spray application, the equipment will be returned to the rinsate area and filled to within 25% to 50% of the tank water holding capacity. The diluted rinsate is then applied in the areas of rough, designated as perimeter rough. This should be sprayed immediately adjacent to each hole where the application of a pesticide was applied. The rinsate will be applied with the same ground speed as the actual application. It should be noted that no rinsate is to be applied in any areas deemed environmentally sensitive or having direct access with potential surface runoff. Secondary rinsate or spillage will be collected in the above ground tanks for later spray application into the safe rough areas. It is recommended that all rinsate material be applied to the target site on the same day of application to avoid the potential of phytotoxicity.

6. Calibration of Sprayers

Judicious use of pesticides and compliance with regulatory label restrictions, requires the golf course superintendent to consistently monitor and calibrate. Additional information regarding spray systems for turfgrass can be found in Appendix B and provides the golf course superintendent with additional safeguards on proper sprayer calibration.

For precise applications a dedicated spray system is recommended. This should include a state of the art flow

meter with clogged nozzle indicators and individual electric shut-off capability. Enclosed cabs with electric isolation switches will provide additional flexibility and protection for the operator and will allow instant on-off target source distribution. The use of "Windfoil" application with spray drift shields will allow the application of pesticides to be applied in a manner that virtually eliminates aerosol drift.

Nozzle attached calibration kits that include containers to measure tip flow distribution are available to record calibration for these state of the art sprayers. Ground speed can be matched with tachometer and power take off cruise control settings. Flow meters will provide the gallonage information for each area of measured square footage treated. Range of distribution through each nozzle can be measured and monitored. This may be used to build a chart for each target site and to determine the appropriate range of speed for each pesticide application. These measures can be used to apply pesticides more accurately once a baseline calibration check has been performed. This will provide additional training and convenience for the operator and provide a cross check for the golf course superintendent.

A major component in an Integrated Pest Management plan is to minimize any potential drift from the application of materials. Steps must be taken to ensure that the intended target receives the appropriate amount of material. Boom height should be adjusted to a level of 14"-18" depending on the nozzle type and size chosen for distribution. Nozzle screens (50-100 mesh) should be installed to filter foreign material. Nozzles spaced 18" apart should be adjusted to apply material evenly. They should be of sufficient angle, so as not to allow the distribution of material to move offsite from the target source.

There are many nozzle sizes available that will change the proportioned droplet size to heavy large microns. These nozzles are generally 200 microns in diameter and must be matched to the gallons per minute and pressure rating of the activating pump control system. There are four nozzles that offer the best in drift control: extended-range flat spray tip, wide-angle full-cone spray tip, wide-angle flat-spray tip, and a wide-angle hollow-cone spray tip. Electric controlled droplet applicator nozzles are also available, when the replacement of standard hydraulic nozzles are determined to be the best alternative to site specific spray applications. The range of options available are designed to make calibration and proper pesticide application, a key component for the golf course superintendent and the Integrated Golf Course Management plan.

State of the art technology should never take the place of simple performance check calibration. To apply more material or to apply the same amount of material in more concentrated solution, you may do any or all of the following: go faster, use smaller nozzles, or reduce the pressure. However, consistent range speeds should be used for all applications. The golf course superintendent should calibrate each nozzle size available for use and record the total gallonage applied. The daily use reports on file in the superintendents office should include verification that the appropriate amount of active ingredient was applied. These rates must comply with state regulatory procedures and be applied according to label restrictions.

Examples of calibrating a sprayer and granular spreader are outlined below:

<u>Calibration Examples</u>

1 acre = 43,560 sq ft
1 mph = 88 ft/min

When calibrating a spray unit and measuring speed in miles per hour, each mile per hour is 88 ft/min and the general formula is:

$$\frac{43{,}560 \text{ ft/acre} \times \text{gal/min}}{88 \text{ ft/min} \times \text{mph} \times \text{ft width of boom}} = \text{gal/acre}$$

If we want to spray small areas we can convert to units of 1,000 square feet:

$$\frac{1000 \text{ ft} \times \text{gal/min}}{\text{ft/min of travel} \times \text{ft width of boom}} = \text{gal/1000 sq ft}$$

One may use the following method to cross check and verify more accurately the above calculation.

- Measure an area 660 feet (40 rods) long.
- Fill the spray tank to the full water mark level with plain water.
- Spray the 660 feet with pressure and speed to be used on the golf course.
- Record the amount of water necessary to refill the tank to the original water mark before spraying.

Use the following calculation to determine the amount of water applied per acre.

$$\text{gpa} = \frac{\text{gals. applied over the 660 ft.}}{\text{width actually treated by sprayer (ft)}} \times 66$$

Example: $\text{gpa} = \frac{10.0}{40.0} \times 66 = 16.5$

The width treated by the sprayer would be the swath width for broadcast application.

Swath width = 40.0
Test length = 660 ft
Area of test = 660 ft x 40 ft = 26,400 sq ft

$$\text{Acres of test} = \frac{26{,}400 \text{ sq ft}}{43{,}560 \text{ (sq ft/ac)}} = .606 \text{ acres}$$

Water to fill = 10.0 gals

$$\text{Vol/acre} = \frac{\text{gals to fill}}{\text{acres of test}} = \frac{10.0}{0.606} = 16.50 \text{ gallons per acre}$$

To perform calculations for the application of granular products using a rotary broadcast spreader a field application may be necessary. The granular product size and the size of the meter opening are both important in determining the amounts of material necessary for application. It is equally important to note the walking speed of each applicator in order to accurately calibrate the amount of material applied. Research has shown that changing the ground speed by only 1 or 2 miles per hour can disrupt the application rate by as much as 50%. Ground speed stabilization becomes the most significant variable which will effect the application rate. Some product manufacturers provide the appropriate settings when using specific rotary or drop type spreaders. These are generally field tested for granular size distribution. They also take into account the total material applied (per unit of measurement) and the designated speed and setting necessary. Some manufacturers do not take into account the miles per hour necessary to apply these materials at the given rate. The

illustrated example provides the measures necessary to calculate the amount of material needed.

For the purpose of this calculation an organic 40 lb. bag of fertilizer has been chosen for application.

Example: A person walks at 4 mph with a 10 ft spreader and takes 4 minutes to apply a 40 lb bag of organic fertilizer.

One mph is 88 ft/min so at 4 mph, 88 x 4 = 352 ft/min.
352 ft/min x 10 ft width of spreader = 3520 sq ft/min.
3520 sq ft/min x 4 min/bag = 14,080 sq ft/40 lb bag.

$$\frac{43{,}560 \text{ sq ft/ ac} \times 40 \text{ lb}}{14{,}080 \text{ sq ft}} = 123.75 \text{ lbs./ai.}$$

Question: The recommended rate is 2 pounds ai/ac. The material purchased is a 20% granular formulation. How many pounds of material should be applied per acre?

Example: $\text{lb product per acre} = \text{lb ai/ac} \times \frac{100\%}{\%\text{ ai in product}}$

$2 \text{ lb ai/ac} \times \frac{100\%}{20\%} = \frac{200}{20} = 10$

7. Pesticide Spill and Response Plan

A written discharge response plan will be part of the training provided to each employee at the Hana Ranch Country Club. The plan will conform to all applicable sections as defined by law. A copy of this plan will be readily available. The Police and Fire Department will be notified that this document has been completed. The Fire Department will be provided with a current copy of all chemicals and pesticides stored in the pesticide storage area. The Material Safety Data Sheets (MSDS) will be provided for each compound in the storage area. In the case of minimal discharge, employees will have the necessary protective equipment and clothing for use. Showers and Eye Wash Stations will be readily available. All materials will be disposed of through a licensed hazardous waste disposal firm. Discharge from dry bulk materials stored within the pesticide storage facility will be recovered by the use of a broom and dust pan used solely for the purpose of recovery of these materials. Any material that is not contaminated and suitable for use, will be repackaged with an original label affixed to the new packaging. It will be used when the appropriate need arises and for its intended purpose. It will not be disposed unless contaminated. As specified, only pesticides for use on the golf course will be stored in the building.

<u>Fire Response Plan</u>

All employees will receive training on the proper procedure to follow in the event of an accident or a fire.

In the event of a fire, the following procedures take effect:

a. The person discovering a fire will notify the local fire department. He will also notify the golf course superintendent as officer in charge.

b. The local fire department will be provided with the home number of the golf course superintendent. The number of two other responsible subordinates will also be provided, so that in the event of a fire, someone may be reached.

c. The golf course superintendent will also be responsible for notifying all the appropriate project managers, state and local authorities as prescribed by law.

d. In the interest of safety all people will be evacuated from the area.

e. The fire will be directly supervised by the Fire Department. Other organizations will be notified if requested by the department.

f. Any other agency deemed necessary after consultation with the above agencies or under advice from the City, Police or Fire Departments will be notified.

g. Following a fire the area will be secured as recommended by the fire marshall or fire department.

h. Containment barriers will be installed as deemed appropriate to prevent further contamination of the surrounding area.

i. Upon approval from state and federal agencies and under the advice of approved consultants licensed in the removal of hazardous waste disposal, the clean up process will begin.

j. The above policy will serve as "all appropriate action" unless otherwise specified or clarified by regulation.

8. <u>Pesticide Storage Facility</u>

A structure of adequate size (approximately 100-200 ft^2) should be built at the furthermost end away from offices, break room, mechanic area, or employee eating areas. It is recommended that the pesticide storage facility be a separate or stand alone structure at least 50 ft from any routinely inhabited building (other than a dead storage building). This will reduce the potential for inadvertent pesticide exposure.

The entrance should provide ventilation that is actuated by an external explosion proof light/fan switch. The room should have a cement containment floor and a block or concrete wall of approximately 6 ft or greater. The storage capacity of the containment floor must retain at least twenty minutes of continuous operation from the fire prevention sprinkler system. This capacity will be independent of the outside storage tanks mentioned in the spray solution section guidelines. A floor drain connected to a sump pump and a line feeding the herbicide-pesticide rinsate tanks should also be installed. A fire extinguisher should be located outside and inside the pesticide storage room. The facility should be designated and posted as a pesticide storage area (as per law), with a copy of all chemicals contained in storage on file in the superintendent's office. One copy should be provided to the local Fire Department. Additional copies should be located in the club or project file.

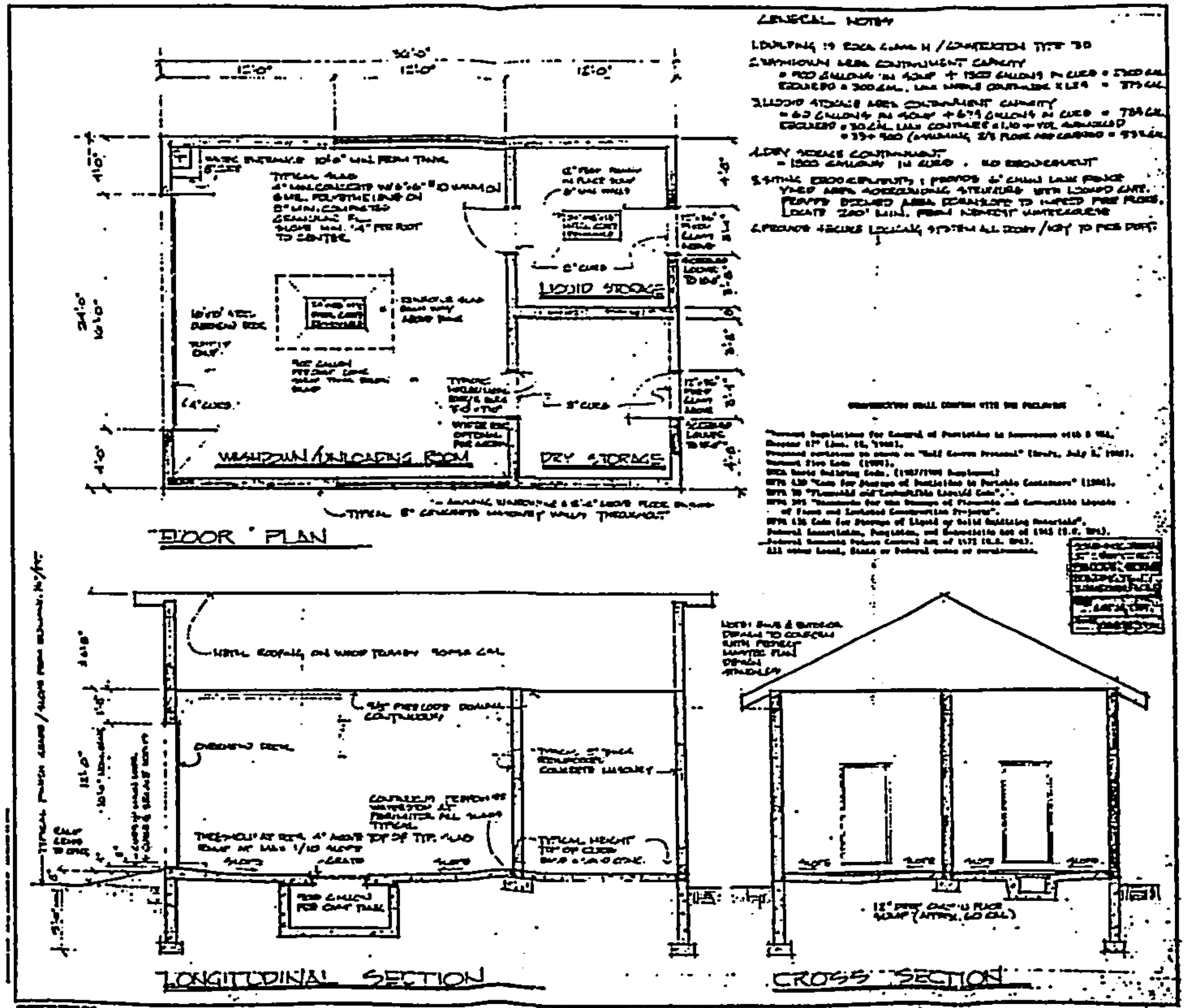
Figure 2 is an illustration of the appropriate type of Pesticide Storage Facility that should be installed on the project site.

9. Storage Facility Check List

The following operating procedure is recommended in regards to the pesticide storage facility at the Hana project site:

a. The building is to be secured and locked at all times.

Figure 2. Pesticide Storage Facility


GENERAL NOTES
FLOOR PLAN
LIQUID STORAGE
DRY STORAGE
WASHDOWN/UNLOADING ROOM
LONGITUDINAL SECTION
CROSS SECTION
30'-0"
15'-0"
15'-0"
24'-0"

b. An additional key is to be placed in the administrative office and in the office of the golf course superintendent in case of emergency.

c. Storage of materials are to be on shelves located high enough to permit cleaning of the floor. No material should be stored above 6 feet from the ground.

d. All materials must have legible labels attached. Any materials whose packaging has been damaged must be in containers clearly marked and labeled.

e. Plastic containers are used to store any open containers in excess of 1 gallon or more for protection of spillage. A plastic trash barrel with a lid is to be located inside the storage facility for cleanup.

f. The staff at Hana Ranch Country Club must be trained in the operating procedures regarding the building.

g. All appropriate protective clothing and equipment will be provided for use by those who handle pesticides.

h. Absorbent material designed to contain any accidental spill within the pesticide storage facility will be available at all times.

i. Disposal of pesticide containers shall comply with the instructions on the label and with other state and federal regulations. Empty containers will not be allowed to accumulate or be stored within the building.

j. The building will be inspected monthly by the golf course superintendent and a record of each inspection will be recorded in the records for pesticide use.

k. Obsolete, excess, and mixtures of pesticides shall be disposed of by a licensed hazardous waste firm or according to the statutes and regulations established by law.

l. Any pesticide accident will be reported immediately to the appropriate authority.

VI. RISK ASSESSMENT OF PESTICIDE AND FERTILIZER USE AT HANA

A. Site Characterization

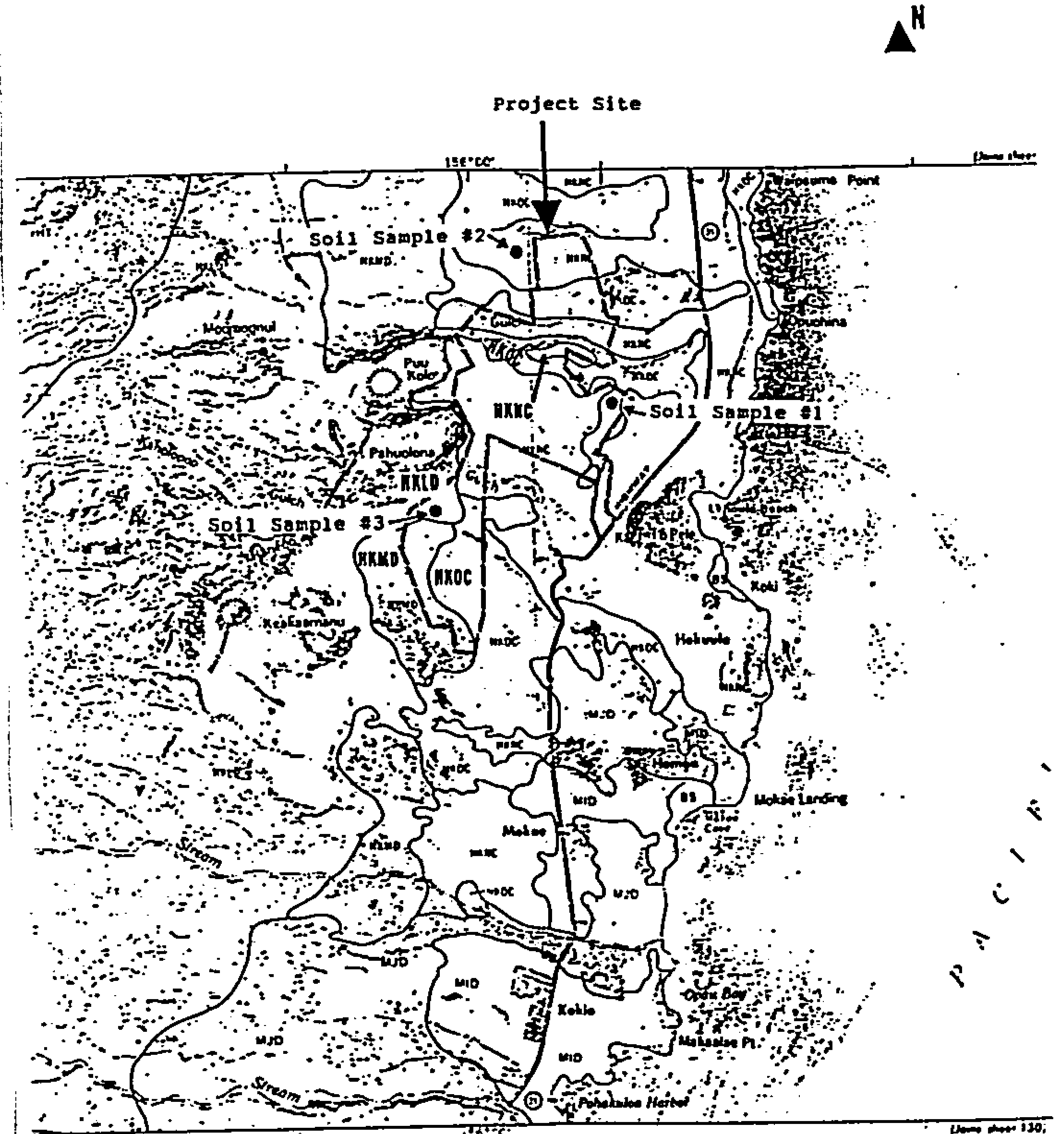
1. Soils

The proposed project site is overlain with soils from the Hana series. These are well drained soils found on the upland areas of Maui (USDA, SCS, 1972). They were developed in volcanic ash from Haleakala. Specific soil types on the project site include HKLD, HKNC, and HKOC (Figure 3). These soils are similar physically (silty clay loams), however, they differ in stoniness and slope of the areas they comprise.

Taxonomically, the Hana soils are classified in the family Typic Hydrandepts. One of the most significant features of these soils is that they dehydrate irreversibly into fine gravel-size aggregates (USDA, SCS, 1972). Thus they behave more like a sandy soil in terms of hydraulic characteristics than as silty clay loams. Permeability is generally moderately rapid and erosion hazard is only slight moderate. Additionally, these soils are comprised heavily of amorphous clays such as allophanes, amorphous iron, and aluminum oxides. These types of clays have a high capacity for fixing phosphorus and thus rendering phosphorus unavailable for crop uptake (Brady, 1990).

Soil samples were collected from the project site by ETS and analyzed for physical characteristics. Sample locations were selected in conjunction with the boring locations (see Figures 1 & 3). The samples collected represent two major and one minor soil types within the Hana series: HKNC, HKOC and HKLD, respectively. HKNC and HKOC are the major soil components of the proposed Hana site with minor contributions from HKLD and HKMD. The results of the analyses are presented

Figure 3. Soils Map



Scale 1" = 2000'
Taken from USDA, SCS,1972.

in Appendix C of this report. They indicate that the soils are primarily clay in texture, but otherwise correspond fairly well with the physical descriptions of the soils in the Soil Survey. Based on the consistency of the results from each of the soil types, the difference in the samples appears mainly to be variability in stoniness. [The new routing plan of June 1992 changes the layout and geometry of the project site. Therefore, soil sample #2 (boring #3) lies outside of the new concept plan, however, the soil is still representative of the area.]

2. Climate

The Hana project site is located on the windward side of Maui and experiences an average rainfall of approximately 76 inches per year (40-50 inches in a dry year and 90-100 inches in a wet year). The temperature ranges between 60° F and 80° F throughout the year. Winds are northeasterly during the days and lesser northwesterly winds prevail at night (Neal & Assoc., 1992). Compared with many other windward locations in the Hawaiian islands, the winds here are light. According to Neal & Assoc. (1992), this is due to Hana's location with respect to the tradewinds and topography. A wind rose (Appendix D) for the Hana airport shows that approximately 90% of the time the windspeed is less than 11 knots (12.65 mph) for the period recorded.

3. Surface Hydrology

The Hana Ranch project site is comprised of five major drainage areas. No perennial streams exist on the property, although during major storm events intermittant flows reach the sea. Only two of the drainage areas would have the potential to transport turf chemicals applied to the golf course directly to gulches which then flow to the ocean, the drainage basin of the Haneoo Gulch and the combined drainage of the Moomoonui and Hoomooiki Gulches. The northern most part of the site drains to the gulch that defines the northern border of the site. The remaining two drainage areas, one in the middle of the site which originates from the makai side of Puu Kolo and the other which comprises a small portion of the southern most part of the site, do not have defined channels that would carry runoff to the ocean. Rather, runoff would appear to be more in the form of sheet flow than channel flow. Within the project boundaries, slopes are generally moderate averaging 10% to 15%.

4. Regional and Site Specific Geology

Hana is located on the east side of Haleakala Volcano which forms East Maui. Elevation at Haleakala's summit is 10,025 ft above sea level (Stearns, 1966). The proposed site is located on the western slope of Haleakala between approximately 200 and 550 ft elevations and is approximately 1 mile mauka of the coastline.

The proposed project site is covered with Hana soils (as described in part 1 of this section) except for the gulches. Underlying the soil is clinker and basalt formed by Haleakala volcanics. The lower unit is typical of basaltic pahoehoe and a from the Honomanu volcanic series. The Kula volcanic series conformably overlies the Honomanu series and is composed of andesitic aa containing many interstratified, thin ash-soil layers (Stearns, 1966). The upper rock unit is the Hana volcanic series, which produced numerous cinder and spatter cones, some of which directly offset the project area (i.e. Puu Kolo). The Wananalua well (located 2000 ft north of the site, Figure 1) shows the interbedding of clinker, more consolidated basalt and ash-soil layers (Appendix E).

Three borings and a seismic refraction survey were completed by Pacific Geotechnical Engineers for the project site. The logs show the interbedding of clinker and fractured basalt. Ash-soil layers were not encountered at these shallow depths. Appendix F is a summary of the subsurface exploration, field permeability tests, laboratory testing, and boring logs.

5. Site hydrogeology

The proposed site is underlain by the Kawaipapa aquifer system of the Hana sector which produces potable water from the surrounding wells. There are no perennial streams on site, however, there are 3 gulches which cross the site. Haneoo gulch cuts across the south end of the. Hoomoonui gulch splits at the western boundary forming two gulches across the site. All three gulches extend to the ocean. These gulches flow in the upper reaches of Haleakala and across the site to the ocean during intense storm events. Figure 1 was taken from the USGS 7.5 minute series topographic map of the Hana Quadrangle and shows the location of the gulches with respect to the project site.

The basal lens at the site is at a depth of approximately 5 ft above sea level (Appendix E) having a chloride content of 70 ppm. Permeability is extremely high where the formation layers are rubbly clinker zones (Mink, 1988). The aquifer has a sustainable yield of 48 mgd which reflects high recharge to the system.

Figure 4 shows a conceptual model of the vadose zone. Although extremely simplified, the model can be used to visualize the complexity of the interstratified layers in the subsurface.

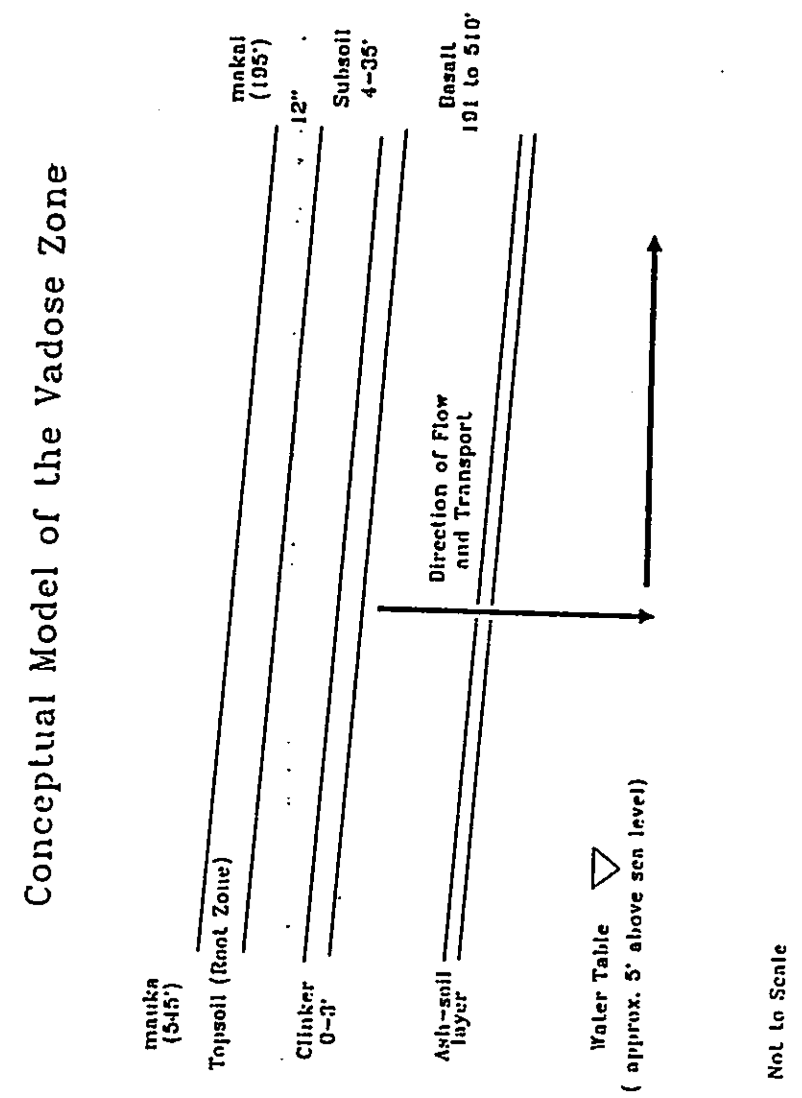


Figure 4. <u>Conceptual Model of the Vadose Zone</u>

B. Potentially Significant Exposure Pathways

One of the most important parts of any risk assessment is the exposure assessment. The first step in an exposure assessment is the identification of potential paths of exposure to sensitive organisms, e.g. runoff to a coral reefin near shore waters, leaching to ground water that is consumed by people, etc. That is the purpose of this section.

Potable ground water underlies the site, but no current or planned wells lie downgradient of the proposed golf course site. The Keola-Hana well is at the 410 ft elevation, approximately 1/2 mile north of the site. The Maui county Department of Water Supply's well is approximately 1/2 mile south of the site at the 350 ft elevation. Both well sites are within the elevation range of the proposed golf course (160-580 ft), but their zones of influence/ well capture zones are far from being able to intercept any golf course leachate. However, it is the policy of the State Department of Health that all potable ground water be protected. Equally important, all of the natural environment is sacred to native Hawaiians, especially water used for drinking or fishing. Therefore a ground water risk assessment was done.

No treated sewage effluent will be used for golf course irrigation. Therefore that is not an environmental issue.There are no perennial streams on site, and no aquatic organisms were found in the gulches up to the highest elevations surveyed by the Department of Land and Natural Resources (600-750 ft). Therefore there is no concern for impacts on fresh water organisms.

There are three major gulches on site. From north to south they are the Moomooiki, Moomoonui, and Haneoo Gulches. The first two gulches join at a culvert under Hana Highway.

The Haneoo Gulch system actually consists of three small gulches at the point where it crosses the highway. The risks of turf chemical runoff from these gulches had to be modeled because of the importance of protecting marine organisms.

Most of the proposed driving range and holes 1,8, and 9 drain via sheet flow toward the highway, i.e. demonstrate no significant potential to drain to the gulches and ultimately to the ocean (based on the 3/18/92 routing plan). In addition, the runoff from most or parts of holes 11, 12, 13, and 14 would have to travel more than 750 ft just to reach a minor gulch that forms the northern property boundary. The areas described in this paragraph were not modeled for runoff to the ocean, but all other areas of managed turf were modeled.

The importance of protecting the shoreline water quality was noted above. This is because fishing is an important part of the quality of life in Hana. Some of the more popular fish seem to be Ulua (jack fish), Kole (yelloweyed surgeonfish), Palani (Hawaiian surgeonfish), Manini (convict tangs), Ahole (Hawaiian flagtail), and Moi (threadpin). Recreational and subsistence fishing has been part of the Hana lifestyle for centuries. Therefore, it is important that turf management practices not impact nearshore water quality.

An examination of the shoreline by the ETS Study director near low tide did not reveal the presence of ground water seeps draining to the ocean. However, the office of Hawaiian Affairs stated in a November 1, 1991, letter to the Maui Planning Department that "...springs that develop from these subterranean flows can be seen at low tide in the ocean fronting the proposed golf course area." It is possible the seeps were not noted by ETS because of the period of abnormally dry weather that preceded the March site visit.

Further, there is likely a significant amount of ground water flux to the coastline -- possibly 1 million gallons per day per mile of coastline or more -- that discharges beneath the ocean's surface. Therefore this potentially significant exposure pathway was included as part of the risk assessment.

C. Evaluation of Pesticide Properties Relevant to Potential Risks

This section contains descriptions and evaluations of the environmental chemistry and toxicity of the pesticides and fertilizers identified in Section VI (Management Plan) above. Key characteristics of all chemicals are listed in Table 19 at the end of this section.

1. Definition of Terms

The following technical terms are used frequently in this section and are defined in the Glossary at the end of the report: half-life ($t_{1/2}$), K_d (soil/water distribution coefficient), K_{oc} (the K_d for organic carbon in soil), ADI (acceptable daily intake), Q^* (carcinogenic potency factor), HAL (drinking water Health Advisory Level), and LC50 and EC50 (toxicity measures for aquatic organisms). It is important for the reader to review these definitions before proceding further.

2. Risk Assessment Principles

A risk assessment is a process that either measures or estimates the probability of harm. This is done by quantifying exposure to particular substances as well as their toxicity to humans and/or other organisms. Thus it can be said that the dose makes the poison i.e. neither toxicity alone nor exposure alone determines whether a pesticide would

cause harm to the environment, rather, the two must be combined.

Thus in this report we evaluate the human and aquatic toxicity of the pesticides, and assess the exposure potential by using computer simulation modeling of the chemicals most likely to pose a problem. But predictions of pesticide concentrations in ground water and surface water may not have a very high degree of accuracy. Therefore an uncertainty analysis is also done, for the ground water assessment and worst case analysis is done for the golf course assessment. Those results are compared with action levels/advisory limits for pesticides in water.

Following are some important concepts that apply specifically to the risk assessment for aquatic organisms. The glossary contains some other important concepts relevant to aquatic toxicity, environmental fate, and human risk assessment.

Relative Aquatic Toxicity - Listed below are five toxicity classifications that EPA uses to qualitatively describe certain ranges of aquatic toxicity (Craven, Sept. 1990) based on the LC50 or EC50 of each pesticide. For example, a pesticide with an LC50 < 0.1 ppm is considered very highly toxic. These classifications are used in this report only to make generic assumptions about how these pesticides may impact organisms of concern in the ocean, and to help determine the highest priority candidates for computer simulation modeling.

Aquatic Toxicity Categories Based on Pesticide Toxicity Data

Category		LC_{50} or EC50
Very highly toxic	=	<0.1 ppm
Highly toxic	=	0.1 ppm to 1.0 ppm
Moderately toxic	=	1.0 ppm to 10.0 ppm
Slightly toxic	=	10.0 ppm to 100.0 ppm
Practically non toxic	=	>100.0 ppm

Presumption of No Aquatic Risk - There is a presumption of no aquatic risk if the estimated environmental concentration (EEC) is less than 1/10th of the LC50 or EC50 of the most sensitive organisms (EPA-OPP/HED, 1986). Also, the same presumption applies to EPA water quality criteria, if they exist.

Availability and Significance of Aquatic Toxicity Data - The United States Environmental Protection Agency (EPA) and the United States Fish and Wildlife Service (FWS) have both compiled and published extensive data bases of acute toxicity of chemicals to aquatic organisms (Johnson and Finley, 1980; Mayer and Ellersieck, 1986; and Mayer, 1987). As extensive as they are, there are many organisms and chemicals not evaluated. Indeed it would be an enormous and very expensive task to do so. The available data are generally provided for certain indicator species, as recommended by the EPA Office of Pesticides Programs guidance document: "Hazard Evaluation Division Standard Evaluation Procedure, Ecological Risk Assessment." These indicator species are selected based on criteria such as demonstrated sensitivities to toxic chemicals and ecological significance in widespread habitats (EPA-OPP/HED, 1986). These data allow for assumptions and extrapolations to be made in assessing risk of chemicals to other organisms (Mayer, April 1987).

Analyses of the acute toxicity data indicate that there are correlations for toxicity to aquatic organisms and that

toxicity of chemicals to one species could be predicted from toxicity to another species (Mayer and Ellersieck, 1986; Mayer, et al., 1987). Correlations are best within the same families of fishes. Variations are expected to within an order of magnitude (Mayer, 1991). For example, interspecies correlation coefficients for acute static test values with coho salmon and rainbow trout, bluegill, and channel catfish are 0.96, 0.96, and 0.74, respectively. Interspecies correlations between chinook salmon and rainbow trout, bluegill and channel catfish are 0.98, 0.99 and 0.79, respectively (Mayer, et al., 1987).

There are also good correlations among invertebrates of the same families (Mayer, et al., 1987). This is not to say that each species would be equally sensitive to a particular chemical, but a range of sensitivities can be determined and the estimated environmental concentrations can be compared with at least the low end of the sensitivities for species more taxonomically distant from the test species and compared more closely to the test values for species within the same family.

3. Summary of Pesticide Chemistry & Toxicity

The environmental fate, aquatic toxicity, and human toxicity of 14 pesticides described in the Management Plan (Section V) were evaluated. (The two organic-based products, potassium salts of fatty acids (pesticidal soaps) and *Bacillus thuringiensis* were not evaluated due to their inherent safety.) The principles for evaluation of environmental fate were described in part by Cohen, et al. (1984). The principles for human toxicity evaluation were described in part in the "Definition of Terms" and "Risk Assessment Principles" sections above and the Glossary section at the end of the report.

The evaluations of all pesticides are summarized in Table 19 at the end of this section and in the following discussions for the modeled pesticides only. Not all of the dozens of references consulted are listed. However, the reader is referred to the following key references for information on the chemicals. Additional specific references are provided in the text.

- Willis and McDowell, 1987
- Davis, et al., 1990
- EPA, 1989
- all EPA Chemical Fact Sheets listed
- EPA/OPP "One Liners" (Environmental Fate & Ground Water Branch 1-3 page review summaries)
- FCH, 1991
- Green and Karickhoff, 1985
- Jury, et al., 1987
- Rao & Davidson, 1980
- SRC (data base)
- USDA, SCS ,1988
- WSSA, 1989

a. Herbicides

Dithiopyr

Dithiopyr is a selective pre-emergent and post-emergent herbicide. It has a complex structure that can be loosely classified as a sulfur-substituted pyridine ester.

Mobility. Its water solubility at 20° C is 1.38 ppm (EPA, 1991). This yields a calculated K_{oc} of 3,600, based on the Kenaga and Goring equation (1980). Therefore, it is not very mobile in soil.

Persistence. Dithiopyr's soil half life ($t_{½}$) varies between 17 and 61 days (EPA 1991), although Monsanto's technical literature states that the average $t_{½}$ is 17 days. The logarithmic mean of 17 and 61 days is 32 days.

Aquatic Toxicity. Based on EPA's NPIRS database, dithiopyr is characterized as highly toxic to vertebrate organisms, with LC50 values for the bluegill sunfish and rainbow trout of 0.47 mg/l and 0.46 mg/l, respectively. Dithiopyr is considered to be very highly toxic to fresh water invertebrates having a 48- hr LC50 of 5.6 mg/l (EPA, 1991).

Human Toxicity. Its Acceptable Daily Intake (ADI) is 0.0035 mg/kg/day, based on a two-year mouse study (Heydens, 1992) This yields a drinking water Health Advisory Level (HAL) of 122 parts per billion (ppb; micrograms per liter 1985). The K_{oc} is 95 (Davis, et al., 1990) indicating that this chemical is mobile in soil and may leach or runoff in the aqueous phase.

Metribuzin

Metribuzin is an herbicide of the triazine family that controls a large number of grass and broadleaf weeds (FCH, 1991).

Mobility. Its water solubility at 20°C is 1200 ppm (EPA, June 1985). The K_{oc} is 95 (Davis, et al., 1990) indicating that this chemical is mobile in soil and may leach or runoff in the aqueous phase.

Persistence. The soil half life is 24 days (Davis, et al., 1990) indicating a moderate persistence.

Aquatic Toxicity. According to EPA's NPIRS database, metribuzin is characterized as slightly toxic to moderately toxic to aquatic organisms. Metribuzin's LC50 values for rainbow trout and bluegill were 76.78 ppm and 75.96 ppm, respectively. The LC50 for marine/estuarine shrimp was 48.3 ppm. It is somewhat more toxic to freshwater invertebrates with an LC50 value of 4.18 ppm (EPA, June 1985).

Human Toxicity. The EPA Office of Drinking Water has established an HAL of 200 ppb based on the RFD of 0.025 mg/kg/day (EPA, 1989).

Oryzalin

Oryzalin is a selective pre-emergent herbicide. It is a dinitroaniline/sulfanilamide compound.

Mobility. Oryzalin is not very mobile in soil. Its water solubility is 2.5 ppm. Its measured K_{oc} is 600 (Dow-Elanco data), compared with a calculated value of 2630.

Persistence. The soil $t_{½}$ varies between 75 days and 158 days. (Dow-Elanco data).

Aquatic Toxicity. Bluegill sunfish and rainbow trout LC50 values of 2.88 mg/l and 3.26 mg/l, respectively, suggest that oryzalin is moderately toxic to fish (WSSA, 1989). There are no data available to indicate toxicity for invertebrate organisms.

Human Toxicity. EPA has determined a provisional ADI of 0.013 mg/kg/day, based on a NOEL (no observable effect level) of 12.5 mg/kg/day and a safety factor of 1,000. An HAL of 46 ppb can be calculated by using an additional 10-fold safety

factor due to the fact that oryzalin is a Category C oncogen (suspected human carcinogen).

b. Insecticides

Chlorpyrifos

Chlorpyrifos is an organophosphate insecticide.

Mobility. Its water solubility is 2 ppm at 25°C and its K_{oc} is 9,000. Therefore it is not mobile and probably not likely to leach or runoff into the aqueous phase.

Persistence. Its soil half life was determined to be 36 days indicating that it is moderately persistent.

Aquatic Toxicity. Ninty-six-hour EC50 values for the Brown shrimp and Pink shrimp (both *Penaeid* shrimp) resulting in immobility are 0.20 μg/l and 2.4 μg/l respectively. The 48-hour EC50 for the Blue crab is 5.2 μg/l (Mayer, 1987). These values would indicate that chlorpyrifos is very highly toxic to these particular marine and estuarine invertebrates.

The 96-hour LC50 values for marine/estuarine fish range from 240 μg/l - 300 μg/l for the sheepshead minnow and from 2.6 μg/l - 6.9 μg/l for the longnose killifish. The 48-hour LC50 for the saltwater fish spot is 7.0 μg/l (Mayer, 1987). These values indicate that chlorpyrifos is also very highly toxic to marine and estuarine fish.

Ninty-six-hour EC50 values resulting in reduced growth for three saltwater algae species range from 120 μg/l - 340 μg/l. These species are not in the same division as the proposed aquaculture species, it is not unreasonable to consider that chlorpyrifos may be highly toxic to most of the marine algae.

The U.S. EPA has established an ambient water quality criteria standard (WQC) for chlorpyrifos in both freshwater and marine environments. The WQC recommendation is considered to be protective of 95% of the aquatic organisms. For marine environment, the chronic WQC is 0.0056 $\mu g/l$. This is the average 96-hour concentration that should not be exceeded more than once every three years. The acute WQC is 0.011 $\mu g/l$ representing the average 1-hr concentration not to be exceeded once every three years (Sabock, 1990).

Human Toxicity. Its RfD is $3x10^{-3}$ mg/kg/day, which yields a HAL of 105 ppb.

Fluvalinate

Fluvalinate is a foliar-applied insecticide which is a member of the sythetic pyrethroid chemical family.

Mobility. Its water solubility is 2 ppb and has a K_{oc} value of 130,000. It has a very small chance of leaching in the soil, however, major soil metabolites may occur in some soils (EPA, 1986).

Persistence. At environmental pH values fluvalinate did not hydrolyze in 30 days. Photodegradation renders a half-life of 0.6-1.0 day in water, but the half-life is 50 days in soil (Wauchope, 1988; Staiger and Quistad, 1983). Aerobic metabolism causes degradation in 4-8 days in sandy soils, while 15 days are necessary in anaerobic conditions (EPA, 1986).

Aquatic Toxicity. Fluvalinate is highly toxic to some aquatic organisms. Bluegill sunfish and rainbow trout have 96-hr LC50 levels of 0.09 and 2.9 mg/l, respectively. Invertebrates, *Daphnia magna* and mysid shrimps have 48-hour LC50 levels of 74 and 2.9 ppm, respectively (EPA, 1986).

Human Toxicity. Fluvalinate is not carcinogenic, mutogenic, or teratogenic, but fetotoxicity was noted at 50 mg/kg in rats and rabbits (EPA, 1986). No ADI was provided, but an ADI of 0.5 mg/kg/day may be inferred from the studies summarized above. If so, then a Health Advisory Level of 3,500 ppb may be calculated, after allowance is made for potential food residues.

c. Fungicide

Fenarimol

Fenarimol is a foliar-applied fungicide. It is a substituted pyrimidine.

Mobility. Its water solubility is 14 ppm (EPA-One Liner) The K_d was measured in four soil types (Saunders and Powell, 1989). A K_{oc} of 716 ± 184 can be calculated from the data. Fenarimol is immobile in soils and therefore, will probably not leach deeper than 12 cm into the soil (EPA, 1985).

Persistence. According to the EPA's Fact Sheet (1985) on fenarimol, it does not degrade in aerobic or anaerobic soil conditions in a 30-day period. However, an Elano study in Florida found a $t_{1/2}$ of 14 weeks (Hoefer, 1988). It is degraded by photolysis and has a half-life of approximately 12 hours.

Aquatic Toxicity. Fenarimol is moderately to highly toxic to fish and daphnids. Ninty-six-hour LC_{50} values for bluegill sunfish, rainbow trout, and *Daphnia magna* are 0.9, 2.1, and 6.8 ppm, respectively.

Human Toxicity. The ADI of fenarimol is 0.6 mg/kg/day, which yields a HAL of 41,000 ppb, after allowance for potential food residues. EPA has classified fenarimol into carcinogenicity category D/E, which means there is evidence that it is not carcinogenic, but more data are required.

Iprodione

Iprodione is a soil or foliar applied fungicide. It is in the same chemical and use class as vinclozolin.

Mobility. Its water solubility is 13 ppm (EPA One-Liner) and its K_{oc} is 1064 based on the Kenaga and Goring equation (1980). Therefore it has only marginal potential for leaching.

Persistence. Soil dissipation data are available from five soils in the EPA one-Liner and six experiments on two soils in Walker (1987). The mean of the results, including two soils where enhanced degradation was detected after the first application, was 26 ± 17 days. Hydrolysis $t_{½}$ data at pH 6 and 9 were obtained from EPA's One Liner. They were plotted as ln k vs pH and a hydrolysis $t_{½}$ of 7 days was extrapolated for neutral pH, pH 7.

Aquatic Toxicity. Iprodione is moderately toxic to fish. Rainbow trout have an LC50 of 6.7 ppb and bluegill sunfish have an LC50 of 2.25 ppb (FCH, 1991). There are no invertebrate data for iprodione.

Human Toxicity. Iprodione has a very good toxicity data base. The RFD (ADI) is 0.04 mg/kg/day, which yields a lifetime drinking water Health Advisory Level of 280 ppb, after allowance is made for potential food residues.

Copper Hydroxide

Copper hydroxide is a foliar-applied fungicide. Copper is almost ubiquitous in nature. Concentrations of 1-10 parts per billion (ppb) occur typically in unpolluted surface water in the U.S. (EPA, 1985). Soil concentrations typically range between 2 and 100 parts per million (ppm). It is a minor nutrient at low concentrations for plants and animals (EPA, 1995).

Mobility. Copper ion had very low mobility in a Molokai clay soil (Dragun, 1988). One might reasonably conclude that copper also has extremely low water solubility. That is true under certain conditions of pH (acid/base) and oxidation/reduction (high or low amounts of oxygen and similar species). But under the conditions expected at the Hana site, water solubility may be moderate (even though the soil binding potential is high). The solubility product pK_{sp} of cupric hydroxide ($Cu(OH)_2$; copper hydroxide) is 18.30. One can calculate a water solubility of 320 ppm, if one assumes slightly acidic conditions (pH = 6). Therefore, copper is expected to be immobile in Hana soils, but moderately mobile in the aqueous phase, a e.g. in a runoff event immediately following application.

Persistence. Copper does not degrade in the manner of organic chemicals. It is mostly chemically fixed in soils, particularly clays. Some is taken up by plants, and a small amount may be volatilized (following, perhaps, reduction biotically or abiotically to the metallic form).

<u>Aquatic Toxicity</u>. EPA has promulgated a water quality criteria for copper (EPA, 1985). The toxicity standard varies with water hardness. Based on standard assumptions about seawater, the one-hour criteria for marine organisms is 2.9 ppb.

<u>Human Toxicity</u>. The lifetime drinking water Health Advisory Level is 1,300 ppb, and is scheduled to be implemented as a standard December 1992 (40 CFR, Section 141.80).

4. <u>Chemical Ranking--Selection of Pesticides for Computer Simulation Modeling</u>

Computer simulation modeling of pesticides running off to surface water and leaching to ground water is a time-and data-intensive process. It would be impractical to model every pesticide and metabolite listed in Table 19. Yet it is a necessary step for conducting a quantitative risk assessment. Thus an evaluation had to be done to flag the chemicals with the greatest probability of traveling offsite at concentrations of concern to humans or aquatic organisms. The pesticides with higher risk potential than others contained in the IGCMP became candidates for intensive computer simulation modeling.

Although it would usually be acceptable to flag these chemicals based solely on a subjective evaluation of the data presented previously in this section, it was decided to apply a more rigorous ranking scheme that was developed by ETS previously. The scheme presented below provides a logical and understandable process for selecting chemicals for modeling.

Two separate but related ranking schemes were developed -- one for surface runoff and the other for ground water

Table 19. Summary of Environmental Fate & Toxicity of Pesticides

			Mobility		Persistence (days)		Toxicity		
								Aquatic**	
Pesticide*	Projected Use - Annual - (lb ai/Ac)	Use Area (Acre)	Water Sol'y (ppm)	K_{oc}	Soil $t_{1/2}$	Water $t_{1/2}$	Human HAL (ppb)	Fish	Invrt
Dithiopyr (H)	0.5	40	1.38	3,600	32	1000†	122	h	vh
Glyphosate (H)	5.0 oz	10	12,000	2,640	10	346†	350	m/s	m/s
Imazaquin (H)	0.51	40	60	460	60	165†	8,750	pn	pn
Isoxaben (H)	1.0	64	1.0	4,400	71	45	1,750	m	m
Metribuzin (H)	0.75	16	1,200	95	24	346†	200	s	s/m
MSMA (H)	2.0	16	57,000	300,000	90†	346†	700	s/m	m
Oryzalin (H)	1.5	40	2.5	600	75	0.5	46*	m	h
Chlorpyrifos (I)	1.0	10	2	9,000	36	36	105	h/vh	vh
Fluvalinate (I)	0.16	10	0.002	133,000	15	180†	3,500*	vh	vh
B. thuringiensis (I)	0.75	30							
Potassium salts of Fatty Acids (I)	1.35	30							
Copper Hydroxide (F)	16.77	12	320*	100,000*					
Fenarimol (F)	2.72	12	14	716	98	42	4,100	m/h	m
Fosetyl-Al (F)	17.42	12	120,000	310	<1	180†	10,000	pn	pn/m
Iprodione (F)	2.72	12	13	1,064	26	7	280*	m	
Thiophanate methyl (F)	2.72	12	3.5	1,000	1		560*	m/vh	m

* H=herbicide, I=insecticide, F=fungicide, M=metabolite. Environmental fate data not provided for Bacillus thuringiensis and fatty acids due to inherent environment safety.
* HALs for these chemicals have been multiplied by 0.2 as an additional safety factor to allow for the possibility of significant food tolerances and/or dietary residues.
** P=practically nontoxic, S=slightly toxic, m=moderately toxic, h=highly toxic, vh=very highly toxic. Quantitative definitions in the text.
† Conservative estimate
* A copper water solubility of 320 ppm was calculated for pH=6 (approximate pH of the soils). Also, the term Koc is relatively meaningless for a metal, but this estimated value of 100,000 reflects a strong binding potential.

contamination potential. The basic ideas behind the schemes are the same--rank each pesticide and/or metabolite according to the relevant parameters listed in Tables 18 and 19, sum the individual ranks, and select for modeling the chemicals with the highest total ranks.

Following are the details of the ground water and surface runoff chemical selection/ranking process.

a. Ground Water

The chemicals were evaluated according to their ground water contamination potential, the reasonable worst case application scenario (poundage), and Health Advisory Levels (HALs) for drinking water consumption. The algorithm for ground water contamination potential was the Ground Water Ubiquity Score or GUS Index, a semi-quantitative ranking tool based on K_{oc} and soil degradation half-life (Gustafson, 1990):

$$GUS = \log (t1/2) \times (4 - \log K_{oc}).$$

GUS scores typically range between 0 and 4, with higher scores indicating higher ground water contamination potential.

Table 20 contains the results of the ranking scheme.

The following chemicals were selected for PRZM-VADOFT modeling of chemical transport to ground water, based on the results of Table 20.

Greens Modeling
iprodione (Fungicide)
fluvalinate (Insecticide)
fenarimol (F)

Table 20. Ranking Chemicals for Unsaturated Zone Modeling (Leaching)

Chemical	Ranks			
	Gus Index	Pounds	HAL	Overall
dithiopyr	6	10	4	5
glyphosate	8	12	8	11
imazaquin(Image)	3	14	11	11
isoxaben(Gallery)	7	7	10	9
metribuzin	2	9	5	3
MSMA	14	8	8	14
oryzalin	4	3	1	1
fluvalinate	12	13	2	10
chlorpyrifos	9	10	3	7
copper hydroxide	13	2	14	13
fenarimol	1	4	13	4
fosetyl-AL	10	1	12	8
ipriodione	5	4	6	2
thiophanate methyl	10	4	7	6

Fairways Modeling
oryzalin (Herbicide)
metribuzin (H)
fluvalinate (I)

Note that the fluvalinate had a fairly low rank. But it is highly toxic to aquatic organisms and was selected to evaluate its potential to leach to ground water, migrate to the shoreline, and threaten marine organisms.

b. Surface Runoff

The pesticides were evaluated according to their aquatic toxicity, poundage, HALs, K_{oc}, and timing of applications relative to months with heavy rainfall. Persistence was not used as a ranking criterion, due to our worst case assumption that significant rainfall events occur within one or two days of application.

Consideration of toxicity to aquatic organisms is generally of greater concern in runoff assessments than toxicity to humans. Therefore, aquatic toxicity was given twice the weight of human toxicity. This was done by ranking aquatic invertebrate and vertebrate toxicity separately, in addition to HALs. Pesticides scheduled for applications in the months of January, December, March, and November were ranked higher for timing than those applied during the drier months of September and June, for example. (Averages were computed for applications made during several times of the year.)

Table 21 contains the results of the surface runoff ranking scheme.

Table 21. Ranking Chemicals for Runoff Modeling

Chemical*	Ranks						
	K_{oc}	Pounds	HAL	Timing	Aq-Vert	Aq-Invrt	Total
dithiopyr	9	10	4	1	3	1	1
glyphosate	8	12	8	13	6	6	12
imazaquin	3	14	11	13	9	9	13
isoxaben	10	7	10	6	5	5	9
metribuzin	1	2	5	13	7	6	6
MSMA	14	14	8	12	6	5	13
oryzalin	5	4	1	10	5	3	1
fluvalinate	13	12	2	7	1	1	8
chlorpyrifos	11	9	3	7	2	1	5
copper hydroxide	12	13	14	2	1	1	10
fenarimol	6	1	13	3	4	5	4
fosetyl-AL	2	10	12	11	9	7	11
ipriodione	4	5	6	3	5	5	1
thiophanate methyl	7	10	7	3	3	5	7

*The metabolites ETU and DDVP were not ranked due to the fact that modeling of storm events assumed rains began 1-2 days after the parent chemicals--mancozeb and trichlorfon, respectively--were applied. Thus there would not likely be time for transformation to metabolites.

The following pesticides were selected for SWRRBWQ modeling of runoff to surface water, based on the results of Table 21.

- dithiopyr (H)
- iprodione (F)
- fenarimol (F)
- chlorpyrifos (I)
- copper hydroxide (F)

Note that fluvalinate, chlorpyrifos, and copper hydroxide were moved ahead of oryzalin due to their high aquatic toxicity.

D. Computer Modeling of Pesticide Transport to Ground Water Using PRZM2 (PRZM-VADOFT)

1. Pesticide Transport Modeling

In order to attempt to assess the risk of potential contamination of ground water from the use of turf chemicals on the proposed Hana golf course, it is essential to try to forecast the migration of those chemicals from the area(s) of application. This is the most scientific and logical approach that can be taken for a proposed development project such as the Hana golf course, since monitoring for potential environmental contamination is not possible. Our approach to making conservative predictions of expected environmental concentrations of turf chemicals is to employ the use of sophisticated computer models that incorporate site-specific data and chemical-specific data to simulate the transport of chemicals overland in runoff and through the soils in leaching water.

a. Model Selection

The discussion above in part B of this section shows that there are three significant pathways for contamination to sensitive receptors. One is through the leaching of chemicals vertically through the turf application area down to ground water, horizontal translocation of the leached chemicals to the ocean runoff, and the gulches.

Because ground water is one of the primary routes of exposure, we have selected an EPA model that links the Pesticide Root Zone Model (PRZM) (Carsel, et al., 1984) with an unsaturated zone flow and transport model called VADOFT. This model link is a recent accomplishment of EPA's Center for Exposure Assessment Modeling (CEAM) in Athens, Georgia, and is referred to as PRZM2 (representing PRZM version 2). It was developed within the scope of a project referred to as RUSTIC -- Risk of Unsaturated/Saturated Transport and Transformation of Chemical Concentrations (Dean, et al., 1989; Dean, et al., 1989b).

b. Modeling Description

The following descriptions of PRZM and VADOFT are adapted from Dean, et al. (1989) and Dean, et al. (1989b).

PRZM

The Pesticide Root Zone Model (PRZM) is a one dimensional, compartmental, numerical solution model that performs computations to simulate the fate and transport of pesticides within and just below the root zone. It also provides for calculation of erosion loss in surface runoff, however, runoff was not simulated with PRZM (see part F in this section). The PRZM model has two major components:

hydrology and chemical transport. These components will be described in some detail in the following paragraphs. Two input files are required to run PRZM, a meteorological file and the PRZM parameter file. Information for both of these files are found below in the Input Parameters description.

The hydrology component considers both horizontal movement across the soil surface and vertical movement of water into the soil. Vertical water movement through the root zone is simulated using general soil characteristics. These include field capacity, wilting point, and saturation water content. Irrigation may also be simulated. Water is "applied" when soil moisture falls below specified conditions.

The pesticide transport component takes into account the location of application (i.e. foliar, incorporated). Pesticide concentrations are estimated for the dissolved, adsorbed, and vapor phases. These concentrations are simulated simultaneously considering the processes of plant uptake, surface runoff (when used) and erosion, decay, volatilization, foliar washoff, advection, dispersion, and retardation. The output can be specified for a daily, monthly, or annual time step. The water flux and chemical concentrations are passed along daily to the Vadose Zone Flow and Transport Model (VADOFT).

VADOFT

The Vadose Zone Flow and Transport Model (VADOFT) is a one dimensional, single phase, finite-element model that simulates movement of water and transport of chemicals through the unsaturated zone (also referred to as the vadose zone). The Galerkin finite-element technique is used for the flow and transport equations. Water flow is governed by Darcy's law and dispersive/diffusive chemical transport is governed by

Fick's law. Transport processes taken into account in the VADOFT model include hydrodynamic dispersion, advection, linear equilibrium sorption, and first order decay. Recharge and pesticide mass are output on the same time step selected for the PRZM model (such as monthly, weakly or daily).

c. <u>Input Parameters</u>

PRZM

The first file contains meteorological data for the simulation. Weather data required are daily precipitation and mean daily temperature. Evaporation data can be input into this file or simulated by the model based on the daily temperature data. Daily wind speed and daily solar radiation data are required if volatilization simulation is desired.

There are no evaporation data for any significant period of record for any nearby locations at similar elevations to the site. Evaporation was thus simulated by PRZM using the daily temperature record. Daily wind speed and solar radiation were not input into this scenario. The net effect of this is that the volatilization of the pesticides simulated would be underestimated.

The second file contains PRZM model parameters. These parameters describe the site specific hydrology, soil, crop (turf in this case), and pesticides. Two scenarios were modeled for the proposed Hana golf course: greens and fairways. Certain soil and pesticide specific parameters differed between the two scenarios. One scenario was set up to simulate pesticide applications to the golf greens. The selection of soil parameters for this scenario was based in part on the assumption that the greens would be constructed according to USGA greens specifications. Figure 5 is a conceptual model of the greens scenario that illustrates infiltrating water will pass through the thatch layer, the root zone of the green, the soil underlying the root zone, and then divert to a rough or out-of-play area to once again pass through a thatch layer, root zone, soil below the root zone, and then through the vadose zone. This obviously is a simplified illustrative description of the flow and does not describe the many different processes that are simulated in the PRZM model. The second scenario was designed to simulate the application of pesticides to the fairways. Figure 6 shows the conceptual model of the flow of water for the fairway scenario through the thatch layer, the root zone of the fairway and the soil underlying the root zone before it passes into the vadose zone. The soil parameters for this scenario were based on the assumption that topsoil which presently exists on the site will be used. These two scenarios represent the most vulnerable areas on the golf course to leaching of pesticides from the area of application. The tee areas would be similar to the fairways except that an additional four inches of greensmix soil would be placed on top of the topsoil. (The tees and greens are managed similarly, therefore, tees are modeled with the greens scenario.) The roughs are not intensively maintained with turf chemicals like the other areas of the golf course and are therefore modeled with the fairways. A detailed listing of the most important PRZM input parameters and some of the lesser significant parameters is provided in Tables 22 and 23. (All of the input parameters can be provided upon request.)

VADOFT

The vadose zone is assumed to be relatively consistent across the project site with one exception. The depth of the vadose zone between the topsoil and the saturated zone varies

Figure 5. Conceptual Model of the Greens Scenario

Conceptual Model of the Greens Scenario

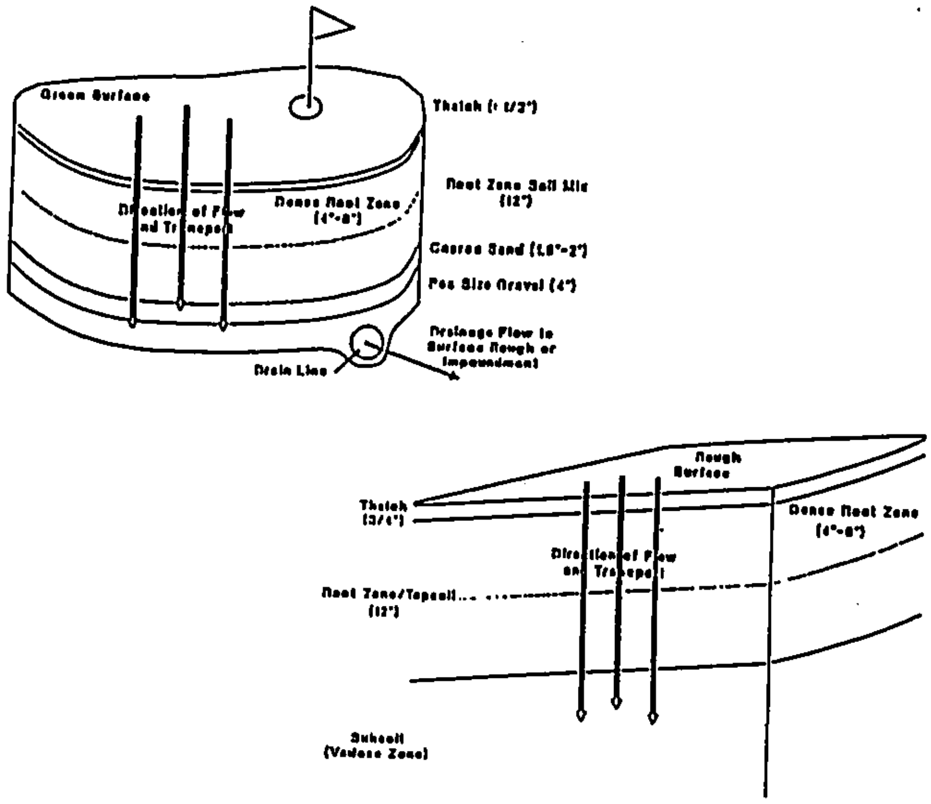
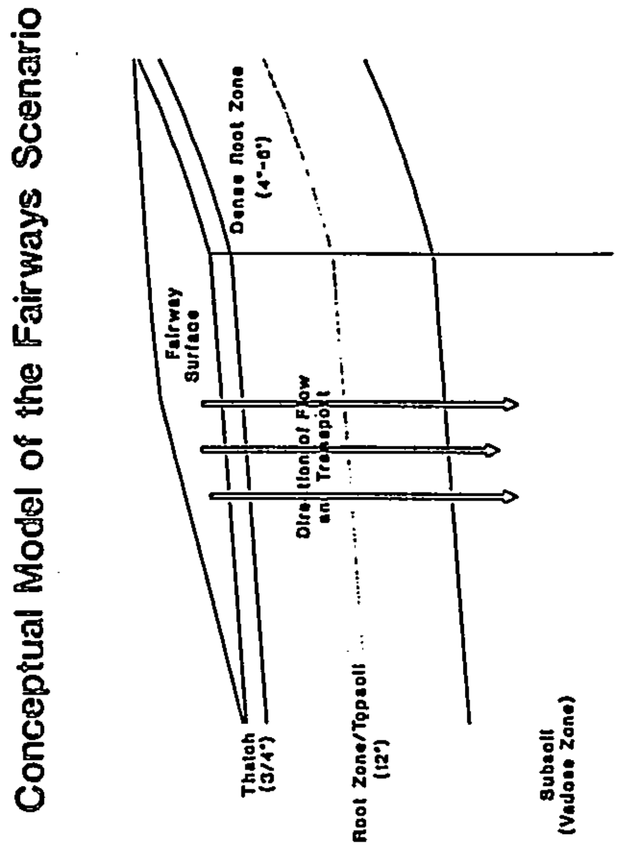


Figure 6. Conceptual Model of the Fairway Scenario



Conceptual Model of the Fairways Scenario

Table 22. PRZM Input Parameters for Hana Greens Scenario*

Control Parameters	
Modeling period	5 years
Time series	daily
Number of chemicals	3
Metabolites	none
Hydrology Parameters	
Pan Factor (estimates ET)	1.0
Min. depth to extract evap.	20.0 cm
Ave. dly hrs of daylight (per month)	11.4 10.8 12.4 12.6 13.6 13.3 13.7 13.3 12.2 12.0 11.2 11.3
Runoff curve no.	39 (hyd grp A soil-good cond) (USDA, SCS, 1986)
Area of plot	4.9 hectares (12 acres)
Active rooting depth	30.5 cm (includes 2 root zones)
Coverage of plant canopy	100%
Pesticide Parameters	
No. of applications	15
No. of diff. chemicals	3
Pesticide names/applications:	
iprodione	2 appls @ 3.05 kg/ha/appl
fluvalinate	2 appls @ 0.179 kg/ha/appl
fenarimol	2 appls @ 3.05 kg/ha/appl
Depth of incorporation	0.0 cm
Pesticide washoff/cm of prcp	0.10 for all pesticides (Smith and Carsel 1984)
Foliar decay rate	0.0161 (all three chemicals)
Vapor-phase decay rate	0.0
Dissolved-phase decay rate	0.038-0.200
K_{oc}	see table 19
Diffusion in air coeff.	4300 cm^2 day^{-1}

Table 22. (cont'd)

Absorbed-Phase Decay Rate (Day^{-1})

	Hrzn 1	Hrzn 2	Hrzn 3	Hrzn 4	Hrzn 5	Hrzn 6	Hrzn 7
iprodione	0.027	0.027	0.009	0.009	0.027	0.027	0.009
fenarimol	0.007	0.007	0.0023	0.0023	0.007	0.007	0.0023
fluvalinate	0.087	0.087	0.029	0.029	0.087	0.087	0.029

Soil Parameters**

Total depth of core 66.5 cm
Number of horizons 3

	Thickness (cm)	Bulk density (g/cm^3)	Field Cap (cm^3/cm^3)	Wilting Pt (cm^3/cm^3)
Hrzn 1 (thatch)	1	0.224	0.250	0.030
Hrzn 2 (root zn1)	15	1.400	0.091	0.033
Hrzn 3 (below rz1)	15	1.400	0.091	0.033
Hrzn 4 (cs sd lyr)	4	1.500	0.018	0.007
Hrzn 5 (Rough Thatch)	1.5	0.224	0.250	0.030
Hrzn 6 (root zn2)	15	1.000	0.571	0.272
Hrzn 7 (below rz2)	15	1.000	0.592	0.272

* Unless otherwise noted, parameters were estimated from information provided in Dean, et al. (1989b).

** Except for field capacity and bulk density in horizon 6 and 7, soil parameters were estimated based on Dean, et al. (1989b) and Dixon (1991).

Table 23. PRZM Input Parameters for Hana Fairway Scenario*

Control Parameters	
Modeling	5 years
Time series	daily
Number of chemicals	3
Metabolites	none
Hydrology Parameters	
Pan Factor (estimates ET)	1.0
Min. depth to extract evap.	10.0 cm
Ave. dly hrs of daylight (per month)	11.4 10.8 12.4 12.6 13.6 13.3 13.7 13.3 12.2 12.0 11.2 11.3
Runoff curve no.	39 (hyd grp A soil-cond) (USDA, SCS, 1986)
Area of plot	43.3 hectares (107 acres)
Active rooting depth	17.0 cm
Coverage of plant canopy	100%
Pesticide Parameters	
No. of applications	10
No. of diff. chemicals	3
Pesticide names/applications:	
fluvalinate	2 appls @ 0.179 kg/ha/appl
metribuzin	2 appls @ 0.84 kg/ha/appl
oryzalin.	2 appls @ 1.68 kg/ha/appl
Depth of incorporation	0.0 cm
Pesticide washoff/cm of prcp	0.10 (for all pesticides) (Smith and Carsel, 1984)
Foliar decay rate	0.161-0.347
Vapor-phase decay rate	0.0
Dissolved-phase decay rate	0.002-0.0038
K_{oc}	see table 19
Diffusion in air coeff.	4300 cm^2 day^{-1}

Table 23 (cont'd)

<u>Adsorbed-Phase Decay Rate</u> (Day^{-1})

	Hrzn 1	Hrzn 2	Hrzn 3
fluvalinate	0.087	0.087	0.029
metribuzin	0.029	0.029	0.0097
oryzalin	0.006	0.006	0.002

<u>Soil Parameters</u>**

Total depth of core 31.5 cm
Number of horizons 3

	Thickness (cm)	Bulk density (g/cm^3)	Field Cap (cm^3/cm^3)	Wilting Pt (cm^3/cm^3)
Hrzn 1 (thatch)	1.5	.224	0.250	0.030
Hrzn 2 (root zn)	15	0.97	0.571	0.272
Hrzn 3 (below rz)	15	0.93	0.592	0.272

* Unless otherwise noted, parameters estimated from information provided in Dean, et al. (1989b).

** Except for field capacity and bulk density in horizons 2 and 3, soil parameters were estimated based on Dean, et al. (1989b) and Dixon (1991).

from about 195 ft above sea level to about 545 ft for the area proposed for the 18-hole golf course development. The vadose zone was divided into three sections for modeling: the soil beneath the root zone (3.6 ft), the clinker zone (14.9 ft) and part of the fractured basalt (36.7 ft). Only 36.7 ft of fractured basalt was modeled to accommodate the source code of the model; this provides for a conservative estimate of pesticide leaching. There are ash-soil zones which are interbedded in the subsurface, however, there is not enough data to model them appropriately. Figure 4 (above) illustrates the conceptual model of the vadose zone across the Hana project site.

Basically, three horizontal layers of materials will make up the unsaturated zone for the purpose of the model. The top layer (the substratum beneath the root zone) is roughly 4 ft deep consisting of clay. Although in some areas of the project site the soil can be a deep as 35 ft, only the major soil type was modeled (see Soils in part 1 of this section). The second layer is highly fractured basalt and clinker gravel. The third layer is less fractured and more consolidated rock that extends to ground water.

The PRZM and VADOFT models are linked together such that the water and chemical flux from PRZM will be read into VADOFT on a daily time step. The input parameters generally define the geometry of the flow region, the soil moisture properties of the different materials simulated (including Darcy's velocity, longitudinal dispersivity, and values for solving the van Genuchten model which specifies the relationship of relative permeability versus water saturation), and solute transport parameters (namely the decay coefficient for the simulated chemicals in water). Table 24 lists the important VADOFT input parameters for the Hana modeling exercise. The data for Darcy's velocity, effective porosity, saturated water

Table 24. VADOFT Input Parameters for Hana

Number of nodal points	222		
Number of diff. porous material	3		
Type of nonlinear iteration proc.	modified Newton-Raphson		
Head tolerance	1.0		
Number of layers (horizons)	3		

	Layer 1	Layer 2	Layer 3
# Finite element	37	114	70
Material #	1	2	3
Thickness(cm)	111	456	1120
Satur'd hydr. cond. (cm/day)	4.32	196	4600
Effective porosity	0.312	0.385	0.200
Longitudinal dispers. (cm)	11.1	45.6	112.0
Retardation coeff.	1.0	1.0	1.0
Molecular diff.	0.0	0.0	0.0
(values for ret. coef. and mol. diff. are for all chemicals simul'd)			
Residual water content (%)	.179	0.105	0.105
van Genuchten (n)*	-1.0	-1.0	-1.0
van Genuchten (α)*	0.008	0.145	0.145
van Genuchten (β)*	1.09	2.68	2.68
van Genuchten (γ)*	0.08	0.62	0.62
Default Darcy velocity	4.32	1.96	4600
Default water saturation (%)	0.312	0.385	0.200
Decay coeff. (day^{-1}) (for all chemicals simul'd, very conservative)	0.002	0.002	0.002

* van Genuchten equation values selected clay for layer 1 and sand values for layer 2 (there are no values for vesicular or fractured basalt; sand is the most porous material available in reference; Dean, et al., 1989).

content, and hydrodynamic dispersivity were obtained from Dean, et. al., (1989b) and Eyre (1991).

2. Quality Assurance

The information gained from modeling can only be as good as the data that are used to define the model. The accuracy and suitability of the data for each of the modeling scenarios for the proposed golf course at Hana were reviewed by several individuals with varied expertise. Some of the hydrology data were taken from a field study by Pacific Geotechnical Engineers, Inc., (PGE). PGE completed 3 soil borings and performed permeability tests at all three locations (Appendix F). Mean values for the soil and clinker zones were calculated and used as input parameters. The basal layer beneath the clinker was estimated from data obtained from Mink and Lau (1987). Other hydrogeology and hydrogeology related parameters were reviewed by the staff hydrogeologist (N.L. Barnes, ETS); with additional guidance from Paul Eyre, hydrogeologist, USGS, Honolulu, HI, who verified vertical hydraulic conductivity for fractured basalt in the Hawaiian islands. The Study Director, S. Cohen, verified two randomly chosen sets of parameters from beginning to end as a QC check. Those parameters were hydraulic conductivity and wilting point. In addition, fluvalinate was chosen as a QC check to verify pesticide input parameters (i.e. K_{oc} and degradation rates).

All environmental fate parameters checked out with the exception of K_{oc}. The Study Director, S. Cohen, determined that there would be no significant difference in the value used and that presented in Table 19, due to fluvalinate being tightly bound in the organic phase.

The hydraulic conductivity for the clinker zone and fractured basalt were verified from original source to the input sequence of the model. Wilting pint was confirmed from source (PRZM manual) to input sequence of the model and verified. However, Chuck Dixon, Vice President of Technical Operations of Turf Diagnostics and Design, said a lower value for Hawaiian soils may be more appropriate.

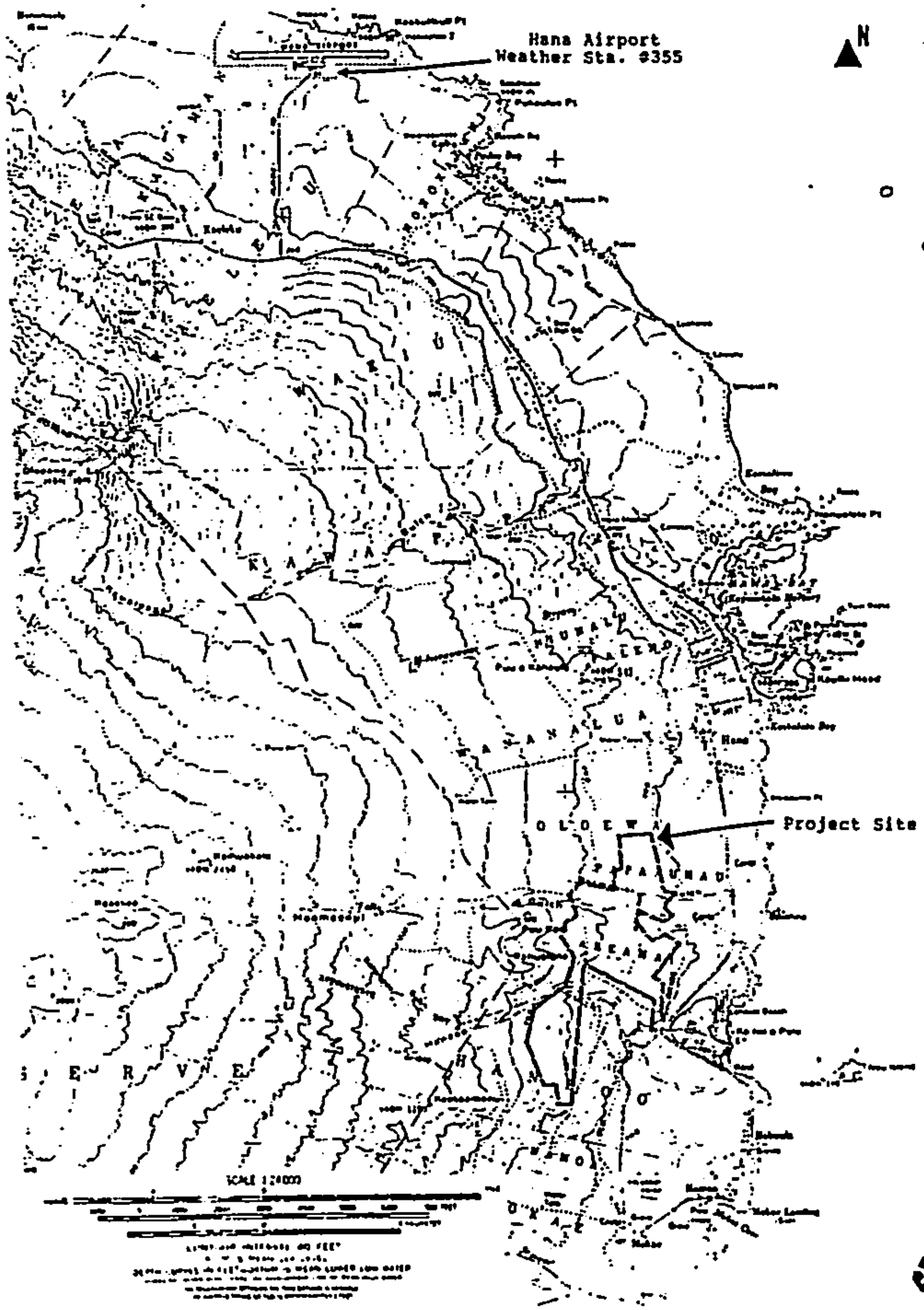
3. Conservative Assumptions

Water is the driving factor for PRZM and VADOFT. Initially, the most important input into the modeling scenario is the daily precipitation data record. There are 37 years of recorded climatological data for use in the simulation. Five years were chosen at random from 20 of the wettest years to insure that a conservative weather scenario was applied to the model. The data were obtained for the Hana Airport weather station #355 (Figure 7).

The conceptual model (Figure 5 above) for the greens scenario shows the flow path of water as it passes through the soil profile of the green to the drainage system. To simplify the modeling, the drainage system was not modeled.

The thickness of the vadose zone (between the root zone and ground water) varies from 195 ft (makai) to approximately 545 ft (mauka) for the area of the proposed golf course. The vadose zone was modeled to a depth of approximately 37 ft which represents only a small portion of the vadose zone at the proposed site. The range of the vadose zone is based on the elevations and the fact that ground water is at about 5 ft above sea level (based on the head at the Wananalua well). A one year degradation half-life was used in VADOFT below the root zone.

Figure 7. Weather Station Location Map



The top five ft of the aquifer was assumed to mix with the mass loss concentration. Using only the top five ft of the aquifer is a conservative estimate for potential ground water contamination from pesticide use.

Simulation of all of the volatilization processes was not conducted in this modeling exercise. Daily wind speed and solar radiation data would be required to run this simulation. These data are not readily available for the project site. The net result of this would be to underestimate volatilization loss of the pesticides.

A backwards-difference scheme was employed to solve the transport equations. This results in a "pulse" transport scenario between soil compartments which may tend to over predict chemical transport through the root zone. This scheme was chosen however to simulate the artificial perched water table that occurs in a golf green as a result of the difference in water tension between the soil and gravel at the interface. The infiltrating water accumulates at the interface until gravity forces overcome the greater capillary tension forces in the soil horizon. The water is then released in a pulse to the gravel drainage system.

4. Modeling Results

The PRZM-VADOFT model was run for five pesticides for two different environmental settings. Each simulation comprised a five year period and output was interpreted from yearly summaries of water outflow and pesticide mass outflow from the vadose zone. (Appendix G shows examples of selected output for PRZM2.) Table 25 summarizes the highest average daily pesticide losses in terms of mass for the worst case.

Table 25. PRZM-VADOFT Modeling Results**

Average Daily Pesticide Mass Loss (kg)

Pesticide	Greens, Tees, Practice (kg)	Fairways/Roughs (kg)	Total (kg)
Iprodione	$2.28 * 10^{-5}$	not applied	$2.28 * 10^{-5}$
Fenarimol	$1.61 * 10^{-3}$	not applied	$1.61 * 10^{-3}$
Fluvalinate	0	0	0
Metribuzin	not applied	$4.81 * 10^{-3}$	$4.81 * 10^{-3}$
Oryzalin	not applied	$1.62 * 10^{-2}$	$1.62 * 10^{-2}$

*Highest worse case daily pesticide mass loss(kg)

The tee and practice areas were figured into the calculations for the greens scenarios and the rough areas were included in the fairway scenario calculations. Greens, tees, and practice area applications account for approximately 4.9 hectares (12 acres) for the golf course.

Applications on fairways and roughs could account for up to 43.3 hectares (107 acres) of the golf course. There are 201 total acres (81.3 ha) for the golf course including buffers. The understanding is that pesticides are going to be applied conservatively (i.e. spot treatments) according to the management plan.

The acreage of the greens, tees, practice areas, fairways, and roughs were used to calculate pesticide mass losses, percolate water volume, and pesticide leachate concentrations. The VADOFT pesticide output is presented in kilograms per hectare (kg/ha) and water outflow in centimeters (cm). As an example, for calculating concentration metribuzin was selected. The highest worst case daily mass loss of metribuzin for the five year simulation was $7.4 * 10^{-4}$ kg/ha. The high year average daily water outflow from the vadose zone was 0.6 cm for the greens and tees simulations and 0.58 cm for the fairways and roughs simulations. Assuming the above acreage yields an average daily metribuzin mass loss of $4.81 * 10^{-3}$ kg (metribuzin is not applied to greens and tees), and a daily percolate water volume of $2.82 * 10^{6}$ liters. The leachate concentration equals the pesticide mass outflow divided by the water outflow: $4.81 * 10^{-3}$ kg ÷ $2.82 * 10^{6}$ liters = $1.71 * 10^{-9}$ kg/l (1.71 µg/l). This is a leachate concentration only and does not incorporate the ground water mixing volume.

5. Uncertainty Analysis of the Pesticide Modeling Results

a. Background

Modeling the environmental fate of organic compounds is a complicated process that must consider the uncertainties in the modeled system. There are three types of uncertainties: model uncertainty, pesticide parameter uncertainty, and environmental parameter uncertainty. Hopefully, model uncertainty is not an issue in this case due to the fact that a widely used EPA-supported and validated modeling system is being used. For example see the discussion in part 1 above, as well as Lorber and Offutt (1986).

Past experience indicates that the degradation rate constant(s) (k) is the most critical pesticide chemistry parameter for leaching assessments. This is because it occurs as an exponential function in the model algorithms. It also has a tendency to vary significantly depending on site conditions. Similarly, the soil-water distribution coefficient (K_d) or its soil organic carbon analog (K_{oc}) can significantly impact pesticide leaching assessments as well. For example, Loague, et al. (1990) demonstrated that uncertainties in K_{oc} and k can introduce significant uncertainties in the application of the Attenuation Factor (AF) model to Hawaiian soils. Boesten and van der Linden (1991) found that changing Kom (K_d divided by the organic matter fraction) by a factor of 2 changed the predicted mass of pesticide leachate by about a factor of 10. They also found that their model was sensitive to k (rate constant) at high values of Kom.

Spatial variability can be large or small depending on the environmental parameters. For example, Jury (1986) found little variability for bulk density but significant variance

in saturated soil hydraulic conductivity (Ks) for specific field sites. The latter environmental parameter is important for modeling water flow through soils. VADOFT modeling has shown that Ks and corresponding porosites are vital to the convergence of the model.

Therefore, it was decided to conduct an uncertainty analysis based on variance in the most critical input parameters: k, K_{oc}, and Ks.

b. Application to Hana

Research was conducted to determine expected standard deviations in the three critical parameters described above. A reference by Rao and Davidson (1980) is an excellent source of information for this issue. They critically reviewed the literature and obtained coefficients of variation (CV; [std. dev./mean] x 100) of rate constant (k) and K_{oc} values for 31 and 42 pesticides, respectively. These CVs were combined and it was found that the average CV for k was 73% and for K_{oc} it was 62%. Therefore these CVs were used for all soil degradation rate constants for all pesticides.

The CV of the saturated hydraulic conductivity (Ks) of the volcanic matter was estimated to be 200%. This value is the average of the CV's for all materials presented in Dean, et al. (1989b). This is more conservative than the average Ks that can be calculated from the data in Jury (1986) -- 119%.

This information was used to calculate 95% confidence limits as follows. The CVs were used to compute the standard deviation for each parameter, based on the mean values used in the modeling assessment above. The PRZM-VADOFT input parameters were then recomputed for the worst case scenario by adding or subtracting one standard deviation (SD) to each parameter as appropriate. Thus the worst case scenario was represented by k - SD, K_{oc} - SD, and Ks + SD. The best case scenario was assumed to be zero. The worst case/best case variance in a single parameter would normally be represented by two SDs (approximating the 95% confidence limit). But it was felt that there would be a very low probability that all three parameters would trend toward an extreme simultaneously. Thus the Hana PRZM-VADOFT scenario was completely rerun to generate a range of results that span the worst case.

The minimum predicted pesticide leachate mass was subtracted from the maximum mass to calculate the expected range of results for each pesticide. This range was divided by four to approximate the standard deviation in each pesticide leachate calculation. (It is a general rule of thumb that one can divide the expected range of results by 4 to 6 to obtain an approximation of the standard deviation (Parrish, 1991). The divisor 4 was used to be more conservative and to account for the fact that the parameter means plus or minus one SD was used as input rather than two SDs.) The final calculation was to add and subtract two standard deviations to the predicted mean pesticide leaching results -- this constitutes an approximation of the 95% confidence interval of each leaching estimate.

The results follow.

c. Uncertainty Analysis Results

Table 26 presents the 95% confidence intervals for all six pesticides and two metabolites for fairways/roughs and greens/tees scenarios. To represent more conservative values, an assumption was made that the aquifer would remain stagnant (no flow) for 30 days.

Table 26. Uncertainty Analysis Results - Pesticide Leachate Concentrations (30 days)

Pesticide	30 day Mass Loss (kg)	Standard Deviation	95% Confidence Int. Upper Limit		
	Worst Case		(kg)	(ug/l)	Human HAL(ppb)
Iprodione	$6.84 * 10^{-4}$	$1.71 * 10^{-4}$	$3.42 * 10^{-4}$	$1.03 * 10^{-3}$	1,400
Fenarimol	$4.83 * 10^{-2}$	$1.21 * 10^{-2}$	$2.42 * 10^{-2}$	$7.3 * 10^{-2}$	21,000
Fluvanlinate	-0-	-0-	-0-	-0-	70
Metribuzin	$1.44 * 10^{-1}$	$3.60 * 10^{-2}$	$7.20 * 10^{-2}$	$2.16 * 10^{-1}$	200
Oryzalin	$4.86 * 10^{-1}$	$1.22 * 10^{-1}$	$2.44 * 10^{-1}$	$7.34 * 10^{-1}$	46

These leachate masses are used to estimate off-site concentrations in ground water in part 6 below. The health and aquatic toxicity implications of these concentrations are also discussed.

6. Conservative Ground Water Dilution Calculations

This section describes the ground water dilution and transport model used to estimate pesticide concentrations migrating offsite.

Projected turf chemical leachate concentrations were generated using PRZM-VADOFT. The next task is to model horizontal transport of this leachate in the saturated zone (aquifer system).

It is assumed that the leachate will only mix in the top 5 ft of the basal lens. This is based on the premise that water would tend to follow preferential flow paths through rock fractures. (A 10 to 20 ft mixing zone would have been more appropriate for more porous homogeneous media such as a sand and gravel aquifer.) Thus the mixing volume would be a 5 ft slice of aquifer under approximately 201 acres of the proposed golf course. This is equivalent to 4.4×10^7 ft^3 (1 acre = 4.36×10^4 ft^2). But voids containing water probably only occupy 15% of the total volume. (The model would not converge with a 15% porosity for the basalt layer, therefore 20% porosity was input.) Thus the total mixing volume is assumed to be $0.20 \times 5.6 \times 10^7$ ft^3 $\times$ 28.32 l/ft^3 = 2.5×10^8 liters (250 million liters; 66 million gallons).

Approximating the pesticide concentrations in ground water is simple mathematics. The pesticide mass loss from the root zone in a given time period, is multiplied by its use area in hectares (acreage) for each specific pesticide then

divided by the sum of the total mixing volume plus the percolate volume from the golf course. The percolate volume is taken from the aquifer recharge amounts calculated by PRZM-VADOFT for greens and fairways. The pesticide mass loss from the root zone for each chemical was used to calculate concentrations in ground water under the golf course to determine pesticides concentrations under the site. The highest worst case concentrations of the 5-year data were used in the calculations. Table 26 (above) shows the results. The pesticides modeled do not show cause for concern if proper management is observed.

7. Impacts of Contaminated Ground Water at the Shoreline

With concentrations this low in the ground water, it is unnecessary to attempt to determine concentrations that might occur down gradient of the site or as a result of ground water extrusion to the open coastline. The additional dilution would further reduce the pesticide concentrations to infinitesimal values, far below concentrations that are action levels or criteria for aquatic organisms.

E. Assessment of Nutrient Transport to Ground Water in Leachate

The prime nutrient of concern for ground water contamination potential is nitrogen. Phosphorus tends to form insoluble complexes under certain conditions, and also binds to clays and organic matter. Therefore, it is not a threat to leach to ground water under normal turf management conditions. Potassium is mobile, but non-toxic. It is not usually a nutrient of concern in ecological assessments, including sensitive wetlands sites. Further, it is a significant food ingredient in electrolyte products such as Gatorade® and salt substitutes.

Nitrogen, however, can cause excessive topgrowth of vegetation, algal blooms, etc. Therefore it is necessary to predict nitrogen losses to the environment. However, there are no readily available, validated leaching models that can simulate the transformation and transport of nitrogen fertilizers. An approach was used in this assessment that differs from the approach used above for pesticides: average nitrogen (N) loss rates from the soil profile were estimated from test plot data published in the scientific literature, and the leached mass was mixed into ground water.

1. Literature Review

Petrovic (1990) recently reviewed the literature on nitrogen losses from turf. He evaluated N uptake by turf and loss in runoff, leachate, and volatilization. Data from approximately 40 papers were reviewed. He concluded that N leaching losses "... generally were far less than 10%."

Two of the papers cited by Petrovic were good multiple test plot studies of the fate of N in bermudagrass turf over permeable soils. This scenario is relevant to Hana, which would have bermudagrass turf over permeable soil (Section V, (IGCMP). Snyder, et al. (1981) studied turfgrass color, growth and N leaching in established plots of Tifgreen bermudagrass over Pompano sand (96% sand). The turf plots were in Florida and were irrigated daily, except during rainy periods. Suction lysimeters were installed to sample leachate, and eight different kinds of quick-release and slow-release N fertilizers were applied. Application rates were 20% below and 60% above normal. Average bi-monthly leachate was 31 cm (1.2 in), indicating a significant amount of rain plus irrigation. The nitrate-N concentration in the leachate averaged less than 5 ppm, and was typically less than 2 ppm. (The drinking water Maximum Contaminant Level is 10 ppm.)

More importantly for this assessment, the average loss of N in the leachate at the highest application rate was 2.6%.

Brown, et al. (1982) studied the fate of five different quick-release and slow-release forms of N in Tifdwarf bermudagrass greens. The soils consisted of different types of greens mixes, but generally had greater than 80% sand. The greens were located in Texas and were irrigated 1 cm/day (0.4 in/day), which was greater than evapotranspiration. N fertilizers were applied at 3-4 times normal rates, and up to 33 times the rates specified in Table 17 of the IGCMP. Therefore the percent N-loss calculations would be less relevant since the turfgrass system could be overloaded, causing greater leaching, particularly for water soluble N. For example, 65-70% of the N-fertilizer recommended in the IGCMP (section V.E.) is in the slow release form, which significantly reduces ground water contamination potential relative to quick release forms of N.

With these reservations, it is still possible to obtain some limited results relevant to Hana. IBDU is the N-source of more than half of the water insoluble (slow release) N-fertilizers listed in Table 17. It was applied by Brown, et al., (1982) at the equivalent rate of 3 lb N/1000 ft², 1.5-3 times the recommended rates in Table 17. Total N loss in leachate averaged 0.9% (0.2% -1.4% range) across the three test plots.

Thus a good conservative N loss rate to assume for Hana would be 2.6%. This value is somewhat conservative because the application rate was very high and the water flux was high as well in the Snyder, et al. (1981), study. The Brown, et al. (1982), study also indicates that a lower percentage may be more appropriate.

In a different approach to calculate N-leaching rates, Dollar and Atkinson (in review) have evaluated nutrient input from golf courses to Big Island nearshore coastal waters. Their focus was on two golf courses on the Kona Coast -- Waikoloa Beach and Keauhou. Based on nitrate concentrations in ground water and surface water, it appeared that 10% of the applied N had leached below the root zone. However, the ratio of slow release to quick release fertilizer products at both sites is unknown. It is known that the Keauhou site uses a significant amount of reclaimed sewage effluent for irrigation. The Waikoloa Beach golf course uses greater than 1,000,000 GPD of irrigation, probably due to a thin soil base which is permeable cinder soil (Mallory, 1991). Thus a heavy water flux through a permeable soil may be increasing the chances for nitrate to leach to ground water. Based on these differences, the relevance of these sites to Hana is unclear.

Therefore it was decided to use two N-leach rate values in our risk assessment: 10% as a worst case value (Table 27), 2.6% as the average expectation value (Table 28).

2. Nitrogen Concentrations Leaching to Ground Water

The calculations below were performed using the two N-leaching rates described above. Thus the maximum N mass in the 2.6% table was determined simply by multiplying 0.026 times the maximum total N likely to be applied (16,933) over the golf course annually. This was based on the maxima of the ranges for N listed in Table 17, and the following areas of managed turf:

Table 27. Predicted N Concentrations Assuming a 10% Leach Rate (Worst Case)

Year	N Mass (annual maximum)	N conc. in leachate	Water flux (annual)
1	1693 kg	3.2 ppm	5.31×10^8 l
2	1693 kg	2.9 ppm	5.87×10^8 l
3	1693 kg	1.6 ppm	1.03×10^9 l
4	1693 kg	1.9 ppm	9.09×10^8 l
5	1693 kg	2.6 ppm	6.59×10^8 l
Ave.	1693 kg	2.4 ppm	7.43×10^8 l

Table 28. Predicted N Concentrations Assuming a 2.6% Leach Rate

Year	N Mass (annual maximum)	N conc. in leachate	Water flux (annual)
1	440 kg	0.83 ppm	5.31×10^8 l
2	440 kg	0.75 ppm	5.87×10^8 l
3	440 kg	0.43 ppm	1.03×10^9 l
4	440 kg	0.48 ppm	9.09×10^8 l
5	440 kg	0.67 ppm	6.59×10^8 l
Ave.	440 kg	0.63 ppm	7.43×10^8 l

tees, greens, practice greens and tees--522,270 ft^2
fairways, practice fairways, roughs, perimeter--4,660,920 ft^2.

The water flux was obtained from the PRZM2 output summarized in part D above.

3. Estimate of Nitrogen Concentrations in Ground Water

Nitrogen leachate concentrations in ground water can be estimated by diluting the percolate concentrations from Tables 27 and 28 above into the top of the aquifer. It is reasonable to assume that the mixing zone in the top of the lava rubble is approximately 10 ft; thus a very conservative assumption about the thickness of the mixing zone is 5 ft (Mink, 1991). If we assume a 20% porosity, this yields a water volume of 2.48 * 10^8 liters in this 201 acre * 5 ft slice of aquifer.

Ground water concentration increases above background were calculated using these assumptions and are presented in Table 29 below.

Thus it is expected that maximum nitrogen concentration in the top of the aquifer at the downgradient edge of the golf course would be elevated by 0.56 ppm, if the maximum amount of nitrogen is applied throughout the year. This is more than one order of magnitude less (ten fold) than the 10 ppm drinking water Maximum Contaminant Level (MCL) for nitrate-nitrogen. (Even the extreme worst case number is less by more than a factor of three.)

Table 29. Estimated Nitrogen Concentration Increases in the Top Five Feet of Ground Water, with Conservative Mixing

N Leaching Rate	Ave. Year	Highest Year
Expected (2.6%)	0.44 ppm	0.56 ppm
Worst Case (10%)	1.7: ppm	2.2 ppm

It is important to note that these concentrations are not representative of actual drinking water concentrations. Community drinking water supply wells are not located downgradient. Further, any future wells would draw from depths much greater than 5 ft. In Hawaii, it is not unusual for wells to draw water from 100 ft lengths. Therefore actual impacts on any future drinking water wells would likely be at least one order of magnitude less than indicated in Table 28.

4. Comparison of Nitrogen Loading to Soil from the Golf Course with Cattle Manure

Information presented in the IGCMP indicates that the maximum amount of nitrogen (N) applied to the golf course would be 37,331 lb/yr (1693 kg/yr). As of January 1992, the Hana ranch had 3,156 head of beef cattle. Assuming 10 tons of manure produced each year by a 1000 lb beef cow and 12.5 lb N/ton manure (Peischel, 1991), one can calculate that the cattle excrete 394,500 lb N/yr in feces and urine, 10.6 times the maximum loading anticipated for the proposed golf course. If Keola Hana Maui, Inc. desires to maintain the current level of N loading to the environment, the herd would have to be reduced by approximately 10%.

F. Computer Modeling of Pesticide and Nutrient Transport in Runoff Using SWRRBWQ

1. Runoff Model Selection and Description

Several computer models are available for the estimation of surface runoff losses of water, sediment, and chemicals. SWRRBWQ (Simulator for Water Resources in Rural Basins, Water Quality Model, Arnold, et al., 1990) and GLEAMS (Groundwater Loading Effects from Agricultural Management Systems, Leonard, et al., 1987) have both been validated with field studies for runoff and chemical transport and are widely used by government, research, and private sector scientists for assessing water quality management options. ETS elected to use the SWRRBWQ model to assess the potential for turf chemical transport in runoff from the Hana Ranch golf course. It is more suited to large scale, hydrologically complex sites like Hana Ranch than field scale models such as GLEAMS. SWRRBWQ also allows for evaluation of nutrient impacts which GLEAMS cannot.

The following description of SWRRBWQ is summarized from Arnold, et al., (1990) and Arnold, et al. (1991). SWRRBWQ version 1.0 is the current version of the SWRRB model originally developed in the mid-1980's by the United States Department of Agriculture, Agricultural Research Service (Williams, et al., 1985). The major components pertinent to this assessment are weather, hydrology, erosion, pesticides, and nutrients. The weather component provides for statistical generation of daily precipitation, temperature, evapotransporation, and solar radiation data or entry of measured daily precipitation and temperature data. Irrigation can also be simulated based on soil moisture stress. The hydrology component calculates a water balance based on the SCS curve number technique (USDA) driven by the daily weather

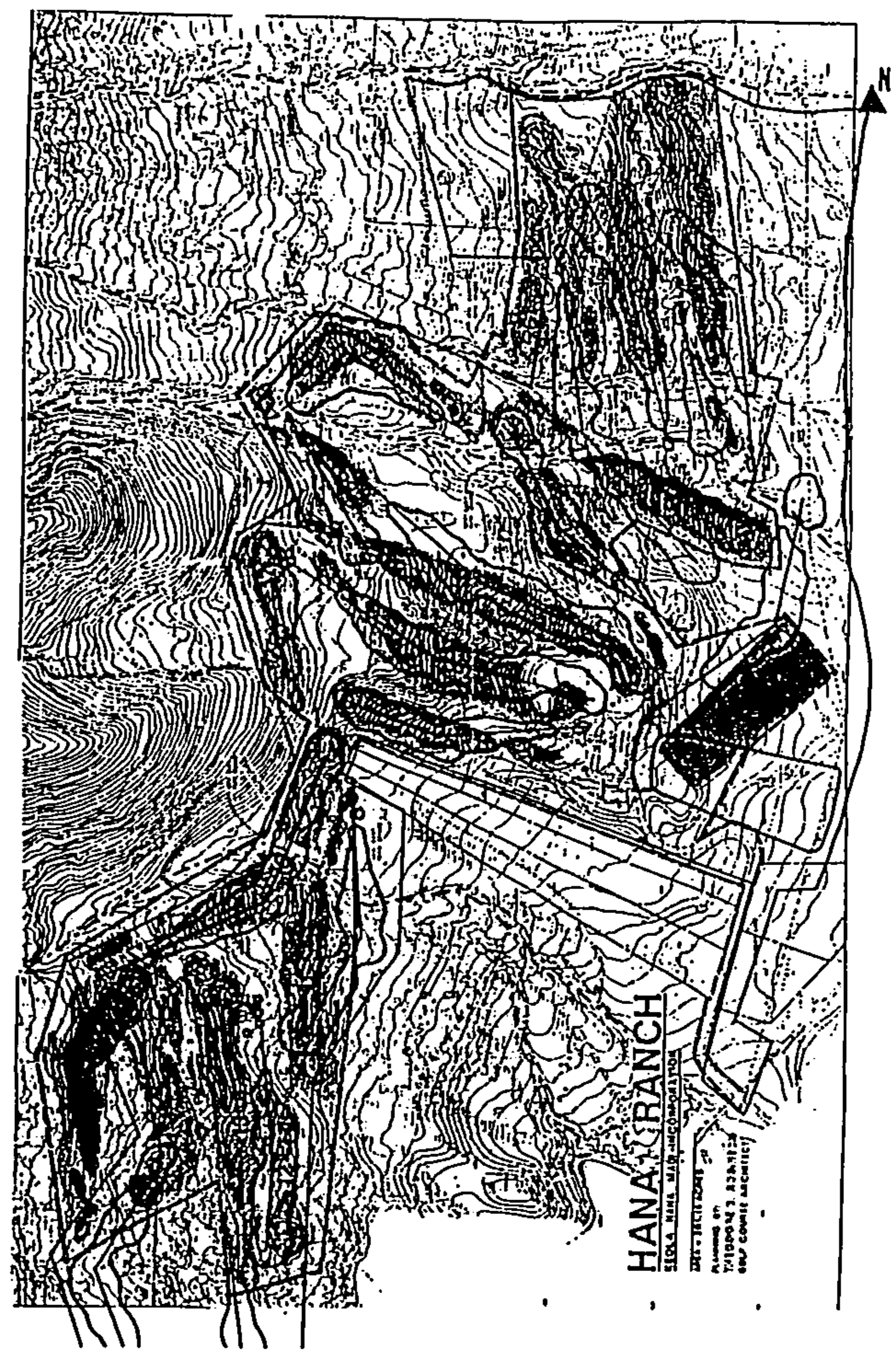
input. Surface and sub-surface runoff, deep percolation, evapotranspiration, and soil storage are all factored into the water balance. Peak flow rates are calculated using a modified version of the rational formula. Erosion losses are predicted with the Modified Universal Soil Loss Equation (MUSLE; Williams and Berndt, 1977) and a simple flood routing component. The pesticide component was adapted from the Chemicals, Runoff, and Erosion from Agricultural Management Systems model (CREAMS; Knisel, 1980). The movement of pesticides is governed by application efficiency, first order decay, mobility, and persistence. The nutrient component is taken from the Erosion/Productivity Impact Calculator (EPIC, Williams, et al., 1984). Nitrogen and phosphorus losses are computed for runoff (soluble) and sediment (organic).

2. Conceptual Model of the Runoff Assessment

The Hana Ranch project site comprising the proposed golf course encompasses approximately 201 acres of land. The maintained areas of the golf course would account for nearly 120 acres of which less than 90 acres would potentially accept any chemical treatment. The runoff assessment was based on the concept plan as revised March 18, 1992, at which time the project site was proposed to comprise about 256 acres. Implications of the most recent changes to the concept plan are considered below. Figure 8 provides an overlay of the March 1992 concept plan on the June 1992 revisions.

In the context of hydrology, the project site is comprised of five major drainage areas. Based on the March 18 revisions, only two of the drainage areas would have the potential to transport turf chemicals applied to the golf course directly to the ocean via surface channels, the drainage basin of the Haneoo Gulch and the compined drainage areas of the Hoomoonui and Hoomooiki Gulches. The watersheds

Figure 8. March Concept Plan Overlayed on June Revised Concept Plan

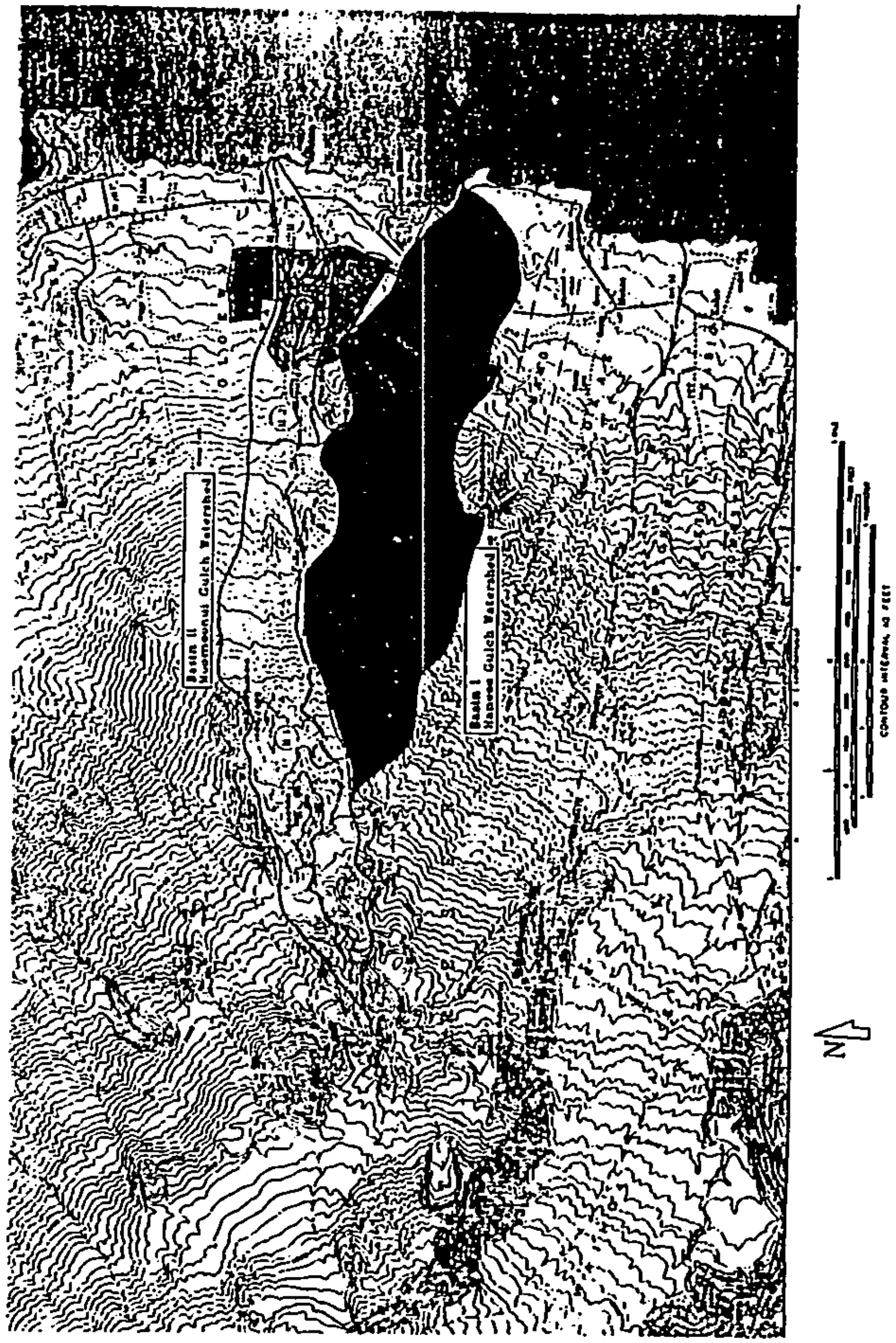


of these gulches are shown on Figure 9. The raw concept plan, revised June 1992, relocates three holes closer to an unnamed gulch along the southern border of the property (Figure 8). Thus three drainage areas would have the potential to transport turf chemicals to the ocean. The third basin which drains to the gulch along the southern boundary of the property was not included in the computer modeling assessment initially. The proposed golf areas within this basin were of sufficient distance from the gulch that no concern of environmental impacts from surface runoff would have been anticipated. The relocation of the three holes within the third basin to a closer proximity to the gulch would not pose any additional significant impacts to the ocean from runoff losses of turf applied chemicals. The only portions of these holes which drain directly to the gulch with less than 100 ft of natural buffer are the greens of holes 3 and 5 and the tee area of hole 4. Greens and tees are constructed primarily with sand and runoff would be minimal.

One can easily see that the proposed golf course of the Hana Ranch actually comprises small portions of the entire watershed areas. With the exception of the three holes mentioned above, the changes to the golf course routing plan between March and June do not affect the computer modeling assessment. Although the holes are rerouted, the approximate acreage of the maintained turf within the modeled drainage areas remains similar. Haneoo Gulch drains about 950 acres from the ocean to nearly 2600 feet elevation (Basin I), and Hoomoonui and Moomooiki Gulches combined drain roughly 930 acres from the ocean to nearly 3500 feet elevation (Basin II). The project site comprises only about 80 acres (8%) and 90 acres (10%) of each basin, respectively.

The Haneoo Gulch watershed (Basin I), which also includes the Kaholopoo Gulch, will have three significantly different

Figure 9. Basin and Sub-basin Areas Modeled with SWRRBWQ



land uses once the golf course is done. These areas are represented in the modeling exercise as individual sub-basins (Figure 8). Sub-Basin I.1 is primarily densely wooded land of the Hana Forest Reserve. Slopes are variable from 15-60% and average about 20%. The second sub-basin (sub-basin I.2) is delineated by project boundaries of the Hana Ranch site. This area will, of course, primarily be minimally to highly maintained turf associated with the golf course. Slopes are less severe than the areas mauka and average about 10%. The makai boundary of Sub-basin I.2 is at least 4000 feet from the ocean following the course of the gulch. Sub-basin I.3 is dominated by pastureland and is dissected by the Hana Highway. Land slope is not much different from Sub-basin I.2 until makai or the highway where it becomes more gentle.

The Moomoonui and Moomooiki Gulches watershed (Basin II) is not significantly different than Basin I. There are four sub-basins because the pastureland between the forest reserve and the ocean would be divided into two areas by the golf course project. Sub-basin II.1 is heavily forested upland with moderate to steep slopes. Sub-basin II.2 is pastureland with moderate slopes averaging about 15%. The grasses are taller but much less dense than managed turf. Sub-basin II.3 is comprised of the golf course with more gradual slopes (10%) than the mauka regions. The pastureland makai of the proposed golf course makes up sub-basin II.4. The vegetation is not much different than sub-basin II.2, rather the slopes on the average are much gentler, about 5%.

3. <u>SWRRBWQ Model Input Parameters</u>

This assessment, designed to evaluate the potential for transport of pesticides and nutrients in runoff to the ocean, was done in two scenarios. The first one considered annual average movement of pesticides and nutrients in runoff water and sediment. This scenario would be most useful for a discussion of sediment laden contaminants. Since there are no perennial streams on the site, and thus runoff and contaminant transport is driven by storm events, a second modeling scenario was executed to address impacts of individual intense rainfall events. Three different storm events were modeled, 1-year, 10-year, and 100-year return 24-hour duration storms. The storm water runoff is quickly diluted and dispersed from the point of discharge at the ocean. Longer-term results would have little utility for turf chemicals in solution. This assessment did not take into account any ocean mixing of the runoff.

The two watersheds were modeled separately and their results combined to determine total shoreline impacts.

There are certain input requirements that are representative of an entire drainage basin and also those that are variable between smaller sub-basins that comprise the whole basin. Examples of data describing the whole basin include the total acreage, weather (temperature and precipitation), and environmental fate data for the pesticides proposed for use on the golf course. Examples of data that vary between the smaller sub-basins include SCS runoff curve numbers, MUSLE parameters, soils data, and pesticide applications. Considerable effort has been made to incorportate as much site-specific information into the input sequence as is available. Daily temperature and precipitation data were input for the Hana Airport station #355 (Figure 7). ETS collected soil samples from across the site and had them analyzed for specific parameters used in the model. Slope measurements, hydrologic boundaries, and vegetation cover and density were estimated from a combination of ETS site visits, aerial photography, and a USGS topography map of the site. Some of the input parameters including all of the key

parameters are in the five modules of Table 30 at the end of part 3. The following paragraphs discuss some of these in more detail. A listing of all of the input sequence can be provided by the authors upon request.

a. <u>Basin Data</u>

The runoff assessment was conducted based on the concept plan revised in March 1992. Although there are some significant alterations to the plan as per the June 1992 revision (Figure 8), these changes would not significantly alter input parameters of the model or the results. Whereas the locations of the holes within the basins have changed the golf course areas within the modeled basins has not significantly changed.

Significant portions of the proposed Hana Ranch golf course project site were modeled within two basins. Basin I represented the drainage area of the Haneoo and Koholopoo Gulches (about 950 acres) and Basin II represented the drainage area of the Moomoonui and Moomooiki Gulches (about 930 acres). The Hana Ranch site comprises only a small portion of each basin, 8% of basin I and 10% of basin II.

The weather data for both basins were assumed to be identical. Daily rainfall, temperature, evapotranspiration, and solar radiation data can be stochastically generated by SWRRBWQ based on long-term monthly average values and certain statistics that describe the distribution and variation of the weather parameters. The option is available to input average daily rainfall and temperature data and bypass those parts of the weather simulator. Daily solar radiation and evapotranspiration are always generated based on rainfall and temperature data by the SWRRBWQ model, primarily because daily measurements of these parameters are not often readily available. The option to input daily rainfall and temperature was exercised for this assessment so that a more realistic weather scenario could be demonstrated. Five years of daily rainfall and temperature were selected randomly from the wettest 20 years of a 39-year record. This procedure was done to ensure that a conservative weather scenario was exercised. These data were obtained from the National Ocean and Atmosphere Administration library in Rockville, Maryland. The information was downloaded from the Earth Info Inc. "Climatedata-NCDC Summary of the Day" CD-ROM data sets which are updated annually. The data set obtained was for the Hana Airport Station #355. Rainfall at this station is slightly greater than at the Hana Ranch site, therefore a 0.86 correction factor was used based on comparison of mean annual rainfall to that of a station close to the site, Hana station #354. Data were not as complete and only rainfall and no temperature was available. The approximate location of the Hana Airport station is indicated on Figure 7. The average annual rainfall for the five years used in the model application (less 15% for correction) was 82.0 inches. This average is approximately 18% greater than the mean annual rainfall of 69.2 inches for the Hana station #354 (Giambelluca, et al., 1986). The rainfall amounts for the individual storm events were estimated from isopluvial maps in Technical Paper 43, "Rainfall Frequency Atlas of the Hawaiian Island" (U.S. Dept. of Commerce, 1962). Values for these storms would be : 5 inches for a 1-year return 24-hour duration event, 12 inches for a 10-year event, and 18 inches for a 100-year event.

Environmental fate data for pesticides proposed for use on the Hana Ranch Country Club, as per the IGCMP in this report, are found in Table 16. Five of the pesticides were selected for modeling according to the ranking scheme

described in section VI.C. above: chlorpyrifos, copper hydroxide, dithiopyr, fenarimol, and iprodione.

b. Sub-basin Data

The sub-basin input parameters consist of seven major categories of data: general descriptive, hydrology, crop, soils, erosion, pesticides, and nutrients. The individual sub-basins were identified on Figure 8.

i. General Descriptive Input

Basin I

The Haneoo Gulch watershed was estimated to cover roughly 950 acres. This basin was divided into three sub-basins based primarily on land use, that is dominant vegetation (Figure 8). Length, slope, and area measurement estimates were based on the USGS topographic map of the Hana quadrangle (USGS, 1983) and the Preliminary Concept Plan for Hana Ranch prepared by Theodore G. Robinson, Golf Course Architect, revised June 1992. Since slope measurements estimates are average values for the basin and sub-basins, the June revisions do not change the vlaues in the model input.

Sub-basin I represents the part of the watershed occupied by the Hana Forest Reserve. This area comprises about 65% of the basin and slopes were estimated to average roughly 15%. The average slope length is defined as the average distance from the point of origin of overland flow to the point where runoff water enters a channel or the slope steepness decreases enough for deposition to occur (USDA, SCS, 1981). The average slope length was estimated using the contour extreme point method described in Arnold, et al, 1990. An average slope length of 140 ft was used. The main channel length in the sub-basin was estimated to be about 8175 feet and the average channel slope was estimated to be roughly 19%.

Sub-basin 2 comprises about 8% of the watershed area and represents the portion of the watershed occupied by the proposed Hana Ranch project site. The entire area (about 80 acres) was assumed to be primarily golf course although in actuality, only about 37 acres would be intensively maintained. Slopes average roughly 10% and slope lengths are in the order of 190 ft. Water features were not modeled since no indications have been given that they would be designed for runoff catchment. The main channel length within the sub-basin was estimated to be about 900 ft. The average slope of the channel was estimated to be about 6%.

Sub-basin 3 comprises the remaining 15% of the Haneoo Gulch watershed area makai of the Hana Ranch project site. It was assumed to be essentially pastureland. Slopes were estimated to be similar to sub-basin 2 and slope lengths, on the average, were determined to be roughly 160 ft. The main channel length is about 6000 ft and the average channel slope was estimated to be 7%.

Basin II

Basin II comprises the watershed of the Moomoonui Gulch, about 930 acres. There are four sub-basins within this area delineated based on dominant land use.

Sub-basin I in the Moomoonui Gulch watershed area in many ways is similar to sub-basin I in basin I. The area represents the portion of the watershed comprised of the Hana Forest Reserve, about 60%. Slopes average 20% and the average

slope length was estimated to be 125 ft. The main channel length in the sub-basin is about 12,000 ft and average about 18% slope. Sub-basin 2 comprises about 15% of the entire basin area and is characterized by pastureland. Slopes average 15% and the slope lengths average about 200 ft and the slope of the channel was estimated to be about 18%.

Sub-basin 3 represents the area within the Moomoonui Gulch watershed occupied by the Hana Ranch project site. Only about 43 acres of the 84 acre sub-basin (which comprises roughly 11% of the watershed) would be intensively managed turf. Slopes average about 10% and slope lengths were estimated to average 150 ft. The main channel length withinthe sub-basin is about 3000 ft and its slope was estimated to be about 8%.

Sub-basin 4 comprises only about 8% of the basin area. It is primarily pastureland. The average slope was estimated to be roughly 5% and the average slope length about 160 ft. The main channel length coursing the sub-basin from the golf course to the ocean was estimated to be about 2500 ft and averaged about 8% slope.

ii. Hydrology Input

Several input parameters describe elements of the hydrology of each sub-basin. These parameters, the SCS runoff curve number, the surface roughness coefficient (Mannings's N), and stream channel routing data all must be averaged across each sub-basin. Weighted averages for these parameters were estimated based on the extent of the different types of soils and vegetation distributed throughout the site. Soils data will be discussed later in this section, percent areas were estimated based the soils map for the area including the site from USDA, SCS (1982). Values for curve number were taken from USDA, SCS (1986). Primarily, the soils across the site and throughout the basins are described as having at least moderately rapid permeability and are included as hydrologic soil group A (HSG-A). The forested areas and golf course areas would be considered to demonstrate good cover conditions. The pastureland, areas are somewhat heavily grazed and exhibit fair cover conditions.

Irrigation was simulated for sub-basins I.2 and II.3, the golf course areas, based on soil moisture stress. Irrigation was "turned on" when the soil moisture had gone below 50% the available water capacity and shut off when field capacity was reached. Because of model limitations, irrigation application can not be restricted to only the areas proposed for intensive golf course management. Conservatively, water was applied to the entirety of these sub-basin areas.

iii. Crop Input

Crop parameters are important primarily for agricultural practices where tillage and harvest activities greatly effect the movement of pesticides, nutrients, sediment, and water within a field. Crop parameters are also used in the model to help predict evapotranspiration losses of water to the atmosphere. Values in Table 30 were taken from Williams, et al. (1990), and were intended to reflect averages of land used across the sub-basins.

iv. Soils Input

Soils data were obtained or estimated from the Soil Survey (USDA, SCS, 1972), results of analyses of on-site soil samples collected by ETS, the SCS Soils-5 data base compiled for SWRRBWQ, and other soil science texts including Brady

Table 30. SWRRBWQ Runoff Model Input Parameters

General Descriptive

	Basin I	Basin II
Basin Area =	3.8 km^2	3.6 km^2
Baseflow Factor =	0 (ephemeral stream ∴ no baseflow)	
Basin Lag Time =	0 days	0 days
10 Year max 0.5 hr Rainfall =	76.2 mm	76.2 mm
10 Year max 6.0 hr Rainfall =	203.2 mm	203.2 mm
Latitude of Watershed =	20.44 deg	20.44 deg
Main Channel Length =	4.57 km	6.40 km
Ave Channel Slope Steepness =	0.15 m/m	0.15 m/m
Ave Channel Roughness Coeff. (Manning's N) =	0.15	0.15
Ave Overland Roughness Coeff. (Manning's N) =	0.30	0.30
Ave Overland Slope Length =	38 m	38 m
Ave Overland Slope Steepness =	0.15 m/m	0.16 m/m

Monthly Ave Daily Solar Radiation (langleys):

J	F	M	A	M	J	J	A	S	O	N	D
320	379	440	487	529	544	543	533	491	418	343	307

Table 30. (cont'd)

Hydrology

	Basin I Sub-basin #			Basin II Sub-basin #			
	1	2	3	1	2	3	4
Fraction of Basin	.65	.10	.25	.60	.15	.12	.08
SCS Curve #	25	39	49	25	49	39	49
Soil Albedo	.125	.125	.125	.125	.125	.125	.125
Main Channel Length (km)	2.49	.27	1.81	3.66	.61	.91	.76
Ave Chnl Slope (m/m)	.19	.06	.07	.18	.18	.08	.08
Ave Chnl Width (m)	2	2	2	2	2	2	2
Effective Channel Hydr Cond (mm/hr)	127	127	127	127	127	127	127
Chnl Manning's N	.15	.15	.15	.15	.15	.15	.15
Overland Manning's N	.30	.30	.30	.30	.30	.30	.30
Return Flow Travel Time (days)	0	0	0	0	0	0	0
Overland Slope Length (m)	42.7	58.0	48.8	38.1	61.0	45.8	45.8
Overland Slope Steepness (m/m)	.15	.10	.10	.20	.15	.10	.05

Table 30. (cont'd)

Soils\Erosion

Soil Surface Values	Basin I Sub-basin #			Basin II Sub-basin #			
	1	2	3	1	2	3	4
MUSLE K Factor	.05	.05	.05	.05	.05	.05	.05
MUSLE P Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MUSLE C Factor	.003	.003	.003	.003	.007	.003	.007
Organic Carbon %	3.95	10.00	3.78	3.95	3.95	10.00	3.78
Org Nitrogen (g/m^3)	3200	3200	3200	3200	3200	3200	3200
Org Phosphorus (g/m^3)	475	475	475	475	475	475	475
Labile P (g/m^3)	48	48	48	48	48	48	48
Bulk Density (t/m^3)	.9	1.0	1.0	.9	.9	1.0	1.0
Avail H_2O Cap (mm/mm)	.13	.13	.13	.13	.13	.13	.13
Satur Hyd Cond (mm/hr)	73.7	48.3	35.6	73.7	73.7	48.3	35.6
% Pass #200 Sieve	79.0	80.1	80.6	79.0	79.0	80.1	80.6
% Clay	53.9	51.7	50.6	53.9	53.9	51.7	50.6
Initial NO_3 (g/m^3)	15.0	14.0	14.0	15.0	15.0	14.0	14.0
Max Root Depth (mm)	1524	864	864	1524	864	864	864

Table 30. (cont'd)

Crop

	Basin I Sub-basin #			Basin II Sub-basin #			
	1	2	3	1	2	3	4
Biomass Conversion Fac	16.5	30	30	16.5	30	30	30
Water Stress Yield Fac	0	.01	.01	0	.01	.01	.01
Harvest Index	.76	.9	.9	.76	.9	.9	.9
Max Leaf Area Index	5	5	5	5	5	5	5
Residue (kg/ha)	0	0	0	0	0	0	0

Pesticide and Nutrient Applications

	Basin I Sub-basin #			Basin II Sub-basin #			
	1	2	3	1	2	3	4
	Application (kg/ha)						
Pesticide (# app/yr)							
Chlorpyrifos (2apps)	0	.06	0	0	0	.06	0
Cu(OH)2 (2 apps)	0	.94	0	0	0	1.04	0
Dithiopyr (1 app)	0	.09	0	0	0	.10	0
Fenarimol (2 apps)	0	.15	0	0	0	.17	0
Iprodione (2 apps)	0	.15	0	0	0	.17	0
Nutrients (# app/yr)							
max. Nitrate-N (4 apps)	0	14.9	0	0	0	16.6	0
max. Phosphorus (4 apps)	0	5.0	0	0	0	5.5	0

(1990) and Foth (1978). ETS collected samples representative of the two major soil types and one minor soil type of the Hana series which comprise the site. The samples were analyzed for key physical and hydrological parameters including texture, pH, organic matter, bulk density, porosity, saturated conductivity, and field capacity. The analyses were performed by Turf Diagnostics and Design, Inc., Olathe, Kansas. The results are presented in Appendix C. Although the texture analyses indicate the soils are primarily clays, Hana soils exhibit irreversible drying into fine granular aggregates. The net effect is improved hydraulic properties inconsistent with typical clay soils.

The golf course sub-basins (I.2 and II.3) included a modification in the surface horizon soil organic carbon content to conservatively account for thatch. Thatch is a dynamic layer of organic material made up of dead and living shoots, stems, and roots of grass plants. It is not yet possible competently model all of the hydraulic and chemadsorptive properties of thatch. However, its presence in turf is a reality and one study has shown it is comprised of more than 50% organic matter (Turgeon, 1992). ETS has conservatively used an organic carbon content of 10% in the top 1 centimeter (0.4 in.) soil layer.

v. Erosion Input

The parameters of the Modified Universal Soil Loss Equation (MUSLE) required for SWRRBWQ are the soil erodibility factor K, the cover-management factor C, and the erosion control practice factor P. The length-slope factor LS is calculated for each sub-basin from input values of average slope length and steepness. No contour or impoundment practices were modeled. Values for both the K and C factors were selected from USDA, SCS, (1981). Assumptions regarding the density and extent of vegetation were made for the estimation of the factors for the different land uses. The forested areas (sub-basins I. 1 and II. 1) were assumed to have an average canopy coverage of trees and brush in excess of 75% and ground cover of grasses and leaf litter in excess of 95%. These assumptions yield a C factor of 0.003. The golf course areas (sub-basins (I.2 and II. 3) were assumed to have no appreciable canopy, but have ground cover of grass at least 95%. These assumptions yield a C factor of 0.003. The pasture areas (sub-basins I. 3, II. 2, and II. 4) have no appreciable canopy and have ground cover of grass in excess of 80% thus yield a C factor of 0.007.

vi. Pesticide Input

The environmental fate data of the pesticides selected for this runoff assessment were already introduced in Section VI.C. and are not expected to vary considerably across the site. No pesticide applications were assumed to take place outside of the Hana Ranch sub-basins in either the Haneoo or Hoomoonui Gulch watersheds. Pesticide application rates were calculated for the two sub-basins. However, one major limitation of SWRRBWQ, as well as all of the popular runoff models, is that applications cannot be restricted to portions of the modeled area. SWRRBWQ, in effect, applies the chemicals to the entire sub-basin. Since only portions of even the two sub-basins that represent the Hana Ranch site will include maintained golf course turfgrass, the application rates had to be normalized to the sub-basin areas. A sample calculation is provided to demonstrate how the adjustments were made.

Sub-basin I. 2

Total sub basin acreage = 80 acres
Pesticide treatment = chlorpyrifos

Anticipate treatment area in the sub-basin = 4.02 ac
Chlorpyrifos application rate = 1.0 lbs ai/acre
Total chlorpyrifos application = 1.0 lbs ai/acre * 4.02 ac
= 4.02 lbs ai

Normalized to sub-basin area:
4.02 lbs ai + 80 acres = 0.05 lb ai/acre
= 0.06 kg ai/hectare

vii. Nutrients Input

The SWRRBWQ model simulates the cycling of naturally occurring nutrients as well as applied nutrients. Certain assumptions were made based on soil science texts to estimate initial levels of nitrogen and phosphorus in the soil. Nearly all of the nitrogen found in soil is in the organic form (Brady, 1990). The amount of nitrogen existing in soil as NO_3^- is generally less than 0.1% (Stevenson, 1986). Further, there is a relationship of the amount of organic carbon in the soil to the amount of nitrogen (known as C/N ratio) of generally 10:1 to 12:1. The average C/N ration of 10 Hawaiian soils in USDA, SCS (172) was calculated to be 11.44 ± 2.66. Estimates of organic nitrogen and nitrate concentrations in the soils for each sub-basin were calculated based on these assumptions and the known organic carbon content of the different soil horizons. Phosphorus contents were estimated from a relationship of 0.125 * nitrogen concentration presented in Arnold, et al. (1990b). Labile phosphorus (slowly available phosphorus) was assumed to 10% of total phosphorus. This was derived from information presented in Brady (1990).

Nutrient applications were calculated in a similar manner as the pesticide applications. Nitrogen rates and use areas were taken from the IGCHP. Only water soluble nitrogen applications were modeled. Slow-release formulations could not be modeled however the nature of slow-release fertilizers are such that little nitrogen is available in water soluble form at any one time for runoff to be a serious concern. Phosphorus applications were assumed to be approximately one-third the nitrogen rates.

4. Quality Assurance

The SWRRBWQ model requires a large input data set that comprises several disciplines including meteorology, hydrology, agricultural engineering, agronomy, pesticide chemistry, etc. Environmental & Turf Services, Inc. maintains a competent staff with knowledge and experience in all of these areas. ETS staff routinely research and review the data input into the modeling scenarios and the assumptions and sources relied on for the input. As an added measure of quality assurance, the study director conducted a random review of key parameters and assumptions in the SWRRBWQ runoff assessment.

Key parameters in hydrology, erosion, and pesticides were reviewed from the source to the input sequence to assure the accuracy and appropriateness of the model data. The following parameters were checked: values selected for the runoff curve number (CN), the modified universal soil loss equations (MUSLE), soil erodibility factor (K), and all input for the pesticide dithiopyr.

Values for CN were determined for each sub-basin based on information in USDA, SCS (1981) and USDA, SCS (1986). Values chosen for the MUSLE K factor were also determined based on information in USDA, SCS (1981). The values selected were corroborated and it was verified that the data were input correctly.

Data for the herbicide dithiopyr used in the SWRRBWQ model include the organic carbon partition coefficient (K_{oc}), water solubility, soil half-life ($t_{1/2}$), foliar half-life, foliar wash-off fraction, application efficiency, application rate, and date of application. These were all reviewed by the study director. One error and two inconsistencies were identified. The error noted was that dithiopyr was "applied" twice each year. This would have no impact on the storm event modeling results. The inconsistencies were in the calculation of K_{oc} and selection of $t_{1/2}$. They were not errors, but rather different interpretations between the SWRRBWQ data input and the environmental fate table (Table 19), regarding literature values for these two parameters. A K_{oc} value for dithiopyr was not directly availabe, it was necessary to estimate it from other data based on empirical relationships. There are several methods for estimating K_{oc}. The method used for the K_{oc} value in the data input was suggested in Dean, et al. (1989b). K_{oc} can be estimated from the octanol/water partition coefficient (K_{ow}) according to a formula developed by Karickhoff, et al. (1979). The resulting K_{oc} was 34,700 cm^3/g using a K_{ow} value taken from EPA (1991). The method used to calculate the value for K_{oc} in Table 19 considers a relationship to water solubility presented by Kenaga and Goring (1980). The value for K_{oc} calculated with this method was $3600 cm^3/g$. The values for soil half-life were presented in EPA (1991) as a range of 17 to 61 days. The maximum value, 61 days, was selected for the SWRRBWQ data input. A logarithymic mean value of 32 was provided in Table 19. Since the storm events simulated in the SWRRBQ modeling occurred only one or two days after the pesticide application, this inconsistency has no impact on the modeling results. All other input date for dithiopyr was satisfactory. Because of the uncertainty regarding the method for calculating K_{oc} and the borderline concerns raised by the resulting dithiopyr concentrations in runoff, mitigative measures are suggested below in Section VII regarding the use of dithiopyr on the proposed Hana Ranch Country Club.

5. Conservative Assumptions

Water is driving factor for any runoff model. The rainfall and irrigation input to the hydrologic component significantly influence all of the components of SWRRBWQ and, ultimately, the results. It is, therefore, vital that suitable rainfall data are used and proper assumptions for irrigation simulation are applied.

Actual daily rainfall and temperature data were input for a weather station located only a few miles from the project site, the Hana Airport station #355. Five years of daily weather data were randomly selected from the top 20 wettest years of a 39 year weather record. The average annual rainfall for these five years was 96.5 inches. The mean annual rainfall for a rainfall gaging station (Hana #354) closer to the site is 69.2 inches (Giambelluca, et al., 1986). Thus the rainfall data input in this assessment represents a scenario about 39% greater than average.

Three intensive storm events were modeled to consider impacts under extreme rainfall conditions. One-year return and 10-year return, 24 hour duration storm event were simulated 1 day after application of turf chemicals and a 100-year return, 24 hour duration storm event was simulated 2 days after application of turf chemicals. These scenarios would represent reasonable worst-case rainfall vs. application relationships.

Irrigation was modeled based on soil moisture stress. Water was applied when soil moisture reached 50% available water capacity. This is a reasonable assumption for golf

course management. However, the SWRRBWQ model is not set up to allow application to only the golf course portions of the sub-basins. Irrigation was thus applied to the entire area of each sub-basin accommodating golf course acreage. The effect of this was that the soil moisture model across the site was extremely conservative; therefore, runoff estimates for the developed setting were most likely over predicted.

SWRRBWQ simulation of pesticide and nutrient applications were limited in much the same manner as the irrigation applications. Chemical applications could not be restricted to the golf course portions of each sub-basin. Although golf course applications were normalized to the total sub-basin areas, the chemicals were applied to the entire sub-basin areas none-the-less. Realistically, most of the runoff from the site would be from the impervious areas such as road surfaces roofs, and parking areas. Associated with the clubhouse and maintenance facilities. Managed turf areas represent only a small contribution to runoff. Because turf chemicals are only applied to a limited extent within the golf course areas, yet the SWRRBWQ model requires chemical applications to the entire basin are, the net result would be an over-prediction of runoff loss of pesticides and nutrients. Normalizing the chemical applications to the sub-basin areas does not mitigate this.

These scenarios also assume that all of the golf course areas within the sub-basins drain directly into the gulches. This is not necessarily the case. For example, only portions of two of the holes in sub-basin I.2 and four of the holes in sub-basin II. 3 drain directly to the main gulches. The runoff from other maintained areas of turf in these sub-basins must pass over ares of little to no maintenance and would essentially be scrubbed clean of chemical contaminants. In sub-basin I.1 in particular, these distances average greater than 1000 feet.

The number of nutrient applications made in a year is limited in SWRRBWQ to five times a year. The nutrient application scenario for water soluble nitrogen was based on expectations of high nitrogen annual average applications. Single applications are typically frequent applications of small precisely determined amounts of nitrogen based on turf needs. Fewer, higher applications were modeled which would render more nitrogen available for runoff.

The golf course sub-basins (I.2 and II.3) included a modification in the surface horizon soil organic carbon content to conservatively account for thatch. Thatch is a dynamic layer of organic material made up of dead and living shoots, stems, and roots of grass plants. It is not yet possible to competently model all of the hydraulic and chemadsorptive properties of thatch. However, its presence in turf is a reality and one study has shown it is comprised of more than 50% organic matter (Turgeon, 1992). ETS has conservatively used and organic carbon content of 10% in the top 1 centimeter (0.4 in.) soil layer.

6. <u>SWRRBWQ Runoff Modeling Results</u>

Two general modeling approaches were taken to assess runoff impacts from the proposed golf course project on the Hana Ranch property. The first approach was intended to look at annual trends of pesticide and nutrient losses based on a 5 year simulation with a conservative rainfall scenario. The gulches that traverse the site, and the golf course turf area in particular, only flow during periods of runoff producing rainfall. Average annual concentrations of chemicals in the runoff would not provide useful information under these

circumstances since runoff that reaches the shoreline via the gulches is very quickly diluted into the rough ocean surf. In this context, a second approach was used which introduced individual statistically significant storm events into the rainfall scenario. Impacts from these storms, 1-year, 10-year, and 100-year return, 24 hour duration events, were evaluated at the shoreline where runoff water enters the ocean. The results from both basins have been combined to consider total impacts to the nearshore environment selected output for these simulations are found in Appendix H.

a. <u>Pesticides</u>

Table 31 shows average annual pesticide losses compared to the amounts that would be applied based on the IGCMP (Section V). Implications of these percentages are discussed in section VI (G) which also considers field results from other studies.

Runoff losses from the individual storm events including pesticide concentration in runoff water at the shoreline are shown in Table 32. Sediment losses would be expected to be fairly low considering the land uses throughout the watershed areas that encompass the project site. Golf course turf would further protect the land from soil erosion. The model output reported no sediment erosion from the simulated areas from any of the storms. This does not necessarily mean that no erosion would occur, rather any erosion that would take place would probably be below the sensitivity of the model.

Pesticide losses are output by SWRRBWQ in terms of kilograms per hectare. To calculate concentrations, the values are multiplied by the total basin acreage and then divided by the basin runoff water yield at the point of exit (i.e. at the shoreline). Copper hydroxide losses are

Table 31. Average Annual Runoff Pesticide Losses

Pesticide	Total Applied -lbs-	Dissolved Phase Runoff Loss -% of applied-	Total Runoff Loss -% of Applied-
Chlorpyrifos	10.3	0.1	0.2
Copper hydroxide	341.4	1.5	16.0
dithiopyr	32.8	0.2	0.8
fenarimol	55.2	5.5	5.6
iprodione	55.2	4.6	4.9

Table 32. Storm Runoff Pesticide Losses

	1-year	10-year	100-year	
Rainfall (inches)	5	12	18	
Basin Runoff Yield (liters)	$6.32*10^7$	$6.29*10^8$	$1.38*10^9$	
Basin Sediment yield (tonnes/hectare)	<0.006	<0,005	<0.005	
Storm Runoff Concentrations (µg/l)				Aquatic Risk Criteria ug/l
Chlorpyrifos	2.2	0.3	0.2	0.011
Copper	2.2	0.3	0.3	2.9
Dithiopyr	0.9	0.1	0.1	0.56
Fenarimol	50.0	6.8	4.7	90.0
Iprodione	59.5	8.1	5.0	220.0

expressed from this point in terms of elemental copper (65% of $Cu(OH)_2$ by weight) because it is the toxicologically significant part of the compound and would be expected to be found in this form in the environment.

The toxicological significance of these concentrations can initially be considered by comparison with risk criteria of the pesticides to aquatic organisms. Ambient water quality criteria standards were available for chlorpyrifos and copper. These are acute toxicity criteria designed to be protective of 97% of all aquatic organisms including invertebrates. Where these standards have not been established, risk criteria can be estimated by applying an uncertainty factor of 10 to the LC50 of the most sensitive organism tested for the particular pesticide (e.e. LC50 + 10). This is the basis for the criteria presented in Table 32 for dithiopyr, fenarimol, and iprodione.

These concentrations do not account for any of the influences at the coastline that would likely dilute the contaminants to infinitesimal levels. These include: the influx of "clean" ocean water into what would be considered the zone of mixing at the shoreline, the additional incidental rainfall over the mixing area at the shore, and the outflux of ground water from the land into the nearshore ocean. Indications are that ground water flow into the ocean may be significant (in excess of 3 million gallons per day) based on reduced salinity measured in the near-shore waters up to 200 feet from the coast.

The concentrations of pesticides in runoff were predicted to be highest for the smallest of the simulated storm events. This is not unexpected considering that less dilution would occur than from storms producing more runoff. During this event, two pesticides were predicted to runoff the site in concentrations exceeding their respective risk criteria chlorpyrifos and dithiopyr. In fact, chlorpyrifos concentrations in runoff exceed its ambient water quality criteria standard in every one of the simulated storm events.

These results are conservative estimates and are most likely well above what would be observed in the field. They are also based on a reasonable worst-case application scheme in response to high pest infestations and an unlikely scenario that the applications would be made only one to two days before a severe storm event.

Further discussion, including mitigative measures and recommendations for alternative pesticide products, is provided below in Section VII.

b. Nutrients

The major focus of this discussion of runoff impacts related to nutrient transport was on nitrate-nitrogen. Conservative estimates of ambient levels of nitrogen and phosphorus were input into the model along with five applications per year of water soluble fertilizers to the golf course areas. Three of the applications were made to greens, tees, fairways, and roughs. The remaining two applications were only made to greens and tees.

This discussion is going to be more qualitative than quantitative. This is because water quality impacts form nutrient laden runoff are not generally regarded as acutely toxic, and nutrient loading from runoff into the ocean from the site would be episodic. That is nutrient loads would only occur from runoff producing storm events and thus do not produce continuous, prolonged exposure to elevated levels.

Results from the five year simulation would provide an estimate of predicted average concentration of nutrients in runoff from any particular event. Since the assessment was based on an above average rainfall scenario, one would expect too see higher than average nutrient levels. The organic forms of the nutrients would sorbed to eroded sediment in the runoff and would not be readily bioavailable. The water soluble forms (i.e. nitrate-N and phosphate-P) would be available for uptake by aquatic organisms. The average nitrate concentration in runoff was predicted to be 1.5 mg/l and soluble phosphorus was compared to the results of analyses of runoff water in the gulches conducted by Brewer Environmental Services for the Hana Ranch Environmental Assessment (Brewer Environmental Services, 1990). An additional simulation was done with no fertilizer applications made in the basins. The results were identical to the original simulations with fertilizer applications. Thus the fertilizer applications appear to have little influence compared to ambient levels.

C. Comparison With Field Results From Other Studies

The results of computer simulation modeling should not be considered in a vacuum, no matter how carefully the modeling is done. Therefore, a brief review of experimental data is provided here. This summary shows that the results of this prospective risk assessment are generally consistent with the limited results available from field studies in Hawaii and other areas.

Brock, et al. (1987), and Brock and Kam (1990) have reported the results of monitoring ground water, anchialine ponds, and nearshore coastal waters near the Waikoloa golf courses for at least six years. They have not detected pesticides in their water samples. Nutrient increases in the anchialine ponds have been observed and these increases are probably due to turf management. However, those increases are within normal expected background levels. Further, the concentrations are 1/70th of concentrations expected to be toxic to aquatic biota.

Duble, et al. (1978), demonstrated that inorganic arsenic from calcium arsenate was lost in the runoff and root zone leachate of a turf lysimeter (turf block) at toxicologically significant concentrations. However, this compound's use on turf has been canceled, and it is more mobile and persistent than other turf pesticides.

Gold, et al. (1988), found that 0.4% of 2,4-D was lost in the leachate at the bottom of a turf lysimeter root zone. The 0.55-0.88 ppb concentrations were approximately 1/100th the 70 ppb health advisory level (HAL). These lysimeter leachate concentrations do not take into consideration attenuation resulting from migration through dozens of feet of overburden, into the aquifer, and into wells. If these processes were allowed to occur, further reduction of pesticide concentrations would be expected.

EPA analyzed all water samples for 2,4-D in its recently completed national survey of pesticides and nitrates drinking water wells (EPA, 1990). No 2,4-D was detected. These empirical 2,4-D results are consistent with other PRZM-VADOFT leaching predictions made by ETS for other sites in Hawaii.

The Cape Cod study (Cohen, et al., 1990) has been briefly discussed in the IGCMP section of this report. Nineteen monitoring wells were installed in four golf courses with highly vulnerable hydrogeology. Sampling over 1 1/2 years detected several pesticides, but no currently-registered turf pesticides were detected at concentrations approaching HALs.

Golf course runoff studies in progress in Fairfax County, Virginia, and Sarasota, Florida, demonstrate no impacts by nitrates. Sediment loads are reduced in the Florida study relative to background concentrations. Other results are not yet available.

The Florida Department of Environmental Regulation installed two monitoring wells at each of two golf courses in Palm Beach County recently. Results are negative for a comprehensive suite of pesticide analytes after two rounds of sampling.

Squillace and Thurman (1992) recently reviewed the literature and reported new data on herbicide runoff from agricultural field plots and watersheds. They concluded that the proportion of the herbicides that typically run off from these environments typically varies from 0.3% to 5% of the amount applied, on an annual basis. This compares well with the SWRRBWQ results presented in this risk assessment: for all five pesticides the average total loss was predicted to be 5.5% and the average lost in the dissolved phase was predicted to be 2.4% in these scenarios.

A recent turf plot lysimeter study demonstrated that turf degrades the insecticide isazophos much quicker than bare soil (Branham, 1992). At 28 days after treatment, the sandy and sandy loam soils had 50% lessisazophos remaining than the soils without turf. These predictions for the Maui site are for turf, which tends to generate less runoff than corn, soybeans, etc.

Arnold, et al. (1987), demonstrated a significant decrease in sediment loss from a rural area after it was urbanized. Sediment loss was reduced from 2.9 to 1.2 tons per acre after a lakeside area in Washington became 77% urbanized.

This urbanization included the replacement of much undeveloped land by turf and impervious surfaces.

Two conclusions were derived following review of the cited literature as well as other reports: (1) responsible turf management at golf courses has minimal impacts, if any, on the aquatic environment; and (2) extreme positions for and against golf course development are also generally wrong in this area of assessment. Thus one cannot say that golf courses would never cause environmental problems, and one cannot say they frequently cause problems.

H. Pesticide Drift

Pesticide spray drift can be a problem for neighboring plants or residences under moderate to high wind conditions. Past experience with the Agricultural Dispersal Model (Bilanin, et al., 1989) indicates that pesticide spray drift from a tractor boom applicator would not be expected to travel farther than 60 ft during 10 mph crosswinds.

The Integrated Golf Course Management Plan presented above recommends use of a spray shroud over the tractor boom to minimize or eliminate spray drift. This is consistent with the recommendation of the State Department of Agriculture March 1992 letter from Y. Kitagawa. This letter also recommended prohibiting pesticide applications when winds exceed 10 mph. Although this prohibition would be redundant with the spray shroud for applications under 15-20 mph, it would not be highly burdensome. A compass wind rose of the Hana Airport provided by Barry Neal (Barry Neal & Assoc., Captain Cook, Hawaii), indicates that winds are less than 11 knots (12.6 mph) 90.3% of the time. Further, it is likely that winds are calmer during the hours of 5-8 am, when most pesticides are typically applied.

I. Impacts on Water Quality -- Summaries of the Hana Risk Assessment and an Evaluation of the Potential for Reef Fish Poisoning (Ciguatera Toxin)

1. Site - Specific Results

The comprehensive risk assessment described in this report addressed all key water quality issues relevant to turf management of the established golf course. Detailed results were provided in sections VI (D), (E), and (F) above. A summary of the key results is also provided in the "Conclusions and Mitigation Measures Section" that follows. Briefly, there are no concerns about pesticides and fertilizers leaching to ground water, with subsequent discharge of contaminated ground water to the shoreline. However, there is a concern about impacts of the insecticide chlorpyrifos (Dursban®) on nearshore water quality during storm events, impacts that could possibly affect fish close to mouths of the gulches. (The highest predicted concentration was when a 1-yr return, 24-hr storm event occurs one day after application of chlorpyrifos.) The insecticide trichlorfon is less toxic and less persistent than chlorpyrifos and is therefore recommended as an alternative. The herbicide dithiopyr is predicted to run off to the shoreline at a concentration (0.9 part per billion; ppb) that marginally exceeds the 48 hr exposure action level (0.56 ppb). However, dilution at the shoreline, though difficult to quantify, would likely lower the event mean concentrations far below any level of concern.

2. Ciguatera Toxin -- Poisoning of Fish by Natural Toxins Associated with Red and Brown Macroalgae

In 1991, some concerns were raised in Hawaii regarding ciguatera toxin. This is the toxin that can produce illness and death in people that consume reef fish. The toxins are produced by microscopic marine organisms called dinoflagellates (*Gambierdiscus toxicus; G. toxicus*) that attach to the surface of red and brown macroalgae. Toxins are concentrated in the gut, liver, roe, and muscle tissue after ingestion of the algae by herbivorous fish. Carnivorous reef fish such as snapper and eel that prey on the herbivores can accumulate the toxin, as can surgeon and parrot fish that feed directly on the algae or the coral reef that supports the algae. Report of illness and deaths from ciguatera have increased in recent years. West Hawaii had the highest number of reported incidents (11) in 1989. (For a good general discussion of the problem, the reader should consult the DOH pamphlet, "Fish Poisoning in Hawaii" (1988).)

The news media publicized a statement in early 1991 discussing a possible link between golf course development and outbreaks of ciguatera poisoning incidents. Subsequently, members of the public repeated the charges in various public forums. Not only is there no linkage between golf courses and ciguatoxin outbreaks, but there is evidence that golf courses do <u>not</u> cause the problem. The appendix to a recent DOH (1990) report plotted locations and types of ciguatera poisoning incidents for Maui, Oahu, The Big Island, and Kauai. It is clear from the pattern of these plots that golf courses are not the source of the problem. Also, a controlled study demonstrated that nitrogen and phosphorus -- typical golf course fertilizers -- did not result in increased abundances of *G. toxicus* (Ballantine, et al., 1985; Caire, et al., 1985).

The cause of ciguatera outbreaks is unknown. However, significant habitat alteration, e.g. coral destruction through storms or dredging, can create ideal habitats for macroalgae. There is, also, speculation that such habitat alteration(s) may cause the proliferation of *G. toxicus*; however, there is no proof for this theory (DOH, 1990). Specific factors have

not been demonstrated to cause dinoflagellate blooms, including alterations of coral reef systems.

A more complete discussion of the subject can be found in the report by Dollar (1991). For example, he noted that the first recorded ciguatera poisoning incident was in 1606, long before the development of golf courses in tropical waters.

VII. CONCLUSIONS AND MITIGATION MEASURES

The Hana Ranch Country Club can be operated in a manner that would not impact the basal aquifer or nearshore organisms as long as responsible turf management is practiced. Fourteen synthetic and two "organic" pesticides are recommended to help the golf course through the first several years of operation. The pesticide and fertilizer scenario presented in the IGCMP is a reasonable worst case scenario. Conclusions about environmental impacts follow.

Ground Water. In the reasonable worst case--an approximation of the upper 95% confidence interval--pesticide concentrations at the top of the aquifer would be no greater than 1/76th of the lifetime Health Advisory Levels and generally much lower. This conclusion applies to the five pesticides most likely to contaminate ground water. These calculations were based on the assumption that the greens would be constructed according to US Golf Association specifications, a reasonable assumption. It was further assumed that the effluent from the greens would be "daylighted" (exposed) onto the surface of a rough, or otherwise conveyed to some other metabolically active environment, such as a pond, irrigation ditch, etc. This too is a reasonable assumption. Therefore we propose as mitigation measures that the greens be constructed according to USGA specifications, and the greens' drainage be conveyed to some other dissipative environment, such as the surface of a rough area. There would probably be no cause for concern if the IGCMP were followed even without these mitigation measures. However, it would be prudent and not impractical to implement these measures, even though most of the ground water under the site is not potable.

The appropriate fertilization program for this site, considering both turf growth and water quality impacts, recommends

that approximately 70% of the fertilizer nitrogen (N) be applied in the slow-release form. This minimizes ground water contamination potential relative to quick-release forms of N.

The expected N concentration increase in the top 5 ft of the aquifer, if the maximum amount of N is applied, would be less than 1 ppm. This is at least one order of magnitude less than the 10 ppm drinking water MCL. Increases in N concentrations at the point where ground water discharges to the shoreline would probably be nondetectable.

There were over 3100 head of cattle at the Hana ranch as of January, 1992. It is estimated that the manure from the cattle produces over 37,000 pounds of nitrogen (N) per year, more than 10 times the maximum loading anticipated for the proposed golf course. If Keola Hana Maui, Inc. desires to maintain the current level of N loading to the environment, the herd would have to be reduced by 10%.

Surface Water. There was no cause for runoff concern for the fertilizers or fungicides. The highly toxic, but efficacious insecticide chlorpyrifos raised some concerns for potential impacts on aquatic organisms during 1 year and 100 year return 24 hour storm events. Dissolved concentrations of chlorpyrifos in runoff from 1 year and 100 year storm events are predicted to be 2.2 ppb and 0.2 ppb, respectively. These predicted concentrations compare unfavorably with chlorpyrifos' 1 hour water quality criteria--0.011 ppb for marine organisms. It is highly unlikely that harmful concentrations would occur at the shoreline, due to the strong wave mixing action and the conservative assumptions we made in our modeling. None-the-less, when in doubt, it is better to err on the side of environmental protection. Consequently, we are tentatively recommending trichlorfon as a near-term mitigative measure. Trichlorfon is less persistent than chlorpyrifos, it has lower aquatic toxicity, it has a lower HAL, and it is registered for turf use in Hawaii against key insect grub pests. In the longer term, it is hopeful that the beneficial nematodes described in this report will provide an effective, non-chemical solution. The concern about the herbicide dithiopyr was based on predicted concentrations following the one year return storm event only. The predicted concentration at the mouth of the gulches (0.9 ppb) was slightly greater than our calculated water quality criteria (0.56 ppb), but did not consider dilution at the shoreline. As a conservative mitigation measure, we recommend that dithiopyr may be applied to 40 acres of the golf courses, but no more than 20 acres at a time, separated by intervals of at least six months.

Other Potential Nearshore Impacts. Ciguatera toxin can accumulate in reef fish under certain circumstances. If the reef fish are consumed by humans, illness and death can result. Nobody knows the reason for outbreaks of ciguatoxin outbreaks, which have been documented as long ago as 1606. But experimental and field data seem to indicate that turf management of golf courses is not the cause.

Spray Drift. Liquid pesticide formulations should not be an overly burdensome restriction since winds in the area are less than 11 knots (12.6 mph) 90.3% of the time. A tractor boom spray shroud may also be used to further reduce drift.

REFERENCES

Arnold, J.G., J.R. Williams, A.D. Nicks, and N.B. Sammons. 1990. SWRRB: A basin scale simulation model for soil and water resources management (1st ed). Texas A&M University Press. College Station, Texas.

Arnold, J.G., J.R. Williams, R.H. Griggs, and N.B. Sammons. 1991. SWRRBWQ. A basin scale water quality model for assessing management impacts on water quality. USDA, ARS, in cooperation with Texas Agricultural Experiment Station. Texas A&M University Press. College Station, Texas.

Arnold, J.G., J.R. Williams, R.H. Griggs, and N.B. Sammons. 1990b. SWRRBWQ basin scale water quality model documentation. USDA, ARS, in cooperation with Texas Agricultural Experiment Station. Texas A&M University Press. College Station, Texas.

Arnold, J.G. and J.R. Williams. 1987. Validation of SWRRB - simulator for water resources in rural basins. Journal Water Resources Planning and Management, ASCE 113(2):243-256.

Baker, J. 1987. Jerry Baker's Lawn Book. Ballantine Books, NY.

Ballantine, D.L., A.T. Bardales, and T.R. Tosteson. 1985. Seasonal abundance of *Gambierscus toxicus* and *Ostreopsis sp.* in costal waters of southwest Puerto Rico. Proc. 5th Int. Coral Reef Congress 4: 417-422.

Bilanin, A., M. Teske, J. Barry, and R. Ekbald. 1989. "AGDISP: The aircraft spray dispersion model, code development and experimental validation." Transactions of the ASAE 32 (1):327-334.

Boesten, J.J.T.I. and A.M.A. van der Linden. 1991. Modeling the influence of sorption and transformation on pesticide Leaching and Persistence. Journal of Environmental Quality 20(2):425.

Bohmont, B.L. 1990. The Standard Pesticide User's Guide, Prentice Hall Publishing Company. Inglewood Cliff, New Jersey. Pages 361-365.

Brady, N.C. 1990. The Nature and Properties of Soils (10th ed). MacMillian Publishing Company. New York, New York.

Brandenburg, R. L. 1989. Improved turfgrass insect management, part 3. North Carolina Turfgrass News 7 (2): 11, 13.

Branham, B. 1992. "Pesticide Fate Studies in Turf Using Model Ecosystems and Field Installed Lysimeters," abstract #AGRO 131, presented at the 203rd American Chemical Society National Meeting, San Francisco.

Brewer Environmental Services, 1990. "Chemical Usage for the Proposed Keola Hana Maui Golf Course, Hana, Maui, Hawaii." in Pacific Planning & Engineering, Inc., 1991. Hana Ranch Golf Course Environmental Assessment, prepared for Keola Hana Maui, Inc. Hana, Maui, Hawaii.

Brown, K.W., J.C. Thomas, and R.L. Duble. 1982. Nitrogen source effect on nitrate and ammonium leaching and runoff losses from greens. Agronomy Journal 74:947-950.

Brown, L. 1979. Grasses: an identification guide. Houghton Mifflin Company. Boston, Massachusetts. Page 6.

Brock, R.E., and A.K.H. Kam. 1990. The Waikoloa AnchialinePond Program Third Status Report. Hawaii Institute of Marine Biology/SeaGrant, University of Hawaii.

Brock, R.E., J.E. Norris, D.A. Ziemann and M.T. Lee. 1987, Characteristics of water in anchialine ponds of the Kona, Hawaii Coast. Pacific Science 41:200-208.

Caire, J. F., A. Raymond and R. Bagnis. 1985. Ciguatera: study of the setting up and the evolution of *Gambierdiscus toxicus* population on and artificial substrate introduced in an atoll lagoon with follow up of associated environmental factors. Proc. 5th Int. Coral Reef Congress 4: 429-435.

Carsel, R.F. C.N. Smith, L.A. Mulkey, J.D. Dean, and P. Jowise. 1984. Users manual for the pesticide root zone model (PRZM), Release 1." Environmental Research Laboratory, U.S. EPA. Athens, GA.

Cohen, S.Z., S.M. Creeger, R.F. Carsel and C.G. Enfield. 1984. Potential for Pesticide Contamination of Ground Water Resulting From Agricultural Use, in Treatment and Disposal of Pesticide Wastes, American Chemical Society Symposium Series 259, R.F. Krueger and J.N. Seiber, ed.. Washington, DC.Pages 297-325.

Cohen S.Z., S. Nickerson, R. Maxey, A. Dupuy, Jr., and J. Senita. 1990. A ground water monitoring study for pesticides and nitrates associated with golf courses on Cape Cod. Ground Water Monitor Review 10:160-173.

Craven, H. September 1990. Personal communication. Office of Pesticide Programs, U.S. EPA. Washington, D.C.

Daar, S. 1982. Managing vegetation: using IPM principals to manage turf without herbicides. IPM Practitioner 4 (9): 3,11.

Daniel, W. H. and R. P. Freeborg. 1979. Turf manager handbook. Harvest Publishing Company. New York, New York.

Davis, F.M., R.A. Leonard, and W.G. Knisel. 1990. "GLEAMS User's Manual, Version 1.8.55. Page 39.

Dean, J.D., P.S. Huyakorn, A.S. Donigian, Jr., K.A. Voos, R.W. Schanz, Y.J. Meeks, and R.F.Carsel. July, 1989. Risk of Unsaturated/Saturated Transport and Transformation of Chemical Concentrations (RUSTIC) Volume I: Theory and Code Verification. EPA/600/3-89/048a, Contract No. 68-03-6304 for the Environmental Research Laboratory, EPA. Athens, Georgia.

Dean, J.D., P.S. Huyakorn, A.S. Donigian, Jr., K.A. Voos, R.W. Schanz, and R.F.Carsel. July 1989b. Risk of Unsaturated/ Saturated Transport and Transformation of Chemical Concentrations (RUSTIC) Volume II: User's Guide. EPA/600/3-89/048b, Contract No. 68-03-6304 for the Environmental Research Laboratory, EPA. Athens, Georgia.

DOH (State of Hawaii, Department of Health, Clean Water Branch). 1990. "Interim Report on Coastal Water Quality and Ciguatoxin Fish Survey in West Hawaii." Honolulu, HI.

Dixon, C. May-August 1991. Personal communication. Soil Scientist. Turf Diagnostics and Design. Olathe, Kansas.

Dollar, S. 1991. "An Evaluation of the Role of Coastal Development in Incidences of Ciguatera Fish Poisoning," Appendix J in the O'oma II Final Supplemental Environmental Impact Statement prepared for Kahala Capital Corporation.

Dollar, S.J. and M.J. Atkinson. 1991. submitted. Effects of nutrient subsidies from groundwater to nearshore marine ecosystems off the Island of Hawaii.

Dragun, J. 1988. The Soil Chemistry of Hazardous Materials. The Hazardous Materials Control Research Institute. Silver Spring, Maryland. Pages 75-194.

Duble, R.L., J.C. Thomas, and K.W. Brown. 1978. Arsenic pollution from underdrainage and runoff from golf greens. Agronomy Journal 70: 71-74.

Ekern, P.C. and J. Chang. August, 1985. "Pan Evaporation: State of Hawaii, 1894-1983." Report R74. State of Hawaii, DLNR, DOWALD, Honolulu, HI; Water Resources Research Center, University of Hawaii at Manoa, Honolulu, HI; in cooperation with the Hawaiian Sugar Planters Association. Aiea, HI.

EPA. September, 1984. Chemical Fact Sheet #37 for Chlorpyrifos.

EPA. 1985. Ambient Water Quality Criteria for Copper - 1984, EPA 440/5-84-031, NTIS # PB85-227023.

EPA. February 27, 1985. Chemical Fact Sheet #37 for Fenarimol.

EPA. June, 1985. Chemical Fact Sheet #53 for Metribuzin.

EPA. 1986. Chemical Fact Sheet #83 for Imazaquin.

EPA. March 26, 1986. Chemical Fact Sheet #87 for Copper Hydroxide.

EPA. March 31, 1986. Chemical Fact Sheet #86 for Fluvalinate (Havric®).

EPA. June 30, 1987. Chemical Fact Sheet #211 for Oryzalin.

EPA. January, 1989. Drinking Water Regulations and Health Advisories. Office of Drinking Water, EPA. Washington, D.C.

EPA/OPP/HED (Environmental Protection Agency/Office of Pesticide Programs/Hazard Evaluation Division). June, 1986. Hazard Evaluation Division Standard Evaluation Procedure, Ecological Risk Assessment. NTIS #PB86-247657, Office of Pesticide Programs, EPA. Washington, D.C.

EPA, Office of Pesticide Programs and Office of Drinking Water. November 1990. "National Pesticide Survey Phase I Report," Washington, D.C.

Eyre, Paul, 1991. Personal communication, USGS. Honolulu, Hawaii.

FCH. 1991. Farm Chemicals Handbook. Meister Publishing Company. Willoughby, Ohio.

Foth, Henry D. 1978. Fundamentals of Soil Science. John Wiley & Sons, Inc. New York, New York.

Giambelluca, T.W., M.A. Nullet, and T.A. Schroeder. June, 1986. Rainfall Atlas of Hawaii. Report R76. State of Hawaii, DLNR, DOWALD Honolulu, HI; Water Resources Research Center, University of Hawaii at Manoa, Honolulu, HI; in cooperation with the Department of Meteorology, University of Hawaii at Manoa. Honolulu, HI.

Gold, A.J., T.G. Morton, W.M. Sullivan, & J. McClory, 1988. Leaching of 2,4-D and dicamba from home lawns. Water, Air and Soil Pollution 37:121-129.

Grau, F. V. 1986. The truth about turf. Science of Food and Agriculture. September 1986.

Green, R.E. and S.W. Karickhoff. 1985. Estimating pesticide sorption coefficients for soils and sediments. in Small Watershed Model (SWAM) for Water, Sediment, and Chemical Movement, Supporting Documentation. United States Department of Agriculture, Agricultural Research Service, ARS-80. 1-18.

Gustafson, D. 1990. Ground water ubiquity score: a simple method for assessing pesticide leachability. Journal of Environmental Toxicology Chemistry 8:339-357.

Hanson, A.A. and Juska F. V. 1978. History of turf usage. American Society of Agronomy Monograph 14: 2, 3, 6-8.

Harrison S.A. 1989. Effects of turfgrass establishment method and management on the quantity and nutrient and pesticide content of runoff and leachate. Master of Science Thesis in Agronomy. College of Agriculture. Pennsylvania State University.

Heydens, W. March 13, 1992. Personal communication. Manager of Toxicology Monsanto Agricultural Company. St. Louis, Missouri.

Hoefer, R. September 30, 1988. Personal Communication. ELANCO. Indiana.

Johnson, W.W. and M.T. Finley. 1980. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication 137. U.S., Dept. of the Interior, Fish and Wildlife Service. Washington, D.C.

Jury. W.A. 1986 Spatial variability of soil properties. in Vadose Zone Modeling of Organic Pollutants, S.C. Hern and S.M. Melancon, [Ed.], Lewis Publishers, Inc. Chelsea, Michigan. Pages 245-269.

Jury, W.A., D.D. Focht, and W.J. Farmer. 1987. Evaluation of pesticide ground water pollution potential from standard indices of soil-chemical adsorption and biodegradation. Journal of Environmental Quality 16:422-428.

Karickhoff, S.W., D.S. Brown, and T.A. Scott. 1979. Sorption of hydrophobic pollutants on natural sediments. Water Resources Research 13:241-248.

Kenaga, E.E., and C.A.I. Goring. 1980. Relationship between water solubility, soil sorption, octanol-water partitioning, and concentration of chemicals in biota, in Aquatic Toxicology ASTM STP 707. J.G. Eaton, P.R. Parrish, and A.C. Henricks, [Eds.], American Society for Testing and Materials, Philadelphia, PA. Pages 78-115.

Knisel, W.G. [Ed.]. 1980. CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. U.S. Department of Agriculture, Conservation Research Report No. 26. Page 640.

Leonard, R.A., W.G. Knisel, and D.A. Still. 1987. Groundwater loading effects of agricultural management systems. American Society of Agricultural Engineers 30 (5):1403-1418.

Loague, K.M., R.E. Green, T.W. Giambelluca, T.C. Liang, and R.S. Yost. 1990. Impact of uncertainty in soil, climatic and chemical information in a pesticide leaching assessment. Journal Contamination Hydrology 5:171-194.

Lorber, M.N. and C.K. Offutt. 1986. A method for the assessment of ground water contamination potential in Evaluation of Pesticides in Ground Water, W.Y. Garner, R.C. Honeycutt, and H.N. Nigg, [Eds.], American Chemical Society, Washington, D.C. Pages 342-365.

Lucas, L.T. 1984. Turf Diseases and Problems in 1984. North Carolina Turfgrass News 2:17.

Mallory, S. 1991. Personal communication. Superintendent, Waikoloa Village Gold Course. Waikoloa, Hawaii.

Mayer, F.L. April, 1987. Acute toxicity of chemicals to estuarine organisms. EPA/600 8-87/017, EPA, ERL. Gulf Breeze, Florida.

Mayer, F.L. 1991. Personal Communication. Environmental Research Laboratory, EPA. Gulf Breeze, Florida.

Mayer, F.L., Deans, C.H., and A.G. Smith. 1987. Inter-taxa correlations for toxicity to aquatic organisms. EPA/600/X-87/332, EPA, ERL. Gulf Breeze, FL; prepared for the Ecological Risk Assessment Program, Office of Pesticides and Toxic Substances, EPA. Washington, D.C.

Mayer, F.L. and M.R. Ellersieck. 1986. Manual of acute toxicity; interpretation and data base for 410 chemicals and 66 species of freshwater animals. Resource Publication 160. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C.

Mink, J.F. 1988. Hana Ranch Wananalua Well, State No. 4550-01. Prepared for Hana Ranch Inc.

Mink, J.F. 1991. Personal communication, Mink & Yuen. Honolulu, Hawaii.

Mink, J.F. and L. Stephen Lau. November 1987. Aquifer Identification and Classification for O'ahu: Ground water Protection Strategy for Hawai'i, Tech. Report No. 179. Page 5.

Morton, T.G., A.J. Gold, and W.M. Sullivan. 1988. Influence of overwatering and fertilization on nitrogen losses from home lawns. Journal of Environmental Quality. 17:124-130.

Neal, B.D. & Asssociates. 1992. Draft Air Quality Study for the Proposed Hana Ranch Golf Course Project, Prepared for Pacific Planning & Engineering, Inc.

Nelson, E.B. 1990. The advent of biological controls for turfgrass disease management. Cornell University. Turfgrass Times 1(1):1,4.

Nelson, E.B. 1991. Disease management. 1989-90. Cornell University. Turfgrass Research Report. Pages 90-118.

Owen, O. S. 1980. National resource conservation: an ecological approach (3rd Ed). McMillan Publishing Company, Inc. New York, New York. Page 231.

Peischel, A. January 19, 1991. Personal communication (letter) to Greg Friel of Hana Ranch.

Petrovic, A.M. 1990. The fate of nitrogenous fertilizer applied to turfgrass. Journal of Environmental Quality 19:1-14.

Petrovic, A.M. 1991. Teaching of natural organics, pesticides, and fertilizers. Proceedings of the International Golf Course Superintendent. Las Vegas, Nevada.

Rao, P.S.C. and J.M. Davidson. 1980. Estimation of pesticide retention and transformation parameters required in nonpoint source pollution models. in Environmental Impact of Nonpoint Source Pollution, M.R. Overcash and J.M. Davidson, [Eds.], Ann Arbor Science Publishers. Ann Arbor, MI. Pages 23-66.

Roberts, E.C. 1991. Turf stands tall amongst the trees. The Lawn Institute.

Roberts, E.C. and B.C. Roberts. 1988. Lawn and sports turf benefits. The Lawn Institute: 1, 12, 14.

Robey, M. J. 1977. Lawns. David McKay Company, Inc. New York, New York. Pages 2, 5.

Sabock, D. September, 1990. Personal communication. Office of Water Regulations and Standards, EPA, Washington, D.C.

Saunders, D.G. and F.L. Powers. 1989. Adsorption and desorption of fenarimol on soil. EWD8718. Page 4.

Schery, R. 1976. Lawn keeping. Prentice Hall, Inc., Englewood Cliffs, New Jersey. 7-8.

Smith, C.N. and R.F. Carsel. 1984. Foliar washoff of pesticides (FWOP) model: development and evaluation. Journal of Environmental Science and Health. B19(3):323-342.

Snyder, G.H., E.O. Burt, and J.M. Davidson. 1981. Nitrogen Leaching in Bermudagrass Turf: Effects of Nitrogen, Sources, and Rates. in Proceedings 4th International Turfgrass Research Conference., U. Guelph, Ont., 19-23 July, R. W. Shead (Ed.), U. Guelph, Guelph, Canada.

Snyder, G.H., B.J. Augustine and J.M. Davison. 1984. Moisture sensor-controlled irrigation for reducing N leaching in Bermudagrass turf. Agronomy Journal 76:964-969.

Squillace, P.J. and E.M. Thurman. 1992. Herbicide transport in rivers: importance of hydrology and geochemistry in nonpoint-source contamination. Environmental Science Technology. 26 (3):538-545.

Staiger, L.E. and G.B. Quistad. 1983. Degradation and movement of fluvalinate in soil. Journal of Agriculture and Food Chemistry 31:599-603.

Stearns, H.T. 1966. Geology of the State of Hawaii, 161-165.

SRC, Syracuse Research Corporation. New York.

Turgeon, A.L. April 28, 1992. Personal comminication. Head, Department of Agronomy, Pennsylvania State University.

USDA, SCS. 1972. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii. Page 232.

USDA, SCS. 1981. Erosion and Sediment Control Guide for Hawaii. U.S. Department of Agriculture, Soil Conservation Service, Honolulu, Hawaii, in cooperation with the Hawaii Association of Soil and Water Conservation Districts and the Soil Conservation Society of America, Hawaii Chapter, March, 1981.

USDA, SCS. 1986. Urban hydrology for small watersheds, 2nd ed. Technical Release No. 55. Washington, D.C. Page 162.

USDA, SCS. November, 1988. I-5 Pesticide Data Base in Water Quality Workshop: Integrating Water Quality and Quantity into Conservation Planning, U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

U. S. Department of Commerce. 1962. Rainfall frequency atlas of the hawaiian islands. Technical Paper No. 43: 60.

USGS, 1983. Hana Quadrangles, Hawaii-Maui County, Island of Maui, 7.5 Minute Series (Topographic) Map. U.S. Department of the Interior, Geological Survey, Reston, Virginia.

Vittum, P.J. 1986. Secret of controlling white grubs. ALA. November 7 (11): 34-38.

Walker, A. 1987. Further observations on the enhanced degradation of Iprodione and Vinclozolin in soil. Pesticide Science 21:219-231.

Water Resource Associates. March 1992. Water Resources and Supply For Proposed Hana Golf Course, Prepared for Pacific Planning & Engineering, Inc. Page 28.

Wauchope, R.D. 1988. USDA-ARS Interim Pesticide Properties Database, Version 1.0.

WSSA (Weed Science Society of America). 1989. Herbicide Handbook of the Weed Science Society of America, 6th ed. Champaign, Illinois.

Williams, J.R. and H.D. Berndt. 1977. Sediment yield prediction based on watershed hydrology. Transactions of the ASAE 20(6):1100-1104.

Williams, J.R., C.A. Jones, and P.T. Dyke. 1984. A modeling approach to determining the relationship between erosion and soil productivity. Transactions of the ASAE 27:129-144.

Williams, J.R., A.D. Nicks, and J.G. Arnold. 1985. Simulator for water resources in rural basins. Journal of Hydrology Engineering, ASCE 111(6):970-986.

Willis, G.H. and L.L. McDowell. 1987. Pesticide persistence on foliage. Review of Environmental Contamination and Toxicology 6 (100):23-73.

GLOSSARY OF TERMS

abiotic -- Non-living substance, at one time may have been living.

ADI - Acceptable Daily Intake for humans in milligrams/kilogram body weight/day, frequently referred to as the reference dose (RfD) when it represents an EPA-wide consensus.

aerification -- A mechanical process used to facilitate soil air/water relationships of the turf without destroying the integrity of the sod.

a. i. -- Active ingredient. Chemical agent in the product primarily responsible for the pesticidal effects. Percentage of a. i. is shown on the pesticide label.

annual -- Plant that completes its life cycle from seed in one year or season.

apron -- Fairway area immediately surrounding the collar of the green. Second cut. (see collar).

ascervuli -- Plural of ascervulus, a microscopic, black structure, embedded in plant tissue, on which fungal spores are produced.

bacteria -- Microscopic, single celled organisms having a cell wall but lacking an organized nucleus and incapable of making their own food. All plant pathogenic bacteria can live saprophytically.

biennial -- Plant that completes its life cycle from seed in two years or seasons. First year it produces a vegetative plant and stores food; the second year or season it produces flowers and seed.

biocoenosis -- A community of animal and plant life.

biotic -- Living substances.

blight -- Affecting a large portion of the leaves or the whole plant.

broadcast application -- Application over the whole area.

broadleaf weed -- Common term for plants in the dicotyledon group (dandelion, plantain, spurge, etc.).

broad spectrum pesticide -- Pesticide which is effective against several pests (in contrast with a specific pesticide which controls primarily one pest).

brushing -- A mechanical process to aid in grain control whereby horizontal stems are lifted so that they may be cut by the mower.

causal agent -- A substance which is involved in causing plant damage.

chlorophyll -- Green pigment found in structures called chloroplasts in plant leaves. Chlorophyll is the material which enables plants to carry out photosynthesis.

chlorosis -- A process by which plant tissue looses its normal green color and gradually becomes yellowed.

clippings -- Leaves, stems and stolons cut off by mowing.

collar -- Area between the putting area and the apron.

fixation -- state of being fixed.

HAL - Health Advisory Level, an acceptable concentration level in drinking water based on the ADI and Q* described above. Standard assumptions for lifetime exposure: 70 kg person consuming 2 liters of water per day. Standard assumptions for childhood exposure to neurotoxins: 10 kg child consuming 1 liter of water per day. An additional 5-fold safety factor was applied to HALs of pesticides with significant food uses, to allow for the possibility of additional exposure through the diet.

Half Life ($t_{1/2}$) - The time required for half (50%) of the original pesticide to transform to chemicals that are non-toxic or have significantly lower toxicity. For example, the herbicide 2,4-D is degraded rapidly with a 5-day half life in soils. On the other hand, the fungicide mancozeb is also nonpersistent, but one of its transformation products is toxic and thus was modeled.(q.v. below). Modeling requires the use of rate constants, k, which are related to other terms as follows for first order decay:

$k = 0.693/t_{1/2}$,

k = decay rate/[P],

where [P] = concentration of the parent pesticide.

innoxious -- harmless.

insolubility -- incapable of being disolved.

insecticide -- Any chemical used to manage (control) insects.

internode -- Part of a stem which lies between two successive nodes.

irrigation -- Applying water to turf.

K_d - Soil/water distribution coefficient. The higher the K_d the more tightly bound the chemical is to soils. This varies for each pesticide from soil to soil. Pesticides with K_d values less thanl are mobile in soils and can leach to ground water if they are persistent.

K_{oc} - The K_d divided by the organic carbon fraction of the soil. This should be calculated from the water solubility if experimental data are not available. The regression equation contained in the Kenaga and Goring reference (1980) was used to calculated K_{oc} when necessary and is expressed as: $\log K_{oc} = -0.55 \log WS + 3.64$, where WS = water solubility in ppm.

landing area -- Part of the fairway where tee shots usually land.

lapping, mower -- Part of the process of sharpening a reel mower.

layering, soil -- Undesirable stratification of different textured material in the soil.

localized dry spot -- Area of the soil which resists wetting,.

mat -- See thatch.

microflora -- Plants invisible to the naked eye, such as diatoms and algae.

monocotyledonae -- Botanical group in which monocotolyledons (one cotyledon or seed leaf) plants are placed. Leaves are usually longer than broad. Leaf veins are parallel.

mycelium (a) -- Thread-like body of the fungus generally invisible except during periods of luxuriant growth.

narrow leaf -- Common term for plants in the monocot group (all grasses, sedges, etc.).

necrosis -- Irreversible decline, death of the tissue. Usually yellow to tan or gray, then brown or black.

nematode -- Microscopic round worm which mainly infects the roots of plants. Most plant parasitic nematodes need to feed on a plant in order to get food required for reproduction.

node -- A stem joint capable of producing buds, leaves and/or roots.

noninfectious -- Incapable of entering a living plant and causing disease.

nonselective -- Herbicide which kills plants irrespective of species. Not selective for controlling weeds without injury to turf

nursery, turf -- Place where replacement sod or vegetative planting material is grown for Planting elsewhere.

obligate parasite -- An organism incapable of completing its life cycle outside a specific host plant.

osmosis -- The process by which liquid passes through a semipermeable membrane from a lower concentration to a higher concentration.

overseeding -- Seeding a semidormant turf with a cool season grass so that a playable turf is available in the wintertime.

panicle -- Many branched flower head with flowers at the end of each branch. Common in grasses such as annual bluegrass.

parasite -- Any living organism which is capable of deriving its nutrition from another living organism but may not necessarily cause disease in the host organism.

pathogen -- Any parasite capable of causing a disease.

pesticide -- A generic name given to a chemical capable of controlling insects, pathogens and/or weeds.

perched water table -- an accumulation of water above the soil interface. An interface between a fine-textured soil and an underlying coarse texture. The continuity of water films is disrupted, slowed, or stopped altogether.

photosynthesis -- Process by which plants containing chlorophyll are capable of Producing their own food (carbohydrates) from carbon dioxide and water in the

physiological -- The functioning of plant processes dependent on biochemical actions.

poling -- Using a limber pole to remove the dew from leaves of grass.

postemergence -- After germination and emergence from the soil.

prostrate -- Growth habit of tendency to lie flat on the ground.

Q* - Carcinogenic potency factor. This is multiplied times the dose, or intake, to produce the carcinogenic risk for group B carcinogens (probable human carcinogens).

reel mower -- Mower that cuts turfgrass by means of a series of curved, rotating blades which pull the grass into a stationary bedknife and cut the grass in a manner similar to a scissor.

renovation -- Improving a turf without completely destroying the turf characteristics. May or may not include planting new seed or vegetative material into an existing

residue -- That which remains.

rhizome -- Below ground stem with nodes and internodes capable of producing a new plant at each of the stem nodes.

rosette -- A tuft or cluster of closely crowded leaves arising from a very short stem. Caused by the dwarfing or compaction of the internodes.

rotary mower -- A mower that cuts the grass by means of a single blade, mounted parallel to the surface of the turf and sharpened on each end. The blade revolves at a high rate of speed in a horizontal plane and cuts the leaves of the grass by impact action.

rough -- Part of the golf course which borders the tee, fairway and greens. Usually mowed at a higher level and maintained less intensively than other parts of the golf course. Does not usually come into play.

scald -- Injury to turf caused by standing water.

scalping -- Excessive removal of the green portion of the turf plant, leaving brown stubble exposed.

sclerotia -- Propagules, composed of hardened masses of mycellium which aid the fungus in surviving periods of adversity. Golden brown to black in color and spherical to irregular in shape. Can be the size of a cabbage seed to microscopic.

selective -- Type of herbicide which will control one plant species without injury to another. Usually indicates that herbicide will kill weeds without injuring certain species of turfgrasses. Excessive rates of application may reduce or eliminate the selectivity.

semidormant -- Turf which is in a quiescent stage because temperatures are below the optimum for normal growth.

senescent -- Plant tissue declining after reaching maturity. Old age.

sheepfooting -- A method of compacting soil in putting green construction. This may be performed by the use of human feet or mechanically by a soil compactor.

slicing -- Method of cultivation or aerification in which a blade cuts through the turf intermittently, perpendicular to the surface.

sod -- Plug, squares or strips of turf which has some adhering soil. Usually produced in a large controlled area.

soil applied pesticide -- Pesticide which is applied to the soil where it has its activity. Some may be taken up by root and translocated to other parts of the plants.

spiking -- Method of cultivation in which a solid tine or pointed blade penetrates the turf and soil.

sporulate -- Process by which a fungus produces spores.

spot spraying -- Application of a pesticide to small areas. Contrasted to broadcast application.

sprig -- a generic term for a vegetative planting material. May include stems, leaves, roots, stolons, rhizomes, etc.

sprigging -- Establishing turf by means of planting sprigs or stolons.

stimpmeter -- A device to measure the speed of putting greens.

stringlining -- The art leveling a soil surface with a marked line using a line with string or the use of a piece of square lumber shuffled across the surface.

stolon -- Above ground stem which spreads laterally at the soil surface producing new plants at the nodes.

suboxidation -- A condition in which soil oxygen is severely limited.

surfactant -- Material which reduces the surface tension of a liquid (such as water) and improves the spreading of the liquid on a surface. Usually used with pesticides applied to the foliage to improve coverage.

syringing -- Applying a small amount of water, usually in the form of fine droplets, to cool the plant, prevent wilt, or remove dew.

systemic -- Pesticide which is absorbed into a plant through the leaves and/or roots and translocated throughout the plant.

thatch -- A layer consisting partially of undecomposed organic matter, between the crown of the plant and the soil surface and/or below the soil surface.

transition zone -- An irregular east-west zone consistent with isothermal lines between warm season grasses are well adapted. Both may be grown in this zone.

translocation -- Movement of materials within the plant from point of entry to other areas, such as leaves to roots or roots to leaves.

vascular system -- Conducting or transport avenues in plant tissue, such as veins in leaves.

vertical mowing -- Use of a mechanical device with vertical cutting blades to manage grain and thatch.

verticutting -- Using a vertical mower.

viruses -- Submicroscopic entities consisting of a nucleic acid and a protein sheath. All viruses are obligate parasites as they can only multiply in living plant cells.

warm season turfgrasses -- Species of turfgrass which are adapted to the warmer subtropical and tropical regions of the world. Members of the subfamilies Panicoideae and Eragrostideae. On golf courses in warm regions of the world, primarily bermudagrasses (Cynodon spp.).

weak pathogen -- Organism not capable of infecting vigorously growing tissue. It generally attacks tissue under a biological stress from abiotic or biotic causes. Often referred to as a "secondary pathogen", as it usually attacks tissue previously infected by a primary pathogen.

wetting agent -- See surfactant.

wilt -- Drooping of turfgrass leaves due to loss of turgor under moisture stress. Wilt may be due to acute and/or chronic lack of soil moisture, a dysfunction of the root system such as from a root rot, excessive salts in the soil water, or from suboxidation which limits the uptake of water as oxygen is essential for the process of water uptake.

Appendix A.

Insect and Mite Management Fact Sheet

BLACK TURFGRASS ATAENIUS

SPECIES: *Ataenius spretulus* (Haldeman). [Phylum Arthorpoda: Class Insecta: Order Coleoptera: Family Scarabaeidae]

DESCRIPTION: The species is found in all states east of the Rocky Mountains. However, most reports of damage have been recorded north of a line running from southern Virginia across to southern Colorado. Similar species in this genus as well as *Aphodius* are know to attack turfgrasses world wide.

HOSTS: Commonly attacks bentgrass, annual bluegrass and Kentucky bluegrass. Occasionally found in other turf where excessive thatch has accumulated.

DAMAGE SYMPTOMS: This grub usually attacks close cropped turfgrasses around golf courses. Turf first wilts and does not respond long after irrigation. The turf is easily peeled back because of the lack of roots. Death of turf in irregular patches occurs in June or August.

DESCRIPTION OF STAGES: The larvae look like typical white grubs but the adults are more elongate than other turf infesting scarabs. This species is also very small and has two generations per year. Several species of *Ataenius* and *Aphodius* require an expert for accurate species identification.

Eggs: The pearly white eggs are approximately .52X.72mm and are laid in clusters of 11-12 eggs. The eggs expand slightly when moist.

Larvae: The C-shaped white grubs are very small but third instars can be separated from other grubs using a 10X hand lens. The tip of the abdomen has two distinct anal pads and the few raster bristles are scattered at random. Smaller grubs have these characters but a microscope may be needed to see them. Full grown larvae are approximately 8mm long.

Pupae: The small, 6-8mm long pupae are first white but become reddish with maturity.

Adults: The small, shiny black beetles are 3.6-5.5mm long and 1.7-2.4mm wide. The prothorax has small pits scattered over the surface and the wing covers have distinct longitudinal grooves. Newly emerged adults are reddish to dark chestnut brown but these become black in a few days.

LIFE CYCLE AND HABITS: There are many species of *Ataenius* in the United States and most are dung feeders. However, a couple of species, especially *A. spretulus* and *A. strigatus*, feed on decaying humus as well as living plant roots. *A. spretulus* was first recorded as damaging golf greens in the 1930's but major outbreaks of this pest began to occur in the 1960's and 1970's on golf course greens, trees and aprons. In heavily managed turf, damage may extend into the fairways. Optimum habitat for this grub seems to be short cut turf with a moist compacted thatch layer. Adult black turfgrass ataenius beetles overwinter 1-2 inches in the soil under leaf litter and plant material along the edges of fairways and in wooded roughs. The adults emerge in early spring, usually when spring crocus and red buds are in bloom. These adults warm in the spring sun and fly to turf areas where they dig into the thatch. Upon finding a suitable oviposition site, usually in April and early May, the females lay clusters of 11-12 eggs in the thatch just above the soil. Most of the eggs are present from mid-May to early June, during which time they take about a week to hatch. The tiny white grubs feed on the organic material in the thatch including grass roots. Grub populations of 200-300 per ft^2 are common and grub populations of 50 per ft^2 can severely damage the turf. The first generation larvae take about 4 weeks to mature. These mature grubs dig into the soil and make a compact pupal chamber. The pupa takes a little more than a week to mature and becomes reddish brown before the adult emerges. Young adults are also reddish brown and these "callow" adults may emerge and craw or fly about before becoming completely black in a few days. The first generation adults are active in July laying a new batch of eggs. The second generation of grubs severely damage the turf in August when rainfall is scarce. Because the summer adults may lay eggs over an extended period of time, a few larvae can be found in September and October. If the larvae do not mature by winter they die. The second generation adults emerge in late August through September and these seek overwintering sites, usually near the edges of wooded lots.

CONTROL STRATEGIES: This grub has two generations per year and insecticides for the grubs may be needed for either generation.

Strategy 1: **Chemical Control - Timing Using Indicator Plant Phenology** - Control of the first generation of grubs is best achieved if pesticides are applied when black locust trees or Vanhoutte spirea shrubs are in full bloom. The second generation of larvae can be controlled when the Rose of Sharon begins to bloom.

Strategy 2: **Cultural Control - Water Management** - Practically all white grub species require moist soil for their eggs to hatch. The young larvae are also very susceptible to desiccation. In areas where turf can stand some moisture stress, do not water white grub eggs and young larvae are present. On the other hand, moderate grub infestations can be out grown if adequate water and fertilizer is applied when the grubs are feeding. This latter strategy is not preferred because mammals may dig up the turf or irrigation bans may occur.

Strategy 3: **Biological Control - Milky Diseases** - Several strains of the bacterium, *Bacillus popilliae*, have been found which effectively attack white grubs. However, the normal commercial preparation of this bacterium is extracted from Japanese beetle grubs and is most effective against this species. Ataenius and aphodius beetles have their own strains of these diseases. None are commercially available.

Strategy 4: **Biological Control - Parasitic Nematodes** - Insect parasitic nematodes in the genera *Steinernema* (=*Neoaplectana*) and *Heterorhabditis* have been shown to be effective against white grubs. However, at present these nematodes are difficult to rear in large quantities and applications of these living organisms can be difficult and expensive. Field trials of *S. carpocapsae* strains have generally resulted in less than 50% control, though *H. heliothidis* strains have achieved 80% control or better. At present, available strains do not appear to be effective from one season to the next. Check with state extension specialists for current information on strain efficacy and usage.

Strategy 5: **Chemical Control - Preventive Pesticide Applications** - Since white grub occurrence is rather sporadic, applying pesticides for control of anticipated grub populations is not recommended. However, in areas where adult activity has been observed or perennial infestations have occurred, preventive applications may be warranted. Currently, isofenphos (Oftanol) and isazophos (Triumph) are the only registered products which seem to have extended activity. Both of these pesticides are susceptible to enhanced degradation and preventive applications may contribute to the development of this phenomenon.

Strategy 6: **Chemical Control - Early Reactive Pesticide Applications** - Most of the modern soil insecticides have short active residual periods (three weeks or less) and must be used

when the grubs are present. None of the registered insecticides is 100% effective; they usually kill 75-90% of the grubs present in any given area. This is why reapplications may be necessary when grub populations get very high. Timing of early reactive treatments is critical for success. You should apply the pesticide when the grubs are small and actively feeding and late enough to catch all of the population that will be present for the season. White grubs can be rather difficult to control because they generally inhabit the zone where the soil and thatch meet. In general, reducing thatch and using good irrigation after making a pesticide application will increase control. By using the adult sampling methods with early white grub sampling, virtually all of the registered grub insecticides work well.

Strategy 7: **Chemical Control - Late Season Reactive Pesticide Applications** - Occasionally turfgrass damaging population of white grubs may go undetected until the turf begins to wilt dramatically. By this time the annual white grubs are usually third instars and may be 70-80 times the body weight of a newly hatched grub. These mature grubs are voracious feeders and may be near the time to pupate. Chemical control of these large grubs is difficult, at best. If a late season insecticide application is needed, diazinon, isazophos (Triumph) and trichlorfon (Dylox, Proxol) have been the most successful. Be sure to irrigate well after the application in order to keep the grubs near the soil/thatch interface and to wash in the pesticide.

BERMUDAGRASS MITE

SPECIES: *Eriophyes cynodoniensis* Sayed. [Phylum Arthropoda: Class Arachnida: Order Acarina: Family Eriophyidae]

DISTRIBUTION: In North America, this pest was first discovered in Arizona. It is now found in virtually all of the states in which bermudagrass is grown. Is has also been spread world wide with records from Australia and Africa.

HOSTS: Bermudagrass, *Cynodon dactylon* (L.) is the only host known to be attacked though some cultivars are resistant.

DAMAGE SYMPTOMS: Damage is first noticed when bermudagrass does not seem to have vigorous growth in the spring and is often yellowed. The turf appears stunted and close inspection reveals that the stem length between nodes is greatly reduced. Leaves and buds at the nodes become bushy, forming a rosette or tuft which is called "witchesbrooming." Heavy infestations produce clumps of distorted stems on leaves which eventually turn brown and die.

DESCRIPTION OF STAGES: This mite has stages typical of the eriophyid mite group. These are extremely small mites with worm-like soft bodies.

Eggs: Round, translucent white eggs are about 1/3 the length of the adult.

Nymphs: The first nymph has the tapered worm-like shape of the adult but is almost clear. These mites have only two pairs of short legs rather than the four pairs of legs found on most mites. The abdomen has minute rings which look like segments. The second nymph is about 2/3 the length of the adult and more white in color.

Adults: Only females are known, as in most eriophyids. These look like the nymphs and are only .2mm long when fully grown but have a whitish cream color.

LIFE CYCLE AND HABITS: Because of their small size, these mites are very difficult to study and little is understood about their life cycles and habits. Most eriophyids lay less than a dozen eggs during their adult span and these usually hatch in 2 to 3 days. At 75°F it is estimated that adulthood is reached in 7 to 10 days and eggs are laid for two to five days. Thus, a cycle can be completed in 1.5 to 2 weeks. This short time period allows for a rapid build up of a population during summer temperatures. The bermudagrass mite seems to be quite tolerant of high temperatures, having moderate mortality at 120°F. Cold temperatures tend to stop development though survival during the winter can take place where bermudagrass remains green at the soil surface. This mite can apparently spread by being blown or carried on the legs of other insects. However, the most common method of spreading is by transportation of infested turf. The mites cannot survive on bermudagrass seed.

CONTROL STRATEGIES: Eriophyid mites usually are not killed by normal miticides but are killed by many insecticides. Controls are probably warranted when 4-8 witchesbroomed tufts per ft^2 are encountered in an area.

Sampling

A three by four foot plastic rectangle should be strung on one ft^2 grids (12 ft^2 total). The sampling hoop consists of four sections of 1-inch PVC pipe. Two are three foot long segments and two are four foot long segments. The segments are joined with right angle connecters and glued. Holes are drilled through the sides at one, two and three (on the four

foot segments only) feet from each corner. A monofiliment string is then threaded, in a grid pattern, through the holes. This hoop is tossed onto the turf and ten of the ft^2 grids are rated for mite activity. Each tuft of turf with a witchesbroom is counted. Fairways and roughs should be sampled every 50 yards and four hoop samples should be taken for each green and apron. Tees should have two hoop samples. When presence of the mite activity is noted, samples should be taken every month. If the activity is increasing and exceeds 4-8 tufts per ft^2, chemical controls are probably warranted. Below four tufts per ft^2, cultural controls should be used.

Strategy 1: Cultural Control - Use Resistant Varieties - Common bermudagrass is often attacked but improved varieties such as Tifgreen (238) and Tifway (419) have shown considerable resistance.

Strategy 2: Cultural Control - Turf Maintenance - The bermudagrass mite does not do well in short turf. However, mowing too short may scalp the turf. Good fertilization and water will help reduce stress and mask mite populations. Mite attacks are seldom damaging during wet periods.

Strategy 3: Chemical Control - Soft Pesticides - Though not specifically registered for this pest, some of the insecticidal soaps can be used on turf. Industry reports indicate that these soaps, when used with sufficient water to thoroughly wet the turf grass blades and stems, are effective in controlling turf attacking mites.

Strategy 4: Chemical Control - Traditional Pesticides - Proper identification is needed because water stress can look like early mite damage. A microscope with at least 30X magnification will be needed to adequately see the mites. Short residual pesticides may have to be reapplied in 7 to 10 days to kill mites hatching from eggs. At present, diazinon (not on golf courses or sod farms), dicofol (=Kelthane ®) and fluvalinate (=Mavrik ®) are the only products registered for this pest. In the literature, chlorpyrifos (=Dursban ®) has also been effective.

BERMUDAGRASS SCALE

SPECIES: *Odonaspis ruthae* Kotinsky. [Phylum Arthropoda: Class Insecta: Order Homoptera: Family Diaspididae]

DISTRIBUTION: This scale is found world wide in tropical and subtropical regions. In the United States, this scale attacks bermudagrass from California to Florida. It is also known from Hawaii.

HOSTS: This scale is most frequently reported on bermudagrass, *Cynodon dactylon* (L.), though it has been found on centipedegrass [*Eremochloa ophiuroides* (Munro.) Hack], bahiagrass [*Paspalum notatum* Flugge]. St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntz] and tall fescue [*Festuca arundinacea* Schreb.].

DAMAGE SYMPTOMS: Bermudagrass first appears to grow slowly and has a yellow color. This often looks like drought stress. Heavy infestations may dramatically thin and kill patches of bermudagrass. This type of damage is more evident during periods of hot, dry weather. Where bermudagrass enters winter dormancy, this scale can cause a delay in the spring green up.

DESCRIPTION OF STAGES: This is a typical armored scale which lays eggs and has winged male stages.

Eggs: The elongate oval eggs are pink to light burgundy-colored and are located within the female shell.

Crawlers: The eggs hatch into a first instar nymph called a crawler. This stage is pink and the body is very flat and oval. They have short legs, antennae and eye spots.

Settled Nymphs: Settled crawlers begin to produce an oval, waxy test (shell) which is first straw yellow and then covered with white waxy secretions.

Adults: Adult females have shells, or tests, which are egg-shaped or oval in outline and 1.0-1.75 mm long. Often, there is a straw yellow area, the exuvium, near the larger end. The actual female body, inside the test, is oval and pinkish in color. Male scale tests are about one-half the size of females. The males are able to emerge from their test and are small gnat-like insects with one pair of wings. Their yellowish-pink bodies are about 0.5 mm long and have 2-3 long white waxy threads arising from the tip of the abdomen.

LIFE CYCLE AND HABITS: Little is known about the actual time periods needed for development of this scale. Most studies have attempted to assess development by counting the numbers of different stages at various times of the year. From these studies, it appears that the bermudagrass scale may have two overlapping generations per year in the southern states. In Georgia and Florida, eggs are laid and crawlers are most active in the spring rainy season. Settled crawlers and adults can be found during much of the season, though little growth occurs during winter dormancy or during summer drought periods. It is suspected that this scale has continuous generations in warmer climates where the bermudagrass does not go dormant.

The eggs are laid and retained inside the female scale test. As the eggs hatch over several weeks, the tiny crawlers move along the stolons and lower grass stems. They prefer to settle under old leaf sheaths at the bases of crowns, but they may be found anywhere on the stolons and lower stems. Often, large numbers of settled crawlers and young adults can be found on stems and stolons in the soil or thatch layer.

Rarely are the scales exposed on upper plant parts. As the settled scales grow, they begin to cover the body with loose waxy filaments which eventually give way to the formation of a solid, waxy shell-like test. At maturity, the scales often extend slightly from under the old leaf sheaths which originally hid the body. Populations can be so large at nodes and crowns that the scales seem to be stacked on top of each other.

CONTROL STRATEGIES: At present, no biological controls are known for this pest. Undoubtedly, small predators take their toll on the crawlers but this has not been confirmed. Insecticide treatments have not been very successful in controlling this pest and none are currently registered for this purpose. Since eggs and crawlers may be present over extended periods, timed applications for crawlers are difficult to make. Damage assessment and control thresholds are not developed for this pest. However, when 30-40% of the turf shows yellowing from this pest, control procedures are probably warranted.

Sampling

When yellowed turf is encountered, the scale should be sampled for by digging out several affected stolons with attached above ground stems. Inspect the nodes and bases of the stems for the oval, white scales. If the scale is confirmed, a sampling program should be followed.

A three by four foot plastic rectangle should be strung on one ft^2 grids (12 ft^2 total). The sampling hoop consists of four sections of 1-inch PVC pipe. Two are cut into three foot long segments and two are cut into four foot long segments. The segments are joined with right angle connecters and glued. Holes are drilled through the sides at one, two and three (on the four foot segments only) feet from each corner. A monofiliment string is then threaded, in a grid pattern, through the holes. This hoop is tossed onto the turf and ten of the ft^2 grids are rated for yellowing from scale activity. Each ft^2 with yellowed turf is counted as one. Fairways and roughs should be sampled every 50 yards and four hoop samples should be taken for each green and apron. Tees should have two hoop samples. When presence of the scale activity is noted, samples should be taken every two months. If the activity is increasing and exceeds four ft^2 grids per 10 sampled, chemical controls are probably warranted. Below four ft^2 grids per 10 sampled, cultural controls should be used.

Strategy 1: **Cultural Control - Water and Fertilize Turf -** Bermudagrass that is well fertilized and watered, generally can outgrow this pest. However, damage can begin to appear if irrigation must be discontinued in the summer.

Strategy 2: **Chemical Control - Traditional Insecticides -** No insecticides are specifically registered for this pest. Literature reports indicate that diazinon reduced populations. Diazinon is no longer registered for golf course or sod farm use. Chlorpyrifos (=Dursban ®) has traditionally had similar effects on scales as diazinon and some golf course managers report success with this product. It should be applied when female scale tests are full of eggs. It must also be washed into the thatch with irrigation immediately after application in order to reach the target pests.

BLACK CUTWORM

SPECIES: There are many species of thick bodied, non-hairy caterpillars which are called cutworms. Some of these attack turfgrasses but the black cutworm, *Agrotis ipsilon*. (Hufnagel), is the most wide spread. This pest is also called the greasy cutworm and the dark sword grass moth. [Phylum Arthropoda: Class Insecta: Order Lepidoptera: Family Noctuidae]

DISTRIBUTION: The black cutworm is found all across North America but is also found in Europe, Asia and Africa. Though this pest has trouble spending the winter where soil temperatures may reach below 15°F, adults are strongly migratory and northern regions can become reinfested each season.

HOSTS: All species of turfgrasses may be attacked as well as a host of field crop plants and vegetables.

DAMAGE SYMPTOMS: This is a true cutworm and is a semisubterranean pest. They usually dig a burrow into the ground or thatch and emerge at night to clip off grass blades and shoots. This feeding damage often shows up as circular spots of dead grass or depressed spots which resemble ball marks on golf greens.

DESCRIPTION OF STAGES: Cutworms are the larvae of moths and thus have complete life cycles with eggs, larvae (caterpillars), pupae and adults.

Eggs: The eggs are usually round, 0.5-0.6 mm in diameter, flat on the lower surface, and bluntly pointed at the top. When freshly laid, they are greenish but become tan to dark brown before hatching.

Larvae: The larvae have generally hairless bodies except for a few bristles scattered over the body. The general body color is gray to nearly black on the upper half and slightly lighter gray below. Often, a pale and indistinct middorsal line is visible. Under a microscope, the body integument appears to have a pebble-like surface. Mature larvae can be 30-45 mm long and 7.0 mm wide.

Pupae: The pupae are brown, reddish-brown or black and 13-22mm long. The antennae, wingpads and legs are firmly joined together, but the abdomen is free to twist around if the pupa is disturbed.

Adults: The adults are generally dark gray to black colored moths with some brown markings. The forewings span 35-45 mm and a black, dagger-shaped marking appears at the outer edge.

LIFE CYCLE AND HABITS: The black cutworm appears to overwinter as larvae or pupae in the northern states. At the level of Ohio, three generations occur but five to six generations can occur in Louisiana. Subtropical regions probably have continuous generations. Adults emerge at night from pupae formed in the soil or thatch. The adults usually mate within the first 2-4 nights after emergence. They actively feed on nectar from flowering plants at night. Each female has the capacity to lay 1200-1600 eggs over 5-10 days. Though the adults prefer to lay eggs on curly dock and mustard, they may lay eggs on any suitable host. They often get into turf where broadleaf weeds are present. Eggs are usually laid in clusters of 20 to several hundred. The eggs hatch in 3-6 days and the first instar larvae usually feed on the leaf surface. After several days and molting, the larvae work their way to the base of plants. The cutworms excavate a hole into the ground and line it with silk. However, on golf courses, the

larvae readily set up in the aeration holes or in the holes left behind from the spikes on golf shoes. From this retreat, the larvae venture forth at night to feed on plant material. Often they will drag a leaf or stem back to their burrow to feed on during the daytime. Most of the larvae go through six to seven molts in 20-40 days to complete their larval development. The pupa is usually formed in the cutworm retreat with some additional silk lining the chamber. The pupa takes about two weeks to mature. These developmental times may be greatly lengthened during the cooler parts of the season.

CONTROL STRATEGIES: Black cutworms are generally controlled by using one of the contact or stomach pesticides. However, if populations are high in surrounding areas, such as in field crops, continual reinfestations may occur. Because of this, contact with local cooperative extension services or pest management consultants may be beneficial in determining local pest activity. Young cutworms are difficult to locate so use of a disclosing solution is beneficial in determining population pressure.

Sampling

A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known to not cause turf damage) in two gallons of water should be used. With a common garden sprinkling can, apply the two gallons of soapy water to a one square yard (1.0 yd²) area. Within 3-5 minutes the caterpillars will come to the surface and can be easily counted. Remedial controls are needed if 5-10 larvae per square yard of green or tee are found.

Adults can be monitored using the black cutworm pheromone trap or black light traps. Larvae can be expected about 7-10 days after peak trap catch.

Strategy 1: Biological Control - Microbial Toxins - Some of the 'Spodoptera' strains of Bt (*Bacillus thruingiensis*) toxins, such as Javelin® and Steward®, have had good activity against the black cutworm's relatives the armyworms. For maximum efficacy against the black cutworm, these pesticides need to be applied when the young larvae (first and second instars) are active. Make applications about seven days after peak adult trap catches are realized.

Strategy 2: Biological Control - Entomopathogenic Nematodes - The insect parasitic nematodes are generally effective against the larger larvae of this pest. Products containing *Steinernema carpocapsae* (=Biosafe®, Biovector®, Exhibit®, Scanmask®) can be applied when the larval populations have been surveyed. Best efficacy is obtained by applying the nematodes in the late afternoon, just before sunset.

Strategy 3: Chemical Control - Poison Baits - These caterpillars often will feed on grain baits and these can be used when continuous adult flights are causing reinfestations. Baits often lose their attractiveness after irrigation or rains.

Strategy 4: Chemical Control - Traditional Insecticides - If a disclosing solution test has indicated considerable activity, a pesticide application may be needed. Acephate (=Orthene®), bendiocarb (=Turcam®, Ficam®), carbaryl (=Sevin®), chlorpyrifos (=Dursban®), cyfluthrin (=Tempo®), diazinon (not on golf courses or sod farms), fluvalinate (=Mavrik®), isazophos (=Triumph®), isofenphos (=Oftanol®) and trichlorfon (=Dylox®, Proxol®) are registered for turf caterpillar control. The synthetic pyrethroids (cyfluthrin and fluvalinate) and the organophosphate, trichlorfon, have the shortest residual periods and probably the least long term affect on beneficials. Applications should be made to the foliage of the turf in the late afternoon. If the label allows, do not irrigate after making an application since the insecticide needs to be on the leaves which are going to be fed on that night.

Strategy 5: Cultural Control - Weed and Aeration Management - Since this pest is attracted to various broadleaf weeds, reduction of these populations will reduce the attractiveness of the turf environment. Since the larvae have better survival in existing burrows, hold back aeration when adult trapping indicates significant activity.

FIERY SKIPPER

SPECIES: *Hylephila phyleus* (Drury). [Phylum Arthropoda: Class Insecta: Order Lepidoptera: Family Hesperiidae] Several species of skippers can be found feeding on turfgrasses. Proper identification probably requires the help of an expert.

DISTRIBUTION: This butterfly is found over most of North and South America. It is most abundant in the Gulf States and becomes rare at the Canadian border. It was detected in Hawaii in 1970 on the island of Oahu and has since spread to most of the other islands.

HOSTS: The larvae seem to prefer bermudagrass, *Cynodon dactylon* (L.), but St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntz, and weedy grasses are commonly fed upon. Turf with crabgrass infestations appear especially attractive.

DAMAGE SYMPTOMS: The individual larvae feed in localized spots and cause isolated round spots, 1-2 inches in diameter. If an extensive infestation occurs, the spots join together and larger irregular brown patches result.

DESCRIPTION OF STAGES: This is a typical butterfly with a complete life cycle.

<u>Eggs</u>: The round eggs look like a small ball cut in half. They are about 0.7 mm in diameter and 0.5 mm tall. When freshly laid they are white but change to a light blue-green in a day or two.

<u>Larvae</u>: Skipper larvae are unique in form. They have dark heads, an obvious constriction of the neck and plump bodies covered with tiny bristles. The first instar larva is a pale greenish yellow and about 2.5 mm long. Mature larvae become yellow brown to gray brown with an indistinct median longitudinal stripe. Mature fifth instar larvae are 24-25 mm long.

<u>Pupae</u>: The pupa is formed in the thatch or in loosely webbed together turf debris. The pupa is 15-18 mm long and changes from a light greenish-tan to an overall brown just before adult emergence.

<u>Adults</u>: The adults are robust yellow butterflies with orange and brown markings. The wings span about 25 mm with a body about 16 mm long.

LIFE CYCLE AND HABITS: In tropical and subtropical regions, this pest is active all year. In these areas, three to five generations are normal. In the northern part of its range, only two to three generations are completed with the adults being most numerous in mid to late summer. Adult fiery skippers are strongly attracted to nectar producing flowers such as lantana and honeysuckle. They will also visit other annual flowers. The males appear to be slightly territorial and often perch near flowers being visited by the females. They strongly pursue females or other males flying into the area. Newly emerged females appear to take 3-4 days before oviposition begins. During the middle of the day, females alight on turf and place eggs at random. The females rarely lay more than one egg per stop and the eggs are usually cemented to the underside of a leaf blade. Egg laying continues for 4-6 days with each female laying between 50 and 150 eggs. At 80°F and above, eggs can hatch in 2-3 days. Up to six days may be needed at lower temperatures. The newly hatched larvae feed on the margins of turf grass blades but soon drop into the turf canopy and spin a loose silk shelter. From within these silken shelters, the larvae emerge at night to remove and eat entire leaves. This produces small round damage spots in the turf. Once larval development is complete, they form their cocoon in the silken shelter. At 75°F, this pest took 48 days to complete development from egg to adult. Above 81°F, the cycle took only 23 days.

CONTROL STRATEGIES: This insect rarely produces enough numbers to damage large areas of turf. However, the scattered damage spots on golf course greens or tees can contribute to poor playing surfaces. There are only a couple of parasites known from this pest and their influence on populations is not known. If suspicious spots are noted in the turf, sampling should be performed.

Sampling

A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known to not cause turf damage) in two gallons of water should be used. With a common garden sprinkling can, apply the two gallons of soapy water to a one square yard (1.0 yd^2) area. Within 3-5 minutes the caterpillars will come to the surface and can be easily counted. Remedial controls are needed if 5-8 larvae per square yard of green or tee are found.

Strategy 1: Biological Control - Microbial Toxins - Some of the strains of Bt (*Bacillus thruingiensis*) toxins are registered for sod webworms and armyworms in turf. These should also have acitivity against the fiery skipper larvae. For maximum efficacy against the fiery skipper larvae, these pesticides need to be applied when the young larvae (first and second instars) are active. Since the larvae are enclosed in silken tunnels and feed only at night, apply the material in the late afternoon or evening and do not irrigate until the next morning.

Strategy 2: Biological Control - Entomopathogenic Nematodes - The insect parasitic nematodes are generally effective against the larger larvae of turf attacking caterpillars. Products containing *Steinernema carpocapsae* (=Biosafe®, Biovector®, Exhibit®, Scanmask®) can be applied when the larval populations have been surveyed. Best efficacy is obtained by applying the nematodes in the late afternoon, just before sunset. Follow the application with a light irrigation.

Strategy 3: Chemical Control - Traditional Insecticides - If a disclosing solution test has indicated considerable activity, a pesticide application may be needed. Acephate (=Orthene®), bendiocarb (=Turcam®, Ficam®), carbaryl (=Sevin®), chlorpyrifos (=Dursban®), cyfluthrin (=Tempo®), diazinon (not on golf courses or sod farms), fluvalinate (=Mavrik®), isazophos (=Triumph®), isofenphos (=Oftanol®) and trichlorfon (=Dylox®, Proxol®) are registered for turf caterpillar control. The synthetic pyrethroids (cyfluthrin and fluvalinate) and the organophosphate, trichlorfon, have the shortest residual periods and probably the least long term affect on beneficials. Applications should be made to the foliage of the turf in the late afternoon. If the label allows, do not irrigate after making an application since the insecticide needs to be on the leaves which are going to be fed on that night.

GRASS WEBWORM

SPECIES: *Herpetogramma licarsisalis* (Walker). [Phylum Arthropoda: Class Insecta: Order Lepidoptera: Family Pyralidae]

DISTRIBUTION: Suspected to have originated from southeast Asia. It is currently found in those countries and adjoining islands and Australia. The pest was first found in Hawaii in 1967 on Oahu. It has since spread to the other islands of Hawaii - Hawaii, Kauai, Maui and Molokai.

HOSTS: Kikuyugrass, *Pennisitum clandestinum* Hochst ex Chior, seems to be the major preferred host though 13 other grass hosts are known in Hawaii. Bermudagrass [*Cynodon dactylon* (L.)], suaturf bermuda [*C. magennisii* Hurcombe], centipedegrass [*Eremochloa ophiuroides* (Munro.) Hack], and St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntz] are common turfgrasses attacked.

DAMAGE SYMPTOMS: The larvae feed on leaves, stems and crowns of turfgrasses. Initial feeding produces grass blades with a ragged edge but continued feeding produces irregular brown patches. Considerable webbing and frass (fecal pellets) is usually very evident.

DESCRIPTION OF STAGES: This insect's stages are typical of moths with complete life cycles.

Eggs: The eggs are flat, oval and scale-like. They measure 0.6 by 0.9 mm and can be laid singly or in groups. They are usually attached to the upper surface of leaves, along the midrib. They start out being creamy white and change to dark orange before hatching.

Larvae: The larvae are light green to brown in color and have the conspicuous rings of dark brown spots, typical of pyralid larvae. There are five instars with the first being about 2.3 mm long and the mature larva is about 20 mm long.

Pupae: The light brown pupae turn dark brown just before the adults emerge. They are placed in a tightly woven silken case and are about 10.5 mm long.

Adults: These moths are fawn to light brown in color and the wings have faint darker spots and a zig-zag line near the outer margin. The body is about 10 mm long and the wing span is 23-24 mm.

LIFE CYCLE AND HABITS: Adults apparently emerge from their pupal cases at night and mating occurs during the same night. The females need 3-6 days before they are ready to lay eggs. They usually feed on flower nectar and moisture on leaves. Once the preoviposition period is over, an average of 250 eggs are laid over 5-7 nights. The eggs take 4-6 days to hatch. The newly hatched larvae feed on leaf upper surfaces. They strip away strips of the upper tissues, leaving the lower epidermis intact. The larvae molt every two days and the third instars begin consuming entire leaf margins. The last instar, the fifth, takes over four days to mature. The larvae hide in silken tunnels in the turf thatch during the day and emerge to feed at night. The larval development takes 10-14 days. Mature larvae construct a silken hibernaculum-like cocoon. This structure has frass and plant debris attached. The pupae take 6-7 days to mature before the adults emerge. A generation takes about 32 days to complete. The adults can be found in large numbers resting in tall grasses or in low shrubs and plants alongside turf.

CONTROL STRATEGIES: Grass webworm outbreaks can occur at any time during the season but are usually associated with rainy weather. Periodic sampling for the larvae should be performed if adults are noticed flying about.

Sampling

A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known to not cause turf damage) in two gallons of water should be used. With a common garden sprinkling can, apply the two gallons of soapy water to a one square yard (1.0 yd^2) area. Within 3-5 minutes the caterpillars will come to the surface and can be easily counted. Remedial controls are needed of 10-15 larvae per square yard are found.

Strategy 1: Cultural Control - Resistant Turfgrasses - Egg laying preference and larval feeding studies indicate that Sunturf bermudagrass, Tifdwarf ™ bermuda, St. Augustinegrass and centipedegrass are the most attractive to this pest. Common bermudagrass and Tifway ™ bermuda is more resistant to attack.

Strategy 2: Biological Control - Conserve Parasites - The tiny wasp, *Trichogramma semifumatum* (Perkins), attacks the grass webworm's eggs. Up to 96% of the eggs in an area may be attacked. Various other larval parasites have lesser effects. Delay or reduce applications of traditional insecticides in order to conserve these parasites.

Strategy 3: Biological Control - Microbial Toxins - Some of the 'Spodoptera' strains of Bt (*Bacillus thruingiensis*) toxins, such as Javelin ® and Steward ®, have had good activity against the grass webworm's close relative, the tropical sod webworm. For maximum efficacy, these pesticides need to be applied when the young larvae are active. Make applications when adults are seen flying or eggs are noticed on grass blades.

Strategy 4: Chemical Control - Standard Insecticides - Acephate (=Orthene ®), bendiocarb (=Turcam ®, Ficam ®), carbaryl (=Sevin ®), chlorpyrifos (=Dursban ®), cyfluthrin (=Tempo®), diazinon (not on golf courses or sod farms), fluvalinate (=Mavrik ®), isazophos (=Triumph ®), isofenphos (=Oftanol ®) and trichlorfon (=Dylox ®, Proxol ®) are registered for turf caterpillar control. The synthetic pyrethroids (cyfluthrin and fluvalinate) and the organophosphate, trichlorfon, have the shortest residual periods and probably the least long term effect on beneficials. Applications should be made to the foliage of the turf in the late afternoon. If the label allows, do not irrigate after making an application since the insecticide needs to be on the leaves which are going to be fed on that night.

HUNTING BILLBUG

SPECIES: *Sphenophorus venatus vestitus* Chittenden. [Phylum Arthropoda: Class Insecta: Order Coleoptera: Family Curculionidae]

DISTRIBUTION: Several subspecies of *S. venatus* are found all across North America. *S. venatus vestitus* is most commonly found from Maryland across to Kansas and south. Apparently, this pest has been transported with sod and is known from the Middle East, Southeast Asia and Hawaii.

HOSTS: Attacks zoysiagrass and occasionally damages bermudagrass, *Cynodon dactylon* (L.). May be found in bahiagrass [*Paspalum notatum* Flugge], centipedegrass [*Eremochloa ophiuroides* (Munro.) Hack] and St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntz]. Also attacks field crops such as corn, sugarcane and wheat.

DAMAGE SYMPTOMS: Patches of turf turn yellow and then brown. General infestations look similar to the results of summer drought or diseases. Because many roots have been damaged, the turf reacts more rapidly to dry conditions. Billbug damage can be confirmed by pulling up some of the damaged turf and looking for hollowed, sawdust filled stems.

DESCRIPTION OF STAGES: All stages are typical for weevils.

Eggs: The elongate, bean-shaped white eggs are inserted into stems of the preferred grasses.

Larvae: First instars are about 1.5mm long and have the typical weevil larval form. Mature larvae have tan to brown head capsules with black mandibles. Full grown larvae are 7-10mm long.

Pupae: The pupae are first cream colored changing to a reddish brown just before the adult emerges. The pupae have the distinct snout of the adult weevil.

Adults: The adults are generally larger and more robust than the bluegrass billbug. Adults range from 6-11mm and often have a coating of soil which adheres to the body surface. Clean specimens have numerous visible punctures on the pronotum with a distinct Y-shaped, smooth, raised area behind the head. This area is enclosed by a shiny parenthesis-like mark on each side.

LIFE CYCLE AND HABITS: Little is known about the biology of this pest. In the northern part of its range, this pest overwinters as dormant adults in the soil. In southern states the adults may be found walking and feeding all year whenever temperatures are high enough for activity. Generally most of the eggs are inserted into grass stems or leaf sheaths in the spring when zoysia and bermudagrasses are well out of winter dormancy. The eggs take 3-10 days to hatch and the young larvae mine down the inner surface of the leaf sheaths and bore into stems. As the larvae increase in size they drop into the ground and feed on roots and stolons. Mature larvae pupate after 3-5 weeks of feeding. The pupae take 3-7 days to mature. Because of the extended period of oviposition larvae may be found from May into October. However, in the northern zoysia growing regions most damage occurs in August. Damage in Gulf States may occur earlier depending on the population size and weather. Draughty conditions seem to aggravate damage symptoms.

CONTROL STRATEGIES: The hunting billbug is more difficult to control than its northern cousin, the bluegrass billbug. Hunting billbugs can be active during most of the season with mixed populations of larvae and adults present. Usually, most of the larval activity is present in mid to late summer.

Sampling

Billbug adults are easily sampled by using pitfall traps. By placing 16-20oz. plastic cups in holes made with a standard 4.5-inch cup changer, the adults can be monitored. Trap catches of 3-5 billbugs per day indicate large populations and larval sampling should be done on a regular schedule. Use a standard cup changer to pull turf plugs with 2-3 inches of soil. Carefully pull away the soil and inspect for billbug larvae. If 1-2larvae per sample are found, grub treatments will be necessary.

Strategy 1: Cultural Control - Reduce Transport of Infested Turf - The hunting billbug has been a severe pest of zoysiagrass and bermudagrass sod farms. In these situations the adults or larvae may be transported to new sites when sod is used. Be sure to obtain certified pest free sod. Sprigging of bermudagrass will also reduce the chances of transporting an infestation.

Strategy 2: Biological Control - Fungal Diseases - Billbug adults and larvae seem to be susceptible to the entomopathogenic fungus, *Beauveria*. However, this fungus rarely attacks billbugs in significant numbers in the field and no commercial preparations are available for use.

Strategy 3: Biological Control - Entomopathogenic Nematodes - The insect parasitic nematodes are generally effective against the larvae and adults of turf attacking billbugs. Products containing *Steinernema carpocapsae* (=Biosafe ®, Biovector ®, Exhibit ®, Scanmask ®) can be applied when the larval populations have been surveyed. Best efficacy is obtained by applying the nematodes in the late afternoon, just before sunset. Follow the application immediately with a heavy irrigation. Resample the larval population 7-10 days after the application to assess control.

Strategy 4: Cultural Control - Masking Damage - The hunting billbug rarely damages actively growing bermudagrass. By keeping the fertility and irrigation moderate to high, most billbug damage can be masked. Unfortunately, this may also help build up billbug populations which can be even more damaging if irrigation has to be withdrawn for a period of time.

Strategy 5: Chemical Control - Standard Insecticides - Carbaryl (=Sevin ®), chlorpyrifos (=Dursban ®), cyfluthrin (=Tempo ®), diazinon (not on golf courses or sod farms), ethoprop (=Mocap ®), isazophos (=Triumph ®)(lawns and golf course greens, tees and aprons only) and isofenphos (=Oftanol ®) are registered for adult billbug control. Bendiocarb (=Turcam ®, Ficam ®), carbaryl, diazinon, ethoprop, isazophos and isofenphos are registered for billbug larval control. For hunting billbug control, it is recommended that the larvae be targeted since the adults will be controlled with the same application.

LAWN ARMYWORM

SPECIES: *Spodoptera mauritia* (Boisduval). [Phylum Arthropoda: Class Insecta: Order Lepidoptera: Family Noctuidae]

DISTRIBUTION: This pest seems to be a native of the Oriental and Indo-Australian regions but has been transported to many of the Pacific islands, including Hawaii. It was first recorded in Hawaii in 1953. It is not known from North America.

HOSTS: Like many of the true armyworms, this species feeds on a wide variety of grasses and sedges. It is especially fond of bermudagrass, *Cynodon dactylon* (L.), and zoysiagrass, *Zoysia* spp.

DAMAGE SYMPTOMS: As their name implies, armyworms can literally march across the turf, eating most of the leaves and stems. Moderate populations produce a ragged appearance to the turf. High populations produce a fairly well defined line between green, undamaged turf and a completely eaten and brown area. This front can move forward by a foot per night.

DESCRIPTION OF STAGES: Armyworms are moths with complete life cycles.

Eggs: The eggs are laid in masses attached to the leaves of trees, on buildings or other objects overhanging or near turf. The mass is usually elongate-oval in outline and has 5-7 layers of eggs. The females usually cover the mass with their abdominal hairs. The masses contain 600-700 eggs and each egg is about 0.5 mm in diameter.

Larvae: The first instars are about 1.2 mm long and are greenish after feeding. Later instars develop patterns of brown to black stripes and spots. Each body segment has a pair of jet black dashes next to the longitudinal yellow stripes. Mature larvae are 35-40 mm long.

Pupae: Pupae are first light brown but soon turn a dark chestnut brown. They are about 16 mm long and 4.5 mm wide.

Adults: Adults resemble the fall armyworm. The male is more distinctly marked than the female. They have a drop-shaped light spot about midway down the wing which is followed with a dark black spot. The wing is generally mottled, dark gray. The females have a wing span of 34-40 mm and the males are slightly smaller.

LIFE CYCLE AND HABITS: This tropical species has continuous generations throughout the season. The adult moths emerge at night and the females are mated within a day. The adults may feed on nectar and water from rain or dew. After a four day preoviposition period, the females begin to lay masses of eggs. Egg laying begins at dusk and is generally completed before midnight. Egg masses are normally attached to the foliage of trees and shrubs near turf. They are almost never laid on grass blades. Since the adults are attracted to lights, many egg masses are often laid on nearby buildings or trees. The eggs take three days to hatch and the young larvae drop to the turf. During the first five instars the larvae feed during the day and night. They seem to prefer to stay together, often with several feeding on the same plant. As they strip off the foliage they move forward to new turf. The older larvae are easier to see and usually hide in the thatch and plant debris during the day. The 7-8instars take nearly 28 days to complete development. The mature larvae burrow into the thatch and pupate. Pupation is completed in 11 days.

CONTROL STRATEGIES: Considerable effort has been made to import biological controls for this pest in Hawaii. Under normal conditions, these parasites and predators do an adequate job but occasionally they do not build up fast enough to prohibit turf damage. If turf is suspected to have a damaging population of lawn armyworms, sampling should be performed.

<u>Sampling</u>

A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known to not cause turf damage) in two gallons of water should be used. With a common garden sprinkling can, apply the two gallons of soapy water to a one square yard (1.0 yd^2) area. Within 3-5 minutes the caterpillars will come to the surface and can be easily counted. Remedial controls are needed of 10-15 larvae per square yard are found.

<u>Strategy 1</u>: **Biological Control - Conserve Predators and Parasites** - Two tiny wasp egg parasites attack this pest (*Telenomus nawai* Ashmead and *Trichogramma minutum* Riley). The larval attacking wasp, *Apanteles marginiventris* (Cress.), seems to be the most important natural enemy of the lawn armyworm. By providing nectar producing flowers and targeting insecticide sprays only to the areas needing them, these parasites can be conserved.

<u>Strategy 2</u>: **Cultural Control - Reduce Night Lighting** - Since the adults are attracted to lights at night and they oviposit nearby, place lights away from sensitive turf areas. Lights within the yellow range are also much less attractive to night flying insects.

<u>Strategy 3</u>: **Biological Control - Microbial Toxins** - Some of the 'Spodoptera' strains of Bt (*Bacillus thruingiensis*) toxins, such as Javelin ® and Steward ®, have had good activity against the lawn armyworm's close relative, the fall armyworm. For maximum efficacy, these pesticides need to be applied when the young larvae are active. Make applications when the first signs of leaf feeding is observed.

<u>Strategy 4</u>: **Chemical Control - Standard Insecticides** - Acephate (=Orthene ®), bendiocarb (=Turcam ®, Ficam ®), carbaryl (=Sevin ®), chlorpyrifos (=Dursban ®), cyfluthrin (=Tempo ®), diazinon (not on golf courses or sod farms), fluvalinate (=Mavrik ®), isazophos (=Triumph ®), isofenphos (=Oftanol ®) and trichlorfon (=Dylox ®, Proxol ®) are registered for turf caterpillar control. The synthetic pyrethroids (cyfluthrin and fluvalinate) and the organophosphate, trichlorfon, have the shortest residual periods and probably the least long term effect on beneficials. Applications should be made to the foliage of the turf in the late afternoon. If the label allows, do not irrigate after making an application since the insecticide needs to be on the leaves which are going to be fed on that night.

RHODESGRASS MEALYBUG (=RHODESGRASS SCALE)

SPECIES: *Antonina graminis* (Maskell). [Phylum Arthropoda: Class Insecta: Order Homoptera: Family Pseudococcidae]

DISTRIBUTION: Recorded from the southern states from South Carolina to southern California; found worldwide in tropical and subtropical regions of Africa, Australia, Central America, India, Japan, Pacific Islands (including Hawaii) and South China.

HOSTS: Attacks over 70 species of grasses including range and weed grasses as well as turfgrasses such as rhodesgrass [*Chloris sayana* Kunth], bermudagrass [*Cynodon dactylon* (L.)] and St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntz].

DAMAGE SYMPTOMS: This mealybug does not commonly kill turf unless stressful conditions are found. Close cut bermudagrass during drought can be damaged. This pest produces considerable honeydew and ants or bees may frequent turf which is heavily infested.

DESCRIPTION OF STAGES: Though this pest is a type of mealybug it acts like true scales by being immobile once settled.

<u>Eggs</u>: Eggs are elongate oval and cream colored. The eggs are contained inside the remains of the female and her waxy cover.

<u>Crawlers</u>: These are the first instar nymphs which are the only mobile form. The crawlers are flat, oval, cream colored insects with a median stripe tinged with purple. Short legs, six-segmented antennae and two tail filaments are evident.

<u>Sessile Nymphs</u>: The crawlers settle on the grass crown or at nodes, insert their mouthparts and begin secreting a waxy coat. After the first molt the new sessile nymph takes on a saclike form without legs. Only the thread-like mouthpart and anal filament emerge from the body. A second molt occurs while the waxy cover grows larger and the anal excretory tube elongates.

<u>Adults</u>: Only females are known and these reproduce asexually. The adult body is also saclike, broadly oval, dark purplish brown and 1.5-3mm long. The fluffy waxy covering turns yellow with age and openings at the anterior and posterior ends expose parts of the body. A very long, 3-10mm, waxy, tubular filament arises from the anus through which honeydew is excreted.

LIFE CYCLE AND HABITS: This pest continues its life cycle year round but is slowed by winter temperatures. Reproduction is considerably reduced during the winter but activity increases in the spring as the grass begins rapid growth. Peak populations are reached by July and populations again are reduced through July and August as summer stress is brought about by dryness. In September and October the populations again resurge until peaking in early November. During the spring, females lay an average of 150 eggs over 50 days. As the crawlers hatch they remain under the waxy cover of the female for several hours before emerging. These crawlers tend to first walk to the tops of plants but eventually settle down by wedging themselves beneath a leaf sheath, usually at a node. Here the mouthparts are inserted and the excretory tube and waxy cover are started. In about 10 days, the first molt takes place and the walking legs disappear and the antennae are much smaller. The excretory tube continues to elongate and the waxy cover becomes thicker and larger. Two more molts take place under the waxy cover and maturity is reached in 25-30 days. During the summer, a generation averages two months but in winter this may take 3.5-4 months to complete. This scale apparently travels by transportation of sod or grass cuttings. The crawlers may climb onto the legs of animals and "hitch a ride." High temperatures, especially near 100°F, reduce scale development and may actually kill individuals. Exposure of the scale to 28°F for 24 hours is fatal. Thus, winter cold limits northern movement and survival of this pest. This scale increases turf mortality during periods of drought.

CONTROL STRATEGIES: This pest rarely kills turf unless it is poorly managed. Do not cut the turf too short. In the Gulf States, several parasitic wasps have been introduced which generally keep this pest under control.

Strategy 1: Cultural Control - Water and Fertilize - Frequent irrigation, fertilization and mowing no shorter than two inches helps prevent damage by this pest even when high populations are present.

Strategy 2: Biological Control - Conserve Parasites - Two parasitic wasps have been sucessful in controlling rhodesgrass mealybug populations. A Hawaiian parasite, *Anagyrus antoninae* Timberlake, and an Indian parasite, *Dusmetia sangwani* Rao, have been established in the southern United States. Apparently, *Dusmetia* seems better adapted and can survive lower temperatures than *Anagyrus*. Both of these parasites, once established should be conserved by being sure to not spray some areas known to have rhodesgrass mealybugs and these parasites. These will serve as innoculum points.

Strategy 3: Chemical Control - Traditional Insecticides - Many contact pesticides do not effectively reach the protected areas where this scale rest. Repeated applications may be necessary if this strategy is used. At present, diazinon (not for golf course or sod farm use) is the only pesticide registered for control of this pest.

SOUTHERN CHINCH BUG

SPECIES: *Blissus insularus* Barber. [Phylum Arthropoda: Class Insecta: Order Hemiptera: Family Lygaeidae]

DISTRIBUTION: This pest can be found from southern North Carolina to the Florida Keys and west to central Texas. This pest has apparently been spread with sod to other countries. It is also found in Hawaii.

HOSTS: This insect is a major pest of St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntz. However, it will occasionally attack centipedegrass [*Eremochloa ophiuroides* (Munro.) Hack], zoysiagrass [*Zoysia* spp.], bahiagrass [*Paspalum notatum* Flugge] and bermudagrass [*Cynodon dactylon* (L.)] turf, especially if these turfs are next to heavily infested St. Augustinegrass.

DAMAGE SYMPTOMS: Usually irregular patches of St. Augustinegrass or bermudagrass turn yellow and then brown. These patches may expand or new patches may begin to form in the lawn. As the southern chinch bug populations build up they may kill extensive areas in a lawn and begin moving in mass across sidewalks and driveways. Though they do not often crawl to the surface of St. Augustinegrass, they may congregate on the tips of other grasses and weeds in the area.

DESCRIPTION OF STAGES: These pests are true bugs and have a gradual life cycle with egg, nymphal and adult stages. This species is difficult to separate from other *Blissus* spp. and an expert is generally needed if specific identification is critical. Generally, if this bug is in St. Augustinegrass or bermudagrass, it will be the southern chinch bug.

Eggs: The eggs are elongate oval, approximately .75mm long by .23mm wide, and are squarely cut off at the top. The blunt end has four small tubercles visible through a dissecting microscope. The eggs are first white but change to bright orange before hatching.

Nymphs: There are 5-6nymphal instars which change considerably in color and markings. The first instars are bright orange with a cream colored stripe running across the abdomen. The head and thorax become brownish with age. The second through fourth instars continue to have this same general color pattern except that the orange color of the abdomen gradually changes to a dusky-gray with small black spots. The fourth instar increases to more than 2mm long. The fifth instars are quite different because the wing pads have expanded and are easily visible. Occasionally an additional instar, the sixth, will be formed, especially in cooler weather. The abdomen becomes blue-black with some darker black spots and the total body length is about 3mm.

Adults: The adults are approximately 3.1mm long and 0.85mm wide. The males are usually slightly smaller than the females. The head, pronotum and abdomen are gray-black in color to dark chestnut-brown and covered with fine yellow to white hairs. The wings are white with a black spot, the corium, located in the middle front edge. The legs are chestnut-brown. Individuals in a population, may have short, nonfunctional wings which reach only half way down the abdomen.

LIFE CYCLE AND HABITS: In the southern range of this pest, adults and a few individuals of all stages overwinter in St. Augustinegrass turf, especially in the thatch. In the northernmost part of the range, only adults overwinter. These insects may become active anytime the temperatures rise above 65°F but reproduction generally does not occur until April or May. Females prefer to deposit their eggs by forcing them between the leaf sheath and stem. Each female may lay 45-100 eggs over several weeks. Some eggs are deposited in the thatch. The eggs hatch in 8-9 days at 83°F and 24-25 days at 70°F. The young nymphs immediately begin feeding under the protection of the leaf sheath. Nymphs hatching elsewhere crawl into available spaces under leaf sheaths. Several nymphs are often congregated together. The nymphs go through 5 and occasionally 6 instars in 40-50 days during warm weather (above 80°F). At cooler temperatures, below 70°F, the nymphs may take 2-3 months to mature. In most areas of the Gulf States, 3-5 overlapping generations occur each season. The first couple of generations are fairly well defined because of the initial start from the winter season. The first major adult peak usually occurs in June and the second peak is in August. Subsequent peaks may be in October and December. The greatest amount of damage occurs during the dry season in the summer.

CONTROL STRATEGIES: The southern chinch bug is very difficult to control because of management practices in St. Augustinegrass and bermudagrass turf. Populations which are resistant to organophosphate insecticides have been found.

Strategy 1: Cultural Control - Watering the Turf - Since this pest requires hot dry conditions for optimum survival and reproduction, cool moist environments may cause mortality, usually through the spread of the fungus, *Beauveria* spp. Irrigation will not drown the adults because of their waterproof hairs but the nymphs are easily moistened.

Strategy 2: Biological Control - Several researchers have been trying to develop a usable formulation of *Beauveria* fungus but at present no practical material is available. Several egg parasites and an adult parasite are known but these do not seem to build up populations rapidly enough to control this pest. Currently no work is being undertaken to augment these parasites. Several predators, especially the bigeyed bugs, *Geocoris* spp., are noted to kill large numbers of chinch bugs. Bigeyed bugs are often mistaken for chinch bugs because of their similarity in size and shape. Bigeyed bugs usually do not build up large populations until after considerable turf damage has occurred.

Strategy 3: Cultural Control - Modify Agronomic Management - Generally, St. Augustinegrass and bermudagrass can be over fertilized and this leads to rapid growth and immense build up of thatch. In fact, many such turf areas are merely growing on their own thatch layer. This environment is very conducive to southern chinch bug survival. Overly thatchy lawns should be dethatched, verticut or top dressed to improve the general conditions. Reducing fertilizers and increasing irrigation can greatly reduce populations of this pest.

Strategy 4: Cultural Control - Use Resistant Turfgrasses - Common St. Augustinegrass is highly susceptible to the southern chinch bug while most bermudagrasses are fairly resistant. The St. Augustinegrass variety Floratam ™ has been the standard in Florida for resistance but in recent years, the chinch bug has seemed to develop the ability to attack this variety. New varieties are under development and Floralawn ™ seems to be a good alternative. In the bermudagrasses, Tifton 292™ seems to be a highly resistant variety. Check with suppliers and local county agents for locally adapted turfs with resistance to chinch bugs.

Strategy 5: Chemical Control - Use Preventive Sprays - In turf areas where chinch bugs have been a perennial problem, early insecticide sprays have been used to reduce the beginning population. Unfortunately, this techniques is believed to be one of the major reasons for development of insecticide resistance.

Strategy 6: Chemical Control - Target Spraying - Chinch bugs are rather easy to detect in turf and targeted insecticide sprays can be applied to reduce populations which appear to be building to damaging levels. Bendiocarb (=Turcam®, Ficam®), carbaryl (=Sevin®), chlorpyrifos (=Dursban®), cyfluthrin (=Tempo®), diazinon (not on golf courses or sod farms), ethoprop (=Mocap®), fluvalinate (=Mavrik®), isazophos (=Triumph®)(lawns and golf course greens, tees and aprons only) and isofenphos (=Oftanol®) are registered for chinch bug control.

Sampling

Several sampling schemes have been developed for assessing chinch bug populations in turf. The simplest method is to visually inspect the turf by spreading the canopy. Chinch bug nymphs tend to hide in the deeper thatch and careful inspection is necessary. Unfortunately, eggs and small chinch bugs are easily missed using this technique. A more reliable method is to use the flotation technique, counting the number of adults and nymphs present over a 10 minute span. Populations of 25-30 individuals per ft^2 warrant control, especially if these numbers are encountered in June and July. More complicated sampling methods use repeated sampling over a long period of time, relating the population numbers to temperature and humidity parameters and predict future populations.

Insecticides and Application

Most insecticides, when applied in liquid form, should not be watered in for chinch bug control, especially when high volume spray equipment is used. This is because the chinch bugs are surface and thatch residents. Some of the granulars require some irrigation in order to activate the insecticide (release it from the granule). Be sure to check the instructions for current information on watering.

Strategy 7: Chemical Control - Treatment of Resistant Chinch Bugs - Populations of southern chinch bugs have been found which are resistant to various insecticides, especially organophosphates. These pests are currently best controlled with synthetic pyrethroids and carbamates. Check with local state agencies to confirm resistance.

Strategy 8: Cultural Control - Recovery From Damage - Lawns with light to moderate damage will recover rather quickly if lightly fertilized and watered regularly. Heavily infested lawns may have significant plant mortality, because of the toxic effect of chinch bug saliva and reseeding will be necessary. Unfortunately, this often occurs when summer germinating weeds are most active. Thus, special care must be taken to reduce establishment of these undesirable plants.

Appendix B.

Spray Systems For Turfgrassess: Calibrating Sprayers & Mixing Pesticides

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CONTENTS

SPRAY SYSTEMS FOR TURFGRASSES:
CALIBRATING SPRAYERS AND MIXING PESTICIDES

C.L. Murdoch

COMPONENTS OF THE SPRAY SYSTEM

The purpose of the sprayer is to accurately meter and distribute pesticides. Pesticides are packaged in concentrated form to facilitate handling. In order to uniformly distribute the active ingredient of the pesticide over the area sprayed, it must be diluted with a suitable carrier (in this case, water). The diluted pesticide must then be uniformly distributed in a manner that gives optimum coverage with minimal drift potential.

The basic parts of a sprayer are presented in Figure 1.

The Tank

The most common materials for construction of tanks are fiberglass, mild steel, and stainless steel. Mild steel is susceptible to corrosion damage and must be cleaned thoroughly after each use. Factory-applied interior paint is usually available for mild steel tanks. Fiberglass and stainless steel tanks are not affected by most common agricultural pesticides.

Cylindrical or rounded-bottom tanks are preferred to rectangular ones because they eliminate dead spots during mixing and agitation. Tanks should also have a large opening for access in cleaning and rinsing.

Mixing and agitation of spray solutions is essential to insure uniform distribution of the active ingredient. Only mild agitation is required for pesticides formulated as solutions or emulsifiable concentrates. Pesticides formulated as wettable powders require more vigorous and continuous agitation. Mechanical agitators should be a part of sprayers used for wettable powder pesticides. The agitation system should be kept operating at all times when wettable powders are in the spray tank to prevent them from settling out.

The Pump

The basic types of pumps used for sprayers are rotary, centrifugal, piston, and diaphragm. Rotary and centrifugal pumps are perhaps the most commonly used on agricultural sprayers. Consult your equipment supplier for pump specifications. Make sure the pump will supply sufficient capacity (gallons per minute) and proper pressure for the job required. Other considerations are longevity, ability to handle corrosive materials, cost, and serviceability.

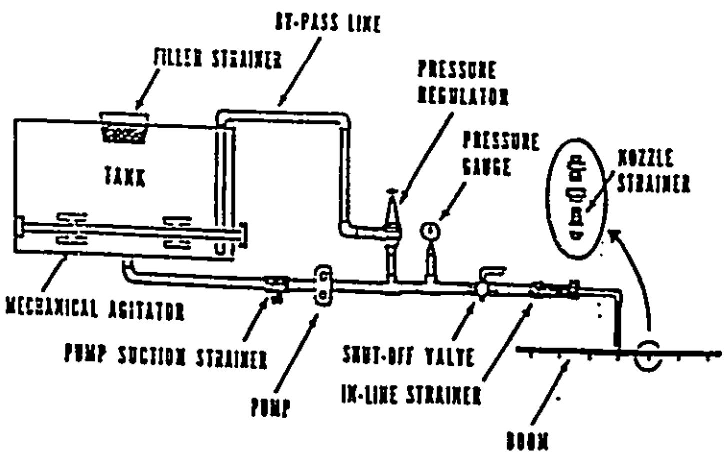


Figure 1. Components of a typical spray system. (From Robert G. Curley and Wesley E. Yates. 1974. Proceedings of the California Golf Course Superintendents Institute. Pp. 37–41.)

Strainers and Screens

Screening is necessary to keep foreign materials out of the spray nozzles and to reduce wear on the pump. All materials poured into the tank should be screened with a coarse (10- to 20-mesh) screen at the opening of the tank. A 25- to 50- mesh screen should be placed between the tank and the suction side of the pump to prevent foreign material from entering the pump. A 50- to 100-mesh screen should be placed in the line between the pump and the spray boom and, additionally, 50- to 100-mesh screens should be placed in each nozzle. Fifty-mesh screens are the smallest size recommended when spraying wettable powders.

The Pressure Regulator

A pressure regulator is required to adjust the pressure for spraying. Most agricultural pesticides should be sprayed at the lowest pressure compatible with the particular spray nozzles in use; this will prevent excessive atomization of the spray droplets. Pressures of 25 to 40 pounds per square inch (psi) are adequate for most materials and most spray nozzles.

The Pressure Gauge

A pressure gauge is essential to measure the pressure at which the spray solution is being applied. Calibration methods covered later in this publication depend on the operator's knowing the spray pressure. The pressure gauge should be located as near as possible to the spray boom to prevent erroneous readings due to friction loss. Keep in mind that pressure may drop in nozzles near the end of the boom when several nozzles are operating at once. When calibrating sprayers, it is desirable to catch the liquid from several nozzles (or even each nozzle) on the boom for a given length of time to determine if nozzle output is uniform.

The By-pass Line

The by-pass line diverts liquid from the pressure regulator valve to the tank in order to reduce the pressure on the line. It also helps agitate spray solutions. The by-pass line should not be considered sufficient for agitation of wettable powders, however. If the spray tank does not have mechanical agitation, it should have a separate line with holes in it from the pressure side of the pump (before the pressure regulator valve), extending into the tank to provide movement of the liquid.

Spray Nozzles

Spray nozzles are perhaps the most important part of the spray rig. They perform the vital functions of breaking up the spray stream into properly sized droplets, metering the spray, and distributing it evenly over the area.

There are three common types of spray nozzles used on agricultural sprayers: the flat fan, the hollow cone, and the solid cone. For broadcast pesticide application, the flat-fan type is most commonly used.

Nozzles may be constructed of brass, stainless steel, ceramics, or nylon. Advantages and disadvantages of each type are related to corrosion resistance, wear resistance, and cost. Consult your spray equipment supplier for specifications of the various nozzle types.

Abrasive materials, such as wettable powders, may cause rapid wear of spray nozzles made of soft metals or nylon. This may change the nozzle delivery rate or the spray pattern drastically. These should be checked periodically. If the sprayer is used often, a systematic schedule of nozzle tip replacement is good insurance for correct spray rate and pattern. Remember that in relation to the cost of pesticides, the cost of replacing worn nozzle tips is insignificant. Nozzle screens are also a vital part of a spray system. They perform the important task of screening out foreign materials that might clog the nozzles and large abrasive materials that might cause excessive wear. As mentioned previously, nozzle screens should be 50 to 100 mesh, with 50 mesh being the smallest size for wettable powders.

Nozzle screens have to be cleaned often to prevent loss of spray pressure. Since pressure gauges are located ahead of the spray nozzles, the gauge will not warn the operator of pressure loss due to a clogged spray screen. Wash the screen thoroughly in soapy water, do not use a wire brush to clean the screen; a soft toothbrush may be used. Nozzle screens should be replaced if they are damaged or clogged so badly they cannot be cleaned.

No-drip nozzle screens are available and will prevent dripping of pesticides when the shut-off valve is closed. These screens have a spring-loaded mechanism to stop the flow of liquid when pressure to the nozzle is stopped. They cause a slight reduction in nozzle delivery rate at a given pressure, consult the manufacturer's specifications for the delivery rate of nozzles with no-drip screens.

Nozzle tips may become clogged occasionally, even though screens are being used. Wire, knife blades, and other hard objects should not be used to unstop nozzle tips because they will enlarge or change the shape of the opening and alter the spray rate or spray pattern. A soft-bristles toothbrush or a small copper wire will remove objects without damage to the tips.

The relationship between nozzle size, spray pressure, and spray delivery rate is discussed later.

SPRAYER CALIBRATION AND PESTICIDE CALCULATIONS

Accurate sprayer calibration and calculation of amounts of pesticides to add to the spray tank are essential for proper use of pesticides. Too little pesticide will fail to control the pest. Too much pesticide is wasteful and may result in excessive damage to desirable plants or adverse effects on the environment. Spray calibration and pesticide calculations are simple. A few basic pieces of information are needed. The following discussion of the principles of sprayer calibration and the formulas, tables, and figures provided should enable one to quickly and accurately calibrate a sprayer and calculate amounts of pesticides to apply. Practice with these methods will help develop confidence in their use.

Calibration of Sprayers

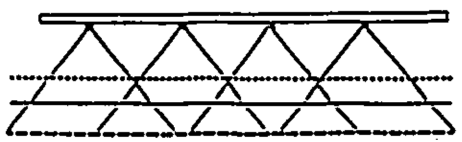
Only three pieces of information are needed to accurately calibrate a sprayer. These are (1) the discharge rate of each spray nozzle, (2) the spacing of the nozzles on the boom, and (3) the ground speed of the sprayer. This information is easily obtained. Two parts of the information are fixed: the discharge rate of the nozzles and the spacing of the spray nozzles on the boom. The third part, the ground speed is easily determined.

Nozzle discharge rate. Flat-fan spray nozzles are the type most commonly used in herbicide application. They are identified by a four-digit number that supplies important information. The first two digits (or three, if the angle is in excess of 100) designate the angle of spray discharge from the nozzle at a designated spraying pressure of 40 psi. This, as we will see later, is important in determining the spacing of the nozzles on the boom. The second two digits designate the nozzle output in gallons (parts of a gallon) per minute, also at the designated spray pressure of 40 psi. Thus an 8002 nozzle produces a spray pattern of 80° and delivers 0.2 gallons per minute.

Tables 1 and 2 illustrate the effect that spray pressure has on spray angle and nozzle discharge rate. Forty psi should be the maximum spraying pressure. If a pressure lower than 40 psi is used, note the effect this has on spray angle and nozzle output and adjust the nozzle spacing and travel speed accordingly. Excessively high spraying pressures will result in a large proportion of small spray particles increasing the drift hazard.

Table 1. Spray angle of flat-fan spray tips at 20 and 40 psi

Nozzle tip number	Spray pressure 20 psi	40 psi
8005	71°	80°
8008	72°	80°
9506	86°	95°
6506	54°	65°



..... Boom 10" high - insufficient overlap

—— Boom 14" high - correct overlap

- - - Boom 20" high - excessive overlap

Figure 2. Effect of boom height on spray pattern. Nozzles are 80° angle flat-fan type spaced 18 inches apart on the boom.

Table 2. Spray delivery rate of flat-fan spray tips at 20, 30, and 40 psi

Nozzle tip number	Spray pressure 20 psi	30 psi	40 psi
	Nozzle delivery rate (gal/min)		
8005	0.35	0.43	0.50
8008	0.56	0.69	0.80
9506	0.42	0.52	0.60
6506	0.42	0.52	0.60

Nozzle spacing. Another important factor to consider in setting up a spray boom is the relationship between nozzle spray angle, nozzle spacing on the spray boom and the proper operating height of the boom. A simple illustration will help to clarify this relationship (Figure 2).

As Figure 2 shows, it is critical that the proper spacing and height for nozzles be used. Perfect calibration of nozzle output will not give proper pesticide distribution if the nozzles are not spaced properly or the boom is not adjusted to the proper height. Excessive boom height will also increase the potential for drift hazard.

Table 3 gives the proper boom height for different nozzles at different spacings on the boom.

Ground speed of sprayer. The ground speed of the sprayer is the third bit of information needed to calibrate a sprayer. If the tractor is not equipped with a speedometer, the speed can be easily determined by measuring the time required to travel a measured distance. Since 88 feet = 1/60 of a mile, this is a convenient distance to use for the sake of simplifying calculations.

First measure 88 linear feet and mark it with stakes or other convenient markers. Then determine a satisfactory gear and throttle setting for spraying. Mark the throttle setting for future reference, or if the tractor is equipped with a tachometer, note the revolutions per minute (rpm). Next determine the time, in seconds, required to travel the 88 feet. Since 60 miles per hour = 88 feet in one second, 60 divided by the measured time in seconds required to travel 88 feet = speed in miles per hour (mph). Table 4 covers the range of speeds normally used in spraying and will eliminate the need for calculations.

Table 3. Relationship between nozzle spacing, nozzle spray angle, and nozzle height

Nozzle spacing (inches)	Nozzle spray angle 65°	80°
	Nozzle height (inches)	
12	13	10
16	17	13
18	19	14
20	21	16
24	25	19

Source: C. R. Kaupke and R. G. Curley. 1964. Sprayer calibrations and calculations. Univ. of California, Davis.

Table 4. Speed required to travel 88 linear feet in different lengths of time

Time Elapsed (seconds)	Speed (mph)
30	2.0
24	2.5
20	3.0
17	3.5
15	4.0
12	5.0

Determining Sprayer Output

Once the needed information is obtained, the sprayer output in gallons per acre may be calculated by the following formulas:

1. Acres covered in one hour by one nozzle = (GS X 5280 X NS)/ 43,560

Where:
GS = ground speed in mph
5280 = feet in one mile
NS = nozzle spacing in feet
43,560 = square feet in one acre

2. Sprayer output in gal/acre = (GPM X 60)/A

Where:
GPM = nozzle output in gal/min
60 = minutes in one hour
A = acres covered in one hour by one nozzle

For example, if you are spraying at 3 mph with 8004 nozzles spaced 18 inches (1.5 feet) apart, at 40 psi, the spray rate is:

1. (3 mph X 5280 X 1.5 ft)/43,560 = 0.55 acres/hr/nozzle

2. (0.4 GPM X 60)/0.55 acres/hr/nozzle = 43.6 gal/acre

Table 5 gives sprayer output when the nozzle output and ground speed are known.

Preparation of Spray Mixtures

Once the spray rate in gallons per acre is determined, it is a simple matter to determine the amount of pesticide to place in the spray tank. Since pesticide label recommendations are usually made in terms of formulated materials per acre, all calculations are made on this basis.

Mixing dry pesticide formulations. Many pesticides are formulated in a dry form (wettable powder, soluble powder, and so on) that is mixed with water and sprayed. To calculate the amount of dry formulation to place in the spray tank, use the following formula:

Wt = R(V/GPA)

Where:
Wt = weight of material for spray tank
R = desired rate of pesticide per acre
V = volume of spray solution in gallon
GPA = spray rate in gal/acre
(Wt and R must be in same units)

For example, you wish to mix 100 gallons of spray mixture with a 50 percent wettable powder and spray at the rate of 2 pounds formulated material per acre. If the spray rate is 40 gallons per acre, then 2(100/40) = 5 pounds of wettable powder per 100 gallons of spray solution.

Table 6 explains how much powder to use per gallon of solution when spraying at different rates. For example, if you wish to mix 75 gallons of spray solution to apply at the rate of 2 pounds formulated material per acre, and the spray rate is 40 gallons per acre, then 75 gallons of spray solution X 0.8 ounce per gallon = 60 ounces (or 3 pounds, 12 ounces).

Table 5. Relationship between ground speed, nozzle discharge rate, and spray rate gallons per acre per nozzles spaced 18 inches (1.5 feet) apart [a]

Nozzle discharge rate (gal/min)	Ground speed (mph) 2.0	2.5	3.0	3.5	4.0	4.5	5.0
	Spray rate (gal/acre)						
0.2	33.0	26.4	22.0	18.9	16.5	14.7	13.2
0.3	49.5	39.6	33.0	28.3	24.8	22.0	19.8
0.4	66.0	52.8	44.0	37.7	33.0	29.3	26.4
0.5	82.5	66.0	55.0	47.1	41.3	36.7	33.0
0.6	99.0	79.2	66.0	56.6	49.5	44.0	39.6
0.7	115.5	92.4	77.0	66.0	57.8	51.3	46.2
0.8	132.0	105.6	88.0	75.4	66.0	58.7	52.8
0.9	148.5	118.8	99.0	84.9	74.3	66.0	59.4
1.0	165.0	132.0	110.0	94.3	82.5	73.3	66.0
1.1	181.5	145.2	121.0	103.7	90.8	80.7	72.6
1.2	198.0	158.4	132.0	113.1	99.0	88.0	79.2
1.3	214.5	171.6	143.0	122.6	107.3	95.3	85.8
1.4	231.0	184.8	154.0	132.0	115.5	102.7	92.4
1.5	247.5	198.0	165.0	141.4	123.8	110.0	99.0
1.6	264.0	211.2	176.0	150.9	132.0	117.3	105.6

[a] For other nozzle spacings, spray rate $\times \frac{18}{\text{nozzle spacing}}$ = correct spray rate.

Preparation of Spray Mixtures

Once the spray rate in gallons per acre is determined, it is a simple matter to determine the amount of pesticide to place in the spray tank. Since pesticide label recommendations are usually made in terms of formulated materials per acre, all calculations are made on this basis.

Mixing dry pesticide formulations. Many pesticides are formulated in a dry form (wettable powder, soluble powder, and so on) that is mixed with water and sprayed. To calculate the amount of dry formulation to place in the spray tank, use the following formula:

Wt = R(V/GPA)

Where:

Wt = weight of material for spray tank
R = desired rate of pesticide per acre
V = volume of spray solution in gallon
GPA = spray rate in gal/acre
(Wt and R must be in same units)

For example, you wish to mix 100 gallons of spray mixture with a 50 percent wettable powder and spray at the rate of 2 pounds formulated material per acre. If the spray rate is 40 gallons per acre, then 2(100/40) = 5 pounds of wettable powder per 100 gallons of spray solution.

Table 6 explains how much powder to use per gallon of solution when spraying at different rates. For example, if you wish to mix 75 gallons of spray solution to apply at the rate of 2 pounds formulated material per acre, and the spray rate is 40 gallons per acre, then 75 gallons of spray solution X 0.8 ounce per gallon = 60 ounces (or 3 pounds, 12 ounces).

Table 6. Amount of dry formulation pesticide to use per gallon of spray solution when spraying at different rates

Desired rate (lb formulation/acre)	Spray rate (gal/acre) 40	50	60	70
	oz formulation/gal spray solution			
1	0.4	0.3	0.3	0.2
2	0.8	0.6	0.5	0.5
3	1.2	1.0	0.8	0.7
4	1.6	1.3	1.1	0.9
5	2.0	1.6	1.3	1.1
6	2.4	1.9	1.6	1.4
7	2.8	2.2	1.9	1.6
8	3.2	2.6	2.1	1.8
9	3.6	2.9	2.4	2.1
10	4.0	3.2	2.7	2.3

Mixing liquid formulations. Pesticides may be formulated in liquid form (soluble concentrates, emulsifiable concentrates, and flowables). To calculate the amount of liquid formulation to add to the spray tank, use the following formula:

Fl oz = R(V/GPA)

Where:

Fl oz = fluid ounces of material for spray tank
R = desired rate in fluid ounces of pesticide per acre
V = volume of spray in gallons
GPA = spray rate in gal/acre

For example, if you wish to mix 75 gallons of a spray mixture to be sprayed at 32 ounces per acre, the pesticide is a liquid formulation, and the spray rate is 50 gallons per acre, then 32(75 gallons/50 gallons per acre) = 48 ounces (or 3 pints) of formulation per 75 gallons of mixture.

Table 7 explains how much liquid to use per gallon of solution when spraying at different rates. For example, if you wish to mix 150 gallons of spray solution to apply at the rate of 3 pints formulated material per acre, then 150 gallons of spray solution X 1.1 ounces per gallon of spray solution = 165 ounces (or 1 gallon, 1 quart, and 5 fluid ounces).

Table 7. Amount of liquid formulation pesticide to use per gallon of spray solution when spraying at different rates

Desired rate (fl oz. formulation/acre)	Spray rate (gal/acre) 40	50	60	70
	fl oz formulation/gal spray solution			
16 (1 pt)	0.4	0.3	0.3	0.2
32 (1 qt)	0.8	0.6	0.5	0.5
48 (3 pt)	1.2	1.0	1.1	0.7
64 (1/2 gal)	1.6	1.3	1.3	0.9
80 (5 pt)	2.0	1.6	1.6	1.1
96 (6 pt)	2.4	1.9	1.9	1.4
112 (7 pt)	2.8	2.2	2.1	1.6
128 (1 gal)	3.2	2.6	2.4	1.8

Conversion Factors for Mixing Pesticides

Liquid measure:
3 teaspoons = 1 tablespoon
2 tablespoons = 1 fluid ounce
16 tablespoons = 8 fluid ounces = 1 cup
1 pint = 16 fluid ounces
2 cups = 1 pint
4 quarts = 1 gallon
1 gallon = 128 fluid ounces
1 gallon = 8 pints

Dry measure:
1 pound = 16 ounces

Linear distance:
1 mile = 5280 feet

Area:
1 acre = 43,560 square feet

Speed:
1 mph = 88 feet/minute
60 mph = 88 feet/minute

Appendix C.
Soil Analysis Results

TURF
DIAGNOSTICS
& DESIGN

"Managing the Elements Through Science"

Environmental & Turf Services
Tom Durborow
11141 Georgia Ave., Suite 208
Wheaton, MD 20902
PHONE:301-933-4700
FAX:301-933-4701

Account No. 79130100
Date 3/19/92
Facility HANA

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity mmhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 18							
LAB ID NO.	SAMPLE NAME								
92020012-1	SS#1 0-6"	19.9	29.2	49.0	Clay		6.6	6.5	
92020012-2	SS#1 6-12"	24.5	23.5	51.3	Clay		6.7	5.7	
92020012-3	SS#2 0-6"	15.9	30.9	52.2	Clay		6.0	6.5	
92020012-4	SS#2 6-12"	17.0	24.8	57.9	Clay		6.3	6.7	
92020012-5	SS#3 0-6"	19.6	25.1	53.9	Clay		5.7	6.8	
92020012-6	SS#3 6-12"	18.1	26.0	55.5	Clay		6.0	6.6	

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	> 4.0	2.0	> 2.0	1.0	0.5	0.25	0.10	0.05
	U.S. Sieve (mesh)	> 5	10	> 10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
92020012-1	SS#1 0-6"	0.0	2.0	2.0	2.9	3.6	4.2	5.4	4.7
92020012-2	SS#1 6-12"	0.0	0.7	0.7	4.9	4.6	4.8	7.6	5.5
92020012-3	SS#2 0-6"	0.0	1.0	1.0	2.5	2.9	2.9	4.8	4.0
92020012-4	SS#2 6-12"	0.0	0.2	0.2	2.1	2.6	2.9	5.6	5.3
92020012-5	SS#3 0-6"	0.0	1.4	1.4	4.2	4.7	3.7	4.2	3.5
92020012-6	SS#3 6-12"	0.0	0.4	0.4	2.8	4.0	3.8	4.3	4.3

Reviewed by: [illegible]
VP Technical Operations

A Kansas Corporation

TURF DIAGNOSTICS & DESIGN

"Managing the Elements Through Science"

Environmental & Turf Services
Tom Durborow
11141 Georgia Ave., Suite 208
Wheaton, MD 20902
PHONE:301-933-4700
FAX:301-933-4701

Account No. 79130100
Date 3/19/92
Facility HANA

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity umhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 18							
LAB ID NO.	SAMPLE NAME	%	%	%					
92020012-1	SS#1 0-6" (Duplicate)	25.4	26.0	48.6	Clay		6.7	6.6	

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	> 4.0	2.0	> 2.0	1.0	0.5	0.25	0.10	0.05
	U.S. Sieve (mesh)	> 5	10	> 10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
92020012-1	SS#1 0-6" (Duplicate)	0.0	0.0	0.0	2.8	4.5	6.0	7.0	6.0

Reviewed by: [signature]
VP Technical Operations

A Kansas Corporation

310-A North Winchester • Olathe, Kansas 66062 • (913) 780-6725 • Fax: (913) 780 6759

TURF DIAGNOSTICS & DESIGN

"Managing the Elements Through Science"

Samples Submitted By

Environmental & Turf Services
Tom Durborow
11141 Georgia Ave., Suite 208
Wheaton, MD 20902
PHONE:301-933-4700
FAX:301-933-4701

Account No. 79130100
Date 20-Mar-92
Facility HANA

LAB ID NO.	SAMPLE NAME	Infiltration Rate In/hr	1/3 Bar Water Holding %(gravimetric)	Bulk Density g/cc	Porosity Total %	Porosity Capillary %	Porosity Non Capillary %
92020012-1	SS#1 0-6"	1.4	50.3	1.0	59.6		
92020012-2	SS#1 6-12"	2.9	58.8	0.9	64.9		
92020012-3	SS#2 0-6"	1.3	59.7	1.0	60.8		
92020012-4	SS#2 6-12"	1.6	58.5	1.0	63.9		
92020012-5	SS#3 0-6"	2.9	61.2	0.9	61.0		

Root-Zone Mix Parameters

		Sand Parameters		Peat Parameters		Chemical Analysis		
LAB ID NO.	SAMPLE NAME	Bulk Density LBS / FT3	Moisture % Dry Wt.	Bulk Density LBS / FT3	Moisture % Wet Wt.	pH	EC umhos/cm	Organic Matter (%)
92020012-1	SS#1 0-6"					6.6		6.5
92020012-2	SS#1 6-12"					6.7		5.7
92020012-3	SS#2 0-6"					6.0		6.5
92020012-4	SS#2 6-12"					6.3		6.7
92020012-5	SS#3 0-6"					5.7		6.8

Reviewed by: [signature]
Title: Vice President Technical Operations

A Kansas Corporation

310-A North Winchester • Olathe, Kansas 66062 • (913) 780-6725 • Fax: (913) 780-6759

TURF DIAGNOSTICS & DESIGN

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PHONE:301-933-4700
FAX:301-933-4701

Account No. 79130100
Date 20-Mar-92
Facility HANA

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	1/3 Bar Water Holding % (gravimetric)	Bulk Density g/cc	Porosity Total %	Porosity Capillary %	Porosity Non Capillary %
92020012-6	SS#3 6-12"	4.7	60.4	0.9	62.9		
92020012-4	SS#2 6-12" (Duplicate)	2.3		0.9	64.3		

Root-Zone Mix Parameters

LAB ID NO.	SAMPLE NAME	Sand Parameters Bulk Density LBS/FT3	Sand Parameters Moisture % Dry Wt.	Peat Parameters Bulk Density LBS/FT3	Peat Parameters Moisture % Wet Wt.	Chemical Analysis pH	Chemical Analysis EC mmhos/cm	Chemical Analysis Organic Matter (%)
92020012-6	SS#3 6-12"					6.0		6.3
92020012-1	SS#1 0-6" (duplicate)					6.7		6.6

Reviewed by: [signature]
Title: Vice President Technical Operations

A Kansas Corporation

310-A North Winchester • Olathe, Kansas 66062 • (913) 780-6725 • Fax: (913) 780-6759

ENVIRONMENTAL & TURF SERVICES, INC.

11141 Georgia Ave. Suite 208
Wheaton, MD 20902
(301) 933-4700

Sample Chain of Custody Record

Project: HANA Site:
Client: ENVIRONMENTAL & TURF SERVICES, INC.
Address: 11141 GEORGIA AVE, STE 208 WHEATON, Md 20902
Phone: 301-933-4700
Sampler's Name/Firm: NL BARNES / ETS
Phone: AA Sampler's Signature: LA JAN BARNES

Preservative Used
Analyses Required: pH, ORGANIC MATTER, TEXTURE, USGA PHYSICAL

Sample Number	Date	Time	Matrix	No. of Containers	pH	Organic Matter	Texture	USGA Physical	Remarks or Sample Location
SS#1/0-6"	2-4-92		SOIL	1	✓	✓	✓	✓	HKOC @ B#2
SS#1/6-12"	2-4-92		SOIL	1	✓	✓	✓	✓	HKOC @ B#2
SS#2/0-6"	2-6-92		SOIL	1	✓	✓	✓	✓	HKNC @ B#3
SS#2/6-12"	2-6-92		SOIL	1	✓	✓	✓	✓	HKNC @ B#3
SS#3/0-6"	2-6-92		SOIL	1	✓	✓	✓	✓	HKLD @ B#1
SS#3/6-12"	2-6-92		SOIL	1	✓	✓	✓	✓	HKLD @ B#1

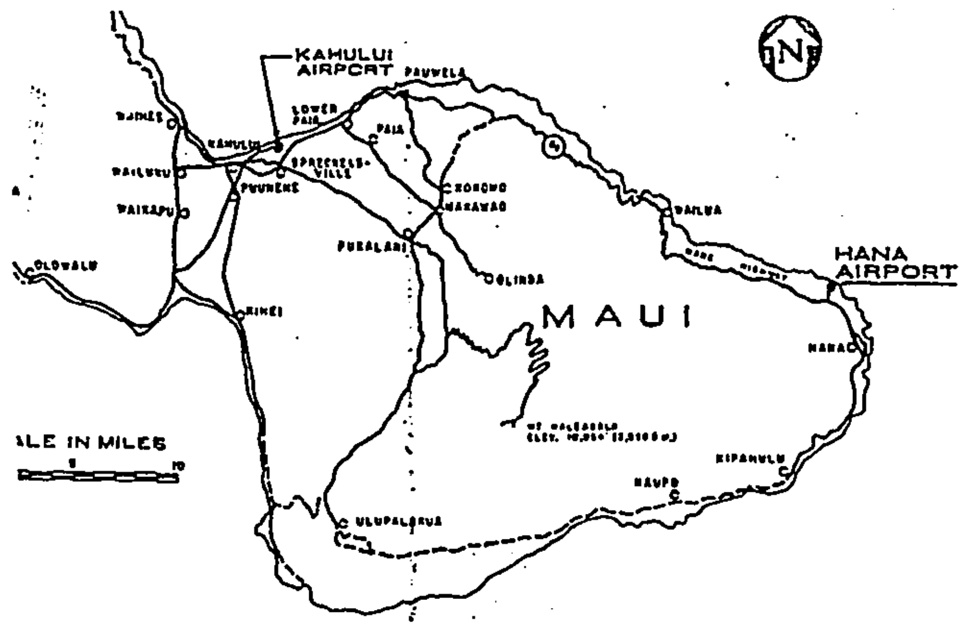
call me when you receive this!
JF called 2-14-92 (talked to Tom)

Relinquished by: (Signature) 1	Date/Time	Received by: (Signature)	Relinquished by: (Signature) 4	Date/Time	Shipping Carrier:
LaJan Barnes	2/4/92				UPS
Relinquished by: (Signature) 2	**Date/Time**	**Received by: (Signature)**	**Received for Laboratory by: (Signature)**	**Date/Time**	**Shipping Ticket Number:**
Relinquished by: (Signature) 3	**Date/Time**	**Received by: (Signature)**	**Sampler Remarks**	**Lab Remarks**	
Jeanne Fell	3/13/92	[signature]			

White-Return to Client Yellow-Retain by Lab (Project File) Pink-Retain by Lab (Client Services) Gold-Retain by Sampler

Appendix D.

Wind Rose



/ICINITY AND LOCATION MAP

ONS	DATE
LTR DATED 8/13/81	6/15/81
LETTER DATED 26 AUGUST 1976	
8/23/76	
8/19/76	

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII
AIRPORTS DIVISION

HANA AIRPORT
HANA, MAUI

AIRPORT LAYOUT PLAN

SCALE: AS SHOWN DATE: 13 AUG 1976

2275.1

Appendix E.

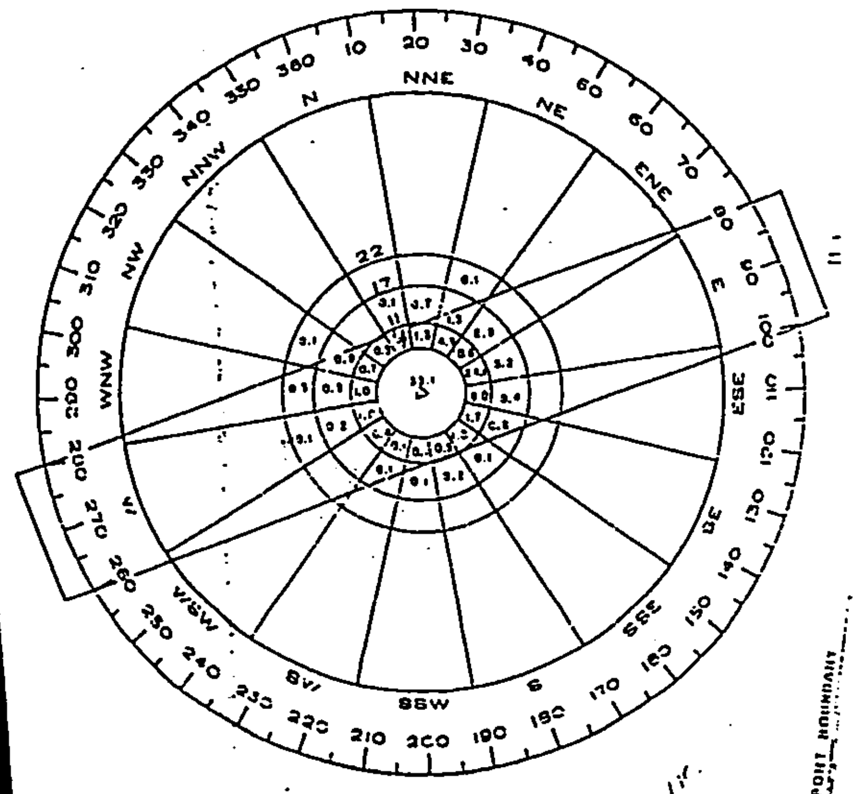
Wananalua Well Log

WIND DATA:

SOURCE: HANA AIRPORT

PERIOD: JANUARY 1967 - DECEMBER 1967

COVERAGE: 98.7% FOR 10.5 KNOTS (19.45 M.) CROSSWIND



WIND ROSE

SCALE: 1" = 20 KNOTS (37.04 KMPH)

XEROX COPY

ENGINEERING REPORT

FOR

HANA RANCH WANANALUA WELL

(State No. 4559-01)

AT

HANA, MAUI, HAWAII

Prepared For:

Hana Ranch, Inc.
Hana, Maui, Hawaii

WARREN S. UNEMORI
REGISTERED PROFESSIONAL ENGINEER & LAND SURVEYOR
No. 1589
HAWAII, U.S.A.

Prepared By:

Warren S. Unemori Engineering, Inc.
Civil and Structural Engineers - Land Surveyors
Wells Street Professional Center, Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

October, 1991

DESCRIPTION

Date of report August 10, 1988 Person filing report L. H. KIDNELLS

A. OWNER HANA DEVELOPMENT WELL NAME HANA RANCH WELL ISLAND MAUI
B. GENERAL LOCATION HANA
C. DRILLING COMPANY ROSCOE MOSS COMPANY
D. TYPE OF RIG Cable tool DRILLING COMPLETED 08 (month) 88 (year) DRILLER E. Couch
E. ELEVATION, msl: Top of drilling platform ______ ft. Bench mark and method used to determine
Height of drilling platform above ground surface ______ ft. elevation:
F. HOLE SIZE: 16 inch dia. to ______ ft. below drilling platform.
______ inch dia. to ______ ft. below drilling platform.
______ inch dia. to ______ ft. below drilling platform. Drilling platform 410.2'
G. CASING INSTALLED: 12 in. I.D. x .312 in. wall solid section to 410 ft. below drilling platform.
12 in. I.D. x .312 in. wall perforated section to 440 ft. below drilling platform.
Type of perforation Louver
H. ANNULUS: Grouted 0 ft. to 200 ft. below drilling platform.
Gravel packed 200 ft. to 440 ft. below drilling platform.
I. PERMANENT PUMP INSTALLATION:
Pump type, make, serial no. ______ Capacity ______ g.p.m.
Motor type, H.P., voltage, r.p.m. ______
Depth of pump intake setting ______ ft. below ______ which elevation is ______ ft.
Depth of bottom of airline ______ ft. below ______ which elevation is ______ ft.

Measured from top of casing el. 409.75

HYDROLOGY

J. INITIAL WATER LEVEL 404.5' ft. below drilling platform. Date of measurement 07/23/88
K. INITIAL CHLORIDE: 60 ppm, total depth of well 440 ft. below drilling platform Sampling Date
L. PUMPING TESTS: Reference point (R.P.) used: ______ which elevation is ______ ft.

Date August 01, 1988					Date				
Start water level	ft. below R. P.				Start water level	ft. below R. P.			
End water level	ft. below R. P.				End water level	ft. below R. P.			
Depth of well	ft. below R. P.				Depth of well	ft. below R. P.			
Elapsed Time (hours)	Rate (gpm)	Draw-down (ft.)	Cl- (ppm)	Temp. °F	Elapsed Time (hours)	Rate (gpm)	Draw-down (ft.)	Cl- (ppm)	Temp. °F
to					to				
to 48 hour test					to				
to					to				
to					to				
to					to				
to					to				

SUBSURFACE FORMATION

M. DRILLER'S LOG:

Depth, ft.	Rock Description & Remarks	Water Level ft.	Depth, ft.	Rock Description & Remarks	Water Level ft.
0 to 33	Gravel Cinder		241 to 258	Gray Rock	
33 to 46	Blue Rock		258 to 273	Brown Rock Hard	
46 to 63	Boulder Cinder		273 to 287	Gray Rock Hard	
63 to 107	Blue Rock		287 to 290	Red Cinders & Clay	
107 to 123	Red Gray Rock		290 to 376	Brown Lava & Cinders	
123 to 165	Blue Rock		376 to 406	Brown Broken Rock	
165 to 174	Red Rock		406 to 437	Red & Gray Cinders	
174 to 197	Gray & Blue Rock		437 to 440	Gray Rock Hard	
197 to 200	Brown Rock		to		
200 to 222	Brown Rock Soft		to		
222 to 241	Gray Hard Rock		to		

N. REMARKS:

FOR DRILLER'S USE
Job Name ______

INSTRUCTIONS: Send three(3) copies to Manager-Chief Engineer, Division of Water and Land Development, P. O. Box 373, Honolulu, Hawaii 96809.
REFERENCES: Chapter 178, entitled "Artesian Wells, Generally," HRS, as amended by Act 123 SLH 1970. Honolulu Board of Water Supply, "Rules and Regulations Providing for the Protection, Development and Conservation of ...

FOR OFFICIAL USE
Latitude ______
Longitude ______

Appendix F.

Summary of Field Permeability Tests
(Pacific Geotechnical Engineers, Inc.)

TABLE 2

SUMMARY OF FIELD PERMEABILITY TESTS

BORING NO.	GROUND SURFACE ELEVATION (feet)	DEPTH INTERVAL TESTED (feet)	MATERIAL TYPE	TYPE OF TEST (1)	TEST PRESSURE (psi) (2)	CALCULATED PERMEABILITY (cm/sec)
1	450.	0.0 to 1.4	Clayey silt	Falling Head		3×10^{-3}
		4.5 to 9.5	Highly fractured basalt	Packer	22	2.4×10^{-3}
2	257.5	0.0 to 4.5	Clayey silt	Falling Head		5×10^{-4}
		8.7 to 14.7	Highly fractured basalt	Packer	5	4×10^{-3}
		8.7 to 14.7	Highly fractured basalt	Packer	15	2.6×10^{-3}
		24.0 to 30.0	Moderately fractured basalt	Packer	7.5	2.5×10^{-3}
		24.0 to 30.0	Moderately fractured basalt	Packer	20	2×10^{-3}
		33.5 to 39.5	Clinker gravel and Slightly fractured basalt	Packer	25	1.5×10^{-3}

TABLE 2 (continued)

BORING NO.	GROUND SURFACE ELEVATION (feet)	DEPTH INTERVAL TESTED (feet)	MATERIAL TYPE	TYPE OF TEST (1)	TEST PRESSURE (psi) (2)	CALCULATED PERMEABILITY (cm/sec)
2	257.5	48.0 to 50.0	Moderately fractured basalt	Packer	27	8.0×10^{4}
3	361.3	0.0 to 0.9	Clayey silt	Falling Head		7×10^{3}
		5.0 to 11.0	Moderately fractured basalt	Packer	19	2.4×10^{3}
		14.5 to 20.5	Clinker gravel	Packer	27	1.7×10^{3}
		21.0 to 30.0	Slightly fractured basalt	Packer	25	1.3×10^{3}

NOTES:

(1) Single Packer used for Packer Test Inflatable.
(2) Test Pressure indicated for Packer Test only.

APPENDIX A

SUBSURFACE EXPLORATION, FIELD PERMEABILITY TESTS, AND LABORATORY TESTING

A.1 SUBSURFACE EXPLORATION

The subsurface exploration was performed during the period from February 4 through February 7, 1992. Three test borings, ranging in depth from 9.5 to 50 feet below existing ground surface, were drilled by our subcontracted drilling crew using a truck mounted drill rig. The drilling was performed using the auger and rotary wash drill methods. A 4-inch diameter steel casing was used to maintain an open borehole during the drilling and testing. A water truck and existing water troughs provided by Keola Hana Maui, Inc. were used to supply water for the exploratory drilling.

The drilling was performed under the technical supervision of our engineer, who prepared a log of the soil and rock materials encountered, and obtained relatively undisturbed and disturbed soil samples and rock cores. The soil samples and rock cores were returned to our laboratory for further inspection and laboratory testing.

The locations of the borings are shown on the Plot Plan, Plate 3 in the text. Graphical representations of the soils and rocks encountered are presented on the Log of Borings, Plates A-1.1 through A-1.3. Soil materials were classified in accordance with the Unified Soil Classification System, Plate A-2.

Soil samples were obtained using a Sprague and Henwood sampler driven with a 140-pound hammer falling 30 inches. The sampler was driven for a total distance of 18 inches, and the blow counts for each 6 inches of penetration was recorded. The blow counts for the last 12 inches of penetration are noted on the Log of Borings.

Rock materials were continuously cored with a double tube NX-size core barrel, which recovers cores approximately 2 inches in diameter. The rock quality designation (RQD) and percentage of core recovery are indicated on the Log of Borings. RQD is defined as the total length of intact core pieces, 4 inches or longer, expressed as a percentage of the overall core run.

At the completion of each boring, a slotted PVC pipe was installed near the bottom of the boring to check for possible groundwater

A.2 FIELD PERMEABILITY TESTS

Permeability tests consisting of falling head and packer tests were performed to obtain data on the permeability characteristic of the near surface soils and underlying lava formation. The results of the permeability tests are summarized on Table 2 in the main text.

The tests consisted of auguring a borehole to the depth of the test zone, filling the borehole to the ground surface with water, then measuring the drop in water level in the borehole after shutting off the water supply. The tests were performed to depths ranging of 1.4 feet in Boring 1, 4.5 feet in Boring 2, and 0.9 feet in Boring 3.

Packer tests were performed at various depth intervals in the basaltic bedrock. The nature of the basaltic material tested included slightly to highly fractured basalt and clinker gravel. The tests were performed by isolating increments of the borehole by means of an inflatable rubber packer. Water was then pumped into the section of the borehole below the packer seal. The water pressure was maintained at a constant value and flow rate was measured. This data was then used to compute an average value of permeability for the tested section. Test water pressures ranged from 5 to 27 pounds per square inch. The basic equipment set up for single packer assembly is shown on Plate A-3.

A.3 LABORATORY TESTING

We performed laboratory testing consisting on moisture content and dry density determinations on relatively undisturbed soil samples. Moisture content is expressed as a percentage of dry weight of each sample. The results of the moisture content and dry density tests are presented on the Log of Borings, Plates A-1.1 through A-1.3 at the appropriate sample depth.

The following plates are attached and complete this appendix.

Plates A-1.1 through A-1.3	-	Log of Borings, Borings 1 through 3
Plate A-2	-	Unified Soil Classification System
Plate A-3	-	Single Packer Assembly

PROJECT Hana Golf Course JOB No. 895-001
LOCATION Hana, Maui, Hawaii DRAWN BY ln

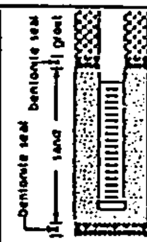
BORING 1 (Page 1 of 1)

SURFACE ELEVATION 443 ± Feet
DATUM MSL

LAB DATA: Moisture Content %	LAB DATA: Dry Density %	CORE INFO: Core Type	CORE INFO: Recovery %	CORE INFO: RQD % or (RQI) %	Blows/Ft.	Depth (feet)	Samples	Graphic Log	Soil Class	Description
28	74				25				ML	Dark yellowish brown fine sandy clayey silt, medium stiff, with basaltic gravel and grass roots, moist grades with basaltic cobbles
		NX	54	0		5				Gray to dark gray basalt, medium hard, closely fractured, moderately to highly weathered grades highly vesicular from 5.5 to 8.5 feet

Boring completed at 9.5 feet on 2-7-92
Groundwater not encountered

WELL



☒ - Standard penetration test sample (split-spoon sampler)
I - Core run
Driving energy 140-lb. dropping 30 inches

LOG OF BORING
Pacific Geotechnical Engineers, Inc.
PLATE A1.1

PROJECT Mana Golf Course JOB No. 5155-001
LOCATION Mana, Maui, Hawaii DRAWN BY ln

BORING 2 (Page 1 of 2)

SURFACE ELEVATION 257 ± Feet
DATUM MSL

LAB DATA: MOISTURE CONTENT %	LAB DATA: DRY DENSITY %	CORE INFO: CORE TYPE	CORE INFO: RECOVERY %	CORE INFO: RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SOIL CLASS	DESCRIPTION
							ML GM	Dark yellowish brown fine sandy clayey silt, medium stiff, with highly weathered basaltic gravel, cobbles, and grass roots, moist
40	70				16			
							SM	Dark brown silty sand, very dense, moist
18					95/4"	5		
								Gray basalt, hard, moderately to highly fractured, moderately weathered, slightly vesicular
		NX	100	58				
		NX	100	0		10		
								grades highly fractured, highly vesicular
							GP	Gray basaltic clinker gravel
		NX	36	14		15		
								Gray basalt, hard, highly fractured, moderately weathered, moderately vesicular
							GP	Gray basaltic clinker gravel
						20		
		NX	58	0				
		NX	100	0				Gray basalt, hard, moderately fractured, moderately weathered, moderately vesicular
		NX	67	17		25		
								grades reddish gray, highly vesicular
						30		
		NX	75	0				grades slightly fractured
							GP	Reddish gray clinker gravel and cobbles
		NX	75	0		35		
								Reddish gray basalt, hard, highly fractured, moderately weathered, highly vesicular
		NX	67	36		40		

WELL: grout; cuttings; cement; bentonite seal

NOTES:
■ - Undisturbed sample
⊡ - Disturbed sample
[ ] - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A1.2

PROJECT Mana Golf Course JOB No. 5155-001

BORING 2 (Page 2 of 2)

LAB DATA: MOISTURE CONTENT %	LAB DATA: DRY DENSITY %	CORE INFO: CORE TYPE	CORE INFO: RECOVERY %	CORE INFO: RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SOIL CLASS	DESCRIPTION
		NX	50	8				
							GP	Reddish gray clinker gravel and cobbles
						45		
		NX	71	0				
								Gray basalt, hard, slightly to moderately fractured, moderately weathered, moderately to highly vesicular
						50		grades slightly weathered, slightly vesicular
								Boring completed at 50.0 feet on 2-5-92 Groundwater not encountered

WELL: bentonite seal

NOTES:
■ - Undisturbed sample
⊡ - Disturbed sample
[ ] - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb dropping 30 inches

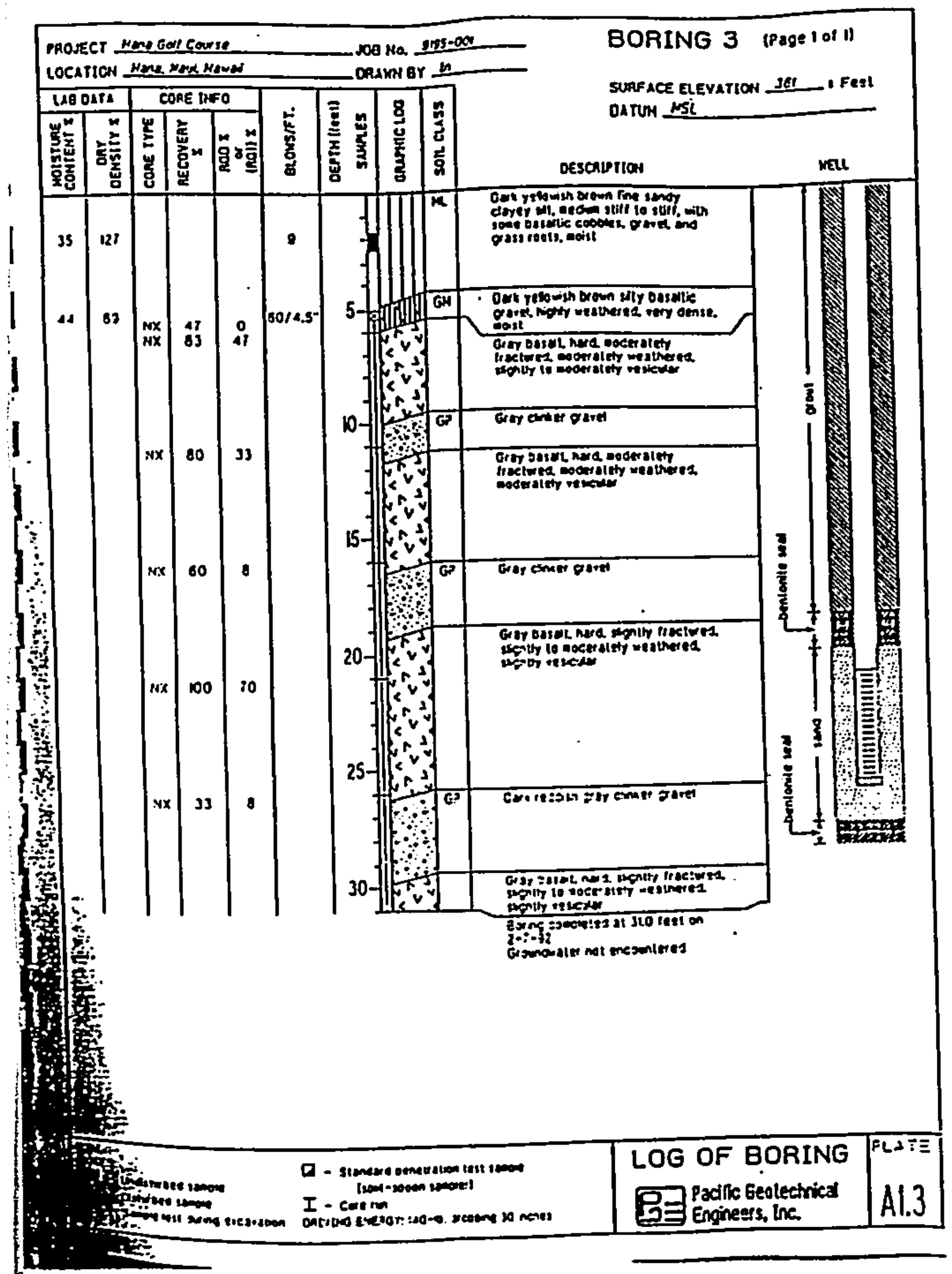
LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A1.2

Appendix G.

Selected Output for PRZM2



```
Flow simulation from  1 Jan  4 to 31 Jan  4
Transport simulation from  1 Jan  4 to 31 Jan  4
Transport simulation from  1 Jan  4 to 31 Jan  4
Transport simulation from  1 Jan  4 to 31 Jan  4
Flow simulation from  1 Feb  4 to 29 Feb  4
Transport simulation from  1 Feb  4 to 29 Feb  4
Transport simulation from  1 Feb  4 to 29 Feb  4
Transport simulation from  1 Feb  4 to 29 Feb  4
Flow simulation from  1 Mar  4 to 31 Mar  4
Transport simulation from  1 Mar  4 to 31 Mar  4
Transport simulation from  1 Mar  4 to 31 Mar  4
Transport simulation from  1 Mar  4 to 31 Mar  4
Flow simulation from  1 Apr  4 to 30 Apr  4
Transport simulation from  1 Apr  4 to 30 Apr  4
Transport simulation from  1 Apr  4 to 30 Apr  4
Transport simulation from  1 Apr  4 to 30 Apr  4
Flow simulation from  1 May  4 to 31 May  4
Transport simulation from  1 May  4 to 31 May  4
Transport simulation from  1 May  4 to 31 May  4
Transport simulation from  1 May  4 to 31 May  4
Flow simulation from  1 Jun  4 to 30 Jun  4
Transport simulation from  1 Jun  4 to 30 Jun  4
Transport simulation from  1 Jun  4 to 30 Jun  4
Transport simulation from  1 Jun  4 to 30 Jun  4
Flow simulation from  1 Jul  4 to 31 Jul  4
Transport simulation from  1 Jul  4 to 31 Jul  4
Transport simulation from  1 Jul  4 to 31 Jul  4
Transport simulation from  1 Jul  4 to 31 Jul  4
Flow simulation from  1 Aug  4 to 31 Aug  4
Transport simulation from  1 Aug  4 to 31 Aug  4
Transport simulation from  1 Aug  4 to 31 Aug  4
Transport simulation from  1 Aug  4 to 31 Aug  4
Flow simulation from  1 Sep  4 to 30 Sep  4
Transport simulation from  1 Sep  4 to 30 Sep  4
Transport simulation from  1 Sep  4 to 30 Sep  4
Transport simulation from  1 Sep  4 to 30 Sep  4
Flow simulation from  1 Oct  4 to 31 Oct  4
Transport simulation from  1 Oct  4 to 31 Oct  4
Transport simulation from  1 Oct  4 to 31 Oct  4
Transport simulation from  1 Oct  4 to 31 Oct  4
Flow simulation from  1 Nov  4 to 30 Nov  4
Transport simulation from  1 Nov  4 to 30 Nov  4
```

```
******************************************************************************
Transport simulation from  1 Nov  4 to 30 Nov  4
******************************************************************************
******************************************************************************
Transport simulation from  1 Nov  4 to 30 Nov  4
******************************************************************************
******************************************************************************
Flow simulation from  1 Dec  4 to 31 Dec  4
******************************************************************************
          SUMMARY OF VOLUMETRIC FLOW BALANCE OUTPUT
          -----------------------------------------

          Elapsed simulation time =   0.3100E+02
          Current value of time increment =   0.1000E+01

          Fluid flux value at first node =  0.8898E+00
          Fluid flux value at last node = -0.1105E+01
          NOTE: These "net" values are only for last day of time step
          Net value of fluid flux = -0.2147E+00
          Net rate of volumetric storage = -0.2148E+00
          FLOW BALANCE ERROR =  0.3131E-04
          NORMALIZED BALANCE ERROR =  0.1417E-04
          NOTE: These "cumulative" values are for the entire time step
          Cumulative volumetric storage =  0.1244E+01
          Cumulative inflow volume =  0.6669E+03
          Cumulative outflow volume = -0.6657E+03

          TIME VS HEAD AT NODE NUMBER    1
          ---------------------------
        0.1000E+01 -0.1144E+04         0.2000E+01 -0.1212E+04         0.3000E+01
-0.1444E+04          0.4000E+01 -0.1204E+04
        0.5000E+01 -0.1440E+04         0.6000E+01 -0.7044E+03         0.7000E+01
-0.1558E+03          0.8000E+01 -0.5344E+03
        0.9000E+01 -0.9849E+03         0.1000E+02 -0.1313E+04         0.1100E+02
-0.1498E+04          0.1200E+02 -0.1593E+04
        0.1300E+02 -0.1641E+04         0.1400E+02 -0.1665E+04         0.1500E+02
-0.1676E+04          0.1600E+02 -0.1682E+04
        0.1700E+02 -0.1584E+03         0.1800E+02 -0.2975E+03         0.1900E+02
-0.7435E+03          0.2000E+02 -0.1155E+04
        0.2100E+02 -0.1412E+04         0.2200E+02 -0.1550E+04         0.2300E+02
-0.1620E+04          0.2400E+02 -0.1654E+04
        0.2500E+02 -0.1671E+04         0.2600E+02 -0.1333E+04         0.2700E+02
-0.9995E+03          0.2800E+02 -0.1044E+04
        0.2900E+02 -0.3789E+03         0.3000E+02 -0.3257E+03         0.3100E+02
-0.4528E+03

          TIME VS HEAD AT NODE NUMBER   38
          ---------------------------
        0.1000E+01 -0.1034E+04         0.2000E+01 -0.1103E+04         0.3000E+01
-0.1333E+04          0.4000E+01 -0.1094E+04
        0.5000E+01 -0.1329E+04         0.6000E+01 -0.5994E+03         0.7000E+01
-0.1038E+03          0.8000E+01 -0.4249E+03
        0.9000E+01 -0.8749E+03         0.1000E+02 -0.1202E+04         0.1100E+02
-0.1387E+04          0.1200E+02 -0.1483E+04
        0.1300E+02 -0.1530E+04         0.1400E+02 -0.1554E+04         0.1500E+02
-0.1565E+04          0.1600E+02 -0.1571E+04
        0.1700E+02 -0.1052E+03         0.1800E+02 -0.2044E+03         0.1900E+02
-0.6338E+03          0.2000E+02 -0.1045E+04
        0.2100E+02 -0.1301E+04         0.2200E+02 -0.1439E+04         0.2300E+02
-0.1509E+04          0.2400E+02 -0.1543E+04
        0.2500E+02 -0.1560E+04         0.2600E+02 -0.1224E+04         0.2700E+02
-0.8914E+03          0.2800E+02 -0.9346E+03
        0.2900E+02 -0.2824E+03         0.3000E+02 -0.2336E+03         0.3100E+02
-0.3508E+03
```

```
          TIME VS HEAD AT NODE NUMBER  152
          ---------------------------
        0.1000E+01 -0.1096E+04         0.2000E+01 -0.1102E+04         0.3000E+01
-0.1112E+04          0.4000E+01 -0.1102E+04
        0.5000E+01 -0.1112E+04         0.6000E+01 -0.1058E+04         0.7000E+01
-0.6234E+03          0.8000E+01 -0.9543E+03
        0.9000E+01 -0.1081E+04         0.1000E+02 -0.1106E+04         0.1100E+02
-0.1114E+04          0.1200E+02 -0.1117E+04
        0.1300E+02 -0.1119E+04         0.1400E+02 -0.1119E+04         0.1500E+02
-0.1120E+04          0.1600E+02 -0.1120E+04
        0.1700E+02 -0.6300E+03         0.1800E+02 -0.8296E+03         0.1900E+02
-0.1042E+04          0.2000E+02 -0.1097E+04
        0.2100E+02 -0.1110E+04         0.2200E+02 -0.1116E+04         0.2300E+02
-0.1118E+04          0.2400E+02 -0.1119E+04
        0.2500E+02 -0.1120E+04         0.2600E+02 -0.1108E+04         0.2700E+02
-0.1089E+04          0.2800E+02 -0.1091E+04
        0.2900E+02 -0.9561E+03         0.3000E+02 -0.9108E+03         0.3100E+02
-0.9820E+03

          TIME VS HEAD AT NODE NUMBER  222
          ---------------------------
        0.1000E+01  0.0000E+00         0.2000E+01  0.0000E+00         0.3000E+01
0.0000E+00          0.4000E+01  0.0000E+00
        0.5000E+01  0.0000E+00         0.6000E+01  0.0000E+00         0.7000E+01
0.0000E+00          0.8000E+01  0.0000E+00
        0.9000E+01  0.0000E+00         0.1000E+02  0.0000E+00         0.1100E+02
0.0000E+00          0.1200E+02  0.0000E+00
        0.1300E+02  0.0000E+00         0.1400E+02  0.0000E+00         0.1500E+02
0.0000E+00          0.1600E+02  0.0000E+00
        0.1700E+02  0.0000E+00         0.1800E+02  0.0000E+00         0.1900E+02
0.0000E+00          0.2000E+02  0.0000E+00
        0.2100E+02  0.0000E+00         0.2200E+02  0.0000E+00         0.2300E+02
0.0000E+00          0.2400E+02  0.0000E+00
        0.2500E+02  0.0000E+00         0.2600E+02  0.0000E+00         0.2700E+02
0.0000E+00          0.2800E+02  0.0000E+00
        0.2900E+02  0.0000E+00         0.3000E+02  0.0000E+00         0.3100E+02
0.0000E+00
******************************************************************************
Transport simulation from  1 Dec  4 to 31 Dec  4
******************************************************************************

          MASS TRANSPORT BALANCE, CHEMICAL 1 (Iprodione)
          ---- --------- -------  -------- --

          NOTE: These "net" values are only for last day of time step
          Net dispersive flux =                0.5583E-07
          Net advective  flux =                0.9641E-04
          Net rate of mass accumulation =      0.8535E-04
          Net rate of formation =              0.0000E+00
          Net rate of mass decay =             0.1102E-04
          MASS BALANCE ERROR =                 0.9655E-07
          NORMALIZED MASS BALANCE ERROR =      0.4255E-03

          NOTE: These "cumulative" values are for the entire time step
          Cumulative mass storage =            0.1123E-02
          Cumulative mass decay =              0.3482E-03
          Cumulative inflow mass =             0.1085E-02
          Cumulative outflow mass =            0.1857E-02
```

```
        ANNUAL SUMMARY OF CUMULATIVE CONCENTRATIONS
        ------ ------- -- ---------- --------------
      NOTE: These "cumulative" values are yearly summaries
      Annual cumulative mass storage =         0.8340E-02
      Annual cumulative mass decay =           0.4409E-02
      Annual cumulative inflow mass =          0.1328E-01
      Annual cumulative outflow mass =         0.1719E-01

      TIME VS CONCENTRATION AT NODE NUMBER    1
      ------------------------------------
    0.1000E+01  0.5204E-04        0.2000E+01  0.5186E-04        0.3000E+01
0.5176E-04        0.4000E+01  0.5151E-04
    0.5000E+01  0.5141E-04        0.6000E+01  0.5105E-04        0.7000E+01
0.5262E-04        0.8000E+01  0.5245E-04
    0.9000E+01  0.5235E-04        0.1000E+02  0.5224E-04        0.1100E+02
0.5214E-04        0.1200E+02  0.5204E-04
    0.1300E+02  0.5193E-04        0.1400E+02  0.5183E-04        0.1500E+02
0.5173E-04        0.1600E+02  0.5162E-04
    0.1700E+02  0.5212E-04        0.1800E+02  0.5239E-04        0.1900E+02
0.5226E-04        0.2000E+02  0.5215E-04
    0.2100E+02  0.5205E-04        0.2200E+02  0.5194E-04        0.2300E+02
0.5184E-04        0.2400E+02  0.5174E-04
    0.2500E+02  0.5163E-04        0.2600E+02  0.5121E-04        0.2700E+02
0.5084E-04        0.2800E+02  0.5060E-04
    0.2900E+02  0.5032E-04        0.3000E+02  0.5036E-04        0.3100E+02
0.5031E-04

      TIME VS CONCENTRATION AT NODE NUMBER   38
      ------------------------------------
    0.1000E+01  0.4838E-04        0.2000E+01  0.4829E-04        0.3000E+01
0.4820E-04        0.4000E+01  0.4812E-04
    0.5000E+01  0.4803E-04        0.6000E+01  0.4799E-04        0.7000E+01
0.4867E-04        0.8000E+01  0.4861E-04
    0.9000E+01  0.4853E-04        0.1000E+02  0.4844E-04        0.1100E+02
0.4835E-04        0.1200E+02  0.4826E-04
    0.1300E+02  0.4816E-04        0.1400E+02  0.4807E-04        0.1500E+02
0.4797E-04        0.1600E+02  0.4787E-04
    0.1700E+02  0.4851E-04        0.1800E+02  0.4864E-04        0.1900E+02
0.4857E-04        0.2000E+02  0.4849E-04
    0.2100E+02  0.4840E-04        0.2200E+02  0.4831E-04        0.2300E+02
0.4821E-04        0.2400E+02  0.4812E-04
    0.2500E+02  0.4802E-04        0.2600E+02  0.4794E-04        0.2700E+02
0.4787E-04        0.2800E+02  0.4779E-04
    0.2900E+02  0.4786E-04        0.3000E+02  0.4797E-04        0.3100E+02
0.4797E-04

      TIME VS CONCENTRATION AT NODE NUMBER  152
      ------------------------------------
    0.1000E+01  0.4943E-04        0.2000E+01  0.4933E-04        0.3000E+01
0.4923E-04        0.4000E+01  0.4912E-04
    0.5000E+01  0.4902E-04        0.6000E+01  0.4889E-04        0.7000E+01
0.4847E-04        0.8000E+01  0.4831E-04
    0.9000E+01  0.4820E-04        0.1000E+02  0.4810E-04        0.1100E+02
0.4800E-04        0.1200E+02  0.4790E-04
    0.1300E+02  0.4780E-04        0.1400E+02  0.4771E-04        0.1500E+02
0.4761E-04        0.1600E+02  0.4752E-04
    0.1700E+02  0.4727E-04        0.1800E+02  0.4713E-04        0.1900E+02
0.4703E-04        0.2000E+02  0.4693E-04
    0.2100E+02  0.4684E-04        0.2200E+02  0.4674E-04        0.2300E+02
0.4665E-04        0.2400E+02  0.4656E-04
    0.2500E+02  0.4646E-04        0.2600E+02  0.4637E-04        0.2700E+02
0.4628E-04        0.2800E+02  0.4618E-04
    0.2900E+02  0.4608E-04        0.3000E+02  0.4599E-04        0.3100E+02
0.4591E-04

      TIME VS CONCENTRATION AT NODE NUMBER  222
      ------------------------------------
    0.1000E+01  0.4664E-04        0.2000E+01  0.4657E-04        0.3000E+01
0.4648E-04        0.4000E+01  0.4641E-04
    0.5000E+01  0.4633E-04        0.6000E+01  0.4631E-04        0.7000E+01
0.4703E-04        0.8000E+01  0.4711E-04
    0.9000E+01  0.4705E-04        0.1000E+02  0.4697E-04        0.1100E+02
0.4688E-04        0.1200E+02  0.4679E-04
    0.1300E+02  0.4670E-04        0.1400E+02  0.4661E-04        0.1500E+02
0.4651E-04        0.1600E+02  0.4642E-04
    0.1700E+02  0.4683E-04        0.1800E+02  0.4692E-04        0.1900E+02
0.4687E-04        0.2000E+02  0.4679E-04
    0.2100E+02  0.4670E-04        0.2200E+02  0.4661E-04        0.2300E+02
0.4651E-04        0.2400E+02  0.4642E-04
    0.2500E+02  0.4633E-04        0.2600E+02  0.4624E-04        0.2700E+02
0.4616E-04        0.2800E+02  0.4608E-04
    0.2900E+02  0.4606E-04        0.3000E+02  0.4605E-04        0.3100E+02
0.4600E-04
*****************************************************************************
Transport simulation from  1 Dec  4 to 31 Dec  4
*****************************************************************************
        MASS TRANSPORT BALANCE, CHEMICAL 2 (Fluvalinate)
        ---- --------- -------- -------- --
      NOTE: These "net" values are only for last day of time step
      Net dispersive flux =                0.0000E+00
      Net advective  flux =                0.0000E+00
      Net rate of mass accumulation =      0.0000E+00
      Net rate of formation =              0.0000E+00
      Net rate of mass decay =             0.0000E+00
      MASS BALANCE ERROR =                 0.0000E+00
      NORMALIZED MASS BALANCE ERROR =      0.0000E+00
      NOTE: These "cumulative" values are for the entire time step
      Cumulative mass storage =            0.0000E+00
      Cumulative mass decay =              0.0000E+00
      Cumulative inflow mass =             0.0000E+00
      Cumulative outflow mass =            0.0000E+00

        ANNUAL SUMMARY OF CUMULATIVE CONCENTRATIONS
        ------ ------- -- ---------- --------------
      NOTE: These "cumulative" values are yearly summaries
      Annual cumulative mass storage =         0.0000E+00
      Annual cumulative mass decay =           0.0000E+00
      Annual cumulative inflow mass =          0.0000E+00
      Annual cumulative outflow mass =         0.0000E+00

      TIME VS CONCENTRATION AT NODE NUMBER    1
      ------------------------------------
    0.1000E+01  0.0000E+00        0.2000E+01  0.0000E+00        0.3000E+01
0.0000E+00        0.4000E+01  0.0000E+00
    0.5000E+01  0.0000E+00        0.6000E+01  0.0000E+00        0.7000E+01
0.0000E+00        0.8000E+01  0.0000E+00
    0.9000E+01  0.0000E+00        0.1000E+02  0.0000E+00        0.1100E+02
0.0000E+00        0.1200E+02  0.0000E+00
    0.1300E+02  0.0000E+00        0.1400E+02  0.0000E+00        0.1500E+02
0.0000E+00        0.1600E+02  0.0000E+00
    0.1700E+02  0.0000E+00        0.1800E+02  0.0000E+00        0.1900E+02
0.0000E+00        0.2000E+02  0.0000E+00
    0.2100E+02  0.0000E+00        0.2200E+02  0.0000E+00        0.2300E+02
0.0000E+00        0.2400E+02  0.0000E+00
    0.2500E+02  0.0000E+00        0.2600E+02  0.0000E+00        0.2700E+02
0.0000E+00        0.2800E+02  0.0000E+00
    0.2900E+02  0.0000E+00        0.3000E+02  0.0000E+00        0.3100E+02
0.0000E+00
```

```
          TIME VS CONCENTRATION AT NODE NUMBER   38
          ------------------------------------
       0.1000E+01  0.0000E+00          0.2000E+01  0.0000E+00          0.3000E+01
0.0000E+00      0.4000E+01  0.0000E+00
       0.5000E+01  0.0000E+00          0.6000E+01  0.0000E+00          0.7000E+01
0.0000E+00      0.8000E+01  0.0000E+00
       0.9000E+01  0.0000E+00          0.1000E+02  0.0000E+00          0.1100E+02
0.0000E+00      0.1200E+02  0.0000E+00
       0.1300E+02  0.0000E+00          0.1400E+02  0.0000E+00          0.1500E+02
0.0000E+00      0.1600E+02  0.0000E+00
       0.1700E+02  0.0000E+00          0.1800E+02  0.0000E+00          0.1900E+02
0.0000E+00      0.2000E+02  0.0000E+00
       0.2100E+02  0.0000E+00          0.2200E+02  0.0000E+00          0.2300E+02
0.0000E+00      0.2400E+02  0.0000E+00
       0.2500E+02  0.0000E+00          0.2600E+02  0.0000E+00          0.2700E+02
0.0000E+00      0.2800E+02  0.0000E+00
       0.2900E+02  0.0000E+00          0.3000E+02  0.0000E+00          0.3100E+02
0.0000E+00

          TIME VS CONCENTRATION AT NODE NUMBER  152
          ------------------------------------

       0.1000E+01  0.0000E+00          0.2000E+01  0.0000E+00          0.3000E+01
0.0000E+00      0.4000E+01  0.0000E+00
       0.5000E+01  0.0000E+00          0.6000E+01  0.0000E+00          0.7000E+01
0.0000E+00      0.8000E+01  0.0000E+00
       0.9000E+01  0.0000E+00          0.1000E+02  0.0000E+00          0.1100E+02
0.0000E+00      0.1200E+02  0.0000E+00
       0.1300E+02  0.0000E+00          0.1400E+02  0.0000E+00          0.1500E+02
0.0000E+00      0.1600E+02  0.0000E+00
       0.1700E+02  0.0000E+00          0.1800E+02  0.0000E+00          0.1900E+02
0.0000E+00      0.2000E+02  0.0000E+00
       0.2100E+02  0.0000E+00          0.2200E+02  0.0000E+00          0.2300E+02
0.0000E+00      0.2400E+02  0.0000E+00
       0.2500E+02  0.0000E+00          0.2600E+02  0.0000E+00          0.2700E+02
0.0000E+00      0.2800E+02  0.0000E+00
       0.2900E+02  0.0000E+00          0.3000E+02  0.0000E+00          0.3100E+02
0.0000E+00

          TIME VS CONCENTRATION AT NODE NUMBER  222
          ------------------------------------

       0.1000E+01  0.0000E+00          0.2000E+01  0.0000E+00          0.3000E+01
0.0000E+00      0.4000E+01  0.0000E+00
       0.5000E+01  0.0000E+00          0.6000E+01  0.0000E+00          0.7000E+01
0.0000E+00      0.8000E+01  0.0000E+00
       0.9000E+01  0.0000E+00          0.1000E+02  0.0000E+00          0.1100E+02
0.0000E+00      0.1200E+02  0.0000E+00
       0.1300E+02  0.0000E+00          0.1400E+02  0.0000E+00          0.1500E+02
0.0000E+00      0.1600E+02  0.0000E+00
       0.1700E+02  0.0000E+00          0.1800E+02  0.0000E+00          0.1900E+02
0.0000E+00      0.2000E+02  0.0000E+00
       0.2100E+02  0.0000E+00          0.2200E+02  0.0000E+00          0.2300E+02
0.0000E+00      0.2400E+02  0.0000E+00
       0.2500E+02  0.0000E+00          0.2600E+02  0.0000E+00          0.2700E+02
0.0000E+00      0.2800E+02  0.0000E+00
       0.2900E+02  0.0000E+00          0.3000E+02  0.0000E+00          0.3100E+02
0.0000E+00
```

```
*******************************************************************************
Transport simulation from  1 Dec  4 to 31 Dec  4
*******************************************************************************

          MASS TRANSPORT BALANCE, CHEMICAL 3 (Fenarimol)
          ---- --------- -------  -------- -

NOTE: These "net" values are only for last day of time step
Net dispersive flux =              0.1362E-03
Net advective  flux =              0.7361E-02
Net rate of mass accumulation =    0.6656E-02
Net rate of formation =            0.0000E+00
Net rate of mass decay =           0.8369E-03
MASS BALANCE ERROR.=               0.4231E-05
NORMALIZED MASS BALANCE ERROR =    0.2518E-03

NOTE: These "cumulative" values are for the entire time step
Cumulative mass storage =          0.4455E-01
Cumulative mass decay =            0.2407E-01
Cumulative inflow mass =           0.1173
Cumulative outflow mass =          0.1377

          ANNUAL SUMMARY OF CUMULATIVE CONCENTRATIONS
          ------ ------- -- ---------- --------------

NOTE: These "cumulative" values are yearly summaries
Annual cumulative mass storage =           0.1765
Annual cumulative mass decay =             0.1502
Annual cumulative inflow mass =            0.6643
Annual cumulative outflow mass =           0.6900

     TIME VS CONCENTRATION AT NODE NUMBER    1
     ------------------------------------

       0.1000E+01  0.5081E-02          0.2000E+01  0.5078E-02          0.3000E+01
0.5067E-02      0.4000E+01  0.5068E-02
       0.5000E+01  0.5057E-02          0.6000E+01  0.5085E-02          0.7000E+01
0.5348E-02      0.8000E+01  0.5320E-02
       0.9000E+01  0.5310E-02          0.1000E+02  0.5299E-02          0.1100E+02
0.5288E-02      0.1200E+02  0.5278E-02
       0.1300E+02  0.5267E-02          0.1400E+02  0.5257E-02          0.1500E+02
0.5246E-02      0.1600E+02  0.5236E-02
       0.1700E+02  0.5525E-02          0.1800E+02  0.5592E-02          0.1900E+02
0.5573E-02      0.2000E+02  0.5562E-02
       0.2100E+02  0.5550E-02          0.2200E+02  0.5539E-02          0.2300E+02
0.5528E-02      0.2400E+02  0.5517E-02
       0.2500E+02  0.5506E-02          0.2600E+02  0.5514E-02          0.2700E+02
0.5524E-02      0.2800E+02  0.5524E-02
       0.2900E+02  0.5589E-02          0.3000E+02  0.5662E-02          0.3100E+02
0.5690E-02
```

Appendix H.

Selected Output from SWRRBWQ

```
          TIME VS CONCENTRATION AT NODE NUMBER   38
          -------------------------------------

        0.1000E+01  0.3740E-02        0.2000E+01  0.3737E-02        0.3000E+01
0.3731E-02          0.4000E+01  0.3728E-02
        0.5000E+01  0.3723E-02        0.6000E+01  0.3733E-02        0.7000E+01
0.3962E-02          0.8000E+01  0.3965E-02
        0.9000E+01  0.3963E-02        0.1000E+02  0.3959E-02        0.1100E+02
0.3952E-02          0.1200E+02  0.3945E-02
        0.1300E+02  0.3937E-02        0.1400E+02  0.3930E-02        0.1500E+02
0.3922E-02          0.1600E+02  0.3914E-02
        0.1700E+02  0.4139E-02        0.1800E+02  0.4205E-02        0.1900E+02
0.4207E-02          0.2000E+02  0.4203E-02
        0.2100E+02  0.4197E-02        0.2200E+02  0.4189E-02        0.2300E+02
0.4181E-02          0.2400E+02  0.4173E-02
        0.2500E+02  0.4165E-02        0.2600E+02  0.4160E-02        0.2700E+02
0.4161E-02          0.2800E+02  0.4160E-02
        0.2900E+02  0.4206E-02        0.3000E+02  0.4267E-02        0.3100E+02
0.4295E-02

          TIME VS CONCENTRATION AT NODE NUMBER  152
          -------------------------------------

        0.1000E+01  0.2596E-02        0.2000E+01  0.2595E-02        0.3000E+01
0.2591E-02          0.4000E+01  0.2590E-02
        0.5000E+01  0.2586E-02        0.6000E+01  0.2593E-02        0.7000E+01
0.2771E-02          0.8000E+01  0.2805E-02
        0.9000E+01  0.2808E-02        0.1000E+02  0.2805E-02        0.1100E+02
0.2801E-02          0.1200E+02  0.2796E-02
        0.1300E+02  0.2790E-02        0.1400E+02  0.2785E-02        0.1500E+02
0.2779E-02          0.1600E+02  0.2774E-02
        0.1700E+02  0.2948E-02        0.1800E+02  0.3023E-02        0.1900E+02
0.3034E-02          0.2000E+02  0.3033E-02
        0.2100E+02  0.3029E-02        0.2200E+02  0.3024E-02        0.2300E+02
0.3018E-02          0.2400E+02  0.3013E-02
        0.2500E+02  0.3007E-02        0.2600E+02  0.3003E-02        0.2700E+02
0.3003E-02          0.2800E+02  0.3003E-02
        0.2900E+02  0.3035E-02        0.3000E+02  0.3082E-02        0.3100E+02
0.3108E-02

          TIME VS CONCENTRATION AT NODE NUMBER  222
          -------------------------------------

        0.1000E+01  0.1616E-02        0.2000E+01  0.1615E-02        0.3000E+01
0.1613E-02          0.4000E+01  0.1612E-02
        0.5000E+01  0.1610E-02        0.6000E+01  0.1616E-02        0.7000E+01
0.1744E-02          0.8000E+01  0.1770E-02
        0.9000E+01  0.1773E-02        0.1000E+02  0.1771E-02        0.1100E+02
0.1769E-02          0.1200E+02  0.1766E-02
        0.1300E+02  0.1762E-02        0.1400E+02  0.1759E-02        0.1500E+02
0.1755E-02          0.1600E+02  0.1752E-02
        0.1700E+02  0.1882E-02        0.1800E+02  0.1941E-02        0.1900E+02
0.1950E-02          0.2000E+02  0.1950E-02
        0.2100E+02  0.1948E-02        0.2200E+02  0.1945E-02        0.2300E+02
0.1941E-02          0.2400E+02  0.1937E-02
        0.2500E+02  0.1933E-02        0.2600E+02  0.1931E-02        0.2700E+02
0.1932E-02          0.2800E+02  0.1933E-02
        0.2900E+02  0.1958E-02        0.3000E+02  0.1994E-02        0.3100E+02
0.2015E-02
```

```
1
SWRRBWQ 07/05/91 IBM PC  VERSION 1.0
                   4/28/92     11:14:10

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

     NO YRS =    5
     BASIN AREA =      3.800 KM**2
     AVE A RAINFALL/AVE A FOR GAGE
       SUBBASIN
         1    1.00
         2    1.00
         3    1.00
     BASEFLOW FACTOR =      .000
     BASIN LAG TIME =     .00 D
     GENERATOR CYCLES =    0
     WATER STATS =  0
     SEDIMENT STATS =  0


     GENERATOR SEEDS
              9  98 915  92
            135  28 203  85
             43  54 619  33
            645   9 948  65
            885  41 696  62
             51  78 648   0
            227  57 929  37
             20  90 215  31
            320  73 631  49

     CENTROID COORDINATES OF SUB AREAS(KM)
       .00      .00      .00

     CENTROID COORDINATES OF SUB AREAS(KM)
       .00      .00      .00

     TP-40 RAINFALL AMOUNTS (10 YR FREQ) FOR DUR
         0.5 H =  76.20 MM
         6H=203.20 MM

     NO YRS RECORD MAX.5H RAIN= 25.0

     LATITUDE= 20.44 DEG
```

```
1
SWRRBWQ 07/05/91 IBM PC  VERSION 1.0
                   4/28/92     11:14:10

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

CLIMATE DATA

     RAINFALL DATA USED IN THIS RUN ARE:
      **MEASURED SINGLE RAINGAGE**

     TEMPERATURE DATA USED IN THIS RUN ARE;
      **MEASURED FOR ENTIRE BASIN**

                     -NO RAIN PROB--     -NO STATS FOR DAILY RAIN-
                      W/D       W/W     MEAN      ST DV      SKW CF
                      .411      .103   199.000   150.000     2.000
                      .362      .091   194.000   145.000     2.000
                      .435      .109   242.000   182.000     2.000
                      .375      .094   185.000   139.000     2.000
                      .339      .085   149.000   112.000     2.000
                      .375      .094    97.000    73.000     2.000
                      .484      .121   138.000   104.000     2.000
                      .460      .115   145.000   109.000     2.000
                      .375      .094   132.000    99.000     2.000
                      .411      .103   175.000   131.000     2.000
                      .425      .106   203.000   152.000     2.000
                      .411      .103   175.000   131.000     2.000
           RSMX       TMX       TMN      RA       CVT     RAIN      DAYP      ALPH
   JAN    76.20     27.20     18.90    320.00     .10   1939.10     9.74      .10
   FEB    68.60     27.20     18.90    379.00     .10   1601.98     8.26      .10
   MAR    76.20     27.20     18.90    440.00     .10   2462.66    10.19      .10
   APR    68.60     27.20     18.90    487.00     .10   1624.39     8.78      .10
   MAY    38.10     27.20     18.90    529.00     .10   1247.58     8.37      .10
   JUN    38.10     27.20     18.90    544.00     .10    851.71     8.78      .10
   JUL    38.10     27.20     18.90    543.00     .10   1518.82    11.01      .10
   AUG    53.30     27.20     18.90    533.00     .10   1536.52    10.60      .10
   SEP    53.30     27.20     18.90    491.00     .10   1159.02     8.78      .10
   OCT    61.00     27.20     18.90    418.00     .10   1705.24     9.74      .10
   NOV    68.60     27.20     18.90    343.00     .10   1962.65     9.67      .10
   DEC    76.20     27.20     18.90    307.00     .10   1705.24     9.74      .10
   YR     59.69     27.20     18.90    444.50     .10  19314.91   113.65      .10
```

```
SWRRBWQ 07/05/91 IBM PC  VERSION 1.0
                  4/28/92      11:14:10

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

    CROP DATA
 SUBBASIN  1

  CROP 1                          CROP 2                        CROP 3
  NUMBER OF CROPS =  1
  PLANTING DATE =  1/ 1           PLANTING DATE =  0/ 0         PLANTING DATE =  0/ 0
  CURVE NO PLANTING =    .0        CURVE NO PLANTING =    .0      CURVE NO PLANTING =
.0
  HARVEST DATE = 12/31            HARVEST DATE =  0/ 0          HARVEST DATE =  0/ 0
  CURVE NO HARVEST =    .0       CURVE NO HARVEST =    .0     CURVE NO HARVEST =    .0
  TILLAGE OPER =     4            TILLAGE OPER =    0           TILLAGE OPER =    0
  POT HEAT UNITS=4763. C         POT HEAT UNITS=   0. C       POT HEAT UNITS=   0. C
  BIOMASS CONV. =     16.50     BIOMASS CONV. =       .00    BIOMASS CONV. =       .00
  WATER STRESS FAC =       .00   WATER STRESS FAC =         .00 WATER STRESS FAC =
.00
  HARVEST INDEX =       .76     HARVEST INDEX =       .00    HARVEST INDEX =       .00
  LEG (1=NO,2=YES) 1             LEG (1=NO,2=YES) 0            LEG (1=NO, 2=YES) 0
  AVE C FACTOR =       .00       AVE C FACTOR =       .00      AVE C FACTOR =       .00

                                   FERTILIZER
 CROP 1                           CROP 2                      CROP 3
 APP. DATE        N        P      DATE        N        P      DATE        N        P
               (KG/HA)  (KG/HA)            (KG/HA)  (KG/HA)            (KG/HA)  (KG/HA)

  1   0/ 0        .00      .00    0/ 0        .00      .00    0/ 0        .00      .00
  2   0/ 0        .00      .00    0/ 0        .00      .00    0/ 0        .00      .00
  3   0/ 0        .00      .00    0/ 0        .00      .00    0/ 0        .00      .00
  4   0/ 0        .00      .00    0/ 0        .00      .00    0/ 0        .00      .00
  5   0/ 0        .00      .00    0/ 0        .00      .00    0/ 0        .00      .00

                                   PESTICIDE
             APPLIED  PEST                APPLIED PEST                APPLIED PEST
 (KG/HA)     (KG/HA)   NO.                (KG/HA)  NO.                         NO.

      0/ 0     .00      0         0/ 0     .00     0          0/ 0     .00     0
      0/ 0     .00      0         0/ 0     .00     0          0/ 0     .00     0
      0/ 0     .00      0         0/ 0     .00     0          0/ 0     .00     0
      0/ 0     .00      0         0/ 0     .00     0          0/ 0     .00     0
      0/ 0     .00      0         0/ 0     .00     0          0/ 0     .00     0

                                  IRRIGATION
             APPLIED                   APPLIED                      APPLIED
              (MM)                      (MM)                         (MM)

      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
```

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                  4/28/92      11:14:10

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

    CROP DATA
 SUBBASIN  2

  CROP 1                          CROP 2                        CROP 3
  NUMBER OF CROPS =  1
  PLANTING DATE =  1/ 1           PLANTING DATE =  0/ 0         PLANTING DATE =  0/ 0
  CURVE NO PLANTING =    .0        CURVE NO PLANTING =    .0      CURVE NO PLANTING =
.0
  HARVEST DATE = 12/31            HARVEST DATE =  0/ 0          HARVEST DATE =  0/ 0
  CURVE NO HARVEST =    .0       CURVE NO HARVEST =    .0     CURVE NO HARVEST =    .0
  TILLAGE OPER =     4            TILLAGE OPER =    0           TILLAGE OPER =    0
  POT HEAT UNITS=4763. C         POT HEAT UNITS=   0. C       POT HEAT UNITS=   0. C
  BIOMASS CONV. =     30.00     BIOMASS CONV. =       .00    BIOMASS CONV. =       .00
  WATER STRESS FAC =       .01   WATER STRESS FAC =         .00 WATER STRESS FAC =
.00
  HARVEST INDEX =       .90     HARVEST INDEX =       .00    HARVEST INDEX =       .00
  LEG (1=NO,2=YES) 1             LEG (1=NO,2=YES) 0            LEG (1=NO, 2=YES) 0
  AVE C FACTOR =       .00       AVE C FACTOR =       .00      AVE C FACTOR =       .00

                                   FERTILIZER
 CROP 1                           CROP 2                      CROP 3
 APP. DATE        N        P      DATE        N        P      DATE        N        P
               (KG/HA)  (KG/HA)            (KG/HA)  (KG/HA)            (KG/HA)  (KG/HA)

  1   4/10       1.13      .38    0/ 0        .00      .00    0/ 0        .00      .00
  2   5/10      14.94     4.98    0/ 0        .00      .00    0/ 0        .00      .00
  3   6/10      14.94     4.98    0/ 0        .00      .00    0/ 0        .00      .00
  4   9/10       1.13      .38    0/ 0        .00      .00    0/ 0        .00      .00
  5  10/10      14.94     4.98    0/ 0        .00      .00    0/ 0        .00      .00

                                   PESTICIDE
             APPLIED  PEST                APPLIED PEST                APPLIED PEST
 (KG/HA)     (KG/HA)   NO.                (KG/HA)  NO.                         NO.

      2/ 1     .94      2         0/ 0     .00     0          0/ 0     .00     0
      3/ 1     .09      3         0/ 0     .00     0          0/ 0     .00     0
      5/10     .06      1         0/ 0     .00     0          0/ 0     .00     0
      5/10     .94      2         0/ 0     .00     0          0/ 0     .00     0
     10/10     .09      3         0/ 0     .00     0          0/ 0     .00     0

                                  IRRIGATION
             APPLIED                   APPLIED                      APPLIED
              (MM)                      (MM)                         (MM)

      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
      0/ 0     .00                0/ 0     .00                0/ 0     .00
```

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Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

CROP DATA
SUBBASIN 3

CROP 1	CROP 2	CROP 3
NUMBER OF CROPS = 1		
PLANTING DATE = 1/ 1	PLANTING DATE = 0/ 0	PLANTING DATE = 0/ 0
CURVE NO PLANTING = .0	CURVE NO PLANTING = .0	CURVE NO PLANTING = .0
HARVEST DATE = 12/31	HARVEST DATE = 0/ 0	HARVEST DATE = 0/ 0
CURVE NO HARVEST = .0	CURVE NO HARVEST = .0	CURVE NO HARVEST = .0
TILLAGE OPER = 4	TILLAGE OPER = 0	TILLAGE OPER = 0
POT HEAT UNITS=4763. C	POT HEAT UNITS= 0. C	POT HEAT UNITS= 0. C
BIOMASS CONV. = 30.00	BIOMASS CONV. = .00	BIOMASS CONV. = .00
WATER STRESS FAC = .01	WATER STRESS FAC = .00	WATER STRESS FAC = .00
HARVEST INDEX = .90	HARVEST INDEX = .00	HARVEST INDEX = .00
LEG (1=NO,2=YES) 1	LEG (1=NO,2=YES) 0	LEG (1=NO, 2=YES) 0
AVE C FACTOR = .01	AVE C FACTOR = .00	AVE C FACTOR = .00

FERTILIZER

APP.	CROP 1 DATE	N (KG/HA)	P (KG/HA)	CROP 2 DATE	N (KG/HA)	P (KG/HA)	CROP 3 DATE	N (KG/HA)	P (KG/HA)
1	0/ 0	.00	.00	0/ 0	.00	.00	0/ 0	.00	.00
2	0/ 0	.00	.00	0/ 0	.00	.00	0/ 0	.00	.00
3	0/ 0	.00	.00	0/ 0	.00	.00	0/ 0	.00	.00
4	0/ 0	.00	.00	0/ 0	.00	.00	0/ 0	.00	.00
5	0/ 0	.00	.00	0/ 0	.00	.00	0/ 0	.00	.00

PESTICIDE

(KG/HA)	APPLIED (KG/HA)	PEST NO.		APPLIED (KG/HA)	PEST NO.		APPLIED	PEST NO.
0/ 0	.03	0	0/ 0	.00	0	0/ 0	.00	0
0/ 0	.00	0	0/ 0	.00	0	0/ 0	.00	0
0/ 0	.00	0	0/ 0	.00	0	0/ 0	.00	0
0/ 0	.00	0	0/ 0	.00	0	0/ 0	.00	0
0/ 0	.00	0	0/ 0	.00	0	0/ 0	.00	0

IRRIGATION

	APPLIED (MM)		APPLIED (MM)		APPLIED (MM)
0/ 0	.00	0/ 0	.00	0/ 0	.00
0/ 0	.00	0/ 0	.00	0/ 0	.00
0/ 0	.00	0/ 0	.00	0/ 0	.00
0/ 0	.00	0/ 0	.00	0/ 0	.00
0/ 0	.00	0/ 0	.00	0/ 0	.00

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Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

SUBBASINS	IRRIGATION DATA IRRIGATE (1=YES,0=NO)	WATER STRESS	RUNOFF RATIO (1 minus fraction that runs off)
1	0	.00	.00
2	1	.50	.00
3	0	.00	.00

SUB-BASIN DATA

SUB-BASIN AREA/BASIN AREA
.650 .100 .250

POND CATCHMENT AREA FRACTION
.000 .000 .000

POND SURFACE AREA(HA)
.00 .00 .00

MAX POND STORAGE(MM)
.0 .0 .0

INTIAL POND STORAGE(MM)
.0 .0 .0

INITIAL SED CONC IN PONDS(PPM)
0. 0. 0.

NORMAL SED CONC IN PONDS(PPM)
0. 0. 0.

SAT CONDUCTIVITY FOR POND BOTTOMS(MM/H)
.00 .00 .00

RESERVOIR CATCHMENT AREA FRACTION
.000 .000 .000

RESERVOIR SURFACE AREA AT EMERGENCY SPILLWAY(HA)
.00 .00 .00

RESERVOIR STORAGE AT EMERGENCY SPILLWAY(MM)
.0 .0 .0

RESERVOIR SURFACE AREA AT PRINCIPAL SPILLWAY(HA)
.00 .00 .00

RESERVOIR STORAGE AT PRINCIPAL SPILLWAY(MM)
.0 .0 .0

```
INITIAL RESERVOIR STORAGE(MM)
 .0         .0         .0

AVE RESERVOIR RELEASE RATES(M**3/S/KM**2)
.00000     .00000     .00000

INITIAL SED CONC IN RESERVOIRS(PPM)
0.          0.         0.

NORMAL SED CONC IN RESERVOIRS(PPM)
0.          0.         0.

SAT CONDUCTIVITY OF RESERVOIR BOTTOMS (MM/H)
.00         .00        .00

2 COND CN
25.0       39.0       49.0

SOIL ALBEDO
.13         .13        .13

WATER CONTENT OF SNOW COVER (MM)
.0          .0         .0

MAIN CHANNEL LENGTH (KM)
2.49        .27        1.81       4.57

CHANNEL SLOPE(M/M)
.1900      .0600      .0700      .1500

AVERAGE MAIN CHANNEL WIDTH (M)
2.00       2.00       2.00

HYDR COND OF CHANNEL ALLUVIUM(MM/H)
127.00     127.00     127.00

CHANNEL N VALUE
.150       .150       .150       .150

OVERLAND FLOW N VALUE
.300       .300       .300       .300

TIME OF CONCENTRATION FOR SUB-BASINS(H)
1.07        .75       1.29       1.60

RET FLO SED CONC (PPM)
500.       500.       500.

RET FLO TRAVEL TIME(D)
.000       .000       .000

SLOPE LENGTH(M)
43.        58.        49.        38.

SLOPE STEEPNESS(M/M)
.1500      .1000      .1000      .1500

EROSION CONTROL PRACTICE FACTORS(P)
1.00       1.00       1.00

SLOPE LENGTH AND STEEPNESS FACTORS(LS)
3.29       2.06       1.86
```

```
ROUTING DATA -- SUB-BASIN TO BASIN OUTLET
AVE CHANNEL WIDTH(M)
2.00       2.00       .00

AVE CHANNEL DEPTH(M)
1.00       1.00       .00

CHANNEL SLOPE(M/M)
.07        .07        .00

CHANNEL LENGTH(KM)
2.08       1.81       .00

CHANNEL N VALUE
.15        .15        .00

HYDR COND OF CHANNEL ALLUVIUM(MM/H)
127.00     127.00     .00

USLE SOIL FACTOR K FOR CHANNEL
.001       .001       .000

USLE SOIL FACTOR C FOR CHANNEL
.180       .190       .000

PESTICIDE DATA
PEST 1 - INITIAL PEST ON FOLIAGE
.0000      .0000      .0000

INITIAL PEST ON GROUND
.0000      .0000      .0000

ENRICHMENT RATIOS FOR PESTICIDES
.0000      .0000      .0000
PEST 2 - INITIAL PEST ON FOLIAGE
.0000      .0000      .0000

INITIAL PEST ON GROUND
.0000      .0000      .0000

ENRICHMENT RATIOS FOR PESTICIDES
.0000      .0000      .0000
PEST 3 - INITIAL PEST ON FOLIAGE
.0000      .0000      .0000

INITIAL PEST ON GROUND
.0000      .0000      .0000

ENRICHMENT RATIOS FOR PESTICIDES
.0000      .0000      .0000
PEST 4 - INITIAL PEST ON FOLIAGE
.0000      .0000      .0000

INITIAL PEST ON GROUND
.0000      .0000      .0000

ENRICHMENT RATIOS FOR PESTICIDES
.0000      .0000      .0000
```

PEST 5 - INITIAL PEST ON FOLIAGE
.0000 .0000 .0000

INITIAL PEST ON GROUND
.0000 .0000 .0000

ENRICHMENT RATIOS FOR PESTICIDES
.0000 .0000 .0000

TOTAL NO OF PESTICIDES SIMULATED = 5

WATER SOLU.	PEST	KOC	WASH OFF FRAC.	HALF LIFE ON FOLIAGE	HALF LIFE IN SOIL	APPL. EFF
2.00	1 Chlorpyrifos	9000.0	.65	3.30	36.0000	.95
320.00	2 Copper hydroxide	100000.0	.65	9999.00	9999.0000	.95
1.40	3 Dithiopyr	34700.0	.65	21.00	61.0000	.95
14.00	4 Fenarimol	716.0	.65	4.30	98.0000	.95
13.00	5 Iprodione	500.0	.65	4.30	50.0000	.95

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Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

SOILS DATA

INITIAL ST NO3 (G/T)	LAYER NO	DEPTH (MM)	ORG CARBON (%)	POROSITY (MM/MM)	15 BAR SW (MM/MM)	.3 BAR SW (MM/MM)	AVAIL W ST (MM)	INITIAL W ST (MM)	SAT COND (MM/H)
SUBBASIN 1				Hana (HNLO & cHT					
15.00	1	10.0	3.95	.66	.19	.32	1.30	1.30	73.66
15.00	2	177.8	3.95	.66	.19	.32	21.81	21.81	73.66
14.00	3	863.6	3.84	.66	.20	.33	89.15	89.15	119.38
1.40	4	1524.0	.38	.55	.00	.02	13.21	13.21	508.00
TOTALS							125.5	125.5	
SUBBASIN 2				Hana (HKNC, HKOC					
9.90	1	10.0	30.00	.92	.00	.25	2.50	2.50	508.00
14.00	2	177.8	3.84	.62	.21	.34	21.81	21.81	48.25
14.00	3	863.6	3.68	.62	.22	.35	89.15	89.15	78.24
1.40	4	1524.0	.37	.55	.00	.02	13.21	13.21	508.00
TOTALS							126.7	126.7	
SUBBASIN 3				Hana (HKNC & HKO					
14.00	1	10.0	3.78	.62	.20	.33	1.30	1.30	35.56
14.00	2	177.8	3.78	.62	.20	.33	21.81	21.81	35.56
13.00	3	863.6	3.60	.62	.22	.35	89.15	89.15	55.88
1.30	4	1524.0	.36	.55	.00	.02	13.21	13.21	508.00
TOTALS							125.5	125.5	

INITIAL COMPOSITE ST = . 125.6 MM

SOIL SURFACE LAYER

SOLUBLE P (G/M3)	P (G/M3)	SUB-BASIN	CLAY	SILT	SAND	K	ORG N (G/M3)	ORG
475.00	47.50	1	.54	.25	.21	.05	3200.00	

```
475.00 2    .00        .80        .20        .05     3200.00
          47.50
475.00 3    .51        .30        .19        .05     3200.00
          47.50

                        SEDIMENT SIZE DISTRIBUTION
  SUB-BASIN                      SIZE(MM)
              SAND      SILT      CLAY      SM AG      L AG
              .20       .01       .002      .03        .50

      1       .031      .033      .108      .570       .259
      2       .199      .104      .000      .000       .697
      3       .034      .039      .101      .570       .256
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Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

                          SUB   WATER  PERCO           SED          ORGANIC ORGANIC SURQ
SOL    CROP   SSQ PERC    RES.
        R      SURQ  SURQ      YIELD  LATE   ET       YIELD   SW
P      NO3    NO3   NO3   VOL                                      N       P       NO3
      (MM)    (MM)  (MM)       (MM)   (MM)   (MM)     (T/HA)  (MM)
--------(KG/HA)--------  (MM)

1 1955.70  26.85   .11  17.24 1145.37 876.84    .00  56.37    .00     .00     .23
 .04    .00   .02 16.91  .00

2 2094.30  21.21   .12  12.36 1192.33 922.82    .00  40.62    .00     .00     .20
 .03    .00   .01 16.57  .00

3 3039.20  86.56   .32  54.25 2017.65 958.02    .39  69.48   1.01     .15     .75
 .14    .00   .01 37.97  .00

4 2855.10 104.69   .26  76.87 1800.00 953.69   2.57 110.35   6.46     .94    1.10
 .20    .00   .01 23.71  .00

5 2311.40  94.58   .16  75.25 1383.16 914.63   3.52  64.38  12.12    1.64    1.44
 .20    .00   .01 12.06  .00
```

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Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

FINAL VALUES

SOIL WATER FOR LAYER NO

SUB-BASIN NO	1	2	3	4
1	.0	3.7	20.3	13.2
2	.0	8.3	89.1	13.2
3	.0	14.1	89.1	13.2

	TOTAL SOIL WATER
1	37.2
2	110.7
3	116.4

FINAL COMPOSITE ST = 64.4 MM
MIN INDIVIDUAL WATER ST = .0 MM

FINAL CONTENTS

	-----PONDS-----		---RESERVOIRS---	
SUB-BASIN NO	WATER VOL (MM)	SED CONC (PPM)	WATER VOL (MM)	SED CONC (PPM)
1	.0	.0	.0	.0
2	.0	.0	.0	.0
3	.0	.0	.0	.0

FINAL COMPOSITE POND ST = .00 MM
FINAL COMPOSITE RESERVOIR ST = .00 MM

IRRIGATION - AVE. ANNUAL

SUB-BASIN NO.	NO.OF APPLICATIONS	VOLUME APPLIED(MM)
1	0	.000
2	46	167.058
3	0	.000

SOIL WATER BALANCE = .189353E-03 MM

POND BALANCE
Q = .000000E+00 MM Y = .000000E+00 T/HA

RESERVOIR BALANCE
Q = .000000E+00 MM Y = .000000E+00 T/HA

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Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

SUB-BASIN STATISTICS

AVE ANNUAL VALUES

SUB-BASIN NO	RAIN (MM)	SUR Q (MM)	SUB SUR Q (MM)	Y (T/HA)	TOTAL BIOMASS(KG/HA) CROP 1	CROP 2	CROP 3
1	2449.8	10.4	.0	.1	.0		
2	2449.8	105.3	.3	1.6	.0		
3	2449.8	197.9	.6	4.6	.0		

AVE MONTHLY BASIN VALUES

NO	R (MM)	SNOW FALL (MM)	SUR Q (MM)	SUB SUR Q (MM)	WATER YIELD (MM)	ET (MM)	Y (T/HA)
1	267.44	.00	14.72	.03	11.45	64.65	.32
2	222.48	.00	17.55	.02	13.86	57.48	.50
3	304.08	.00	11.41	.04	7.22	84.11	.10
4	265.54	.00	9.49	.03	6.48	79.94	.24
5	188.78	.00	2.64	.02	1.57	89.86	.03
6	145.38	.00	.00	.00	.00	99.02	.00
7	195.38	.00	4.12	.00	2.87	91.31	.03
8	163.64	.00	.11	.00	.00	84.84	.00
9	143.04	.00	.31	.00	.00	64.81	.00
10	175.22	.00	.73	.01	.35	73.30	.02
11	199.78	.00	3.75	.01	2.55	72.57	.03
12	186.52	.00	2.44	.02	1.22	64.88	.05

BASIN STATISTICS

CN--MEAN = 36.027 MAX = 70.862 MIN = 12.786

PRED PK FLOW
MEAN = .233 M**3/S ST DEV = .424 M**3/S
NO PKS = 69
MAX = 2.533 M**3/S

PRED NO WATER YLD
MEAN = 3.93 MM
ST DEV = 10.55 MM

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Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

     AVE ANNUAL BASIN VALUES

          PRECIP =   2449.8 MM
          SNOW FALL =      .00 MM
          SNOW MELT =      .00 MM
          PRED SURFACE Q =   66.74 MM
          SUB-SUR Q =     .19 MM
          PRED H2O YLD =    47.17 MM
          DEEP PERC = 1506.88 MM
          ET =    924.7 MM
          TRANS LOSSES =    19.77 MM
          TOTAL SUB-BASIN SED YLD =      1.394 T/HA
          BASIN SED YLD =    1.296 T/HA
          POND BUDGET
               EVAPORATION =      .000 MM
               SEEPAGE =      .000 MM
               RAINFALL ON POOL =     .000 MM
               INFLOW
                    Q =     .000 MM
                    Y =     .000 T/HA
               OUTFLOW
                    Q =     .000 MM
                    Y =     .000 T/HA
          RESERVOIR BUDGET
               EVAPORATION =      .000 MM
               SEEPAGE =      .000 MM
               RAINFALL ON POOL =     .000 MM
               INFLOW
                    Q =     .000 MM
                    Y =     .000 T/HA
               OUTFLOW
                    Q =     .000 MM
                    Y =     .000 T/HA
          YIELD LOSS FROM PONDS
               Q =    .000 MM
               Y =    .000 T/HA
          YIELD LOSS FROM RESERVOIRS
               Q =    .000 MM
               Y =    .000 T/HA
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Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

          AVE ANNUAL BASIN VALUES

          NUTRIENTS
               ORGANIC N =     3.92 (KG/HA)
               ORGANIC P =      .55 (KG/HA)
               NO3 YIELD (SQ) =      .74 (KG/HA)
               NO3 YIELD (SSQ) =     .01 (KG/HA)
               SOL P YIELD =     .12 (KG/HA)
               NO3 LEACHED =    21.43 (KG/HA)
               N UPTAKE =      .00 (KG/HA)

          PESTICIDES

chlorpyrifos   1    DISSOLVED =         72.6975 (mg/HA)
                    SORBED =        35.6281 (mg/HA)
                    LEACHED (PAST ROOT ZONE) =             .1244 (mg/HA)
                    APPLIED =       5696.8780 (mg/HA)
                    DECAYED =       5579.2190 (mg/HA)
                    SUBSURFACE =           .0066 (mg/HA)
                    FINAL PEST ON PLANT =          .0000 (mg/HA)
                    FINAL IN GROUND =       391.7336 (mg/HA)
Cu(OH)2        2    DISSOLVED =        7941.4110 (mg/HA)
                    SORBED =     137878.4000 (mg/HA)
                    LEACHED (PAST ROOT ZONE) =             .3262 (mg/HA)
                    APPLIED =     178502.2000 (mg/HA)
                    DECAYED =       7979.3390 (mg/HA)
                    SUBSURFACE =           .5300 (mg/HA)
                    FINAL PEST ON PLANT =          .0000 (mg/HA)
                    FINAL IN GROUND =    1210230.0000 (mg/HA)
dithiopyr      3    DISSOLVED =         181.9066 (mg/HA)
                    SORBED =       1381.1480 (mg/HA)
                    LEACHED (PAST ROOT ZONE) =             .0191 (mg/HA)
                    APPLIED =      17090.6400 (mg/HA)
                    DECAYED =      15073.4800 (mg/HA)
                    SUBSURFACE =           .0118 (mg/HA)
                    FINAL PEST ON PLANT =          .0000 (mg/HA)
                    FINAL IN GROUND =      24287.3300 (mg/HA)
```

SWRRBWQ 07/05/91 IBM PC VERSION 1.0
4/28/92 11:14:10

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/28/92 input) Daily weather from Hana Airport station #355

AVE ANNUAL BASIN VALUES

fenarimol	4	DISSOLVED =	3573.7930 (mg/HA)
		SORBED =	136.9572 (mg/HA)
		LEACHED (PAST ROOT ZONE) =	312.9593 (mg/HA)
		APPLIED =	28484.3900 (mg/HA)
		DECAYED =	24136.0100 (mg/HA)
		SUBSURFACE =	3.3205 (mg/HA)
		FINAL PEST ON PLANT =	.0000 (mg/HA)
		FINAL IN GROUND =	15964.2800 (mg/HA)
iprodione	5	DISSOLVED =	3983.1930 (mg/HA)
		SORBED =	211.0646 (mg/HA)
		LEACHED (PAST ROOT ZONE) =	265.8271 (mg/HA)
		APPLIED =	28484.3900 (mg/HA)
		DECAYED =	24012.3600 (mg/HA)
		SUBSURFACE =	2.8961 (mg/HA)
		FINAL PEST ON PLANT =	.0000 (mg/HA)
		FINAL IN GROUND =	292.7706 (mg/HA)

BEGINNING TIME: 11:14:10.92
ENDING TIME: 11:17:52.49

TOTAL RUN TIME: 3:41.57

SWRRBWQ 07/05/91 IBM PC VERSION 1.0
4/28/92 12:36:28

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/17/92 input) Daily weather from Hana Airport station #355

SURQ / NO3	SOL R / P (MM)	CROP NO3	SSQ SURQ NO3 (MM)	SUB PERC SURQ NO3 (MM)	WATER RES. YIELD VOL (MM)	PERCO LATE (MM)	ET (MM)	SED YIELD (T/HA)	SW (MM)	ORGANIC N	ORGANIC P
	--------(KG/HA)--------				(MM)						
60	.00		.00	.00	.00	.00	2.67	.00	113.35	.00	.00
.00	.00	.00	.00	.00							
61	5.10		.00	.00	.00	2.99	2.67	.00	112.79	.00	.00
.00	.00	.00	.00	.00							
62	3.80		.00	.00	.00	2.01	3.11	.00	111.47	.00	.00
.00	.00	.00	.00	.00							
63	1.80		.00	.00	.00	1.25	4.03	.00	107.99	.00	.00
.00	.00	.00	.00	.00							
64	.00		.00	.00	.00	.00	1.98	.00	106.01	.00	.00
.00	.00	.00	.00	.00							
65	2.80		.00	.00	.00	1.55	2.02	.00	105.24	.00	.00
.00	.00	.00	.00	.00							
66	1.80		.00	.00	.00	1.25	2.67	.00	103.12	.00	.00
.00	.00	.00	.00	.00							
67	5.30		.00	.00	.00	2.96	3.11	.00	102.35	.00	.00
.00	.00	.00	.00	.00							
68	4.60		.00	.00	.00	2.50	3.13	.00	101.33	.00	.00
.00	.00	.00	.00	.00							
69	.30		.00	.00	.00	.30	2.55	.00	98.78	.00	.00
.00	.00	.00	.00	.00							
1 year storm, 1 day after application											
70	127.00		13.11	.01	9.19	88.73	2.15	.00	125.70	.00	.00
.13	.02	.00	.00	.02							
71	.00		.00	.00	.00	1.66	3.06	.00	120.98	.00	.00
.00	.00	.00	.00	.00							
72	.30		.00	.00	.00	.40	2.33	.00	118.55	.00	.00
.00	.00	.00	.00	.00							
73	.00		.00	.00	.00	.00	2.47	.00	116.07	.00	.00
.00	.00	.00	.00	.00							
74	.00		.00	.00	.00	.00	1.39	.00	114.68	.00	.00
.00	.00	.00	.00	.00							
75	.00		.00	.00	.00	.00	1.09	.00	113.59	.00	.00
.00	.00	.00	.00	.00							
76	.00		.00	.00	.00	.00	.92	.00	112.67	.00	.00
.00	.00	.00	.00	.00							
77	.00		.00	.00	.00	.00	.82	.00	111.86	.00	.00
.00	.00	.00	.00	.00							
78	.30		.00	.00	.00	.30	1.04	.00	110.82	.00	.00
.00	.00	.00	.00	.00							
79	.00		.00	.00	.00	.00	.68	.00	110.14	.00	.00
.00	.00	.00	.00	.00							
80	9.90		.00	.00	.00	5.10	1.98	.00	112.96	.00	.00
.00	.00	.00	.00	.00							
81	.00		.00	.00	.00	.00	2.36	.00	110.60	.00	.00
.00	.00	.00	.00	.00							
82	2.50		.00	.00	.00	1.42	2.00	.00	109.68	.00	.00

SWRRBWQ 07/05/91 IBM PC VERSION 1.0
4/28/92 12:37:59

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/17/92 input) Daily weather from Hana Airport station #355

	R (MM)	SURQ (MM)	SUB SURQ (MM)	WATER YIELD (MM)	PERCO LATE (MM)	ET (MM)	SED YIELD (T/HA)	SW (MM)	ORGANIC N	ORGANIC P	SURQ NO3 (KG/HA)	SOL P (KG/HA)	CROP NO3 (KG/HA)	SSQ NO3 (KG/HA)	SUB PERC NO3 (KG/HA)
60	.00	.00	.00	.00	.00	2.67	.00	113.35	.00	.00	.00	.00	.00	.00	.00
61	5.10	.00	.00	.00	2.99	2.67	.00	112.79	.00	.00	.00	.00	.00	.00	.00
62	3.80	.00	.00	.00	2.01	3.11	.00	111.47	.00	.00	.00	.00	.00	.00	.00
63	1.80	.00	.00	.00	1.25	4.03	.00	107.99	.00	.00	.00	.00	.00	.00	.00
64	.00	.00	.00	.00	.00	1.98	.00	106.01	.00	.00	.00	.00	.00	.00	.00
65	2.80	.00	.00	.00	1.55	2.02	.00	105.24	.00	.00	.00	.00	.00	.00	.00
66	1.80	.00	.00	.00	1.25	2.67	.00	103.12	.00	.00	.00	.00	.00	.00	.00
67	5.30	.00	.00	.00	2.96	3.11	.00	102.35	.00	.00	.00	.00	.00	.00	.00
68	4.60	.00	.00	.00	2.50	3.13	.00	101.33	.00	.00	.00	.00	.00	.00	.00
69	.30	.00	.00	.00	.30	2.55	.00	98.78	.00	.00	.00	.00	.00	.00	.00
10 year storm, 1 day after application															
70	305.00	97.77	.01	86.91	187.08	2.15	.00	127.63	.00	.00	1.28	.24	.00	.00	.05
71	.00	.00	.00	.00	3.25	3.06	.00	121.32	.00	.00	.00	.00	.00	.00	.00
72	.30	.00	.00	.00	.51	2.33	.00	118.78	.00	.00	.00	.00	.00	.00	.00
73	.00	.00	.00	.00	.00	2.47	.00	116.31	.00	.00	.00	.00	.00	.00	.00
74	.00	.00	.00	.00	.00	1.39	.00	114.92	.00	.00	.00	.00	.00	.00	.00
75	.00	.00	.00	.00	.00	1.09	.00	113.83	.00	.00	.00	.00	.00	.00	.00
76	.00	.00	.00	.00	.00	.92	.00	112.91	.00	.00	.00	.00	.00	.00	.00
77	.00	.00	.00	.00	.00	.82	.00	112.09	.00	.00	.00	.00	.00	.00	.00
78	.30	.00	.00	.00	.30	1.04	.00	111.05	.00	.00	.00	.00	.00	.00	.00
79	.00	.00	.00	.00	.00	.68	.00	110.37	.00	.00	.00	.00	.00	.00	.00
80	9.90	.00	.00	.00	5.23	1.98	.00	113.06	.00	.00	.00	.00	.00	.00	.00
81	.00	.00	.00	.00	.00	2.36	.00	110.70	.00	.00	.00	.00	.00	.00	.00
82	2.50	.00	.00	.00	1.39	2.00	.00	109.81	.00	.00	.00	.00	.00	.00	.00
83	13.70	.00	.00	.00	7.35	2.40	.00	113.63	.00	.00	.00	.00	.00	.00	.00
84	.00	.00	.00	.00	.00	2.94	.00	110.69	.00	.00	.00	.00	.00	.00	.00
85	2.50	.00	.00	.00	1.42	2.59	.00	109.18	.00	.00	.00	.00	.00	.00	.00
86	1.80	.00	.00	.00	1.25	3.22	.00	106.51	.00	.00	.00	.00	.00	.00	.00
87	1.80	.00	.00	.00	1.25	2.29	.00	104.77	.00	.00	.00	.00	.00	.00	.00
88	.50	.00	.00	.00	.49	2.92	.00	101.86	.00	.00	.00	.00	.00	.00	.00
89	.00	.00	.00	.00	.00	1.38	.00	100.48	.00	.00	.00	.00	.00	.00	.00
90	.00	.00	.00	.00	.00	1.08	.00	99.40	.00	.00	.00	.00	.00	.00	.00
3	185.80	13.11	.01	9.19	124.19	69.04	.00	99.40	.00	.00	.13	.02	.00	.00	.02

```
SWRRBWQ 07/05/91 IBM PC  VERSION 1.0
                    4/28/92      12:38:52

Environmental & Turf Services, Inc. -- SWRRBWQ Runoff Assessment

Hana Ranch, Hana, Maui, Hawaii -- Haneoo Gulch Watershed (Basin I)

(4/17/92 input) Daily weather from Hana Airport station #355

                         SUB   WATER  PERCO         SED          ORGANIC ORGANIC
SURQ   SOL    CROP  SSQ PERC  RES.
        R      SURQ  SURQ     YIELD  LATE  ET      YIELD   SW       N       P
NO3    P      NO3  NO3  NO3  VOL
      (MM)    (MM)  (MM)      (MM)   (MM)  (MM)    (T/HA)  (MM)
 --------(KG/HA)--------  (MM)

   60    .00     .00   .00    .00    .00   2.67     .00 113.35    .00     .00
 .00   .00    .00  .00  .00
   61   5.10     .00   .00    .00   2.99   2.67     .00 112.79    .00     .00
 .00   .00    .00  .00  .00
   62   3.80     .00   .00    .00   2.01   3.11     .00 111.47    .00     .00
 .00   .00    .00  .00  .00
   63   1.80     .00   .00    .00   1.25   4.03     .00 107.99    .00     .00
 .00   .00    .00  .00  .00
   64    .00     .00   .00    .00    .00   1.98     .00 106.01    .00     .00
 .00   .00    .00  .00  .00
   65   2.80     .00   .00    .00   1.55   2.02     .00 105.24    .00     .00
 .00   .00    .00  .00  .00
   66   1.80     .00   .00    .00   1.25   2.67     .00 103.12    .00     .00
 .00   .00    .00  .00  .00
   67   5.30     .00   .00    .00   2.96   3.11     .00 102.35    .00     .00
 .00   .00    .00  .00  .00
   68   4.60     .00   .00    .00   2.50   3.13     .00 101.33    .00     .00
 .00   .00    .00  .00  .00
   69    .30     .00   .00    .00    .30   2.55     .00  98.78    .00     .00
 .00   .00    .00  .00  .00
   70    .50     .00   .00    .00    .49   1.50     .00  97.29    .00     .00
 .00   .00    .00  .00  .00
100 year storm, 2 days after application
   71 457.00 200.37    .01 187.68 236.16   3.60     .00 126.84    .01     .00
2.62   .51    .00  .00  .08
   72    .30     .00   .00    .00   2.69   3.03     .00 121.42    .00     .00
 .00   .00    .00  .00  .00
   73    .00     .00   .00    .00    .21   2.96     .00 118.25    .00     .00
 .00   .00    .00  .00  .00
   74    .00     .00   .00    .00    .00   1.52     .00 116.73    .00     .00
 .00   .00    .00  .00  .00
   75    .00     .00   .00    .00    .00   1.14     .00 115.59    .00     .00
 .00   .00    .00  .00  .00
   76    .00     .00   .00    .00    .00    .96     .00 114.63    .00     .00
 .00   .00    .00  .00  .00
   77    .00     .00   .00    .00    .00    .84     .00 113.79    .00     .00
 .00   .00    .00  .00  .00
   78    .30     .00   .00    .00    .30   1.06     .00 112.74    .00     .00
 .00   .00    .00  .00  .00
   79    .00     .00   .00    .00    .00    .69     .00 112.04    .00     .00
 .00   .00    .00  .00  .00
   80   9.90     .00   .00    .00   5.36   2.05     .00 114.54    .00     .00
 .00   .00    .00  .00  .00
   81    .00     .00   .00    .00    .00   2.42     .00 112.12    .00     .00
 .00   .00    .00  .00  .00
   82   2.50     .00   .00    .00   1.39   2.00     .00 111.22    .00     .00
 .00   .00    .00  .00  .00

   83  13.70     .00   .00    .00   7.35   2.40     .00 113.76    .00     .00
 .00   .00    .00  .00  .00
   84    .00     .00   .00    .00    .00   2.94     .00 110.82    .00     .00
 .00   .00    .00  .00  .00
   85   2.50     .00   .00    .00   1.39   2.59     .00 109.34    .00     .00
 .00   .00    .00  .00  .00
   86   1.80     .00   .00    .00   1.24   3.22     .00 106.68    .00     .00
 .00   .00    .00  .00  .00
   87   1.80     .00   .00    .00   1.24   2.29     .00 104.96    .00     .00
 .00   .00    .00  .00  .00
   88    .50     .00   .00    .00    .49   2.92     .00 102.05    .00     .00
 .00   .00    .00  .00  .00
   89    .00     .00   .00    .00    .00   1.38     .00 100.67    .00     .00
 .00   .00    .00  .00  .00
   90    .00     .00   .00    .00    .00   1.08     .00  99.58    .00     .00
 .00   .00    .00  .00  .00
    3 363.80   97.77    .01  86.92 224.28  69.04     .00  99.58    .00     .00
1.28   .24    .00  .00  .05
```

83	13.70	.00	.00	.00	7.35	2.40	.00	115.17	.00	.00
.00	.00	.00	.00	.00						
84	.00	.00	.00	.00	.00	2.94	.00	112.24	.00	.00
.00	.00	.00	.00	.00						
85	2.50	.00	.00	.00	1.42	2.58	.00	110.73	.00	.00
.00	.00	.00	.00	.00						
86	1.80	.00	.00	.00	1.24	3.22	.00	108.07	.00	.00
.00	.00	.00	.00	.00						
87	1.80	.00	.00	.00	1.25	2.29	.00	106.33	.00	.00
.00	.00	.00	.00	.00						
88	.50	.00	.00	.00	.49	2.92	.00	103.42	.00	.00
.00	.00	.00	.00	.00						
89	.00	.00	.00	.00	.00	1.38	.00	102.04	.00	.00
.00	.00	.00	.00	.00						
90	.00	.00	.00	.00	.00	1.08	.00	100.96	.00	.00
.00	.00	.00	.00	.00						
3	516.30	200.37	.01	187.69	273.17	70.51	.00	100.96	.01	.00
2.62	.51	.00	.00	.08-						

APPENDIX F

BIOLOGICAL AND WATER QUALITY SURVEYS OF FRESH WATER AND MARINE ENVIRONMENTS FOR THE HANA RANCH GOLF COURSE

Prepared by AECOS, July 1992

AECOS No. 671

BIOLOGICAL AND WATER QUALITY SURVEYS OF FRESH WATER AND MARINE ENVIRONMENTS FOR THE HANA RANCH GOLF COURSE

Prepared For:

Pacific Planning & Engineering, Inc.
1221 Kapiolani Blvd., Suite 740
Honolulu, Hawaii 96814

Prepared By:

AECOS, Inc.
970 N. Kalaheo Ave., Suite C311
Kailua, Hawaii 96734

July 1992

TABLE OF CONTENTS

DESCRIPTION OF THE PROJECT ENVIRONMENT

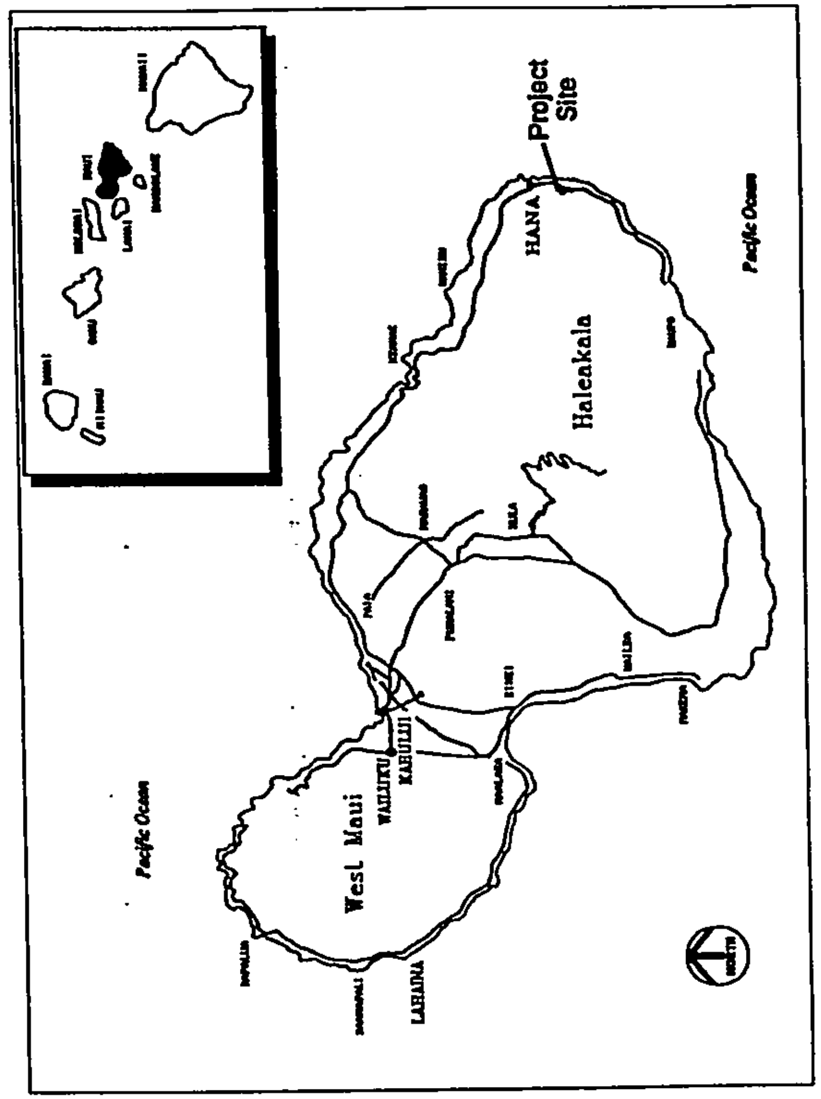
TERRESTRIAL ENVIRONMENTS

The countryside south of Hana is gently rolling hills mostly in pasture. Prominent on the landscape are old cinder cones, found offshore ('Alau Islet) and up into the highlands. These steep-sided hills are the remnants of secondary eruptions and mark the east rift zone of Haleakala volcano. Kauiki Head is one such cone which defines the south side of Hana Bay (Kapueokahi). Another found at the shore is Ka Iwi o Pele. Pu'u o Kahaula, Pu'u Kolo, and Pu'u Keaka'amanu form a slightly more inland row of cinder cones south from Hana. These features give the landscape here much of its vertical relief, because erosion has not yet deeply dissected the geologically recent lava flows (Hana Volcanic Series) that formed this eastern end of the Island of Maui (Macdonald and Abbott, 1970).

The proposed project site (Figures 1 and 2) is located at elevations from 200 feet to 600 feet above sea level between Ka Iwi o Pele and Pu'u Kolo. The site is presently pasture lands operated for grazing cattle by the Hana Ranch.

A vegetation survey of the project site was completed by Char & Associates (1990). The survey noted two major vegetation types: the pastureland dominated by grasses and sedges (mostly pangola grass, _Digitaria decumbans_); and a mixed shrubland of mostly guava (_Psidium guajava_) and Christmasberry (_Schinus terebinthifolius_).

The mixed shrubland is found on the rocky, steeper ground, particularly in the southern portion of the site. Pasture occupies the areas of deeper soils. Several narrow gulches transect the site. These are the stream beds of Haneo'o, Mo'o'mo'onui, Mo'omo'oiki, and a fourth, unnamed stream. Char & Associates (1990) noted that stands of kukui trees (_Aleurites moluccana_) occur in these gulches. In the lower parts of the site, hau trees (_Hibiscus tiliaceus_) grow within the gulches. Haneo'o Stream is found within a dense



bamboo thicket (<u>Bambusa</u> sp.) where the stream passes beside the cinder cone, Pahuolona (south peak of Pu'u Kolo).

Despite the abundant rainfall, these gulches do not contain flowing streams. The relatively recent lava flows and cinder deposits that underlie the soil mantle are highly permeable, and not easily saturated. Flowing water that appears during rainy periods tends to disappear quickly (infiltrates) into the ground, leaving scattered pools on pahoehoe or intruded basalt (dike) outcrops. Major storms can send torrents down the mountainside. While these flows are usually accomodated by the gullies, the occurrence of braided channels on moderately steep slopes testifies to the substantial difference between peak flows and "average" flows.

FRESH WATER ENVIRONMENTS

General

The unnamed gulch and Ho'omo'oiki are intermittent streams: streams that flow only during a period of heavy rainfall (such flow is called a freshet). Ho'omo'onui and Haneo'o have been classified as perennial and interrupted (Timbol and Maciolek, 1978; Commission on Water Resource Management, 1990); that is, water flow occurs at lower elevations only during periods of high runoff from substantial rainfall events. Presumably, continuous (year around) flow occurs at higher elevations. Thus, whether these two streams are perennial and interrupted or intermittent can only be determined by inspection of the entire stream course.

At lower elevations, the absence of water flow some or much of the time limits the value of the lower stream segment as habitat for native fishes or crustacea. However, these species may inhabit the stream in wetter areas found at higher elevations, or might maintain populations within pools along the stream course during dry periods.

A reason for focusing interest on Haneo'o and Ho'omo'onui Streams, is that east Maui is known to be an area where native fishes, shrimp, molluscs, and insects do occur in fresh water aquatic environments (Kinzie and Ford, 1977). Many of these native species are diadromous: eggs are laid in the stream and the larvae which hatch from these eggs move down stream and out into the ocean, where they develop for a time before migrating back into fresh water to grow to maturity. Because of this life style, all of the length of a stream may be significant habitat in the support of these native species, even where the lower reaches lack water flow for much of the time. Hawaii's diadromous stream animals are well adapted to moving upstream against strong currents and past the seemingly impassable barriers presented by waterfalls (Kinzie and Ford, 1977).

Inspection of several streams which drain the east end of Maui from Hana to Waiho'i Valley was undertaken in February 1992 by helicopter. The purpose was to establish which streams were perennial, which were intermittent, and which were interrupted. The course flown by helicopter encompassed much of the lengths (coastal segment to headwaters) of Kawaipapa (south fork), Mo'omo'oiki, Mo'omo'onui, Haneo'o, Kapia, and Waihonu streams (Figure 2).

Nearly all of these streams show relatively wide stream beds of well-worn basalt rock that suggests occasional periods of very substantial stream flow. In places, the stream bed is braided on moderately steep slopes, another indication of the torrential flow which can occur. For most of the streams, the only water present at the time of the aerial survey was that confined to pools of various sizes. These include both plunge pools and shallow pools on solid basalt. The latter tended to increase in number with elevation, and in many cases were connected within the cloud zone. Kawaipapa, Kapia, and Waihonu appeared to be interrupted streams (and are so listed in Timbol and Maciolek, 1978), with flowing water at elevations above about 2000 feet (610 meters).

Haneo'o and Mo'omo'onui, streams which pass through the project site, are listed (by Timbol and Maciolek, 1978) as possibly interrupted and interrupted, respectively. Within or below the project site, it was difficult to find even standing water in either stream in February 1992. Bruner (1990) described the drainages as "...apparently intermittent as no water was running in any of them at the time [October] of the survey" he conducted on birds and mammals of the project site. A report by Water Resources Associates (1990) described perennial flow in both streams above 1000 feet elevation in October 1990, and concluded that these streams are "losing streams" in which perennial flows gradually diminish downstream. Although from the air in February 1992, some small pools could be seen in Haneo'o and Mo'omo'onui, these pools were separated by long sections of dry, rocky stream bed. A branch of Mo'omo'onui named Mo'omo'oiki is relatively short and seems to arise below the 800-foot (240-meter) elevation. A few shallow pools on rock substratum at around the 700-foot (210-m) elevation, were observed from the air.

The U.S. Geological Survey maintains a water level (peak flow) gage (Station 16502800) on Mo'omo'onui Gulch just down-

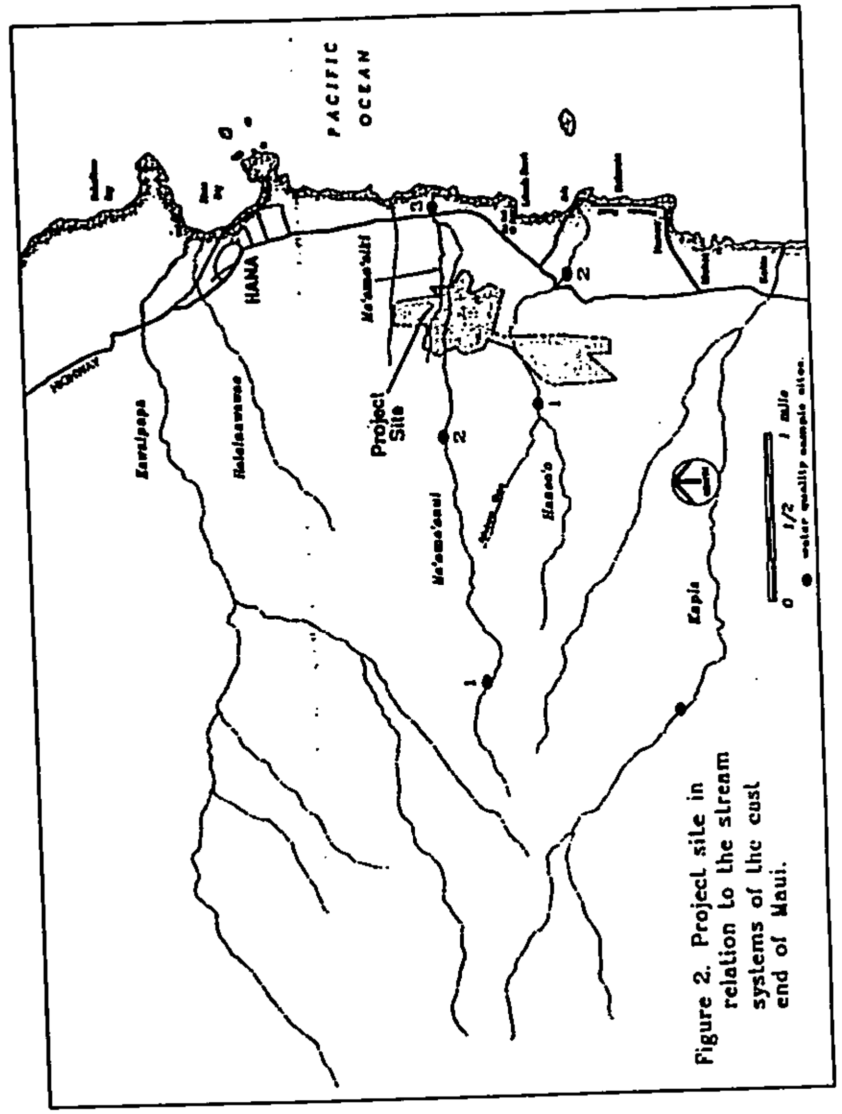


Figure 2. Project site in relation to the stream systems of the east end of Maui.

stream of the confluence with Ho'omo'oiki (and just above Pi'ilani Highway). Information provided in the USGS Water-Data Report for 1989 (USGS, 1990) relates that the two gulches above the gage have a drainage area of 0.9 square mile and flood stage records are available for the period 1963-89 (to present, still active). Annual maximum flow (1989) is given as 1,190 cubic feet per second (cfs) and a gage height of 13.62 feet on April 7, 1989. These values represent a very substantial peak discharge considering the reportedly small drainage area.

<u>Haneo'o Stream</u>

Haneo'o Stream, with headwaters at around 2200 feet (670 meters), is one of the smaller streams in the Hana area. Median annual rainfall at the headwaters elevation is around 100 inches (254 mm)(Water Resource Associates, 1990). This stream seems clearly to be intermittent, and not "possibly interrupted" as listed by Timbol & Maciolek (1978) or "perennial and interrupted" as listed by the Commission on Water Resource Management (1990) and Water Resource Associates (1990). Pools of various sizes were present all along the length above 800 feet (240 meters) elevation, but these were not connected by surface flow during the February observation period. Establishing a proper designation (whether interrupted or intermittent) for a stream such as Haneo'o Stream, located in a high rainfall area, will depend largely on when observations are made in relation to recent weather conditions.

Water samples were obtained, and field observation made, from isolated pools at the 600-foot (180-meter) elevation and just below Hana Highway at an elevation of about 140 feet (43 m). This stream is braided through and below the project site and the water sample was obtained from the south channel.

<u>Ho'omo'onui Stream</u>

Ho'omo'onui Stream arises from numerous small branch streams draining the slopes of cinder cones at the 3000 to

3400 feet (915 to 1035 meters) elevations. The drainage from higher elevations on these slopes of Haleakala tends to be intercepted by headwaters of either Kapia or Kawaipapa Streams. The headwaters of Ho'omo'onui are within the cloud zone, and the stream thus might be expected to be perennial in the upper reaches (i.e., truly an interrupted stream rather than an intermittent one). Median annual rainfall at this elevation is over 150 inches (380 mm)(Water Resource Associates, 1990). Consequently, it was decided to traverse this segment on foot to determine if native fauna inhabited the stream. The survey began at about the 2800-foot (850-m) elevation, and extended downstream to about the 2100-foot (640-m) elevation, where a series of cataracts of increasing height made further travel on foot impossible without climbing ropes.

At the 2800-foot level, the stream has cut a narrow channel through the basalt within the cloud zone. Water is present as a series of disconnected pools on the order of one to several meters long, by 0.5 to 1 m wide by 0.3 m deep. The surrounding vegetation is a lowland wet forest ('ohi'a /'olapa forest) with an abundance of cryptogams (lichens, mosses, hepatics, and small ferns) which coat tree stems and exposed rocks. The surrounding forest of dwarfed trees is an open canopy of <u>Metrosideros polymorpha</u> ('ohi'a lehua), <u>Cheirodendron</u> spp. ('olapa), and <u>Cibotium</u> sp. (hapu'u). The native forest is heavily invaded by a naturalized ginger, <u>Hedychium gardnerianum</u> ('awapuhi kahili). Other plants noted to be common in or close to the stream bed are <u>Dicranopteris linearis</u> (uluhe), <u>Freycinetia arborea</u> ('ie'ie), <u>Ageratina adenophora</u> (Maui pamakani), ?<u>Cyanea</u> sp., <u>Paspalum conjugatum</u> (Hilo grass), <u>Agrostis sandwicensis</u>, <u>Pipturus forbesii</u>, <u>Scaevola</u> sp. (naupaka kuahiwi), <u>Carex</u> sp., and other Cyperaceae.

Many small side streams, most carrying only a trickle of water, coalesce to form Ho'omo'onui Stream, which carries a small flow of water (probably on the order of 0.001 mgd at the time of the survey) from around the 2700-foot (825-m) elevation. The first cataract of appreciable size (over 10 meters high) is found near the 2600-foot (790-m) level beside the cinder cone remnant called Kcaekea. <u>Hedychium gardnerianum</u>

comes to dominate the canyon of the stream and slopes of the cinder cone almost to the complete exclusion of other plant species. A small amount of Hedychium coronarium was seen established in this area, and a Peperomia sp. was found growing on narrow rock ledges near the stream.

A large pool is present at the base of the waterfall, but stream flow is normally only a trickle over the falls. A series of large pools occur down stream from this point, but these are no longer connected by flowing water; i.e., the stream has become influent under low flow conditions and would be defined as "interrupted". The stream bed gradually widens below the falls, reflecting the coalescing of small side streams and the occasional periods when heavy rains produce tremendous torrents which move down these slopes.

In some cases, on Mo'omo'onui as well as other streams observed along this part of Maui, plunge pools appear to have broken into either lava tubes or into very permeable strata. Even under conditions of modest stream flow from above, water flow would be interrupted at these points except during exceptional freshets. In these cases, the plunge pool features are physically deep relative to the stream bed immediately down stream, and contain much accumulated bed load material (boulders, cobble, and sand), but are dry.

Although the principal waterfall on Mo'omo'onui Stream is indicated on the USGS quadrangle sheet (Hana, 7.5 minute series) at the 1200-foot (370-m) elevation, Mo'omo'onui Stream between the 2100-foot (640-m) elevation and the 1200-foot (370-m) elevation is confined within a steep sided canyon marked by several cataracts of greater than 30 feet (10 m) height.

The lowland wet forest in this area is characterized by taller Metrosideros, Cheirodendron, and a much denser growth of Dicranopteris linearis (uluhe) which covers ridge tops and side slopes. Hedychium (ginger) is confined to the bottoms of small ravines. A large Lycopodium, Sadleria ('ama'u), and several lobelioids (e.g., Clermontia spp.) are common to abundant. Observed also is Rubus rosaefolia (thimbleberry) and Hedyotis sp. At lower elevations, the stream area is

characterized by Aleurites moluccana (kukui), Eugenia, Psidium guajava (guava), and Mangifera indica (mango). Extensive bamboo forests cover some slopes in this area.

Stream Biota

The only animals observed within the perennial section and isolated pools of Mo'omo'onui Stream above 2100 feet (640 m) elevation were dragonfly naiads. Both dragonflies and damselflies were common around the stream.

While no native stream fishes (o'opu) were observed in Mo'omo'onui, a single o'opu alamo'o (Lentipes concolor) was observed in Kapia Stream, well off the project site, at an elevation of 2200 feet (670 m). A water sample was collected from a pool just downstream of the sighting (see below and Figure 2). No other fishes, neither introduced (exotic) nor indigenous species, were observed in the stream surveys.

Dragonfly naiads were abundant everywhere water could be found in Haneo'o and Mo'omo'onui Streams except for the lowest elevation pools (those below Hana Highway). Tadpoles and young frogs (Rana catesbiana) were present in both streams in the large pools at low elevations (i.e., within or just above the project site).

Statewide Stream Assessment

The Hawaii Stream Assessment (Commission on Water Resource Management, 1990) is a compilation of existing information on Hawaii's perennial streams. Both Haneo'o (State Code: 6-5-02) and Mo'omo'onui (State Code: 6-5-01) are listed. However, in the aquatic resources inventory and assessment section, neither is included among the streams with important aquatic resources (i.e., native fauna and habitat). In the section on riparian (stream side) resources, Mo'omo'onui is listed as being 10% within native forest, associated with a wetland (on 1978 USFWS maps, Portland office), and showing damage from pigs (the latter detriment also cited for

Haneo'o). All of these "factors" would certainly refer to segments of the stream(s) well above the project site.

The cultural resource listings refer to some unspecified significance of the "valley" of each stream based on "very limited" information. A more competent assessment of relevant archaeological information for the project site is provided by Cultural Surveys Hawaii (1990). The resource assessment summary which ranks both streams as having "substantial" cultural resources is unsupported. Certainly the Hana area is rich in cultural resources, but no particular ties to Haneo'o or Mo'omo'onui Streams in the project area require special consideration here.

Under the "recreational resources" assessments, the document (Commission on Water Resource Management, 1990) lists hunting and hiking as recreational opportunities associated with these two streams. Both Haneo'o and Mo'omo'onui are ranked "moderate" for recreational resources, a rather low ranking compared to most other streams on east Maui (and in the resource assessment summary, the lowest rank given).

Stream Water Quality

Water quality samples were collected from six locations on streams in the Hana area (Figure 2). These samples included two from higher elevation sites where some stream flow was occurring on Kapia and Mo'omo'onui Streams; and four samples from isolated pools on Haneo'o and Mo'omo'onui Streams at elevations below 1000 feet (300 meters). The sample from Kapia Stream was taken from a pool located just downstream of a large plunge pool at an elevation of 2200 feet (670 meters) near Pu'u Ho'olewa. The upper reach sample from Mo'omo'onui Stream (Sta. 1) was from an area of shallow pools where the stream flows through a meadow at 2500 feet (760 meters) elevation. Two of the lower elevation samples were from large pools located above the proposed golf course site, on Hana Ranch land in areas accessible to cattle; and the two from small, shallow pools (all that could be located) below Hana Highway and thus downstream of the project site.

The results of water quality analyses on these samples are presented in Table 1 and discussed here. The samples from the highest elevation locations (Kapia Stream and Mo'omo'onui Stream, Station 1) showed nearly identical pH, turbidity, and NFR values, but differed considerably in the concentrations of various forms of nitrogen (nitrate, ammonia, organic nitrogen). Both had low concentrations of phosphorus. High nitrate values (as found in Kapia Stream) are not necessarily unusual, and this area is certainly as pristine a location as one could find with respect to an absence of human influences on water quality.

Table 1. Water quality measurements from stream pools on East Maui in February 1992.

Stream:	Kapia	Mo'omo'nui			Haneo'o	
Station:		1	2	3	1	2
Date	2/19	2/19	2/21	2/21	2/21	2/21
pH	7.0	7,1	7.1	6.7	7.1	6.9
Turbidity (NTU)	0.6	0.6	2.0	1.7	0.8	0.9
NFR (mg/L)	0.33	0.36	1.8	3.4	2.2	0.8
Nitrate+nitrite (ug N/L)	64	2	< 1	2	1	1
Ammonia (ug N/L)	6	19	1	17	4	27
Total nitrogen (ug N/L)	110	186	105	722	220	522
Total phosphorus (ug P/L)	< 1	1	4	40	12	15

Nitrate plus nitrite values were low at all of the lowland locations (which representing isolated pools of water). In such situations, algal growth usually removes most of the available inorganic nitrogen out of the water. Ammonia might also be reduced, although in stagnant waters, microbial activity in bottom sediments could continue to generate ammonia from decaying organic matter. The relatively high total N and total P values from the small stagnant pools probably represent biological processes at work on various nutrient inputs from an earlier period when water flow occurred and/or the breakdown of organic matter deposited in the pool.

A set of samples collected and analyzed previously by Brewer Analytical Laboratories (Brewer Environmental Services, 1990) from (presumably) isolated pools in the gulches crossing the project site provide information for comparison with the more recent water quality data. These 1990 results are presented in Table 2.

Table 2. Water quality measurements from stream pools on east Maui in October 1990 (Brewer Environmental Services, 1990)[1].

Stream:	Ho'omo'oiki	Ho'omo'onui	Hanao'o
Date	11/17	11/17	11/17
Nitrate (ug N/L)	10	20	< 10
Total nitrogen[2] (ug N/L)	490	460	470
Total phosphorus (ug P/L)	30	20	30
Sulfate (mg/L)	2	1	1
Total Dissolved Solids (mg/L)	102	74	68

1 - Values from corrected data sheet dated 03/12/92.
2 - Based on sum of TKN and nitrate measurements.

Although the nitrate results are generally higher in 1990 than in 1992, the reason is probably related to difference in analytical methodology. The 1990 values appear to be close to the detection limit for the method used. The total nitrogen and total phosphorus values were also obtained using different methods, although these parameters can be expected to be quite variable spatially and temporally in isolated fresh water pools adjacent to cattle ranch lands. Although sulfates are

not often measured in surface waters, the values reported are consistent with unpolluted stream water. The total dissolved solids values indicate fresh water.

MARINE ENVIRONMENTS

No part of the proposed project borders on the shoreline. All of the proposed golf course is located on lands mauka of Hana Highway which itself passes no closer than 500 feet to the shore in this area. Thus, impacts of the project on the marine environment would not be direct ones because no fill or dredging of aquatic environments will occur. Nonetheless, indirect impacts mediated through either runoff from the site or through contamination of the ground water require consideration. A survey of the marine environment was undertaken in February 1992 in order to provide background information for assessing these indirect impacts.

Marine Nearshore Survey

The nearshore area from north of the Mo'omo'onui Stream mouth to just south of Koki Beach Park (Figure 3) was surveyed by two observers using snorkel gear on February 19 to 21, 1992. Water conditions were relatively calm during this period due to prevailing south winds and small wave conditions. Water clarity was excellent on February 19-20, with underwater visibility of around 75 feet, but was reduced to a maximum of about 25 feet on February 21 at Koki Beach because of Tradewind driven waves.

Four dives were made: one from about 250 feet to about 1000 feet north of Mo'omo'onui stream mouth; one from the stream mouth southward to about 500 feet south of 'Opuohina Point; one from Leho'ula Beach to approximately halfway across the embayment then beyond the promontory on the north side of the bay; one from Koki Beach along the south side of the bay to just south of Koki Beach Park (Figure). On each dive both observers noted the type of substratum, characteristic and relative abundance of bottom cover and prominent benthic organisms, and rated all species of fishes noted as 1 (rare), 2 (present), 3 (common), and 4 (abundant). Observations were noted on underwater paper and compared between the observers following each dive.

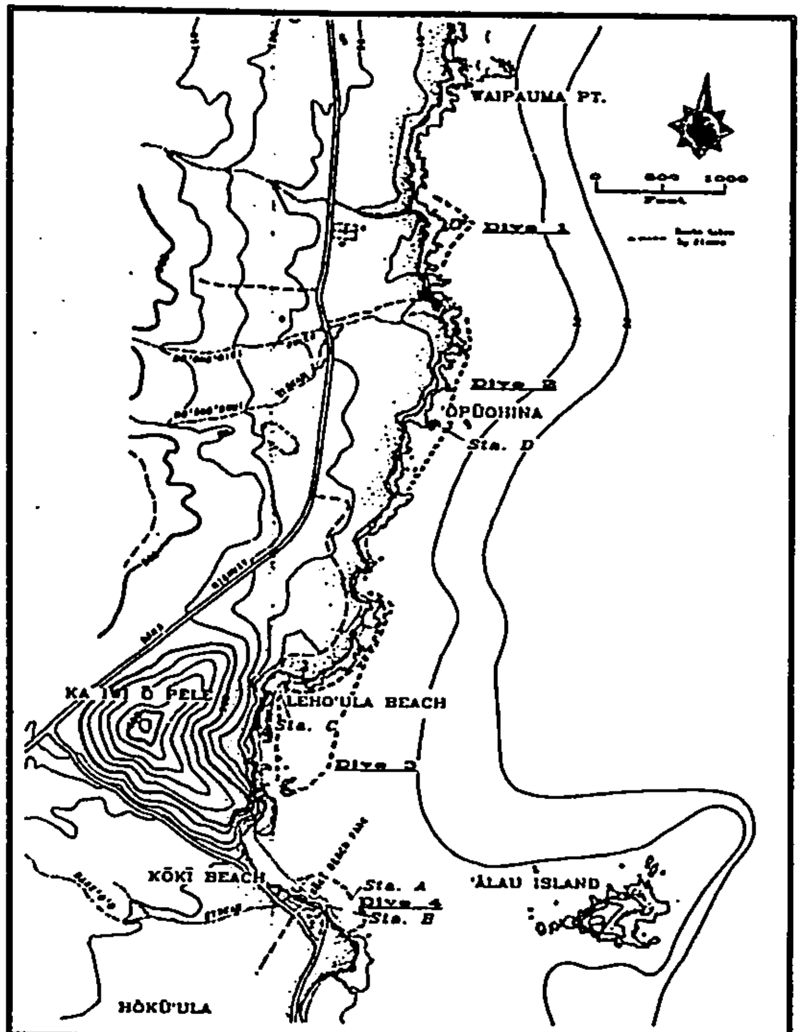


Figure 3. Map of coastline south of Hana showing marine survey areas and water quality sample stations.

Two principal environments occur in the study area: 1) the rugged open coastline extending north of Leho'ula Beach, and 2) the area within the embayment between Leho'ula and Koki Beaches. Both areas are exposed, high energy environments usually dominated by waves and seas generated by northeast Tradewinds. Resident organisms, particularly those of the benthos, must be able to withstand highly turbulent conditions most of the time. This has resulted in a relative low coverage of epibenthic and sessile organisms, few of which were found on the surveys.

The shoreline north of Leho'ula Beach is a series of small promontories of basalt with shallow seaward extensions separated by coves where the shoreline rises as a shear cliff 30 to 40 feet above the sea. The basalt shelves provide much vertical relief and habitat in the subtidal, extending down to about 25 feet depth, and comprise the only substantial horizontal surfaces for intertidal organisms along this coast. The upper intertidal is dominated by the dense yellow growths of the alga, Ahnfeltia concinna (aki'aki), with the red algae, Pterocladia capillaea and Amansia glomerata, abundant in respective zones just below. The intertidal sea urchin, Colobocentrotus atratus, is also abundant in the lower intertidal. At the top of the subtidal zone the substratum is honeycombed in some places with burrows of the rock boring sea urchins, Echinometra mathaei and E. oblonga. Not all of the burrows are occupied, as usually occurs along less turbulent coastlines, and the borrows here are much deeper than usual, with the urchins present several inches below the rock surface.

From the upper intertidal downward to 25 feet depth the basalt substratum is usually coated with a thin veneer of the calcareous red algae Porolithon onkodes. Reef coral coverage in this usually highly turbulent area ranges from very low to approximately 15%, dominated by colonies of Pocillopora meandrina (5-10%) up to 1.5 feet in diameter. The blue encrusting coral, Montipora flabellata, is second most abundant (1-5%), followed by the soft coral, Palythoa tuberculosa, (1-5%) except at depths of less than 3 feet where P. tuberculosa exceeds 60% cover. The only other prominent invertebrate to be found in this zone is the sea cucumber,

Holothuria mauritiana. At depths below 20 feet, the coral, Porites lobata, normally the dominant coral species on most Hawaiian reefs, occurs infrequently at abundances of 1-5%, and the coral, Montipora patula, is rarely found. A few heads of the coral, Pocillopora damicornis, were seen in shallow water near shore off Leho'ula Beach.

The subtidal zone at the base of the cliffs in the coves is mostly loose basalt ranging from large pebbles up to boulders 4 feet diameter. In contrast to the steep relief of the promontories, subtidal zones, these boulder areas slope gradually seaward, providing a less varied habitat. Reef corals or other sessile invertebrates are not common on the boulders, suggesting that they are frequently rolled around by the surf, preventing or interrupting settlement of young stages of benthic organisms. This unstable environment was even more apparent off the Mo'omo'onui stream mouth, where the basalt boulders were generally smaller, more cobbles occurred, and all signs indicated the periodic offshore deposition of large amounts of debris from the stream during high runoff.

The benthic environment in the embayment between Leho'ula and Koki Beaches contrasted strongly with the open shoreline to the north. Most of the bottom throughout the bay is a mixture of calcareous white and basaltic black sand with no prominent macroinvertebrates. Rocky areas occur near the shoreline in the central part of the bay and the north and south shorelines are basalt boulders or solid rock. However, the surfaces are coated with a sand/algal turf throughout the bay, and coral coverage is low. Although the same species occur as are found further northward, coral abundance in most of the bay does not exceed 5% and is generally about 1%. The exception to this condition occurs in about 15 feet depth along the shore 150 feet east of Leho'ula Beach, where a small, incipient coral reef has developed. Here sufficient calcium carbonate has accumulated to form a calcareous substratum, and coral coverage has reached about 15% for Porites lobata, and 5% each for Pocillopora meandrina and Montipora flabellata. Landward of this reef, the substratum is heavy, rounded boulders with a thin coating of Porolithon onkodes

On the rocky areas at the central and south shores of the bay, the lacy red alga *Desnia hornemanni* was abundant on the horizontal surfaces of the upper subtidal. Below this zone, *Pterocladia* and *Amansia* were abundant, as on the open coastline further north, and all surfaces supported a ubiquitous coating of algal turf and sand. The black sea cucumber, *Holothuria atra*, was common in mixed sand and rock areas in the embayment, and *Holothuria mauritiana* and the sharp spined sea urchin, *Diadema paucispinum* ("wana"), were present. All rocky surfaces within the bay appeared thoroughly scoured from wave driven sand, and this undoubtedly contributed to the low abundance of corals and other reef animals.

Fishes observed throughout the study area are reported in Table 3. A total of 46 fish species were found, and 40 of these were sighted along the open coastline. Only 28 species were observed from the central to the north side of the bay off Leho'ula Beach, and only 13 on the south side of the bay off Koki Beach. Fish in this latter area were also less abundant as well as less diverse, although visibility was reduced off Koki Beach on the day of the survey, and these observations are not strictly comparable to the other areas.

The most common fish sighted was the tang, *Acanthurus leucopareius* ("maikoiko"), which was rated very abundant both in and outside of the bay. Other species with abundant or very abundant individuals were *Acanthurus triostegus* ("manini"), *Naso lituratus* ("kala"), *Thalossoma duperrey* ("hinalea lau-wili"), *Plectroglyphidodon imparipennis* and *P. sindonis*, *Kyphossus bigibbus* ("nenue"), *Mulloides flavolineatus* ("weke"), *M. vanicolensis* ("weke ula"), and *Parapeneus pleurostigma* ("malu"). Most fish in all areas were sighted in the vicinity of vertical surfaces provided by rocky outcrops.

These surveys provide the first information on nearshore marine communities north of Koki Beach Park. The only previous study in this vicinity was done in preparation of the Maui Coral Reef Inventory (AECOS, 1981). Field notes for a survey just offshore of the fishponds south of Koki Beach Park list

Table 3. Relative abundance of fishes observed on the marine surveys off the coast south of Hana.

Species	Location 1 Waipauma Point	 2 Opuohina Point	 3 Leho'ula Beach	 4 Koki Beach
Albulidae				
Albula vulpes "O-i-'o"			1	
Hemiramphidae				
Hemiramphus depauperatus		1	2	
Fistulaidae				
Fistularia petimba	1	1	1	1
Cirrhitidae				
Cirrhitus pinnulatus "po'o-pa'a"		1		
Lutjanidae				
Lutjanus fulvus "to'au"		1	1	
Kyphosus bigibbus "nenue"	3	2	2	
Monotaxi grandoculis "mu"		1		
Mullidae				
Mulloides flavolineatus "weke"			3	
M. vanicolensis "weke ula"	2	3		
Parapeneus chryserydros "moano"		1		
P. multifasciatus "moano"	2	2	1	1
P. pleurostigma "malu"			3	
Chaetodontidae				
Chaetodon auriga "kikakapu"		1	1	
Chaetodon fremblii "kikakapu"	2	1		
C. ornatissimus	1	1		
C. lunula "kikakapu"		1	1	
C. quadrimaculatus "lau-hau"		1		1
Forciper flavissimus "lau-wiliwili-nukunuku-'oi'oi"		2		

Table 3. (Continued)

Species	1 Waipauma Point	2 Opuohina Point	3 Laho'ula Beach	4 Koki Beach
	Location			
Carangidae				
Caranx melampygus "Omilu"		1		
Pomacentridae				
Abudefduf abdominalis "mamo"	1	1		1
A. sordidus "kupipi"	1	1	1	2
Plectroglyphidodon imparipennis	2	3	2	1
Plectroglyphidodon sindonis	1	3	1	1
Labridae				
A. cuvier "opule"		1	1	
Bodianus bilunulatus "a'awa"		1		
Halichoeres ornatissimus "ohua"			1	
Labroides pthirophagus		1		
Stethojulis balteata "omaka'		1		
Thalassoma duperrey "hinalea lau-wili"		3	2	1
T. trilobatum		2	2	
Scaridae				
Scarus dubius	1	2	1	
Zanclidae				
Zanclus cornuta "kihikihi"	2	2		
Acanthuridae				
Acanthurus achilles	1	2		
A. blochii "pualu"			2	1
A. guttatus "api"	1	2		
A. leucopareius "maikoiko"	4	4	4	1
A. olivaceus "na'ena'e"	1	1		
A. triostegus "manini"	2	4	2	2
A. xanthopterus "pualu"	1	2	2	

Table 3. (Continued)

Species	1 Waipauma Point	2 Opuohina Point	3 Laho'ula Beach	4 Koki Beach
	Location			
Ctenochaetus strigosus "kole"	3	2		1
Naso lituratus "kala"	2	3	2	
N. unicornis	2	2	2	
Balistidae				
Rhinecanthus rectangulus "humuhumu-nukunuku-a-pua'a"		2	1	1
Melichthys niger "humuhumu-ele'ele"	1		1	
Tetradontidae				
Canthigaster jactator	1	1	1	
Ostracion meleagris		1	1	
TOTAL SPECIES	23	40	28	13

Abundance scale: 1 - rare (one or two individuals seen), 2 - present (several individuals seen), 3 - common (many individuals seen), 4 - abundant (numerically dominant species in area)

three species of corals, seven algal species and 16 species of fish sighted, most of which were also observed in the present study. By contrast 61 fish species were found by the Maui Coral Reef Inventory (AECOS, 1981) at about 25 feet depth north of 'Alau Island, suggesting much greater fish diversity offshore where reef development is more pronounced.

Ocean Water Quality

Water quality samples from the marine environment were collected at four stations on February 21, 1992. Samples were stored on ice and returned to Honolulu for analysis of salinity (by refractometer), pH, turbidity, ammonia, nitrate plus nitrite, total nitrogen, total phosphorus, silicate, and chlorophyll a. The station locations are shown in Figure 3. Two sites were located off Koki Beach Park: a Station "A" located 200 feet offshore, in front of the shallow shelf which extends eastward from the park and a Station "B" from the shoreline east of the park. The Station "C" sample was obtained from just off the beach at Leho'ula; and the Station "D" sample from off the rocky shore at 'Opuohina. The results are presented in Table 4.

Table 4. Water quality measurements from coastal waters on East Maui in February 1992.

Station:	A	B	C	D
Date	2/21	2/21	2/21	2/21
Salinity (ppt)	25	17	23	24
pH	8.0	8.2	8.2	8.2
Turbidity (NTU)	0.7	2.2	0.5	0.5
Nitrate+nitrite (ug N/L)	1	35	14	4
Ammonia (ug N/L)	10	9	4	14
Total nitrogen (ug N/L)	153	98	74	77
Total phosphorus (ug P/L)	10	33	13	8
Silicates (ug Si/L)	130	3980	840	710
Chlorophyll a (ug / L)	0.46	0.66	0.45	0.79

While these sampled areas are potentially in waters influenced by streams draining the project site (Sta. "A" and "B" near the mouth of Haneo'o Stream; Station "D" near the common mouth of Mo'omo'onui and Mo'omo'oiki streams), conditions at the time of sampling were such that no stream influence on near shore waters was occurring. Nonetheless, salinities at all locations were depressed. Sea water should have a salinity between 34 and 36 ppt (parts per thousand),

yet these samples ranged from 25 down to 17 ppt. Ground water seepage occurs all along this coastline, and should have most influenced our sample from Station "B" where the depth was shallow and the nearshore water somewhat confined by emergent boulders. In fact, the water quality results with respect to salinity, silicates, and nitrates (the latter are usually good indicators of ground water efflux into coastal waters) corroborate the conclusion that ground water efflux is substantial in this area.

A single set of samples alone can provide only a limited sense of the representativeness of the analytical results. The State of Hawaii, water quality regulations (see Table 5) provide no basis for comparing measurements from a single sampling event, unless one assumes that the values obtained during the visit are "typical" or average. To characterize the existing water quality in terms of the standards established for marine waters requires that samples be collected regularly over a period of time which encompasses in a representative fashion the range of sea and weather conditions which impinge on the location.

The waters around the east end of Maui are classified as Class AA, and in the Hana area quite probably fall within the open coastal "wet" criteria. However, the "208-Committee" report (DOH, 1977) classifies this particular area as a seasonally wet coast (as opposed to a perennially wet or perennially dry), more than likely because stream flows are absent during the drier months. For a seasonally wet coast, the "wet" criteria apply when runoff plus groundwater efflux exceed 3 million gallons per day (mgd) per shoreline mile, usually handled administratively as applicable during the months between November and April. The "dry" criteria would then be applicable during the months between and including May to September. The reason for using wet season and dry season months instead of the actual discharge volumes (i.e., greater than or less than 3 mgd) has to do with the difficulty of regularly determining ground water efflux volumes. Clearly, the discharge of water from streams in this area is seasonal, but such discharges might well account for only a small proportion of the total volume of fresh water that enters the ocean along this coast.

Table 5. State of Hawaii Water Quality Criteria for open coastal waters (DOH, 1989).

Parameter	Geometric mean not to exceed the given value	Not to Exceed the given value more than 10% of the time	Not to Exceed the given value more than 2% of the time
Total Nitrogen (ug N/L)	150* 110**	250* 180**	350* 250**
Ammonia Nitrogen (ug NH4-N/L)	3.5* 2.00**	8.50* 5.00**	15.00* 9.00**
Nitrate + Nitrite Nitrogen (ug N/L)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (ug P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**
Chlorophyll a (ug/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Light extinction coeff. (k units)	0.20* 0.10**	0.50* 0.30**	0.85* 0.55**

pH units shall not deviate more than 0.5 units from 8.1

Dissolved Oxygen (DO) shall not be less than 75% saturation.

Temperature shall not vary more than 1 C° from ambient conditions.

Salinity shall not vary more than 10% from natural or seasonal changes considering hydrologic and oceanographic factors

* wet criteria (fresh water inflow > 3 mgd/mile of shore) ** dry criteria (fresh water inflow < 3 mgd/mile)

In any event, reviewing our limited water quality measurements in relation to the wet season criteria presented in Table 5, suggests that the nutrient criteria (nitrates, ammonia, total nitrogen, and total phosphorus) are probably

not exceeded in the ocean waters off this coastline, except very near shore where the discharge of fresh or brackish water contributes these nutrients as, for example, at Station "B". Here, the nitrate plus nitrite criterion (and possibly the total phosphorus criterion) will be exceeded. This particular sample also shows the waters in this area (the shore east of Koki Beach Park) to be more turbid than the criterion for turbidity. Considering that this sample was collected close to shore during moderately heavy wave conditions probably contributed to the result.

The chlorophyll a criterion (0.30 ug chlorophyll a/L) is slightly exceeded by all of the measurements made along this coastline. The significance of this result is uncertain. Chlorophyll a is a measure of phytoplankton abundance and high concentrations indicate eutrophic conditions. The waters here in February were generally clear and the seas calmer than usual because the winds had been from the south to southwest for at least a week prior to the collection of samples on February 21. The slightly elevated chlorophyll may indicate a response by the phytoplankton assemblage in the near shore waters to ground water inputs of nutrients needed for growth. In more confined waters (e.g., embayments), excessive inputs of nutrients can lead to much higher chlorophyll a values indicating algal bloom conditions. In turn, algal growth results in a reduction in water clarity. The "elevated" values obtained in February are not reason for great concern because they are only slightly higher than the most stringent criterion and represent only a single sampling event.

PROJECT IMPACTS ON AQUATIC ENVIRONMENTS

Fresh Water Aquatic Impacts Assessment

Construction of the proposed Hana Ranch golf course will not have significant direct impacts on existing aquatic environments because of the nature of these environments within the project area. Alteration of stream beds and gulches is not proposed for this golf course development. Only minimal use of such features, beyond aesthetics, could be incorporated into the project because of the very substantial flows that occur, albeit infrequently, in these gulches. Alterations to the gulches could result in substantial damage to adjacent developed features during floods. Concern about such damage will be greater for the golf course lands than for the existing pastures because of the greater economic loss associated with the developed land. Clearing of brush in some areas might increase the aesthetic value and reduce the hazard of flows overtopping banks. Removal of larger trees and/or channelizing portions of the streams would reduce the potential damage from floods, but would adversely impact on the aesthetic value of the gulches, and consequently, could reduce the economic viability of the golf course.

Stream crossings (vehicle and cart traffic) will have to be designed to provide for the occasional high peak flows that will occur beneath them. This fact will rule out the use of structures restrictive to upstream migration of aquatic animals. Construction activities, particularly grading activities and any instream work, should always be conducted in a manner to minimize erosion of soils into stream beds. Most of this work can be accomplished during periods of no water flow in the gulches.

Within the project area, fresh water habitats are mostly absent within the stream beds. Those bodies of water that do exist are either ephemeral (pools on impermeable rock, subject to drying up between rainfalls) or very isolated (pools maintained in depressions by ground water seepage). In either case, the fauna of these pools is limited to a few species, mostly introduced, that are only partly dependent upon the

existence of the body of water (i.e., insects and amphibians which utilize the water for growth and development of juvenile stages). Water features (ponds) on the proposed course will actually increase the available habitat utilized by these species. This man-made habitat will be isolated, but permanent (not ephemeral).

Once the construction phase has ended, the nature of the direct impacts will change. Soil loss potential from the land, once greens and fairways are established, will be substantially reduced, and will be less than from the existing pasture lands. Environmental concerns will then shift to fertilizers and pesticides used to promote growth and maintain turf on the greens and fairways. Because of the nature of the aquatic environments on the project site, impacts from man-made chemicals will not be of significant concern. The streams here do not support native fresh water species, nor do these streams appear to serve as migratory routes to perennial stream habitats in the upper reaches. Nonetheless, the introduction of pesticides into aquatic habitats, either the man-made water features or the ephemeral aquatic environments within or below the project site, should be avoided to limit or prevent bioaccumulation and indirect environmental impacts. The potential for adverse impacts to the marine environment is discussed below.

Managers of the golf course may be tempted to introduce fishes to the water traps and other water features built for the project. Considerable care must be exercised in selecting these species. East Maui has numerous streams which support native aquatic species, and few areas where introduced species have become established. The Hana Ranch golf course should not become a source of exotic species harmful to the native fauna of the area, even though several miles may separate the water bodies. Fish populations in ponds on the course will attract water birds, particularly night herons. These birds, and perhaps humans, may mediate transfers to other aquatic habitats. Also, some tilapia species, if flushed into the nearshore waters during a flood, can survive until a fresh or brackish water stream is found.

Marine Impacts Assessment

Construction of the proposed golf course will have no direct adverse impacts on marine ecosystems. The golf course will be located well inland from the shoreline, and the streams which exist on the project site carry water only during exceptional rainfall events. The contribution of terrestrial sediment to nearshore waters might be enhanced during the construction phase of the golf course if precautions are not observed in grading practices and if one or more high rainfall events occur during when extensive areas of bare ground are exposed by the grading operations.

Along this coastline, the impact of runoff events which carry high sediment concentrations into nearshore waters are short term; no doubt these events occur presently. Waves and currents move the fine sediment away from this coast fairly quickly, and little or no change in benthic assemblages occurs. Once the construction phase is ended, the sediment content of runoff water from streams which cross the golf course will be the same or less than at present, because soil erosion from land with a well maintained grassy turf is less than that from pasture land (Soil Conservation Service, 1985).

The potential exists for the transfer of chemicals (fertilizers and pesticides) used in golf course tees and greens maintenance operations (and to a lesser extent, fairways maintenance) into the nearshore marine waters. Chemical transfers might be by means of entrainment into runoff from the treated areas or by seepage downward into the ground water. Site runoff into the streams can flow into the marine environment only at times of freshets caused by storms, and would be accompanied by substantial dilution. Chemicals finding their way to the ground water may eventually be released along the shore because of the considerable movement of ground water suspected for the aquifer located beneath the project site.

The potential for movement of pesticides and fertilizers from points of application to the ground water is assessed in other documents prepared for the project environmental assessment (see Water Resource Associates, 1990; Brewer

Environmental, Inc., 1990; Environmental & Turf Services, 1992). One point concerning the gullies which cross the site should be emphasized. Although dry most of the time, these features represent the most direct routes for runoff to reach the ground water under the property. Prevention of ground water contamination will depend in part upon percolation through soil layers, and the clay and organic content of that soil. Runoff from greens and tees (areas of greatest fertilizer and pesticides use) should be prevented from flowing directly into the stream gullies, even though these gullies do not contain water flowing towards the sea. Under low or no flow conditions (the usual situation), runoff water entering the stream bed will percolate down into ground water without much of the filtering benefit provided by soils.

The degree of threat to the marine environment from chemicals contamination is dependent firstly on the extent to which ground water is subject to chemical contamination because this would be the most likely route that contaminants would take. This potential cannot be rigorously evaluated because of limited knowledge of the extent of ground water efflux for the Hana coastline, and limited information about the potential effects of contaminants on the local marine biota. However, the potential for serious harm to marine assemblages (fishes, corals, etc.) certainly would be reduced by the physical characteristics of the coastline and receiving waters. The substantial water motion from wind and waves, strong currents, and open coastal environments lacking shallow reef development all contribute to relatively short residence times of the nearshore water. That is, the ocean here is well mixed and does not retain materials in the immediate area that might lead to long exposure or bioaccumulation in the marine food chain.

As with all impacts from chemical contamination, the nature and seriousness of the impacts are entirely a matter of concentration and duration of exposure. The threat posed to the marine environment by fertilizers is one of promoting unwanted plant growth. Where waters are confined, fertilizers can enhance phytoplankton abundance. In extreme situations, eutrophic conditions ensue, characterized by much reduced water clarity and changes in the benthic community as species populations respond to the greater abundance of phytoplankton and zooplankton. Where water exchange is less restrictive, as is the case along most or all of the coastline south of Hana, benthic algal growth may be promoted. Problems can arise with increased quantities of seaweeds washing ashore under certain conditions. Generally, fish populations are enhanced by nutrient additions, although some species populations may respond more positively than others.

While several chemical elements may be regarded as plant nutrients, only the nitrates (or other nitrogen compounds) and phosphates are of real concern as potential pollutants in aquatic environments. To promote maximum growth, nutrients must be supplied in proportion to the needs of the growing plants, with much more nitrogen required than phosphorus. Fertilizer nutrients which enter the marine environment through ground water intrusion are usually limited to the nitrates because of their relatively high solubility. Phosphates tend to bind to soil particles and not move far from the point of application (see Water Resource Associates, 1990). Thus, if phosphates are not present, excess nitrates may be supplied without promoting algal growth. On the land side, the turf manager will attempt to balance applications of nitrogen and phosphorus in amounts and ratios close to that needed by the grasses in order to reduce the loss of excess nutrients in the leachate or runoff.

Only abstinence in fertilizer and pesticides use can guarantee that these chemicals will never get into the marine environment, no matter how remote the potential for such problems are assessed to be. However, a golf course is not the only activity that might pose risks of chemical contamination to the marine environment. The ranching activities which presently occupy the land contribute soluble nutrients to runoff and ground water, because cattle increase the rate at which nutrients are recycled on the land. Beef cattle typically excrete, in urine and feces, 0.34 pounds of nitrogen (measured as total Kjeldahl nitrogen) and 0.092 pounds of phosphorus (as total phosphorus) per day per 1000 pounds of animal (ASAE, 1991). For a herd of 3000 cattle, as is presently kept at Hana Ranch (and assuming an average animal is 800 pounds), this represents 816 pounds of nitrogen

and 221 pounds of phosphorus deposited in manure across the ranch lands every day. Average nitrogen application for the proposed golf course would be on the order of 100 pounds per day; phosphorus applications would range between 25 and 42 pounds per day at the highest application rates (and could be as low as 10 pounds per day). The quantities are equivalent to the nitrogen from about 370 beef cattle and the phosphorus from 340 to 570 animals. Of course, only a fraction of these nutrients, whether from cattle or fertilizer applications, will actually enter the marine environment as runoff during storms or leachate percolating down into the ground water.

Pesticides and other pollutants are often found in runoff from both urban and agriculture land. The risks from a golf course can be greatly reduced by a management plan designed to minimize the migration of nutrients and potentially harmful pesticide residues away from the site of applications. Obviously, a significant part of any management plan is an emphasis on approaches which minimize fertilizer and pesticides use (e.g., selection of disease resistant turf grasses; applying water and fertilizer in response to turf needs, rather than a preset schedule). The plan should also assess the degree of risk associated with each type of pesticide on a site specific basis. The management plan, coupled with establishment of an appropriate monitoring plan, provides a framework within which problems of environmental contamination can be avoided.

Monitoring requirements for ground and surface waters, imposed on all new golf course developments (DOH, 1992), will provide information on compliance with a chemicals management plan. From an analytical perspective, the lysimeter and ground water samples will provide the lowest detection limits for pesticides. That is, while samples of soils, storm runoff water, marine surface water, and marine animal tissues may be analyzed as part of a monitoring program, the ground water analyses will provide the best indication of developing problems in time to minimize impacts on the marine environment. Pesticide monitoring of surface runoff may be necessary in certain situations (e.g., storms occurring shortly after pesticides applications). Presumably, the detection of any pesticides in runoff or ground water would result in appropriate corrective action by the grounds management team.

Ground waters are probably already high in nitrates relative to marine waters. If levels are also variable in space and time, then detecting shifts in concentration resulting from golf course operations will be difficult. Nitrates must be quite high (>10 ppm) before they are considered a contaminant of potable water, whereas much lower levels are significant to algal growth in marine waters. However, the waters off the project site can assimilate relatively high inputs of nitrates without noticeable or significant changes in the biota. Monitoring for biological indications of nutrient enhancement in the adjacent waters could be extremely difficult, because conditions off this coast are not conducive to establishing and servicing biological monitoring stations. Water quality monitoring will need to establish a reasonable baseline for comparison, and stations will have to be established in relation to significant ground water intrusion locations and possibly with some consideration of the volume discharged at specific points or along specific segments of the shore.

BIBLIOGRAPHY

AECOS, Inc. 1981. Hawaii Coral Reef Inventory, Island of Maui (MICRI). Prep. for the U.S. Army Corps of Engineers.

ASAE. 1991. American Society Agriculture Engineers Standards 1991. Standards, Engineering Practices, and Data. 38th Edition. American Society Agriculture Engineers, St Joseph, Minn. 745 p.

Brewer Environmental Services. 1990. Chemical usage for the proposed Keola Hana Maui Golf Course, Hana, Maui, Hawaii. Prep. for Ronald M. Knoll Consulting Group. BES No. E18-1: 27 p.

Bruner, P.L. 1990. Survey of the avifauna and feral mammals for a Hana Golf Course EA, Hana, Maui. Prep. for Pacific Planning & Engineering, Inc. October 1990, 13 p.

Char & Associates. 1990. Botanical survey, Hana Golf Course, Hana District, Island of Maui. Prep. for Pacific Planning & Engineering, Inc. December 1990, 16 p.

Commission on Water Resource Management. 1990. Hawaii stream assessment, a preliminary appraisal of Hawaii's stream resources. State of Hawaii, Commission on Water Resource Management and National Park Service, Hawaii Cooperative Park Service Unit. Report R84, 294 p.

Cultural Surveys Hawaii. 1990. Archaeological inventory survey of the proposed Hana Ranch Golf Course. Prep. for Pacific Planning & Engineering, Inc.

DOH. 1977. An ecosystem approach to water quality standards. Report of the Technical Committee on Water Quality Standards. Dept. of Health, State of Hawaii. 166 p.

______. 1989. Amendment and compilation of Chapter 11-54, Hawaii Administrative Rules, November 20, 1989. Dept. of Health, State of Hawaii.

______. 1992. Twelve (12) conditions applicable to all new golf course development. January, 1992 (Version 4). Dept. of Health, State of Hawaii. 3 p.

Macdonald, G.A., and A.T. Abbott. 1970. Volcanoes in the Sea. The Geology of Hawaii. The University Press of Hawaii, Honolulu. 441 p.

Soil Conservation Service. 1985. Procedures for predicting soil loss with the Universal Soil Loss Equation. U.S. Department of Agriculture, Soil Conservation Service, Honolulu, Hawaii. Technical Guide Section IC.

Timbol, A.S., and J.A. Maciolek. 1978. Stream channel modification in Hawaii. Part A: Statewide inventory of Hawaiian streams including survey of habitat factors associated biota. U.S. Dept. Interior, Fish and Wildlife Service, FWS/OBS-78/16, 171 p.

USGS. 1990. Water Resources Data, Hawaii and Other Pacific Areas, Water Year 1989. Vol. 1. Hawaii. U.S. Geological Survey, Water-Data Report HI-89-1.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the Flowering Plants of Hawai'i. Univ. of Hawaii Press and Bishop Museum Press, Bishop Museum Spec. Publ.83.

Water Resources Associates. 1990. Water resources and supply for proposed Hana Golf Course, Hana, Maui. Prep. for Pacific Planning & Engineering, Inc. 15 p.

APPENDIX G

ARCHAEOLOGICAL INVENTORY SURVEY AND SUBSURFACE TESTING FOR THE PROPOSED HANA RANCH COUNTRY CLUB

Prepared by Cultural Surveys Hawaii, November 1992

Archaeological Inventory Survey and Subsurface Testing for the Proposed Hana Ranch Country Club Hana, Maui, Hawaii (TMK: 1-4-07:4, 6; 1-4-02:8, 9, 10 and 1-4-03:9)

by

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Abstract

This report details the archaeological inventory survey results for the proposed Hana Ranch Country Club, Hana, Maui. The project was done at the request of Pacific Planning and Engineering for Keola Hana Maui, Inc. The survey covered approximately 400 acres of pasture land (former sugar cane lands) south of Hana Town. The acreage being petitioned for is approximately 200 acres within the overall 400 acres.

There were a total of 51 sites located and described during the survey; 23 of which are within the petition area. The majority of sites observed are of probable historic age and are site remnants. This is due to the long-term effects of commercial sugar cane activities followed by cattle ranching. Sites included habitation, agricultural, and religious features. Of the habitation sites only two (Sites 50-50-13-2739 and 50-50-13-2741) are not remnant-type features and this is due to their location outside of the area directly impacted by cane activities. Agricultural sites include remnant terraces and walls of possible pre-1776 (prehistoric) age, but the majority are related to either sugar cane cultivation or historic subsistence farming. Sugar plantation related sites include infrastructure features such as a railroad grade (Site 50-50-13-2742) and road system (Site 50-50-13-2746), and a remnant wall system that appears to relate to the earliest commercial sugar plantation activities (ca. 1850). The single recorded religious site is Koahaepali *heiau* (Site 50-50-13-117) which was recorded in the late 1920s by Winslow Walker and relocated during the general state-wide survey (State File Folder 50-50-13-117) in the 1970s. The *heiau* is situated just outside of the petition area.

Subsurface testing was conducted at 13 sites and consisted of both hand-dug units and backhoe trenching. The purpose of the testing was to aid in determining site functions and probable age. The testing resulted in the recovery and subsequent analysis of three radiocarbon samples, two of which had ranges into the modern era (1425-1950 and 1648-1950), and one with a range entirely within the prehistoric era (1345-1650).

In general, the project area is wide-open pasture lands with only vestiges of the former landscape. Traditional accounts attest to the desirability and importance Hana had during the pre-contact (pre-A.D. 1776) era. Historically, Hana was one of the earliest locales in the Hawaiian Islands involved in commercial sugar cane activities (ca. 1850). The results of long-term cane cultivation and ranching have made it difficult to clearly define certain site remnants. However, Hana has the potential to yield excellent historic background data which could help better define these site remnants. Historical research could include plantation and ranch records as well as an oral history project. It is our recommendation that a program of data recovery in accordance with a plan approved by the State and County include not only archaeological fieldwork but historical research and oral history as well.

Acknowledgements

We would like to thank Mr. Liebert Landgraf and Mr. Charlas Kamaka of Keola Hana Maui, Inc. for logistical help while in Hana. We would also like to thank Mr. Al Chong of Pacific Planning and Engineering for coordination of the project and procurement of maps and photographs. Thanks go as well to the Hotel Hana Maui staff and especially to Ms. Annette Smith at the Hotel's Comptroller's Office, who assisted in locating historic data. Also while we were in Hana, Ms. Maria Orr got us in touch with Mr. Clifford Hashimoto and arranged an on-site informant interview with Mr. Hashimoto. Mahalo to both these individuals. Mr. John "Boy" Hanchett gave freely of his recollections of ranch activities within the project area which were of great assistance in understanding recent land usage.

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I. Introduction

The project area is on the eastern end of the island of Maui within the District of Hana. The subject parcel is situated just south of Hana Town and *mauka* (west) of the Hana Highway (Figs. 1 - 3). The archaeological survey covered approximately 400 acres though the actual area of the proposed golf course is approximately 200 acres. The project area is designated by Tax Map Key (TMK 1-4-07:4,6; 1-4-02:8, 9, 10 and 1-4-03:9). The proposed golf course area was formerly part of Hana Plantation sugar cane lands that were converted to cattle pasture starting in 1946. Presently, the project area is generally characterized by expanses of pasture cut by narrow densely vegetated gulches as well as scattered clumps of dense vegetation.

This report details two phases of archaeological research for the proposed Hana Country Club. The first phase, conducted in late 1990 and early 1991 involved approximately 50 working days. The aim of which was to provide Keoloa Hana Maui, Inc. with an archaeological assessment of their proposed development. The second phase was conducted in early 1992 and involved approximately 36 working days. The second phase was done to upgrade the assessment level report for inclusion in a more comprehensive Environmental Impact Statement.

During the survey 51 sites were located (Fig. 4) and described: 23 of the sites are within the proposed golf course petition area. Included in the Hana fieldwork was perusal of the Hana Plantation records and historic maps. Other research conducted while in Hana included: 1) an Oct 1990 on-site field trip and interview with Mr. Clifford Hashimoto, former Director of the Hana Cultural Center, long-time resident of the Hana-Hamoa area, and whose family used to conduct supplemental

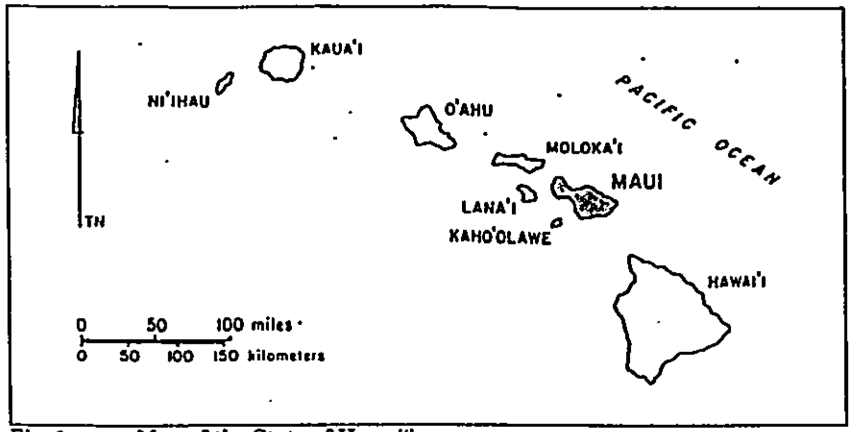


Fig. 1 Map of the State of Hawai'i

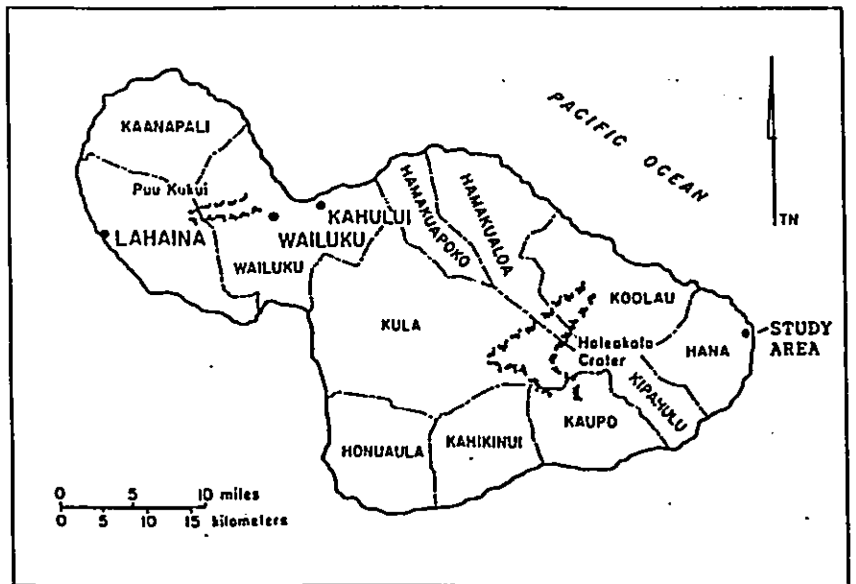


Fig. 2 General Location Map, Maui Island

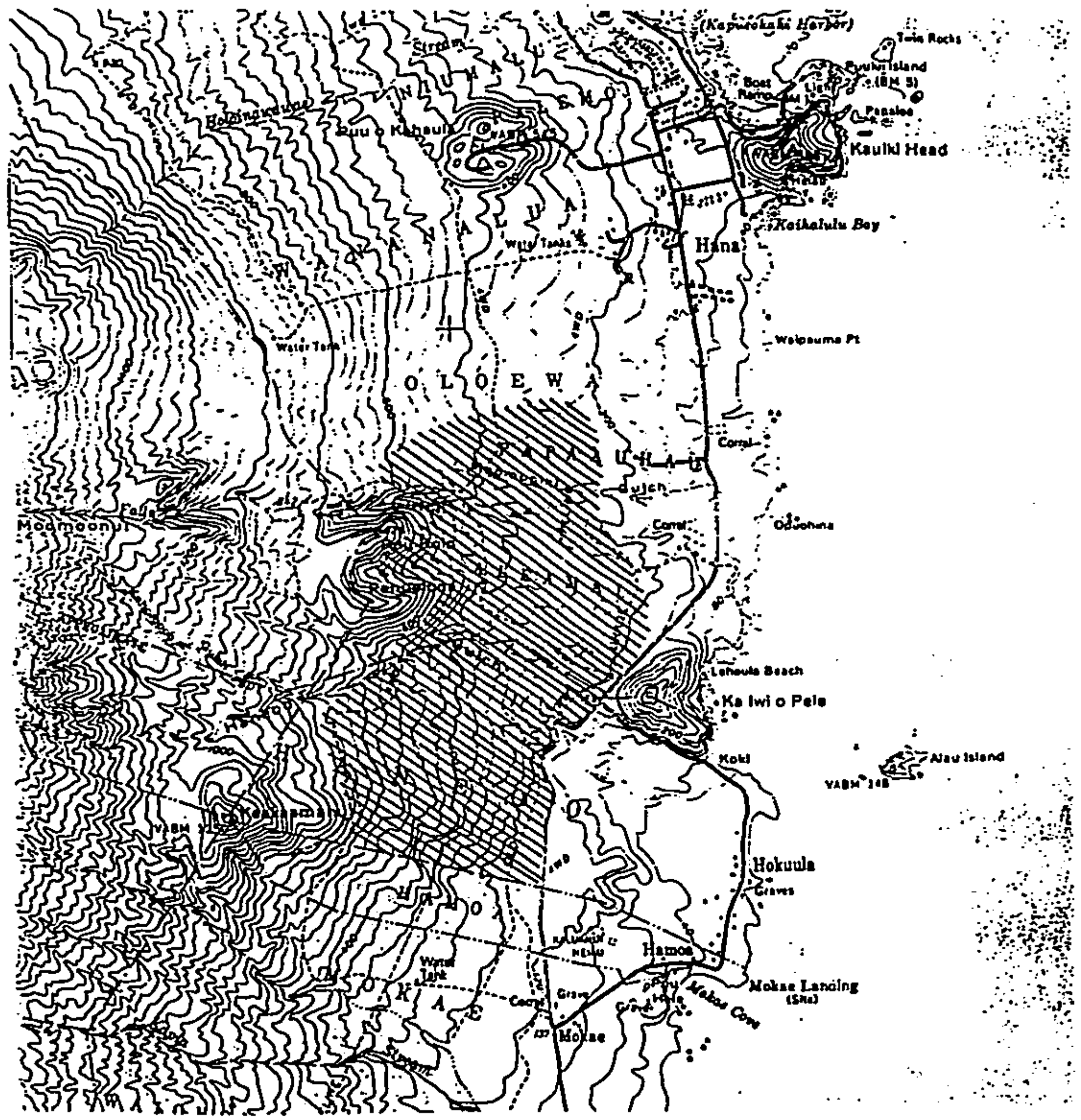


Fig. 3 USGS Map Hana Quad (1:24,000) Showing Surveyed Area (Shaded)

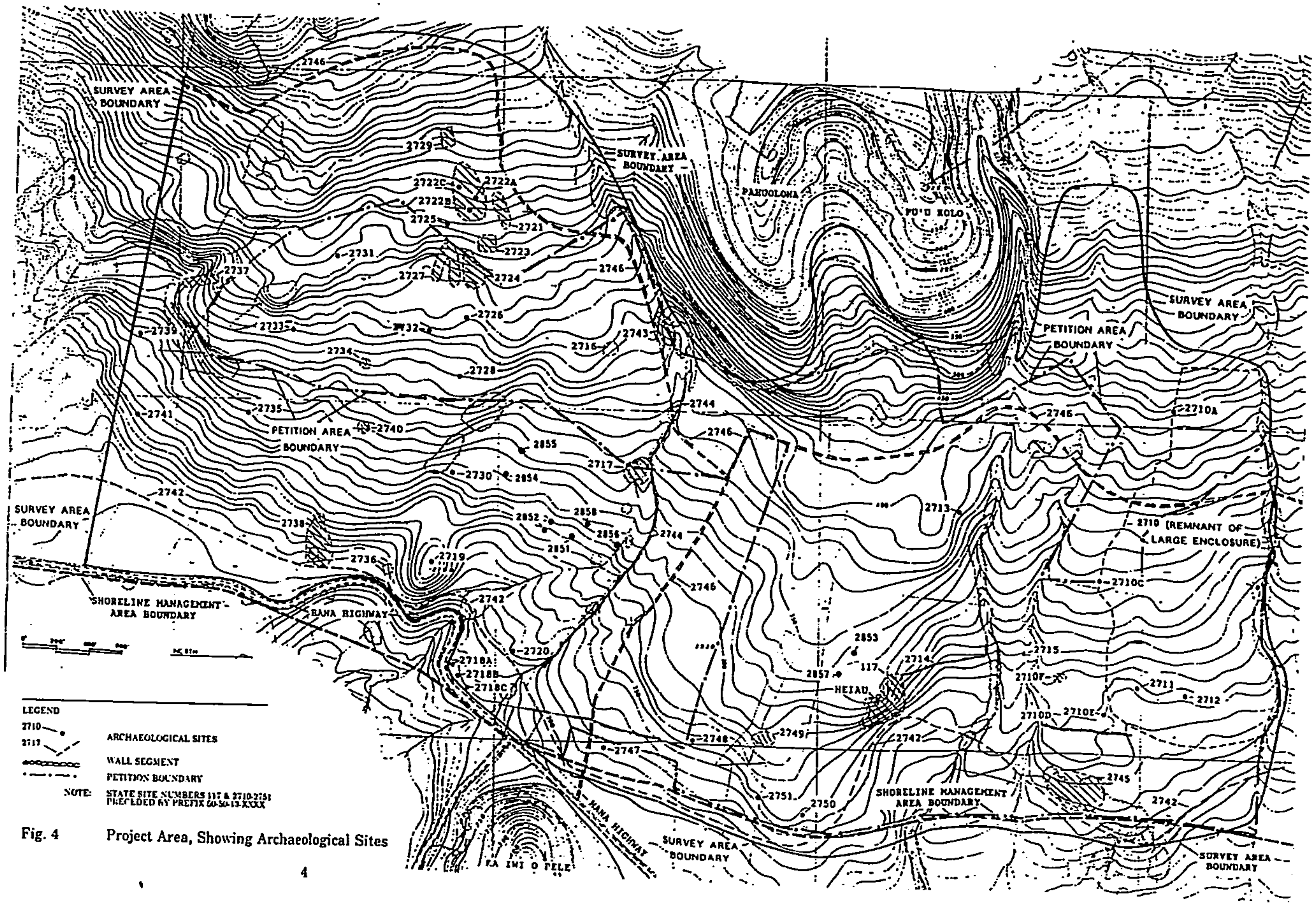


Fig. 4 Project Area, Showing Archaeological Sites

subsistence agriculture within the project area, Mrs Maria Orr and Ms. Coila Eade, concerned Hana residents were also on the field trip; 2) an informal interview with Mr. John "Boy" Hanchett, Jr., one-time company manager of Hana Ranch and son of former long-time ranch manager John Hanchett, Sr.; 3) a Feb. 1991 site tour with Maui County Planner, Keoni Fairbanks, and State Archaeologist (Maui County) Ms. Agnes Griffin; 4) a March 28th 1991 meeting and site tour which included Maui County Council members, and representatives of, the Hana Community Association, Ka Pilinao o Hana, Hana Cultural Center, Maui Burial Council, Golf Course Negotiating Committee, and other concerned community members, (i.e., Parley Kanakaole, Terry Lee Poanipuni, Mrs. Konohia); and 5) informal interviews with Hana residents Mr. James Pu and Ms. Chris Vilarim.

However, one facet of the interviews, field trips, and meetings, that became clear was the virtual absence of information concerning "Hawaiian Sites". The oldest recollections were of extensive sugar cane fields, mill operations, and sugar camp life. This is not surprising considering commercial sugar cane cultivation was the focus of land use within the project area and for all of Hana, from the 1860s to the 1950s.

II. Environmental and Cultural Setting

A. Environmental Setting

The proposed Hana Ranch Country Club site consists of 200 acres of generally moderately sloping pasture lands just south of Hana Town. The approximate boundaries include the twin-peaked cinder cone of Pahuolona and Pu'u Kolo on the west, Papa'auhau Gulch to the north, Hana Highway in the east, and the Haneo'o-Hāmoa *ahupua'a* boundary to the south.

The project area lies essentially within the 200 to 600 foot elevation range. Average annual rainfall is 70 to 80 inches per year (Armstrong, 1923:56). The soils in the project area belong to the Hana series which are developed in volcanic ash. The volcanic ash overlies *'a'ā* type lava which is the dominant type in the Hana area. Specific to the project area are the soil types Hana silty clay loam and Hana extremely stony silty clay loam (Foote et al., 1972).

The project area is dissected by three gulch systems: Kaholopo'o, Mo'omo'onui, and Mo'omo'oiki; a fourth gulch, Papa'auha, is the northern boundary. These gulches presently do not have permanent flows but run with sufficient rainfall. In general, the gulches are densely vegetated and relatively narrow with steep sides.

Vegetation in the project area is dominated by pangola (*Digitaria pentzii*) pasture grass. The gulches and vegetation clumps contain Christmas-berry, lantana, banyan, java plum, guava and other introduced species. There are also native plants, such as kukui nut and breadfruit trees.

B. Cultural Setting

The Hana area is considered one of Hawai'i's *wahi pana* ("legendary places") as there are many important legendary and traditional accounts specific to Hana. Recent historical and archaeological studies done in the Hana area have summarized much of this information. These include studies by Lynn Nakkim (1970), Inez Ashdown (1971), Paul Cleghorn and Kathie Rogers (1987), and Agnes Griffin (1987). These works are based on original sources such as Abraham Fornander (1880, 1979), Thomas Thrum's Annuals (1909-1918), Martha Beckwith (1970), Samuel M. Kamaka (1961), and Elspeth Sterling (n.d.). The earliest compilation of much of this material appears in Winslow Walker's manuscript (1931) of the Maui Island survey he conducted in the late 1920s.

The bulk of this material is not retold here and the reader is referred to sources mentioned above. The following is an overview of the general types of information associated with the legends and traditional accounts concerning the Hana area and credit is given to the authors already mentioned above.

1. Legendary Accounts

Legendary references, for the most, concern geomorphological features such as Pu'u Ka'uiki and the *pu'u*, Ka Iwi o Pele. One legendary account concerning the creation of Pu'u Ka'uiki tells of a sister of the goddess Pele, Pu'uhele (wandering hill), being left behind at Hana, becoming Ka'uiki Hill. In another Pu'uhele is killed and Ka'uiki rises from the burial place.

Ka Iwi o Pele (the bones of Pele), the hill or *pu'u* across (east) Hana Highway

from the project area, also has a number of origin legends. One relates that Pele was driven from her original homeland by one of her sisters, Namakaokahai, for having a love affair with her brother-in-law. Pele is pursued by Namakaokahai and killed: her physical remains form the hill of Ka Iwi o Pele. Another legend relates that Pele, looking for a home, pauses at each of the Hawaiian Islands and, while at Haleakalā, creates various parts of Maui including Ka Iwi o Pele and 'Ālau Island just off the coast.

Another type of legend concerns the many fishing-related activities, such as fishpond building and fishhook and octopus lure-making, which were taught to humans by Kū'ula and his son 'Ai'ai. In one account Kū'ula, a legendary resident of Hana, builds Hawaii's first fishpond at the base of Ka Iwi o Pele. However, a chief of Hana becomes angry with Kū'ula who escapes, along with his wife, to the sea where they turn into fish. It is left up to Kū'ula's son 'Ai'ai to travel the islands and teach humans Kū'ula's techniques as well as how to worship Kū'ula. Fishing shrines or *ko'a* found on all the islands contain Kū'ula stones, which are usually oblong water-rounded boulders. The *Ko'a Ku'ula* are stone altars or houses for rites to attract and cause fish to multiply and to ensure a good catch (Kawaharada, 1992:6).

Though these legendary accounts are not specific to the project area, they refer to Ka Iwi o Pele and Lehoula Fishpond (Kū'ula's pond) in the *ahupua'a* of Aleamai, which are parts of the State Site Complex 50-50-13-573 situated *makai* of Hana Highway adjacent to the study area. In general, the legendary source material confirms the importance of the Hana area during Hawai'i's pre-contact (pre- 1776) period.

2. Traditional Accounts

Traditional accounts concerning the Hana area focus mainly on armed strife between Hawai'i Island and Maui Island. Pu'u Ka'uiki is the pivotal point in these accounts. The top of Ka'uiki was made into a defensive fortress where the defenders of Hana, whether Maui or Hawai'i forces, could withstand long-term sieges. Ka'uiki was reported to have been fortified sometime in "the 12th Century with the building of two war *heiau*, Honualua and Kaiawali, both now destroyed (Sterling, n.d.;Fornander, 1969;39)" (Rogers, 1987:8).

The next major account concerning Ka'uiki has to do with the Chief Pi'ilani, who united all of Maui under his rule during the 16th or 17th century. Pi'ilani's sons Lonopi'ilani and Kiha-a-Pi'ilani fought over control of Maui with Kiha-a-Pi'ilani, eventually taking refuge at Hana. While in Hana, Kiha-a-Pi'ilani took as his wife Koleamoku, who had been betrothed to Lonopi'ilani, which again put the two brothers to warring. Kiha-a-Pi'ilani and his wife Koleamoku fled to Hawai'i Island to enlist the aid of Umi. Umi was married to Pi'ikea, the daughter of Pi'ilani (sister of Lonopi'ilani and Kiha-a-Pi'ilani), a marriage which had formerly brought peace between the islands of Hawai'i and Maui. However, Umi sided with Kiha-a-Pi'ilani and sent an invasion fleet to Hana. In Hana, at Ka'uiki, Lonopi'ilani's forces, under the command of Ho'olaemakua, withstood the Hawai'i forces for a while until a nighttime raid overwhelmed the Maui forces. With this battle Kiha-a-Pi'ilani gained control of Maui. Kiha-a-Pi'ilani "is credited with finishing the paved road around the island (Ke Alaloa o Maui), which his father (Pi'ilani) had begun ... and restoring

Honua'ula *heiau* just inland of Pu'u Ka'uiki" (*Ibid*, 1987:9).

During the last half of the 18th century the battles between Maui and Hawai'i were carried on by the high chiefs Kahekili of Maui and Kalani'ōpu'u of Hawai'i. Kalani'ōpu'u was in control of the Hana and Kipahulu areas from ca. 1759 to 1765 when Kahekili won out. However, the Hawai'i forces were able to regain control from ca. 1775 to 1783. In 1778, when Capt. James Cook's ships returned from their North American explorations, they stopped off Hana but didn't land. Kalani'ōpu'u and Kamehameha both visited Cook's ships, indicating who controlled the Hana area. With the death of Kalani'ōpu'u in 1782, Kahekili regained control of Hana, which he retained, though not without further battles with Hawai'i Island forces (i.e. Kamehameha), until his death in 1794. With the death of Kahekili and the assistance of newly acquired foreign power (canons, muskets, men) Kamehameha gained control not only of Maui, but of all the Hawaiian Islands, except Kaua'i, by 1795.

This brief overview of legendary and traditional accounts indicates the particular importance attributed to Hana during Hawaiian times. The accounts do not specifically state but do suggest that the productivity of the Hana area, in terms of food resources, is the main reason for its desirability. The productivity of the ocean, enhanced by fishponds, allowed direct access to fish protein for the chiefly class (*ali'i*) while residing in Hana. The relatively gentle slope of the Hana plain, having fertile volcanic soils combined with up to 80 inches of rain per year, probably reduced the need for labor-intensive irrigation, while still supplying abundant vegetable resources. The combination of ocean and terrestrial food sources would probably have made Hana one of the richer resource areas within all the Hawaiian Islands.

3. Historic Period

The project area spans from south to north the traditional land units, or *ahupua'a*, of Haneo'o, 'Aleamai, and Papa'auhau (or Pā'auhau). During the Mahele period, or mid-1800s, land tenure changed from traditional use rights to private ownership. The majority of Haneo'o was awarded to Julia Alapai, in Land Commission Award (LCA) 8525-B to Kauwa (family name) which included some 874 acres. The bulk of 'Aleamai was awarded to Kaleimakali'i in LCA 8660 for 1,093 acres. No *ahupua'a* award for Papa'auhau could be located; however, as in the other *ahupua'a*, individual lots or *kuleana* were awarded within its boundaries.

The *kuleana* awards (from south to north) within the project area with information gleaned from archival sources are presented below:

LCA	Name	Ahupua'a	Acreage	Usage
2865	Puau	Haneo'o	No data (n.d.)	n.d.
4670B	Kamule	Haneo'o	7.90	n.d.
4838	Kaihe	'Aleamai	14.18	n.d.
4937	Poohina	'Aleamai	3.13	n.d.
4836	Kaikaina	'Aleamai	7.65	kalo patch
4835	Kamaikaaloa	'Aleamai	3.70	n.d.
4933	Mahu	'Aleamai	2.80/or 3.5	n.d.
3038	Kaleleike	'Aleamai	2.56	n.d.
4930	Napuanui	'Aleamai	5.31	n.d but hala & sweet potato patch adjacent

LCA	Name	Ahupua'a	Acreage	Usage
4934	Manu	'Aleamai	2.10	n.d.
4940	Papua'a	'Aleamai	5.16	n.d.
4941	Huluhulu	'Aleamai	2.10 or 14.10	n.d.
4942	Kikoo	'Aleamai/Mooiki	5.10	n.d.
5178	Kapule	Papahau 3	21.00	n.d.

For the most part, land use information is absent from the archival sources. However, there is some usage information that indicates traditional subsistence crops of sweet potatoes and taro were being grown within the project area in 1852 when the bulk of the awards was recorded. The archival source material includes other information that could be the basis for further research. This information includes, in part, names of *konohiki*(s), name of the transcriber (the missionary Condé), specific place names, and who the claimant received the land from.

The general absence of usage data, especially residential information, is somewhat unusual, thus making interpretations of the mid-1800 settlement pattern for the project area tenuous. However, based on a number of factors - including sizes of claims and the fact that generally single, not multiple, claims were made - it is inferred that the claimants both lived and farmed on their single LCA award. The LCA patterning as shown in Fig. 5, a 1894 plantation map, also suggests that the mid-1800s habitation zone was relatively narrow, generally within a half mile of the coast. The map shows what apparently was a structure, possibly a house, within LCA 4835 (to Kamaikaaloa) as the only one within the entire project area at that time.

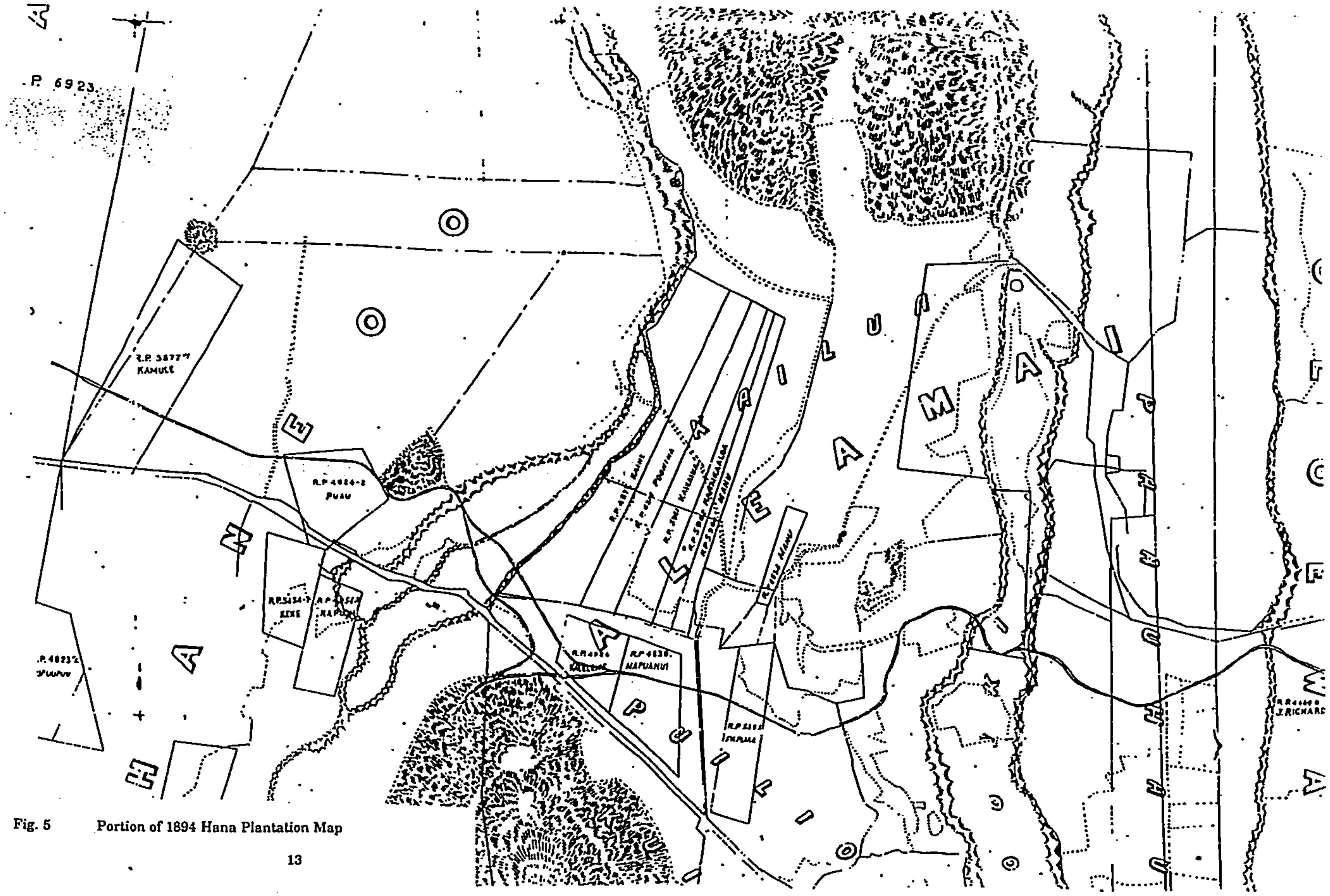


Fig. 5 Portion of 1894 Hana Plantation Map

Sugar Industry

The sugar industry began in the Hana area about the same time as the Mahele was taking place (ca. 1850). Sugar was an indigenous crop but small-scale commercial harvesting of the crop began in the mid-1800s. Hana was one of the earliest locales to become involved in commercial cane operations in "1849 or 1850, when a Mr. Lindgren cultivated 60 acres of cane and ground it with a mill erected in a grass shack" (Condé and Best, 1973:247). This grass shack mill was reported to be in the Haneo'o-Hāmoa flats *makai* of the Hana Highway. In 1861 August Unna gained control of these and other sugar plantation lands and began two decades of land consolidation and improvements including the building of the plantation railroad. During this early period (ca. 1850s-1880s) of commercialization, small farmers apparently raised cane crops within LCAs and grants (Fig. 6), then sold the cane to the mills. The 1894 plantation map (refer to Fig. 5) shows an extensive wall system that probably relates to this early era cane farming by individuals as well as cattle ranching on a similarly small scale. However, by the end of the century, Hana Plantation had taken over large tracts of land and the little farmers disappeared as did most of the remains associated with this era.

The 1894 plantation map also indicates the expansion of Hana Plantation after a Mr. Grinbaum purchased in 1889 "the Hana lands and [combined] them with the lands of the old Reciprocity Plantation and some lands at Hāmoa, [forming] the Hana Plantation Company" (*Ibid.*:248).

The plantation continued to mechanize throughout the early 1900s when Theo H. Davies and Co. assumed ownership from Grinbaum. The plantation name changed to Kaeleku Sugar Co. with the Theo H. Davies acquisition It was during

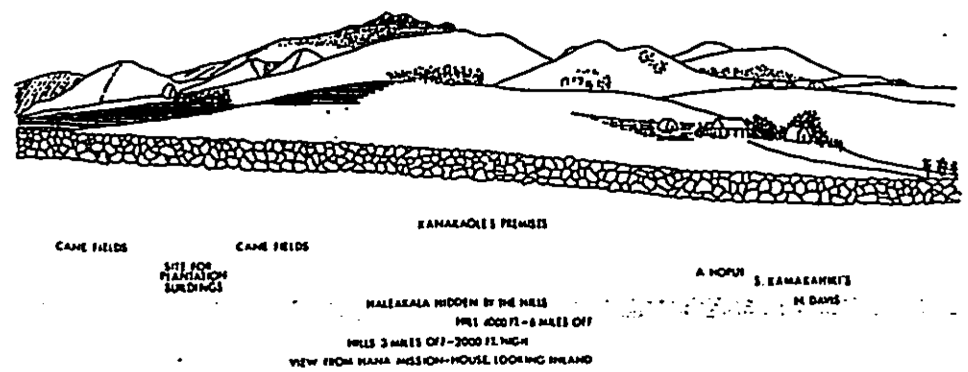


Fig. 6 1862-65 Drawing by Serano Bishop, Traced by Rodney Chiogioji the Theo H. Davies control that the virtual disappearance of former features took place. A plantation map dated 1917 (Fig. 7) shows the former LCAs and related acreage of LCAs planted in cane. It is also shows "waste area(s)" that are rock piles which can be related to the former wall system (shown on the 1894 map: Fig. 6) and to some LCAs. The use of natural bedrock outcrops, ledges, gulch edges and lava flow edges to pile excess rocks is an observable pattern of past land utilization, especially of the commercial sugar cane era. Commercial sugar plantation activities in general concentrate rocks from field clearing into larger and larger rock piles. Additionally, these rock piles contain rocks that by their size alone indicate use of mechanical power in their displacement and subsequent relocation to rock consolidation piles. These piles were informally maintained, i.e., faced up, so that they would cover less area and keep loose rocks out of the fields. Some of these rock piles or "waste areas" are designated as archaeological sites (see Site Description section).

In 1933, the ownership of the plantation changed to C. Brewer & Co. By 1945 the plantation closed and was liquidated (Condé and Best, 1973:242).

The 14,000 or so acres of Hana Plantation were bought up in 1946 by Paul Fagan, who had previously owned Pu'u o Hoku Ranch on Moloka'i as well as Maunawili Ranch on O'ahu. Fagan converted the plantation to a cattle ranch and began Hotel Hana Maui. The conversion from sugar to pasture lands was done for the most part by the cattle themselves. Cattle were put in the abandoned cane fields to graze, thus destroying the cane (personal communication John Hanchett, Jr.). Pasturage was improved over the years through use of a variety of grasses, including pangola which now dominates.

Fig. 7 Portion of 1917 Kaeleku Plantation Map, White Blotches are Rock Piles, or Waste Land

There was a portion of the project area within Haneo'o *ahupua'a* that informants Clifford Hashimoto and John Hanchett, Jr. indicated was likely not put into commercial sugar plantation activities. It was a place where people from Haneo'o-Hāmoa grew sweet potatoes, dry land taro, and other crops. Lynn Nakkim confirms this, stating: "Families from the Hāmoa Beach area (coastal micro-environment) raised dry taro in the same fields, with some of them raising sweet potatoes in the Haneo'o lands just north of the Hāmoa Ahupua'a as well" (Nakkim, personal communication: 1970:109). The area was cleared by the ranch in the early 1960s (Nakkim, 1970; Hanchett personal communication) at which time the bulldozer created numerous piles and linear mounds (Hanchett). This area includes the southern portion of the present project area where Sites 2721 to 2733, 2740 and 2743 are located. Included in this portion of the project area are a number of large platforms, at least one of which was a water tank foundation (Site 2731, Per Comm. J. Hanchett, Jr.). The other platforms are possible foundations of a cane flume that traversed the area (Fig. 8) during the sugar era or large clearing mounds. The soil type in this area is Hana series extremely stony silty clay loam (Foote et al.). It's stoniness may have forced the sugar company to adopt a planting technique where not all areas were utilized. The area contains evidence of both commercial cane cultivation and smaller scale supplemental subsistence farming as mentioned above. The cane cultivation is evidenced by open pasture areas with many narrow soil terraces of former sugar cane rows. The supplemental subsistence farming is evidenced by modified rocky outcrops and vegetation clumps which contains sites like 2722.

Presently, the entire project area is utilized as cattle pasturage. Cattle

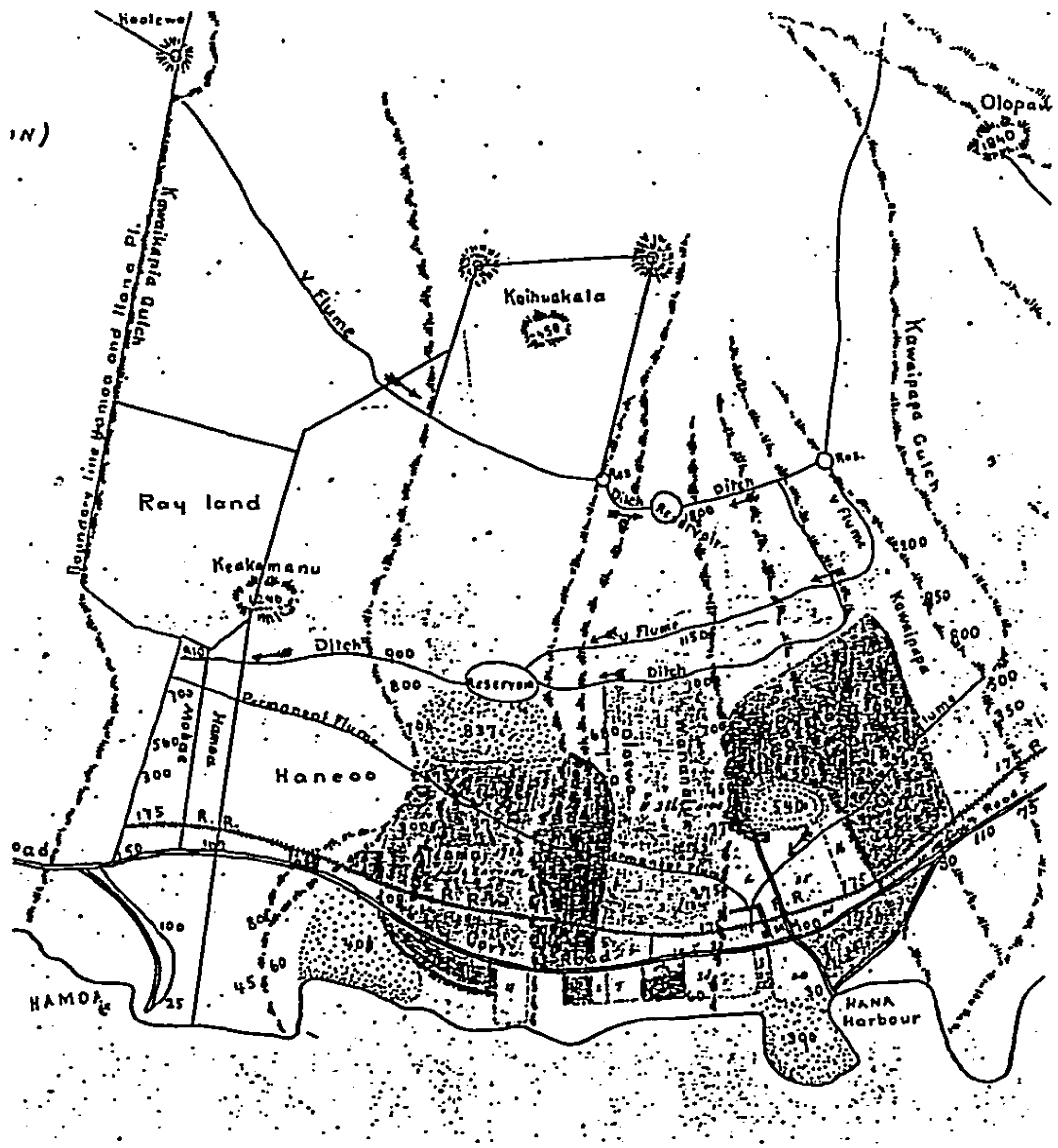


Fig. 8 Portion of 1907-1909 Kaeleku Plantation Map, Showing Cultivated Areas of the Early 1900s

management has also changed over time and now electric fences are utilized extensively. Cattle are moved nearly daily from one adjoining pasture to another to maximize grazing productivity. This new management technique within the project area has created a few new bulldozer tracks related to building fences. In the Haneo'o area this new bulldozing has turned up a few indigenous artifacts (Hanchett) in areas not formerly impacted by commercial sugar plantation activities.

The historical overview clearly indicates that the pasture vistas characterizing modern Hana are the result of commercial sugar cane operations followed by cattle ranching. The sugar plantation operations evolved from small farms within LCAs and grants, and eventually culminated in Hana/Kaeleku Plantation which included some 14,000 acres.

The settlement pattern, from time of contact (1778) to the present, has been altered most significantly by sugar cane plantation development. The mid-1800s Land Commission Awards testimonies and register documents indicate the settlement pattern at contact and into the mid-1800s was one of dispersed households living and farming within a relatively narrow coastal zone (0-600 ft. a.m.s.l.). This seme coastal zone continues to be the focus of land utilization, however the population became concentrated around the mill and port of Hana. The settlement pattern thus became one where the habitation was concentrated and the majority of the remaining coastal zone lands were put to commercial agricultural usage.

III. Previous Archaeology

There have been a number of archaeological surveys with specific references to the project area. These include Walker (1931); Nakkim (1970); State Survey (1973); and Cleghorn and Rogers (1987).

The earliest work, by Winslow Walker (1931), is an island-wide (Maui) survey conducted in 1928 and 29. This survey focused on major archaeological sites including *heiau*, fishponds, and intact village sites. The single site Walker recorded within the project area was *Heiau* Site 117, Koahaepali. Walker also listed four other *heiau* sites (113-116) in proximity to the project area, but referred to them as already destroyed by sugar cane operations. The names of these other *heiau* (Kaikaiea, Kilinui, Lanakila and Pu'uhe'ewale) were recorded in Thomas G. Thrum's "Maui's Heiau and Heiau Sites Revised" (1917:52-61). However, the very general location information and sometimes contradictory information makes pinpointing the former locations tenuous at best. Walker's description of Site 117, Koahaepali, corresponds well with what was observed in the field during the present survey, indicating no essential change since 1930 (see Site 117 description). Based on Thrum's list(s) and his own survey, Walker recorded some 18 *heiau* sites from the Hana Bay area south to Hāmoa *ahupua'a*.

Lynn Nakkim's (1969-1970) survey of the Hana area was broader in scope and constituted a general or reconnaissance level surface survey. This survey recorded some six sites within the present project area. (These sites correspond to our Sites 2721, 2723, 2731, 2738 and 2743 of the present survey). Nakkim recorded another site, just *makai* of the project area, that corresponds to State site # 50-50-13-522 (paved enclosure). Nakkim described the sites within the project area as relating to historic agriculture of sweet potatoes, breadfruit, and dry land taro. Her report also included environmental, historical, and oral history information concerning the Hana area. In all there were 66 sites described, in varied detail, from the Ulaino *ahupua'a*, in the north to Pu'uiki *ahupua'a* in the south.

The state-sponsored survey conducted in the early 1970s essentially relocated previously described sites. This included *heiau* site 117 within our project area. A brass washer, imprinted with "117" was noted in the present study in a cupboard in the *heiau*. The State File folder for site 50-50-13-117 is located at the State Historic Preservation Office and includes Winslow Walker's basic information.

The Bishop Museum conducted preliminary archaeological and historic investigations of "Hana Ranch Lands" (Cleghorn and Rogers, 1987) in the early part of 1987. Kathie Rogers conducted the historical research. The archaeological research included compilation of a list of known sites, analysis of aerial photographs and a brief field inspection. Paul Cleghorn notes: "The analysis of aerial photographs proved to be quite productive" (*Ibid*:13). Combined with aerial photographic analysis, field inspection located and briefly described four site areas within the present subject parcel. These site areas include T7, T14, T15, and T16. These site areas generally correspond to sites of the present survey as follows: T7 = 2734, 2740; T14 = 2718 (A,B,C); T15 = 2719, and T16 = 2721-2731. Site T7 refers to historical agricultural-feature remnants in pasture lands; T14 refers to cave shelters adjacent to Hana

Highway; T15 is an L-shaped Wall on a *pu'u* next to Hana Highway; and T16 refers to historic agriculture and water tank foundations in the southwest corner of the project area.

In general, this aerial photographic survey was very helpful in predicting site locations and site types. This survey, like Nakkim's survey, indicated the existence of remnant-type agricultural features scattered throughout Hana Ranch. Prior to these surveys most of the archaeology of Hana was associated with *heiau* structures. Generally absent from the Hana archaeological record are quantitative dates, because of the lack of subsurface investigation.

IV. Survey Results

A. Methods

This project involved archaeological survey of approximately 400 acres of Hana Ranch pasture lands within which the smaller (200-acre) petition area is situated. Survey methods included use of a 1990 color aerial photograph at a scale of 1" = 500 ft. to predict possible site areas, as well as to plot located sites. Ground coverage was done on foot with archaeologists spaced generally 15 meters apart in vegetated areas, and up to 35 meters apart in the wide-open pasture areas.

The sites located were given temporary field numbers and flagged with yellow surveyor's tape. There was a total of 55 field numbers utilized which included some individual features of sites. Subsequent to the fieldwork, 51 sites were given State site numbers. In this process individual features that were part of a single site were assigned alphabetical designation following the state numbers. Temporary and State site numbers along with description, probable age, significance and tentative recommendations are presented in Table 1. Table 2 listed all sites within the petition area.

During the survey it became apparent that virtually all of the archaeological sites observed had been heavily impacted by commercial sugar plantation and ranching activities. There were numerous rock piles and linear mounds and decisions were made as to whether these features represented actual site remnants or were just rock consolidation piles caused by the aforementioned activities.

Thus, to be designated a site, certain minimal criteria were utilized. These included: facings on walls or terraces, presence of artifacts, midden, or manuports and size of rocks present. However, the presence of facing on certain rock piles is clearly related to commercial sugar plantation activities of clearing rocks from the edges of fields. Sites were explored for surface artifacts and/or midden and their presence is noted within individual site descriptions.

The presence of certain manuports, especially large water-rounded boulders, was utilized in attempting to affix probable age determinations. The Hana area, specifically Aleamai *ahupua'a*, is the legendary home of Kū'ula. The worship of Kū'ula is associated with water-rounded stones from the ocean. Observed during this survey were a number of large ocean (non-stream) rounded boulders termed "rollers." It was thus postulated that sites or site remnants that contained rollers or Kū'ula stones may be pre-contact sites. Sites that contained these stones included Koahaepali *heiau* (Site 117), 2711, 2712, 2747, and 2853. All of these sites are suggested to be pre-contact sites, except for 2747 which is tentatively listed as a possibly historic site based upon its location within Land Commission Award (3037 to Kaleleike). It is suggested that Kū'ula stones were present at a number of habitation sites that have since been destroyed by commercial sugar plantation activities with the rollers being displaced. However, based on our observation, certain site remnants still contain these stones and thus are, in the least, indicators of former site areas. This pattern of Kū'ula stones at habitation sites appears to be unique to the Hana area of Hawaii.

B. Site Summary Quantifications for Table 1

The functions and probable ages of sites were based on field observations, historical research, informant information, and subsurface testing (Table 1). There are 3 sites of probable historic age and 19 of probable prehistoric age. One site, Lava Tube Site 2732, which appeared to be recently broken open by modern electric fence corridor clearing and contained no artifactual, midden or manuport materials, is listed as "non-cultural."

The historic age designation includes two (2) probable habitation site remnants that may have been related to LCAs within the project area. These sites include 2747 and 2749. The remaining 29 sites of probably historic age have a probable agricultural function designation. Of these, 16 relate to farming of dryland taro and sweet potatoes that took place until at least the 1930s. The 13 remaining historic agricultural sites relate to sugar plantation or cattle operations.

The 19 probable prehistoric sites include religious, agricultural and habitation sites. Site 117, Koahaepali *heiau*, does contain historic-era artifacts but, based on the 1930s *heiau* designation by W. Walker, it continues to be designated prehistoric. Sites 2711, 2712, 2735 are remnant-type features but based on surface remains and manuports present they are designated as probable habitation sites. Additionally, sites 2711 and 2712 were subjected to limited sub-surface testing which confirmed the probable prehistoric age determinations. Sites 2737, 2739, and 2741 contain features of both agricultural and habitational function. Site 2719, an L-shaped wall, is listed as prehistoric based on wall construction style but assigning a specific function is difficult. It is described as a possible shelter or defensive position.

Table 1: Hana Ranch Site Summary with Tentative Recommendations

Significance Codes are explained below the table

State Site 50-50-13-	CSH #	Description (Probable Type)	Function	Probable Age	Significance	Tentative Recommendations
117	11	*heiau*	Religious	Prehistoric/ Historic	D,E	Preserve
2710	1,2,6, 8	Walls, Enclosure	Ag	Historic	D	Hist. Research Data Recovery
2711	4	Terrace Remnant	Habitation	Prehistoric	D	Preserve
2712	5	Terrace/ Mound/ Remnant	Habitation	Pre-historic	D	Preserve
2713	9	Terrace Remnant	Ag	Historic	D	Data Recovery
2714	10	Wall	Ag	Historic	D	Hist. Research Preserve
2715	12	Terrace Remnant	Habitation	Prehistoric	D	Preserve
2716	13	Terrace Remnant	Ag	Historic	D	Data Recovery
2717	14	Cave shelters	Habitation	Prehistoric	D	Data Recovery
2718	15	Cave Shelters	Habitation	Historic	D	Preserve
2719	16	Wall	Ind.	Pre-historic	D	Preserve
2720	17	Platform	Ag	Historic	D	Preserve
2721	18	Platform/ Terraces	Ag	Historic	NLS	No further work
2722	19	Platform/ Enclosure	Ag	Historic	D	Hist. Research Preserve
2723	20	Platform/ Enclosure	Ag	Historic	D	Hist. Research Data Recovery
2724	21	Walls/Mounds	Ag	Historic	D	Data Recovery
2725	22	Mound	Ag	Historic	D	Data Recovery
2726	23	Platform	Ag	Historic	D	Data Recovery
2727	24	Mound/Walls	Ag	Historic	NLS	No further work

State Site 50-50-13-	CSH #	Description (Probable Type)	Func-tion	Probable Age	Signi-fi-cance	Tentative Recom-mendations
2728	25	Platform	Ag	Historic	NLS	No further work
2729	26	Platform/Enc-losure/Terraces	Ag	Historic	D	Data Recovery
2730	27	Enclosure	Habi-tation	Pre- histor-ic	C,D	Preserve
2731	28	Platform	water tank foun-dation	Historic	C,D	Preserve
2732	29	Lava tube	Non-cultural		NLS	
2733	30	Modified Outcrop	Ag	Historic	D	Data Recovery
2734	31	Terrace	Ag	Historic	D	Hist. Research Data Recovery
2735	32	Wall/Pavement/ Remnants	Habi-tation	Pre- histor-ic	D	Preserve
2736	33	Enclosure/Ter-race	Ag	Historic	D	Preserve
2737	34	Terraces/Pits/ Wall	Ag	Pre- histor-ic	D	Preserve
2738	35	Terrace Remnants	Ag	Historic	D	Preserve
2739	36	Enclosure	Habi-tation / Ag	Pre- His-toric	D	Preserve
2740	37	Terrace Remnants	Ag	Historic	D	Preserve
2741	38	Enclosures/ Terrace	Ag	Pre- His-toric	D	Preserve
2742	39	Railroad grade		Historic	ABCD	Selective Pre-servation
2743	40	Terraces/Align-ments/Shelters	Ag/ Habi-tation	Historic	D	Data Recovery
2744	41	Wall	Ag Bound-ary	Historic	D	Hist. Research Selec. Preservation

State Site 50-50-13-	CSH #	Description (Probable Type)	Func-tion	Probable Age	Signi-fi-cance	Tentative Recom-mendations
2745	42	Wall/Terraces/ Mounds	Ag/Ha-bitation / Burials	Pre- His-toric	D,E	Preserve
2746	43	Roadway system		Historic	A,D	Selective Pre-servation
2747	44	Mound	Habi-tation	Historic	D	Data Recovery
2748	45	Wall Remnant	Ag	Historic	NLS	No further work
2749	46	Enclosure/ Terraces	Ag	Historic	D	Data Recovery
2750	47	Wall Remnant	Ag	Historic	NLS	No further work
2751	48	Terrace Remnant	Ag	Historic	NLS	No further work
2851	49	Platform/Ter-race	Ag	Pre- histor-ic	D	Data Recovery
2852	50	Terrace/ Paving	Ag/ Habitati on	Pre- histor-ic	D	Data Recovery
2853	117A	Terrace	Ag	Pre- histor-ic	D	Data Recovery
2854	52	Walls/ Enclosure	Ag	Pre- histor-ic	D	Data Recovery
2855	53	Enclosure	Ag	Pre- histor-ic	D	Data Recovery
2856	54	Platform	Burial	Pre- histor-ic	D,E	Preserve
2857	117B	Terrace/Rem-nants	Ag	Historic	NLS	No further work
2858	56	Enclosure/Rem-nant	Habi-tation	Pre- histor-ic	D	Data Recovery

CODES FOR CRITERIA FOR SITE SIGNIFICANCE

A Site reflects major trends or events in the history of the state or nation.

B Site is associated with the lives of persons significant in our past.

C — Site is an excellent example of a site type.

D — Site may be likely to yield information important in prehistory or history.

E — Site has cultural significance; probable religious structures (shrines, *heiau*) and/or burials present.

....

NL3 — No Longer Significant

Table 2: Archaeological Sites Within Proposed Petition Area

State Site 50-50-13-	CSH #	Description (Probable Type)	Function	Probable Age	Significance	Tentative Recommendations
2710	1,2,6, 8	Walls, Enclosure	Ag	Historic	D	Hist. Research Data Recovery
2711	4	Terrace Remnant	Habitation	Prehistoric	D	Preserve
2712	5	Terrace/ Mound/ Remnant	Habitation	Prehistoric	D	Preserve
2713	9	Terrace Remnant	Ag	Historic	D	Data Recovery
2714	10	Wall	Ag	Historic	D	Hist. Research Preserve
2715	12	Terrace Remnant	Habitation	Prehistoric	D	Preserve
2716	13	Terrace Remnant	Ag	Historic	D	Data Recovery
2721	18	Platform/Terraces	Ag	Historic	NLS	No further work
2722	19	Platform/Enclosure	Ag	Historic	D	Hist. Research Preserve
2723	20	Platform/Enclosure	Ag	Historic	D	Hist. Research Preserve
2724	21	Walls/Mounds	Ag	Historic	D	Data Recovery
2725	22	Mound	Ag	Historic	D	Data Recovery

State Site 50-50-13-	CSH #	Description (Probable Type)	Function	Probable Age	Significance	Tentative Recommendations
2726	23	Platform	Ag	Historic	D	Data Recovery
2727	24	Mound/Walls	Ag	Historic	NLS	No further work
2728	25	Platform	Ag	Historic	NLS	No further work
2734	31	Terrace	Ag	Historic	D	Hist. Research Data Recovery
2742	39	Rairoad grade		Historic	ABCD	Selective Preservation
2743	40	Terraces/Alignments/Shelters	Ag/ Habitation	Historic	D	Data Recovery
2744	41	Wall	Ag Boundary	Historic	D	Hist. Research Selec. Preservation
2746	43	Roadway system		Historic	A,D	Selective Preservation
2749	46	Enclosure/ Terraces	Habitation/ Ag	Historic	D	Data Recovery
2853	117A	Terrace	Ag	Prehistoric	D	Data Recovery
2857	117B	Terrace/Remnants	Ag	Historic	NLS	No further work

B. Site Descriptions

State Site #:	50-50-13-117	**CSH Site #: 117**
Site Type:	Platform/Terraces	
Function:	Religious	
Probable Age:	Prehistoric	
Condition:	Fair to Good	
Dimensions:	Including the entire vegetated area covers an area of approximately 91.4 m. (300') by 106.7 m. (350')	

Description: Site 117 (Figures 9 & 10) correlates to Koahaepali Heiau previously recorded by Winslow Walker in 1930. The *heiau* is situated on the top edge of a steep rocky vegetated slope. The *heiau* structure has an L-shaped paved area which measures roughly 18 m. (59') north/south by 21 m. (69') east/west. The rock-paved area is generally 9 m. (29.5') wide and is of boulder and cobble construction. There is a well-built cupboard in the NE corner of the paved area. The rock-paved area is retained on the north and east sides by walls that range in height from 1.5 m. (5') up to 4 m. (13'). The best remaining facing is at the northeast corner of the paved area. Adjoining the paved area on the north side is a large level soil area. This soil area measures 11 m. (36') N/S by 23 m. (75.5') E/W. The soil area is retained on the north and east sides by a discontinuous terrace wall. The wall which runs along a natural break in slope continues to the north where it becomes more substantial and is designated Site 2714. The soil area may well be historic in nature as Winslow Walker does not mention it as part of Koahaepali Heiau. Attached to the southeast portion of the *heiau* is a small rectangular enclosure. The enclosure measures 2m. (6.5') by 3.5 m. (11.5') with wall heights up to 1.5 m. (5'). The site has been impacted by sugar cane operations. The present extent of the paved area appears to be altered by bulldozing. In general, the western and southern extents of this site have been heavily impacted. Thus, the full extent of this site is difficult to accurately delineate. Based on field observations, the actual site area, not including the minimally modified steep slope on the *makai* (east) side of the paved area, is roughly 70 m. (200') N/S by 38 m. (125').

Test Results

Two test units were excavated in association with Site 117. Test Unit 1 was excavated within the cupboard feature in the paved area and Test Unit 2 was excavated in the SE enclosure.

Test Unit 1, in the cupboard, contained a portion of an old wire-type metal fishhook (shank portion), a basalt adz, a few basalt flakes, ceramic fragments and a waterworn cobble. Midden consisted of fairly abundant mammal bone, a pig tooth, and a few fragments of marine shell (cowrie, opihi, pipipi). There was a total of 15 cm. of soil at the base of the cupboard. Enough charcoal was present for a C14 sample; however, because it was mixed with historic era artifacts it was not submitted for analysis.

Test Unit 2, in the enclosure, contained ceramic fragments (6 pcs) representing parts of a blue on white china bowl. There were also indigenous artifacts, consisting of

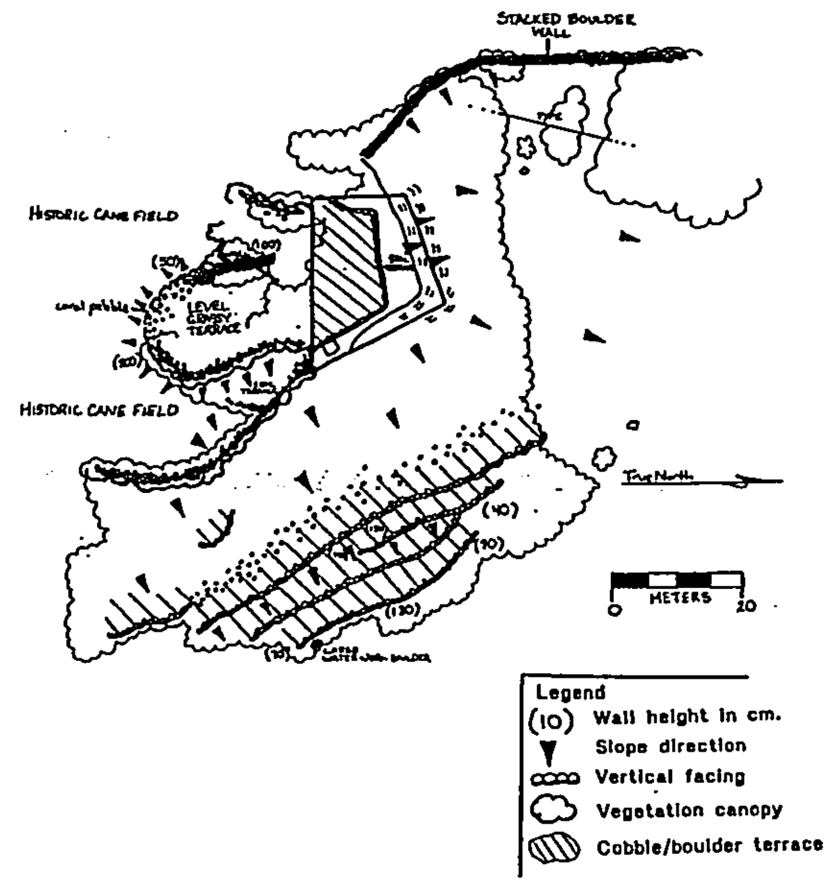


Fig. 9 Site 50-50-13-117. Plan View

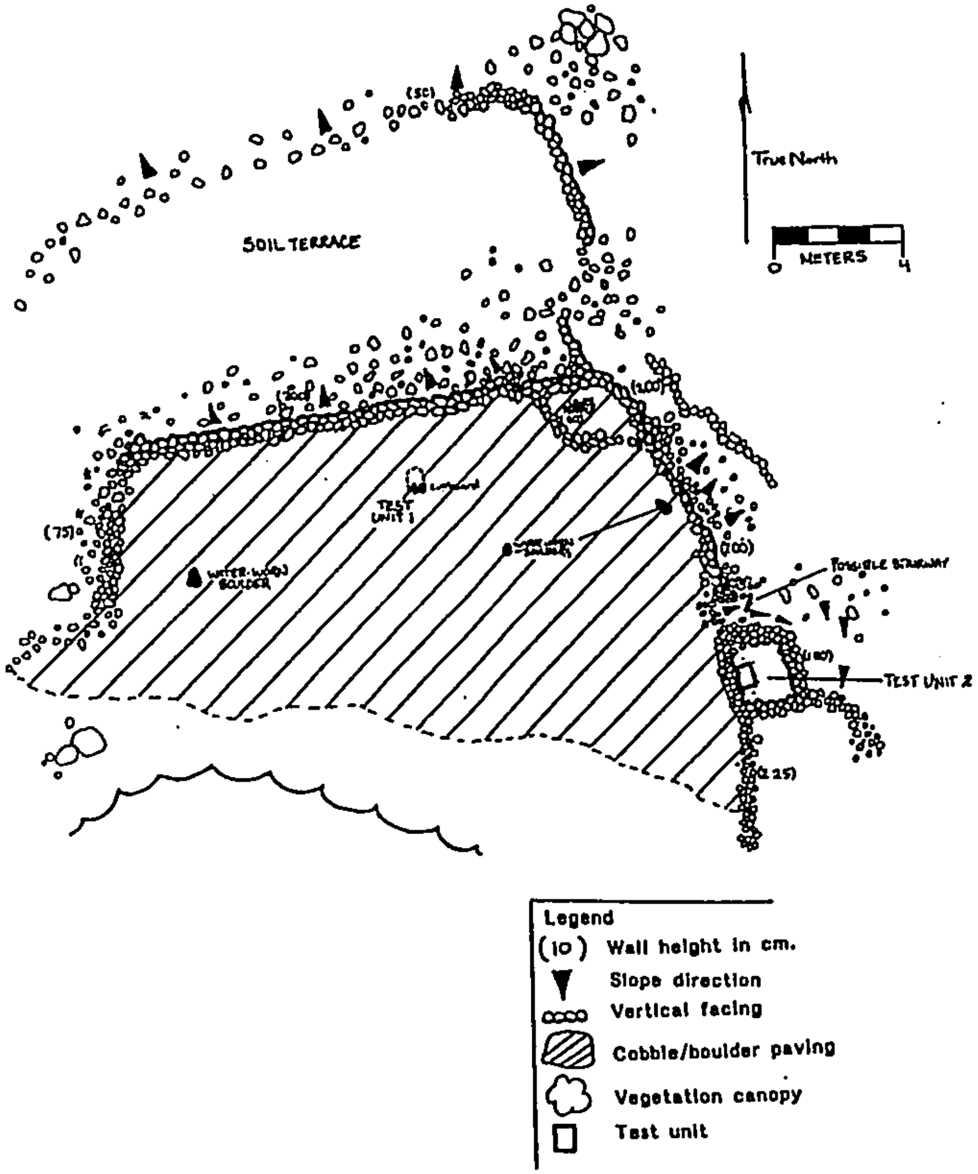


Fig. 10 Site 50-50-13-117. Plan View of Central Platform

basalt hammerstones (2), basalt flakes (3), and a waterworn pebble. There was only 1 gram of midden, consisting of unidentified marine shell.

The excavations suggest historic residential use of this site. However, the relatively small amount of recovered material could well represent occasional use by sugar cane workers. The presence of historic-era artifacts does not in and of itself mean Site 117 is not a *heiau*. Further research, both historical and archaeological, will help clarify usage at Site 117.

State Site #: 50-50-13-2710
Site Type: Enclosure
Function: Agricultural
Probable Age: Historic
Condition: Good to Remnant
Dimensions: Approx. 274.3 m. (900') x 762 m. (2,500')

Description: Site 2710 presently consists of discontinuous wali sections, associated enclosures, terraces and mounds. During the archaeological survey, these features were given separate field numbers. However, during the background research an old Hana Plantation map clearly showed that these features were at one time connected. They apparently created a larger enclosure where cane was cultivated, possibly relating to Grant 1656, with the walls probably serving for cattle exclusion. The different features which comprise this large enclosure are described as Features A, B, C, D, E and F.

State Site #: 50-50-13-2710A **CSH Site #:** 1
Site Type: Wall/Enclosure
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: (in Description)

Description: Feature 2710A is a wall remnant constructed of stacked cobbles and boulders. The one remaining faced section of the wall measures 7 m. (22.9') long by 0.25-0.5 m. (0.8-1.6') wide with a maximum height of 0.5 m. (1.6'). The wall follows the natural contour of the terrain in *makai* and *mauka* directions from the remaining faced section.

No artifacts or midden were observed at the feature

State Site #:	50-50-13-2710B
Site Type:	Wall
Function:	Agricultural/Boundary wall
Probable Age:	Historic
Condition:	Fair - good
Dimensions:	(in Description)

CSH Site #: 2

Description: Feature 2710B is a stacked boulder wall retaining the south slope of an unnamed gulch (probably Pa'auhau) located along the northern boundary of the project area. The wall stands a maximum 1.5 m. (5') high and ranges from 0.25 m. (0.8 ') to 0.8 m. (2.6 ') wide. Vertical facings limited to wall sections running through lower areas of the gulch suggest that this site may have been constructed as some type of channeling mechanism associated with the intermittent stream flow of the gulch. Opposite this site - on the north slope of the gully - the terrain is increasingly steep with more areas of exposed bedrock.

No artifacts or midden were observed at the Section

State Site #:	50-50-13-2710C
Site Type:	Enclosures
Function:	Agricultural
Probable Age:	Historic
Condition:	Remnant
Dimensions:	30.5 m. (100') by 76.2 m. (250')

CSH Site #: 3

Description: This feature consists of 3 rectangular enclosure remnants and an associated alignment running in a *mauka/makai* direction (portion of 2710A). The rectangular enclosures are delineated along their perimeters by low soil and rock embankments. The configurations of these remnants are particularly visible on aerial photographs and together measure roughly 30.48 m. (100') by 76.2 m. (250'). The associated alignment extends from Site 2710A (CSH1) to the remnant enclosures system and continues *makai* but has been seriously disturbed by historic and modern activity. No artifacts or midden were observed at the feature.

Test Results

Five test trenches were excavated by backhoe in Site 50-50-13-2710 C (Fig. 11). The trenches have a maximum length of 7.5 m.(24.6 ft.) and a maximum width of 1.0 m.(3.28 ft.). The depth, to bedrock, within the trenches ranges from a maximum of 1.5 m.(4.92 ft.) in a portion of Trench no. 5, and a minimum of 0.1 m.(0.33 ft.) in a portion of Trench no. 3. Cultural material from the five trenches consisted solely of a thin 10 centimeter thick, 70 centimeter long band of charcoal in Trench 2 and the ubiquitous water-rounded basalt pebbles. No definable cultural layer or midden of any kind other than the pebbles was found in the excavations.

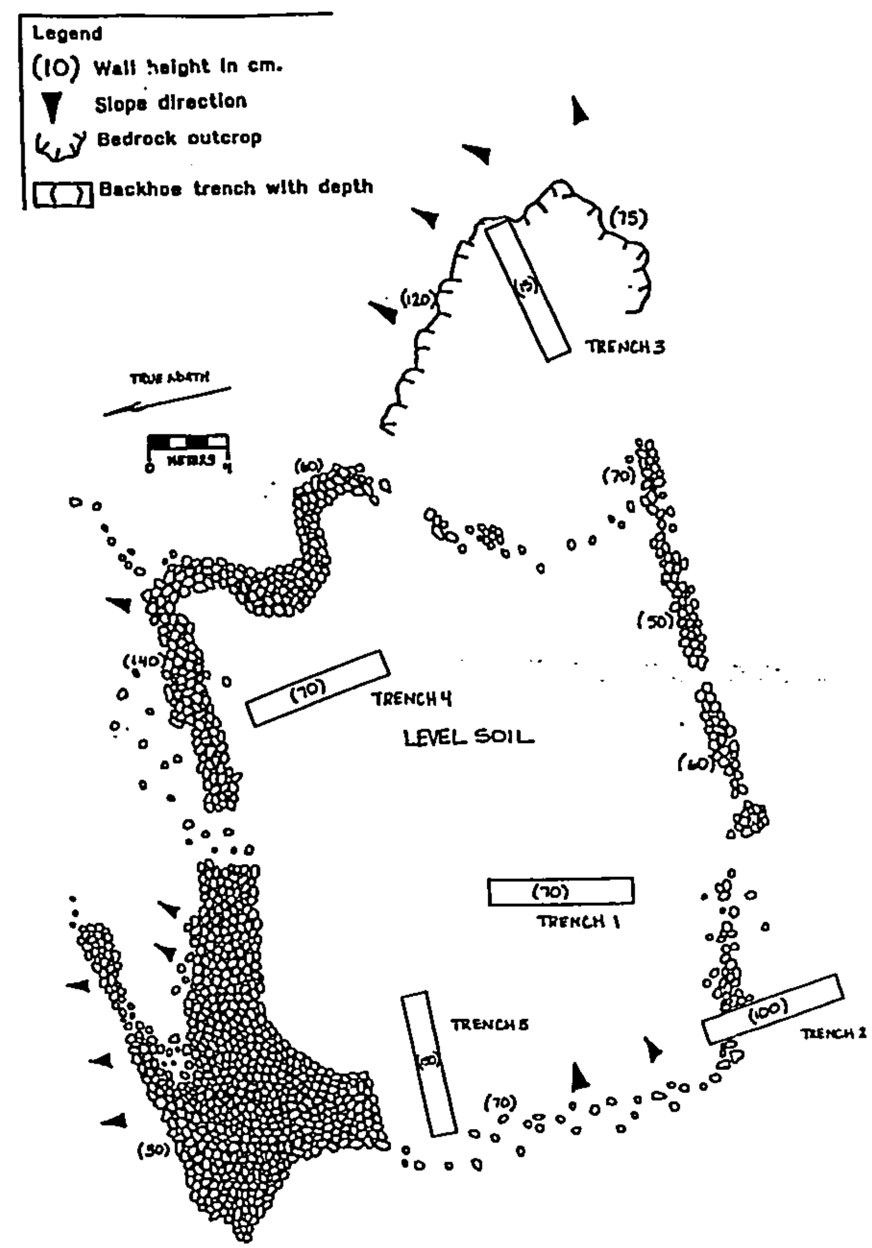


Fig. 11 Site 50-50-13-2710. Feature C, Plan View

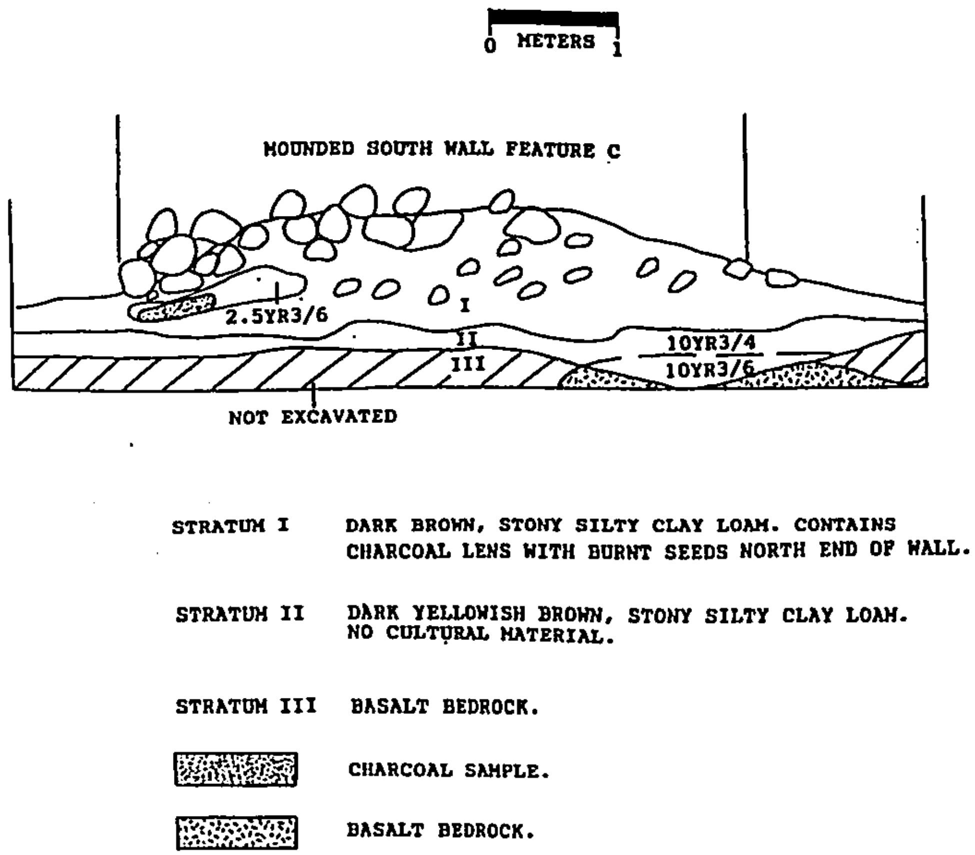


Fig. 12 Site 50-50-13-2710, Feature C. Trench 2, South Profile

Stratigraphy in the five trenches is consistent from one trench to the next with only slight variations in depth of the two soil layers and the bedrock substrate. The description of these soils layers is exemplified in Trench 2 (Fig. 12) as follows:

Stratum I Dark brown (10YR3/3) stony silty clay loam, very fine to fine sub-angular blocky structure, slightly hard, non-sticky, non-plastic, abrupt wavy to irregular boundary. Small boulder field boundary wall has disturbed this layer by its construction.

Stratum II Dark yellowish brown (10YR3/4 grading downwards to 10YR3/6) very fine silty clay loam, weak very fine sub-angular blocky structure, friable consistency, abrupt irregular boundary.

Stratum III Superficially decomposing basalt bedrock.

Excavation of the five trenches in Site -2710 C shows that the low short cross slope and long up-down slope walls of predominantly small boulders, cobbles and pebbles emphasize historic field boundaries mandated by the natural topography of exposed bedrock of the edges and toes of ancient *'a'a* lava flows.

The profile of Trench 2 clearly shows the presence of a well developed A-horizon (Stratum I) that predates the relocating of field stones to form the field walls.

State Site #: 50-50-13-2710D **CSH Site #:** 1
Site Type: Wall
Function: Cattle exclusion
Probable Age: Historic
Condition: Remnant
Dimensions: Length approximately 182.9 m. (600') remaining

Description: Feature 2710D is a NE/SW-oriented wall remnant presently measuring 0.25-0.5 m. (0.8-1.6') high by 0.5-1.25 m. (1.6-4.1') wide. Some sections of the site remnant are constructed of a parallel alignment of water-rounded boulders, core-filled with smaller boulders and cobbles. One historic bottle with "Maui Sake Brewery Co." embossed on the base was found at the site. This wall remnant also appears to have been a portion of the large enclosure designated Site 2710 in this study.

State Site #: 50-50-13-2710E **CSH Site #:** 7
Site Type: Terrace and mound
Function: Habitation
Probable Age: Prehistoric

Condition: Remnant
Dimensions: Length approximately 15.2 m. (50') by 30.5 m. (100')

Description: Feature 2710 Feature E consists of a large terrace structure with two levels, and a faced mound (Fig. 13). There are other remnant-type features within this vegetation cluster (Christmasberry) consisting of a roughly piled boulder mound and a minimally modified soil and rock embankment.

The terrace has overall dimensions of 12 m. (39.5') E/W by 19 m. (62') N/S. The terrace is roughly L-shaped and retains two soil areas which are delineated by linear rock mounds. The east/west oriented leg of the terrace forms the northern wall of the terrace with the soil areas south of this 1.5 m. high boulder and cobble retaining wall. The north/south oriented leg delineates the *makai* or eastern edge of the terrace. This portion of the terrace retaining wall is mostly collapsed and includes exposed bedrock. The soil areas are relatively flat with the lower level measuring roughly 12 m. (39.5') by 5 m. (16.5') and the upper level 8 m. (26.3') by 4 m. (13').

The faced mound or small platform measures 1.5 m. (5') by 2 m. (6.5') by .8 m. (2.5') in height. It is constructed of piled boulders with large boulders as the facings. Its size and construction style are suggestive of a burial platform. However, considering the absence of other possible clues, like manuports of coral and water-rounded stones, and the presumed historic nature of the site it seems unlikely that it is a burial.

Feature 2710 Feature E is included as part of what was once a large enclosure (2710) which also appears to have incorporated a former LCA plot, possibly LCA 5178 to Kapule. The enclosure itself probably relates to Grant 1656 to Maui for 50 acres of Papaauhau in 1855. Because of Feature 2710E's close proximity to this large enclosure (2710) it was numbered as an element of the overall site. Feature 2710E may well represent a habitation area associated with Grant 1656 and/or LCA 5178.

Testing Results

Three test units were excavated in association with Site 50-50-13-2710E (Fig. 14). Test Unit 1 was excavated on the level soil area of the main terrace, test unit 2 was excavated mauka of the small wall(west of the terrace), and test unit 3 was the dismantling of the rock mound north of the terrace.

Test Unit 1, in the terrace, contained three strata:

Stratum I 0-25 cm. Black (10YR2/1) silty clay loam, strong fine sub-angular blocky structure, friable, slightly compact, clear wavy boundary. Approximately 20 percent pebbles and cobbles by volume. Cultural material includes one basalt flake, volcanic glass flakes, 2.7 grams of charcoal bits, and a few water rounded pebbles.

Stratum II 25-50 cm. Dark yellowish brown (10YR3/6) silty clay loam, weak sub-angular blocky structure or crumb structure, very friable consistency. Approximately 70 percent decomposing pebbles and cobbles by vol

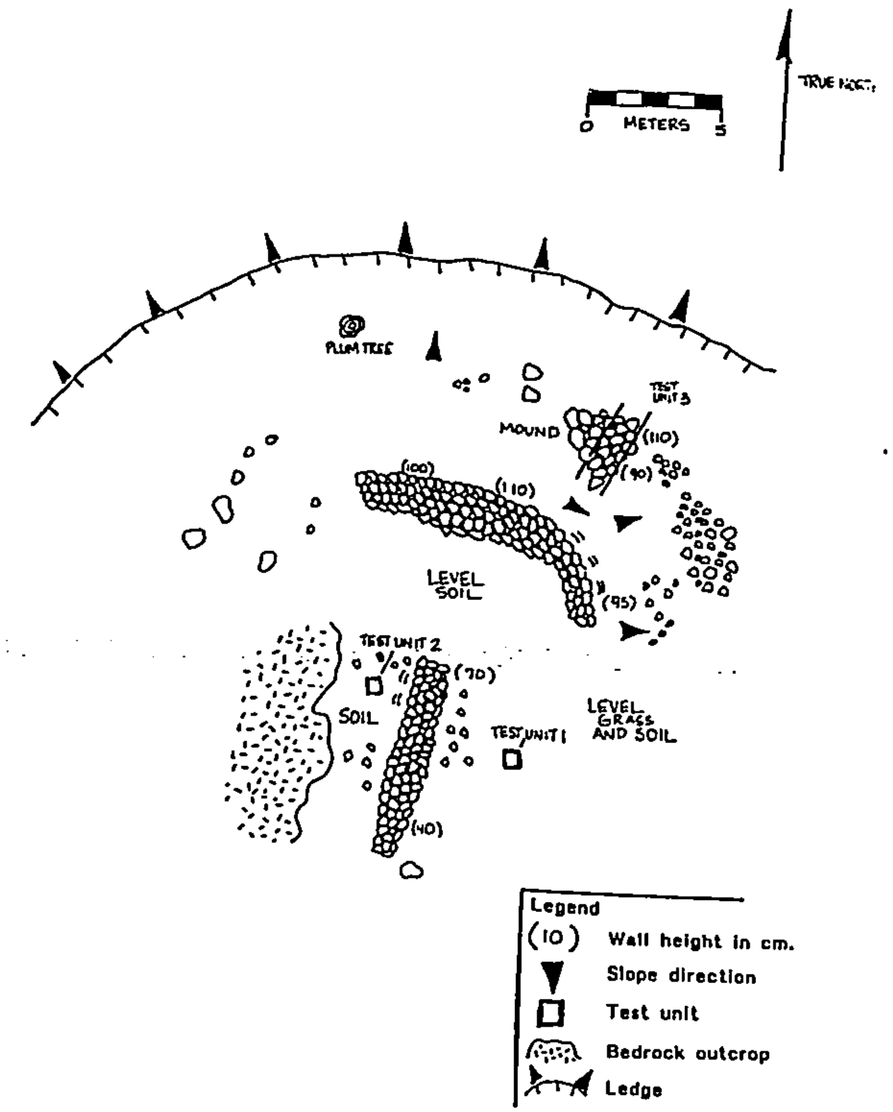


Fig. 13 Site 50-50-13-2710. Feature E, Plan View

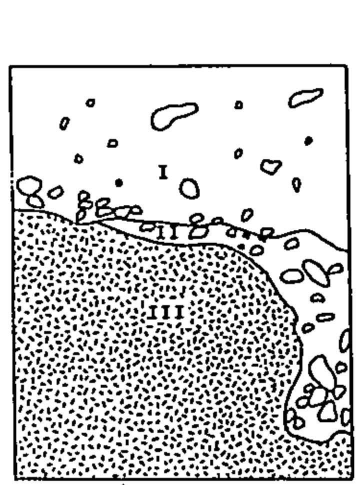


Fig. 14 Site 50-50-13-2710, Feature E. Test Unit 1, East Profile

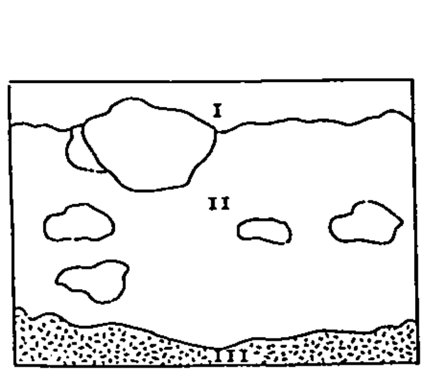


Fig. 15 Site 50-50-13-2710, Feature E. Test Unit 2, East Profile

ume, abrupt irregular boundary. One piece of coral was found at 35 cm. depth in this layer.

Stratum III 20+ cm. Superficially weathered basalt bedrock

Test Unit 2 (refer to Fig. 15), mauka of the small wall, yielded a similar stratigraphy as in Unit 1 as follows:

Stratum I Very dark brown (10YR2/2) silty clay loam, strong fine sub-angular blocky structure, friable, slightly compact, clear wavy boundary. Cultural material includes few small volcanic glass flakes.

Stratum II Dark yellowish brown (10YR3/4) silty clay loam, loose, structureless, abrupt wavy boundary. Contains one basalt flake, one piece of shell, and twelve volcanic glass flakes in the upper 10 centimeters of this stratum.

Stratum III 20+ cm. Superficially weathered basalt bedrock

Test Unit 3 consisted of the dismantling of the small mound north of the terrace. No cultural material of any kind was found within or beneath the mound.

State Site #: 50-50-13-2710F **CSH Site #:** 8
Site Type: Wall
Function: Cattle Exclusion
Probable Age: Historic
Condition: Poor/Remnant
Dimensions: 24.5 m. (80.3') long

Description: Feature 2710 Feature F is a wall section and attached mound, and a linear bulldozer mound extending to Feature 2710E The wall measures roughly 2.5 m. (8.2') wide by 0.8 m. (2.6') high. The mound located immediately adjacent to the wall section is roughly faced; *mauka* of this mound is a bowl-shaped depression with an interior of cobbles and boulders. They may represent an enclosure area which measures 16 m. (52.4') N/S by 8 m. (26.2') E/W. The linear bulldozer mound extends to the north beyond the faced mound structure until it intersects Feature 2710E (CSH 7).

As evidenced by the linear bulldozed mound, this feature has been extensively disturbed by historic and modern activities. It probably relates to early sugar cane activities and cattle exclusion.

No artifacts or midden were observed at the feature.

State Site #:	50-50-13-2711	**CSH Site #:** 4
Site Type:	Terrace	
Function:	Habitation	
Probable Age:	Prehistoric	
Condition:	Remnant	
Dimensions:	23 m. (75.4') N/S by 13 m. (42.6') E/W	

Description: This site (Fig. 16) is a remnant terrace characterized by a roughly mounded construction of piled cobbles and boulders; no vertical facing is observable. The terrace retains a level soil area *mauka* and reaches a maximum height of 0.6 m. (1.9') along its *makai* side. Water-rounded pebbles and cobbles and a single boulder are present along the surface of the terrace's west end.

Presently, the site is situated within a vegetation cluster of Christmasberry trees surrounded by pasture. The site has been adversely impacted by historic and modern activity.

Testing Results

Two test units were excavated in association with Site 50-50-13-2711. Test unit 1 was excavated in the lower cobble pavement and Test unit 2 was excavated in the upper level soil area.

Test unit 1 contained a level pavement of small boulders and cobbles with water-rounded stones (*'ili'ili*) approximately 10 cm.(0.328 ft.) below the surface. A basalt hammerstone was found in the 10 cm. layer above the surface of the boulder pavement, and a small deposit of charcoal (2.5 g.) was collected from beneath the pavement in the SE corner of the unit (Fig. 17). Only one stratigraphic layer is discernable overlying the boulder pavement which is constructed on the bedrock at a maximum depth of 27 cm. It seems certain that the soil deposit overlying the pavement is a result of occupation of the site it. The stratigraphic layers are described as follows:

Stratum I 0-10 cm. Very dark brown (10YR2/2) silty clay loam, compact, structureless. At 10 cm. to 27 cm. interstices of the pavement contain loose component of this layer (Stratum I) filtered through pavement surface. Stratum contains traditional Hawaiian cultural material. No midden was observed.

Stratum II Superficially decomposing bedrock

Test unit 2 in site 2711 contained no cultural material but displayed the two basic stratigraphic layers consistently found throughout the excavations in the project area (Fig. 18). These are:

Stratum I 0-50 cm. Dark brown (10YR3/3) compact silty clay loam, sub-angular blocky structure, comprising approximately 25 percent of the excavated material by volume. The remaining excavated material

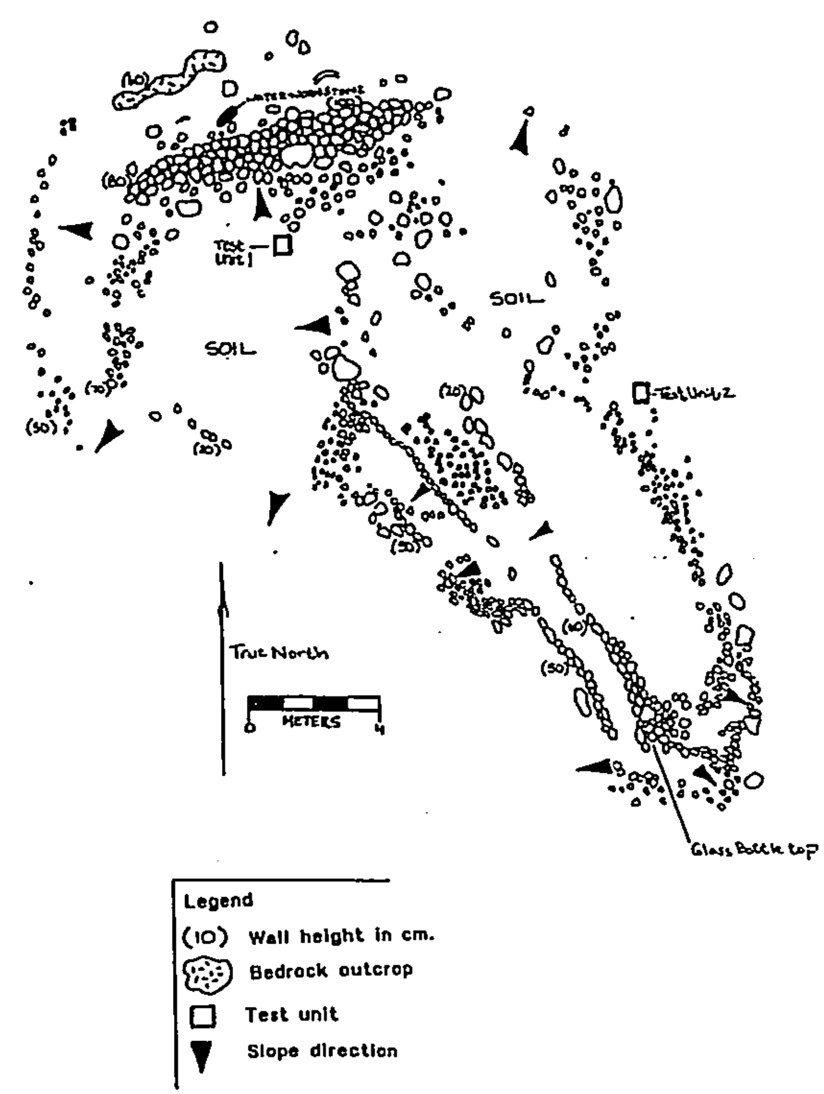


Fig. 16 Site 50-50-13-2711. Plan View

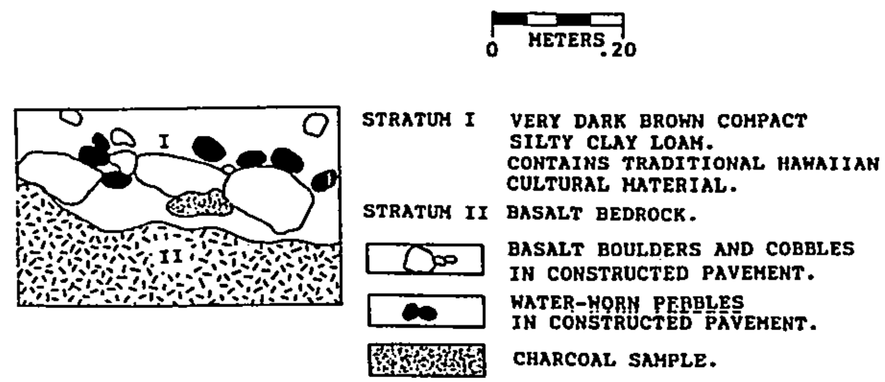


Fig. 17 Site 50-50-13-2711, Test Unit 1. South Profile

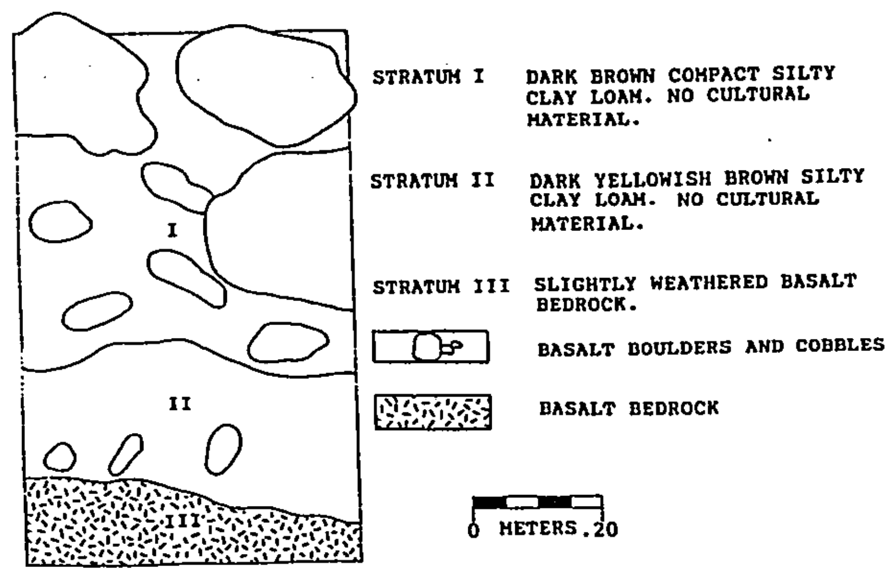


Fig. 18 Site 50-50-13-2711, Test Unit 2. West Profile

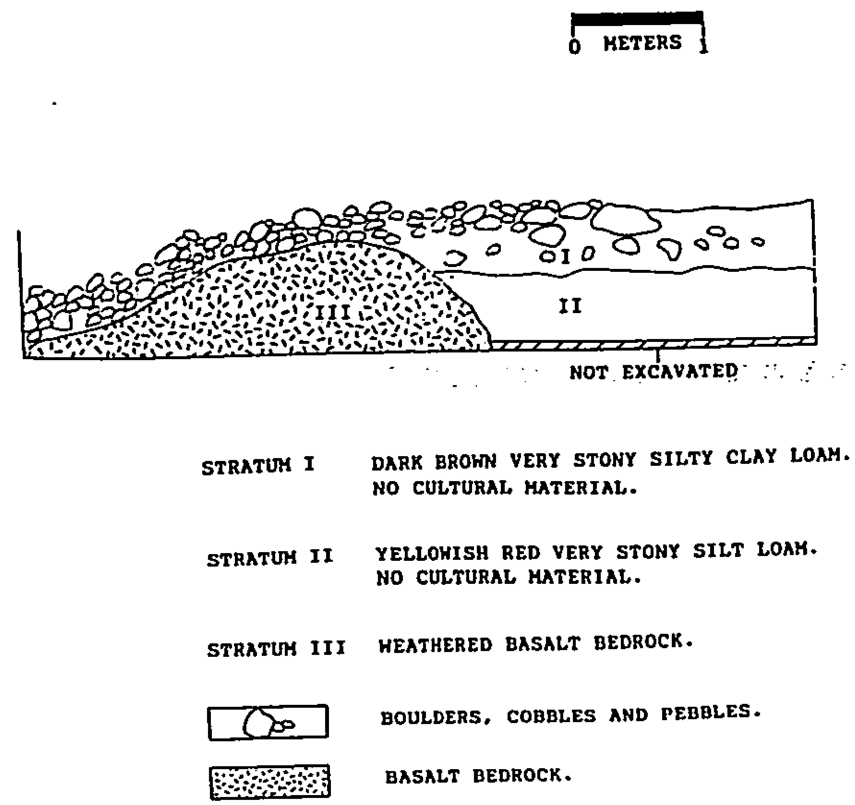
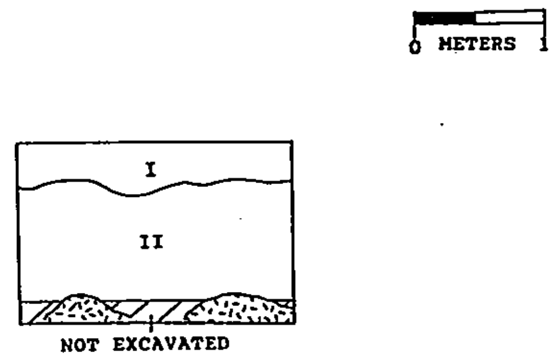


Fig. 19 Site 50-50-13-2711, Trench 1. South Profile



STRATUM I DARK BROWN STONY SILTY CLAY LOAM. NO CULTURAL MATERIAL. A HORIZON.

STRATUM II YELLOWISH RED SILTY CLAY LOAM. ABUNDANT DECOMPOSED PEBBLES. WEAK B HORIZON. NO CULTURAL MATERIAL.

DISCONTINUOUS, WEATHERED BEDROCK.

Fig. 20 Site 50-50-13-2711, Trench 2. East Profile

consists exclusively of angular to sub-angular basalt cobbles, pebbles and small boulders. No cultural materials are present.

Stratum II 50-75 cm. Dark yellowish brown 10YR4/6 silty clay loam, structureless, with approximately 50 percent pebbles and cobbles by volume. No cultural materials are present.

Stratum III Superficially decomposed basalt bedrock

State Site #: 50-50-13-2712 **CSH Site #: 5**
Site Type: Terrace
Function: Habitation
Probable Age: Prehistoric
Condition: Remnant
Dimensions: 12 m. (39.3') NE/SW by 7 m. (22.9') NW/SE

Description: Site 2712 is a terrace remnant presently characterized by an oval-shaped piling of cobbles and boulders reaching a maximum height of 1.5 m. (4.9') along its
makai side. The surface of the central portion of the site remnant is relatively level and contains one water-rounded boulder (Fig. 21).

The site has been seriously disturbed by historic and modern activity, as evidenced by the presence of several large boulders apparently pushed onto the surface of the structure.

Test Results

One test unit was excavated in association with Site 50-50-13-2712. The unit, in the *mauka*, level soil area of the site contained cultural material and a structural pavement with three stratigraphic layers (Fig. 22):

Stratum I 0-50 cm. Dark brown (10YR3/3) loose silty clay loam between basalt rocks of pavement (approximately 20 percent soil by volume) in the upper 20 cm. of this stratum. Below the pavement at 20 cm. to 50 cm. in Stratum I the soil volume increases to approximately 70 percent. Contains traditional Hawaiian cultural material including charcoal bits, volcanic glass and basalt flakes, a small unidentified bone fragment, and a small piece of marine shell(probably opihi).

Stratum II 50-70 cm. Dark yellowish brown (10YR3/4) loosely compacted, structureless silty clay loam, few partially decomposing angular pebbles and cobbles, no cultural materials with the exception few charcoal bits probably derived from Stratum I during excavation.

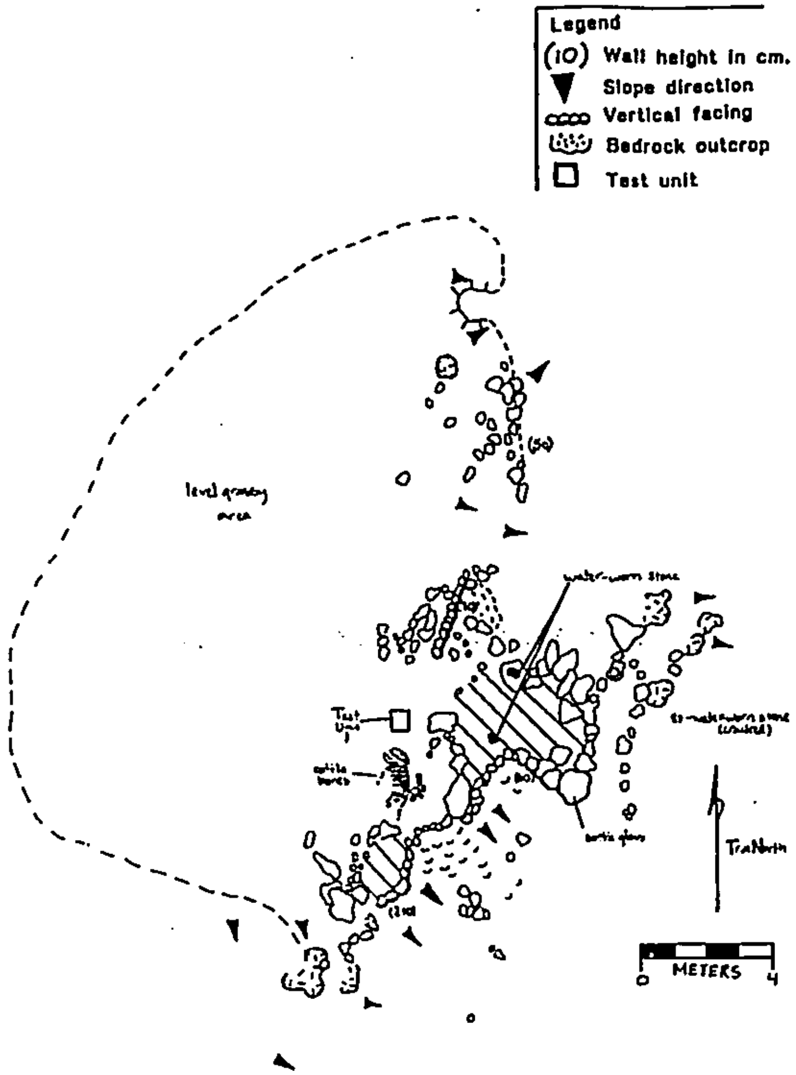


Fig. 21 Site 50-50-13-2712. Plan View

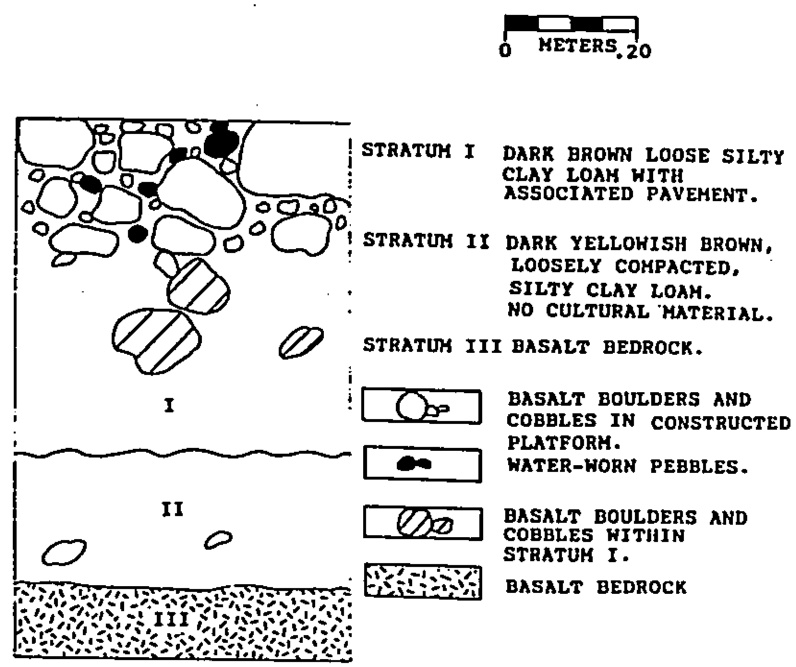


Fig. 22 Site 50-50-13-2712, Trench 1. West Profile

Stratum III Superficially decomposing basalt bedrock

A charcoal sample from Stratum I at 30 cm. to 40 cm. depth was submitted fordating and returned a C13 adjusted date of AD 1365-1650. The date of the charcoal sample and associated traditional artifacts affirm that this site was used prehistorically.

State Site #: 50-50-13-2713 **CSH Site #: 9**
Site Type: Terrace\Mound
Function: Habitation
Probable Age: Historic
Condition: Remnant
Dimensions: 24.4 m. (80') by 30.5 m. (100')

Description: Site 2713 is a terrace and mound which have been designated Features A and B, respectively.

Feature A terrace is constructed predominantly of large boulders stacked along the edge of an outcrop ridge. The terrace retains level soil upslope and measures 4 m. (13.1') N/S by 6 m. (19.6'), with a maximum height of 1 m. (3.2').

Feature B mound - located roughly 8 m. from Feature A - is constructed of piled and stacked cobbles and boulders, and measures 3 m. (9.8') in diameter with a maximum height of 2 m. (6.5') on the *makai* or downslope side. The *mauka* side of the mound lies relatively flush with the ground surface.

Site 2713 is essentially an island of vegetation within the pasture lands (formerly sugar cane). The steepness and rockiness probably precluded incorporation into cane lands. Site 2713 may also represent the remains associated with LCA 4841 (refer to Fig. 7). The 1917 cane field map indicated LCA 4841 included some 14.10 acres of which 2.92 acres were "waste area."

State Site #: 50-50-13-2714 **CSH Site #: 10**
Site Type: Wall
Function: Agricultural/Boundary
Probable Age: Historic
Condition: Fair to Remnant
Dimensions: Approximately 198 m. (650') long.

Description: Site 2714 wall is oriented in a roughly N/S direction, extending from Site 117 to the next gulch north. The wall is roughly faced with stacked cobbles and boulders; it measures an average 1 m. (3.2') wide and 1.5 m. (4.9') high, but is discontinuous due to commercial cane activities. This wall section appears to be just a remnant of what was once a system of walls that excluded cattle from cane fields.

During the earliest years (ca. 1850s to 1880s) of commercial cane cultivation in Hana, the wall system was also probably related to LCAs and land grants.

State Site #: 50-50-13-2715 **CSH Site #: 12**
Site Type: Terrace
Function: Habitation
Probable Age: Historic
Condition: Remnant
Dimensions: 10 m. (33') by 25 m. (82')

Description: Site 2715 is a large terrace situated on the southern edge of a steep-sided gulch (Mo'omo'oiki). The site is constructed predominantly of cobbles with a few boulders and measures 25 m. (82') N/S by 10 m. (32.8') E/W, with a maximum height of 2.5 m. (8.2'); its long axis runs perpendicular to the gulch.

The abundance of cobbles on the site suggests it to be cultural.

No artifacts or midden were observed at the site.

State Site #: 50-50-13-2716 **CSH Site #: 13**
Site Type: Terraces
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: Covers an area of 15.2 m. (50') by 30.5 m. (100')

Description: Site 2716 refers to a series of short walls delineating soil terraces. The terrace wall sections are constructed of small boulders 1 course high, rising to a maximum height of 0.5 m. (1.6'). They measure 5-6 m. (16.4-19.6') long, with the widths of the adjacent soil terraces measuring 1.5-3.5 m. (4.9-11.4').

The site is situated on a roughly oval-shaped knoll visibly impacted by cattle grazing and cane operations.

No artifacts or midden were observed at the site.

State Site #: 50-50-13-2717 **CSH Site #: 14**
Site Type: Cave Shelters and Assoc. Modifications
Function: Habitation/Agricultural
Probable Age: Historic
Condition: Fair
Dimensions: Covers an area approximately 45.7 m. (150') in

diameter.

Description: Site 2717 is two cave shelters and a modified plunge pool basin located at the base of a low waterfall. The site is situated within Haneo'o Gulch at the center of the project area. The shelter area to the north is designated Feature A and the one to the south is Feature B.

Feature A (Fig. 23) consists of a roughly 5 m. (16.4') wide and 5 m. (16.5') deep cave shelter, with an entrance measuring 4.5 m. (14.7') wide and 1.5 m. (4.9') high. Themaximum ceiling height in the interior of the cave is 1.3 m. (4.2'). The interior floor is a soil surface roughly 25 cm deep intermixed with exposed bedrock and talus.

Outside of Feature A shelter - immediately southeast of the entrance - numerous modifications are present within a bowl-shaped plunge pool basin. One of these modifications is a low, stacked boulder wall measuring 1.5 m. (5') long, with a maximum height of 0.75 m. (2.4'). This wall is discontinuous but crosses the width of the natural crevice along its outer boundary. These modifications may have been constructed to divert water for agricultural use or to channel water away from the shelters during times of flooding.

Feature B is a 3 m. (9.8') deep cave shelter with two separate entrances located at the north and south sides of the shelter. The larger, south entrance measures 6 m. (19.6') wide and 1.5 m. (4.9') high. The north entrance measures 1.8 m. (5.9') wide and 1 m. (3.2') high; water flows periodically through this opening as evidenced by a recently deposited trail of debris leading into the overhang from this north entrance. No artifacts or midden were observed at the site. The overhang shelter areas look unutilized and subject to periodic washout. Old plantation maps indicate that a field road crossed Haneo'o Gulch close to this location; modifications to plunge pool basin A are probably historic.

State Site #:	50-50-13-2718	**CSH Site #: 15**
Site Type:	Cave shelters (3)	
Function:	Habitation	
Probable Age:	Historic	
Condition:	Poor	
Dimensions:	See individual descriptions.	

Description: Site 2718 is three cave shelters - designated Feature A, B, and C - located on the SW boundary of the study area, immediately *mauka* of Hana highway near the S-curve crossing Haneo'o Gulch.

Feature A shelter measures 4 m. (13.1') deep by 1.5 m. (4.9') wide, with a maximum ceiling height of 1 m. (3.2'). The interior floor of the shelter is a gravelly silt-loam roughly 25 cm. deep. Two sections of stacked boulder facing are constructed outside of the shelter and extend *makai* from the north and south edges of the entrance.

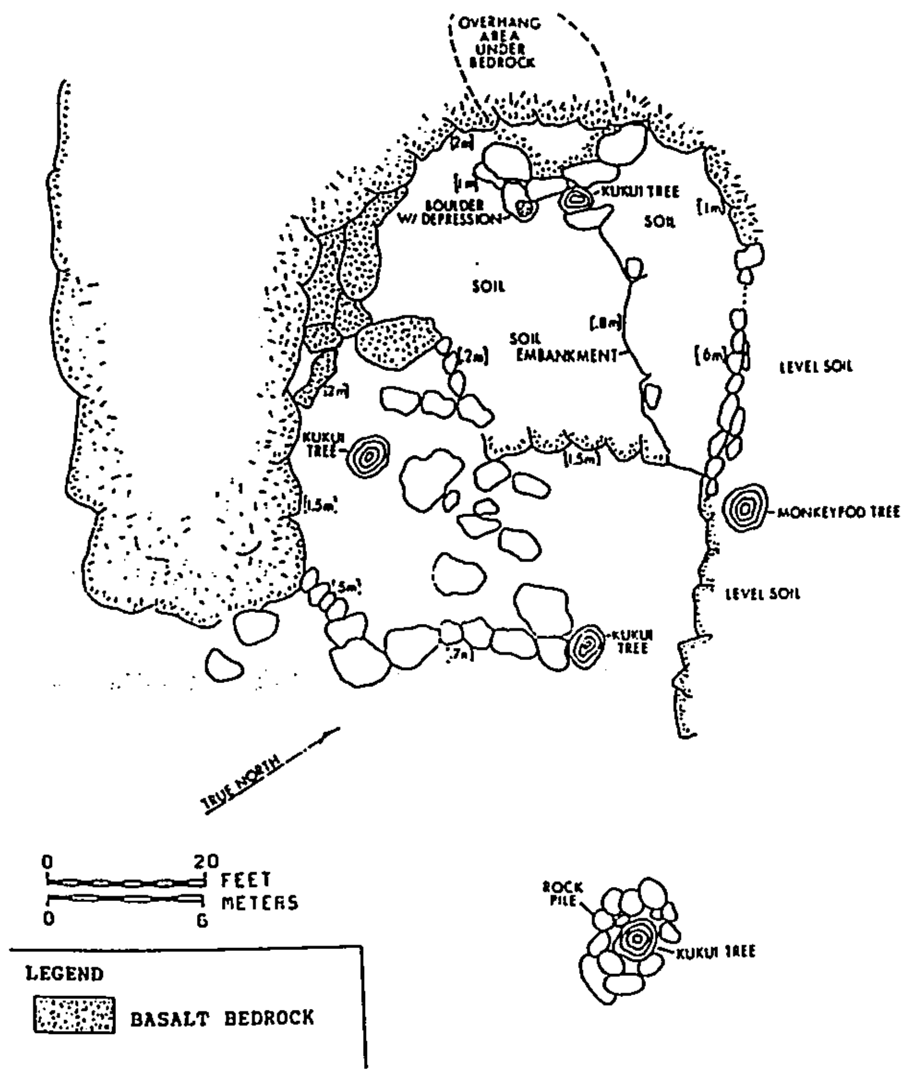


Fig. 23 Site 50-50-13-2717, Plan View of Feature A Area

These facings measure 2.5 m. (8.2') long by 1 m. (3.2') high.

Feature B - located roughly 15.2 m. (50') north of Feature A is situated directly adjacent to the highway. This cave shelter is more substantial in size, measuring 10 m. (32.8') deep by 1-1.5 m. (3.2-4.9') wide; it has a maximum ceiling height of 1.2 m. (3.9'). The interior floor is relatively level with shallow soil deposits, portions of which are covered by modern garbage and natural debris washed in from the adjacent highway.

Feature C is another cave shelter located some 12.2 m. (40') north of Feature B and immediately adjacent to Hana Highway. Feature C has a 1.5 m. (5') by 2.5 m. (8') opening and is 4.5 m. (15') deep. The maximum ceiling height is 2 m. (6.5'). Like the other caves the interior is level soil with plentiful modern trash from the highway.

The caves were given temporary Bishop Museum field number T14 during the 1987 survey of Hana Ranch lands. That survey also noted the "recent historic period rubbish." In general, the caves appear unutilized as the interior floor areas have recent alluvial fill and trash, indicating periodic flooding from the adjacent highway. However the alluvium could cover a sub-surface cultural deposit. Another possibility is that highway construction actually opened these caves up and thus they are modern in nature.

State Site #:	50-50-13-2719	**CSH Site #: 16**
Site Type:	L-shaped Wall	
Function:	Temporary Shelter	
Probable Age:	Prehistoric?	
Condition:	Fair - Good	
Dimensions:	19.5 m. (63.9') long.	

Description: Site 2719 is situated on the peak of a prominent cinder cone located along the *makai* boundary of the project area. It consists of an L-shaped wall open to the south. The wall is bi-faced with boulders and is core filled. It measures 19.5 m. (63.9') in total length. The long axis (NW wall section) measures 12 m. (39.3') The wall ranges in width from 1-1.5 m. (3.2-4.9') and has an average height of .5 m. (1.6').

No artifacts or midden were observed at the site, and it appears to be too "open" for an L-shaped shelter. Possibly, it functioned as a lookout or defensive position during prehistoric times.

State Site #:	50-50-13-2720	**CSH Site #: 17**
Site Type:	Platform	
Function:	Agricultural	
Probable Age:	Historic	
Condition:	Good	
Dimensions:	5 m. (16.5') by 2.5 m. (8.3')	

Description: Site 2720 platform is situated adjacent to the historic railroad bed (Site 2742) near the *makai* boundary of the project area. The platform is roughly faced on all four sides and is constructed of stacked cobbles and boulders; it measures 5 m. (16.4') N/S by 2.5 m. (8.2') E/W with a maximum height of 1 m. (3.2').

Given the site's close proximity to the historic railroad bed, which at this particular location is a cut through a low rock, it is probably associated with historic activities such as sugarcane cultivation and railway activities.

No artifacts or midden were observed at the site.

State Site #:	50-50-13-2721	**CSH Site #:18**
Site Type:	Platform/Terraces	
Function:	Agricultural	
Probable Age:	Historic	
Condition:	Fair - Good	
Dimensions:	Overall area approximately 10.7 m. (35') by 45.7 m. (150').	

Description: Site 2721 (Fig. 24) is a platform and various modifications situated along an exposed bedrock ridge running along the slope of the terrain. The platform and outcrop modifications have been designated as Features A and B, respectively.

Feature A platform is constructed of stacked cobbles and boulders and measures 3 m. (9.8') N/S by 4 m. (13.1') with a height ranging from 1-1.5 m. (3.2-4.9'). The platform is roughly faced on three sides and lies nearly level with the ground surface on its *mauka* side. The platform surface slopes moderately *makai*.

Feature B modifications run *makai* of Feature A platform for roughly 45.7 m. (150') and primarily include step terraces which cross-cut the slope. Modification is minimal and characterized by rough, linear piles of cobbles among the outcrop and associated rubble. One water-rounded pebble was observed adjacent to the most *mauka* of these modifications.

Test Results

A one-meter square test unit was excavated in the center of the Feature A platform. The excavation revealed approximately 1.5 m. of rock fill overlying a thin (20 cm.) culturally-sterile soil layer, below which was bedrock (Fig. 25). The excavation was negative in terms of artifacts or midden, which support the historic-age determination for this site.

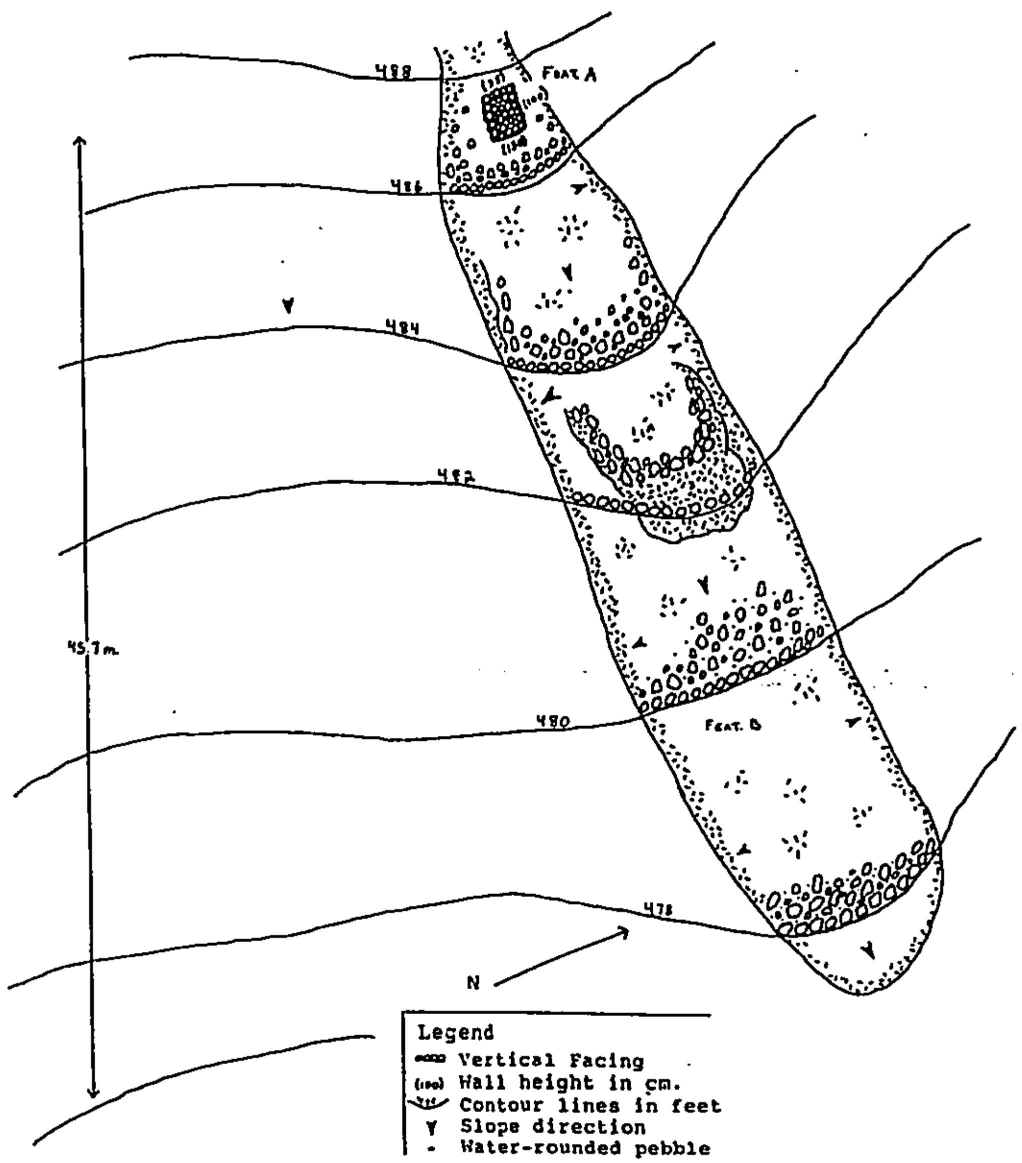
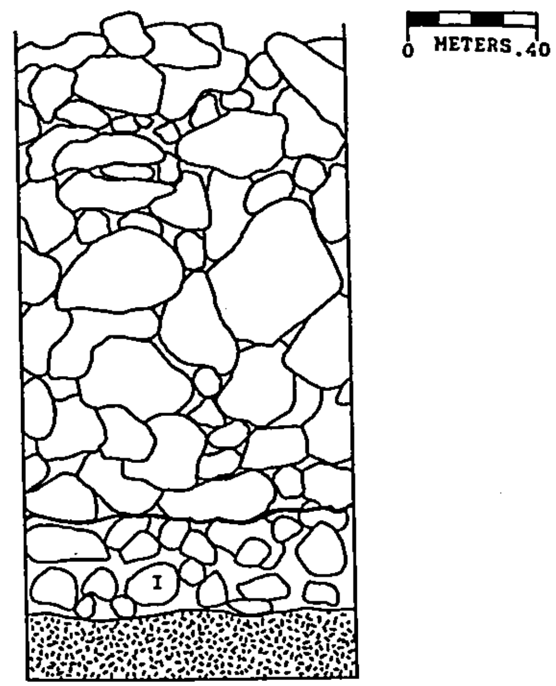


Fig. 24 Site 50-50-13-2721, Plan View.



STRATUM I — VERY DARK GREYISH BROWN (10 YR 3/2 DRY), SILTY CLAY LOAM, STRONG VERY FINE TO FINE SUBANGULAR BLOCKY STRUCTURE, SLIGHTLY HARD TO HARD.

BOULDERS, COBBLES AND PEBBLES.

BASALT BEDROCK.

Fig. 25 Site 50-50-13-2721, Trench 1 North Profile.

State Site #: 50-50-13-2722 **CSH Site #:** 19
Site Type: Platform/Enclosure/Walled soil area
Function: Agricultural
Probable Age: Historic
Condition: Fair - Good
Dimensions: Covers an area of approximately 45.7 m. (150') square

Description: Site 2722 is three features situated on and above an exposed bedrock ledge running along the slope of the terrain. These features include an L-shaped enclosure, platform and walled soil area which are designated Features A, B and C, respectively.

Feature A enclosure cross-cuts the slope of the ridge. The enclosure wall is constructed of piled cobbles and boulders and measures 10 m. (16.4') in total length. Both axes of the L-shaped feature are equal in length and oriented with an opening *makai*.

Feature B platform is constructed of cobbles and boulders with three vertical facings on the north, south and east sides. The west side exhibits a sloped facing and is partially collapsed. The platform measures 3 m. (9.8') N/S by 5.5 m. (18') E/W with a maximum height of 2.5 m. (8.2').

Included in **Feature C** is a E/W-oriented wall located to the south of Feature B. This wall is roughly stacked with boulders and delineates the southern boundary of a series of small rectangular soil areas. The soil areas are bounded and demarcated most extensively along their eastern side (downslope) by soil embankments ranging in height from 0.5-1 m. (1.6-3.2').

No artifacts or midden were observed at the site which is probably historic in age and related to cane operations. Local informant, Clifford Hashimoto, indicated the families from Hāmoa grew sweet potato and dry land taro in this general area. Lynn Nakkim's 1969-1970 survey also indicated sweet potato farming until the 1930s in this area; however, by 1946 it was in sugarcane (L. Nakkim 1970, Site H-3 Haneo'o *ahupua'a*). Other informants suggested that the large platforms in this area were water tank foundations. Old plantation maps suggest they were flume foundations.

The absence of cultural material in the excavation of Site 2721 platform and informant information suggests that the four large platforms, Sites 2721, 2722, 2728, and 2731 are historic in construction and probably relate to cane cultivation infrastructure (i.e., water tanks and/or flume foundations).

State Site #: 50-50-13-2723 **CSH Site #:** 20
Site Type: Enclosure/Platform
Function: Agricultural
Probable Age: Historic

Condition: Fair - Good
Dimensions: 22 m. (72.1') E/W by 27 m. (88.5') N/S

Description: Site 2723 (Fig. 26) is a rectangular enclosure with interior features that include a small enclosure and a large platform. The overall enclosure is designated as Feature B; the platform and the smaller interior enclosure are designated Features A and C, respectively.

Feature B is a four-sided enclosure encompassing roughly 590 sq. m. (1948 ft.) of moderately sloped terrain. The north and east sides of the enclosure walls exhibit the most formal construction; these two wall segments are roughly stacked at an average width and height of 1 m. (3.2'). The south and west walls are characterized by a simple alignment of boulders rising roughly 0.5 m. (1.6') high.

Feature A platform is incorporated into the enclosure's southwest corner. It is roughly rectangular and constructed of stacked cobbles and boulders forming vertical facing on all four sides. The platform is 5 m. (16.4') by 6 m. (19.7') with a maximum height of 1.7 m. (5.5 ft).

Feature C enclosure is an L-shaped addition to the interior of Feature B's northeast corner and - in conjunction with the larger enclosure's NW corner - contains an area roughly 35 sq. m. (114.8'). This interior structure is limited to an alignment construction of cobbles modifying an outcrop. The northeast corner of the larger enclosure is more massive in construction than its average wall size; here the wall becomes a mound-like structure measuring at least 5 m. (16.4') wide. An opening followed by a narrow passageway formed between a small exterior alignment and the massive wall is present in the northwest corner of Feature B enclosure. A second opening is observable immediately south of the interior L-shaped structure. Both of these openings likely represent entrances to the overall site area.

No artifacts or midden were observed at the site. This site, like the previously described site 2722 is probably associated both with historic sweet potato farming and cane infrastructure.

Test Results

Two trenches were excavated at Site -2723 to determine if any cultural deposits were present, and to obtain a representative stratigraphic profile of the site. The first of these, Trench 1, was oriented *mauka-makai*, beginning within Feature C of the site and proceeding through the *makai*, north-south oriented wall (being part of Feature B). No Cultural material was present in the excavation of Trench 1 or Trench 2. Three stratigraphic units were identified in Trench 1 (Fig. 27);

Stratum I Very dark grayish brown (10YR3/2 dry) silty clay loam, strong very fine to fine subangular blocky structure, slightly hard to hard, many rootlets, roots common. Abrupt wavy boundary. Very stony (30 to 50 percent by volume) A-horizon.

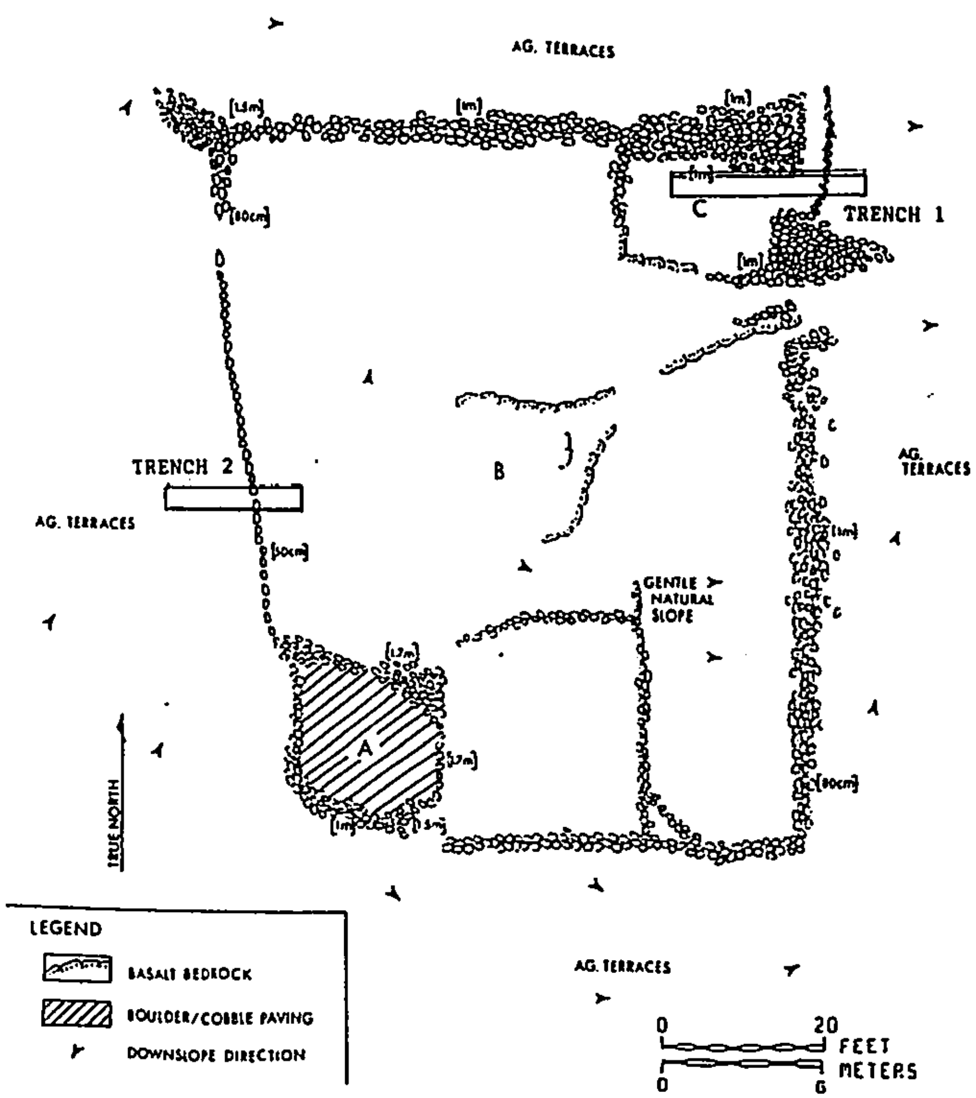


Fig. 26 Site 50-50-13-2723. Plan View

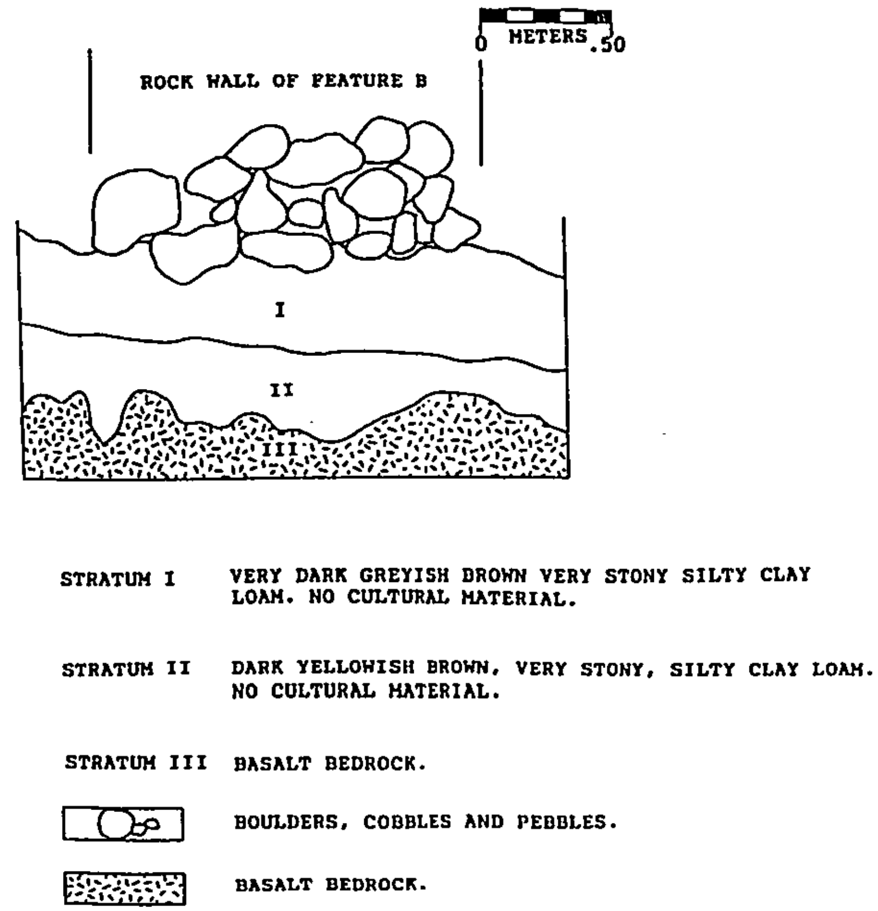
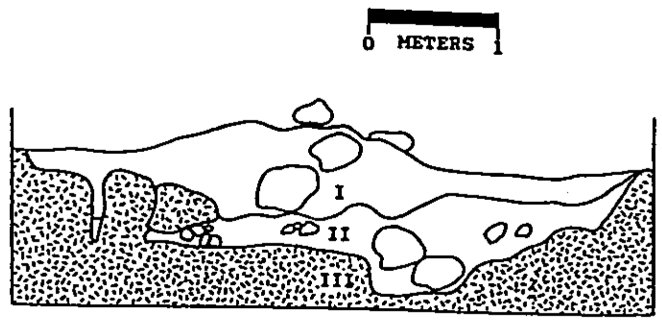


Fig. 27 Site 50-50-13-2723, Trench 1. North Profile



STRATUM I — VERY DARK GREYISH BROWN SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM II — DARK YELLOWISH BROWN SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM III — SLIGHTLY WEATHERED BASALT BEDROCK.

BASALT BOULDERS, COBBLES AND PEBBLES.

BASALT BEDROCK.

Fig. 28 Site 50-50-13-2723, Trench 2. North Profile

Stratum II Dark yellowish brown (10YR3/4 moist) very fine silty clay loam, weak very fine subangular blocky structure, friable. Very stony.

Stratum III Basalt bedrock

The north profile of Trench 1 clearly shows the stacking of boulders which forms the northeast corner of Feature B lie upon the surface of Stratum I and thus postdate Stratum I.

Excavation of Trench 2 proceeded through the *mauka* (west) wall of Feature B. In this trench the stratigraphic profile was identical to that observed in Trench 1 with the addition that both Stratum I and Stratum II were considerably more stony (Fig. 28). There was little soil matrix in Stratum II, the interstices between the naturally faulted bedrock blocks and cobbles and pebbles being voids. In the excavation of Trench 2 it became apparent that the north-south alignment described as the *mauka* boundary of Feature B, is a natural change in level of the old *'a'a* flow.

State Site #: 50-50-13-2724 **CSH Site #: 21**
Site Type: Wall/Modified Outcrop
Function: Agricultural
Probable Age: Historic
Condition: Poor-Remnant
Dimensions: Covers an area of approximately 30.5 m. (100') by 53.3 m. (175').

Description: Site 2724 consists of a wall and various other outcrop modifications. The primary wall of the site runs for 15 m. (49.2') along a moderately sloped terrain with its linear extent confined to a vegetation cluster surrounded by pastureland. This wall exhibits two types of construction separated by a gap roughly 1 m. (3.2') wide. The upslope, west end is characterized by a stacked cobble and boulder construction 4-5 courses high and 0.5 m. (1.6') wide. The east portion contains a remnant core-filled wall rising .7 m. high.

Other minor modifications in the site area include alignments and rough step-terraces cross-cutting the natural slope of the terrain. This site is probably related to historic sweet potato farming.

No artifacts or midden were observed at the site.

State Site #: 50-50-13-2725 **CSH Site #: 22**
Site Type: Mound
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: 10 m. (32.8') SE/NW by 5 m. (16.4') SW/NE

Description: Site 2725 is a mound constructed along the upper portion of an E/W-oriented outcrop ridge. Its northeast side exhibits a roughly vertical face rising 1 m. (3.2') high. Some disturbed soil areas were observed upslope of the mound, suggesting that it may represent a bulldozed pile.

No artifacts or midden were observed at the site.

State Site #: 50-50-13-2726 **CSH Site #: 23**
Site Type: Platform
Function: Agricultural
Probable Age: Historic
Condition: Fair
Dimensions: 4.5 m. (14.7') E/W by 9 m. (29.5') N/S

Description: Site 2726 is a substantial platform constructed of stacked boulders. It measures 4.5 m. (14.7') E/W by 9 m. (29.5') with a maximum height of 2.5 m.(8.7'). The eastern and northern portions of this platform are in good condition; the western and southern portions are partially collapsed. The surface of the platform is boulders and cobbles and is relatively level. This site also appears to be related to sugar plantation infrastructure.

State Site #: 50-50-13-2727 **CSH Site #: 24**
Site Type: Mound
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: 5 m. (16.4') diameter

Description: Site 2727 (Fig. 29) consists of a roughly piled boulder and cobble mound situated within a roughly U-shaped agricultural feature. The U-shape has been created by loosely piling boulders and cobbles along natural contours of the slope that extend *makai* (east) from a modified outcrop that joins the two arms of the U on the upslope (west) side. The U-shaped area measures approximately 18 meters north/south by 25 meters east/west and is open on the downslope or eastern side.

The mound, which is within the *makai* (eastern) central portion of the U-shape, measures roughly 5 meters in diameter with a maximum height of 1 meter. The mound was tested, with the aid of a backhoe, to better determine function.

Test Results

Site 2727 was tested with a single backhoe trench that revealed a stratigraphy comprised of three layers consistent with the project area in general (Fig. 30). These layers are

Stratum I 0-80 cm. Very dark grayish brown, stony, silty clay loam. No cultural

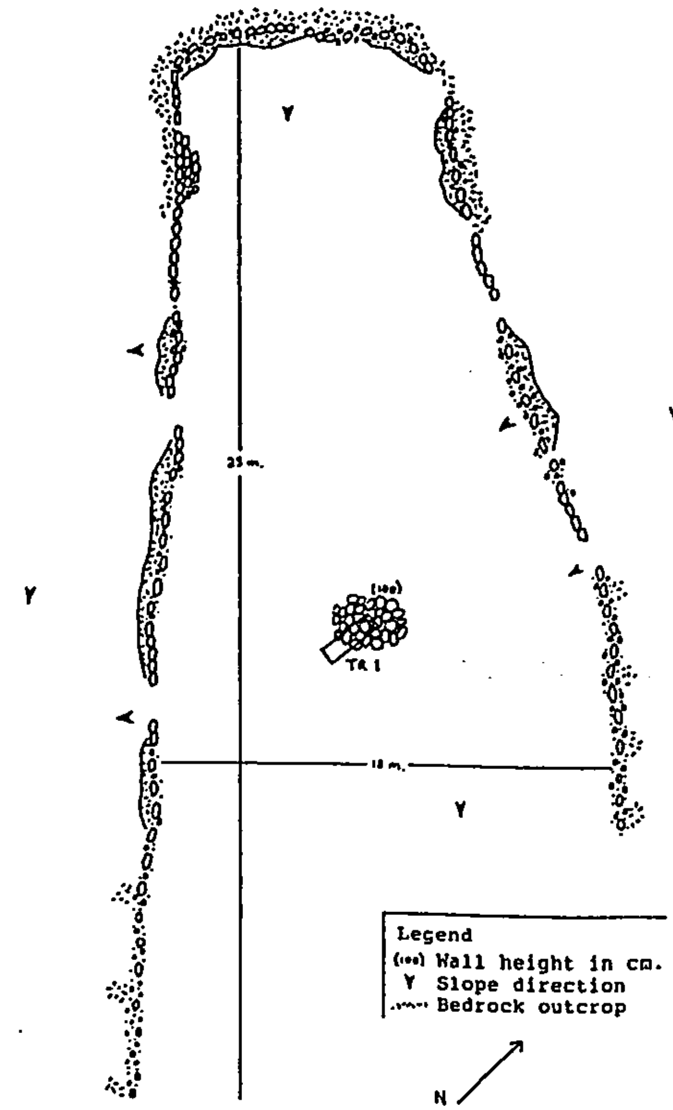
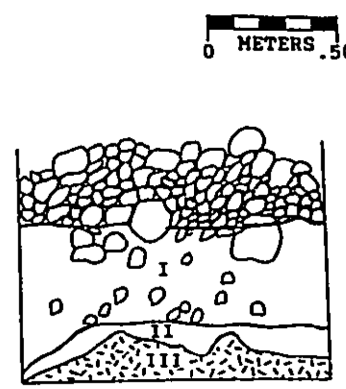


Fig. 29 Site 50-50-13-2727. Plan View.



STRATUM I VERY DARK GREYISH BROWN SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM II DARK YELLOWISH BROWN SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM III SLIGHTLY WEATHERED BASALT BEDROCK.

BOULDERS, COBBLES AND PEBBLES.

BASALT BEDROCK.

Fig. 30 Site 50-50-13-2727. North Profile

material.

Stratum II 80-100 cm. Dark yellowish brown, stony, silty clay loam. No cultural material.

Stratum III Basalt bedrock

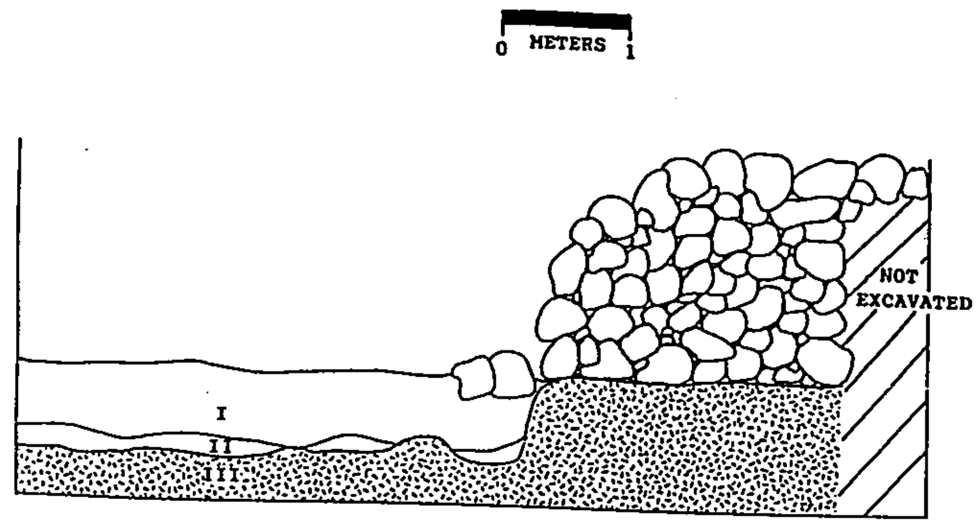
The surface structure (i.e., mound) of basalt boulders was clearly built upon the surface of Stratum I, and thus post dates the deposition of the stratigraphic layers. The stratigraphic position, absence of any artifactual material, and the rough construction of the mound is indicative of historically modified agricultural sites in this portion of the project area. The testing confirmed our assumptions as to function (i.e., agricultural) and probable age (i.e., historic).

State Site #: 50-50-13-2728 **CSH Site #:** 25
Site Type: Platform
Function: Agricultural
Probable Age: Historic
Condition: Fair
Dimensions: 5.5 m. (18') by 6 m. (19.7').

Description: Site 2728 is a roughly circular platform constructed of stacked boulders and cobbles. The sides of this platform are not well faced, giving this site a mounded appearance. However, the size and construction style are similar to the other large platforms just described. This site probably also represents a structure related to historic agriculture infrastructure such as a water tank foundation.

Test Results

Testing of this site consisted of trenching through the raised basalt boulder and cobble platform from its center, horizontally through the platform perimeter and vertically to the bedrock substrate (Fig. 31). The north profile shows that the rock structure comprising the site is of a stacked boulder construction style, built on bedrock level with the surrounding ground surface. Beyond the edge of the platform to *mauka* the excavation showed a shallow soil deposit of less than 70 cm. consisting of the widespread Stratum I of dark brown, stony silty clay loam without cultural material overlying a layer of dark yellowish brown silty clay loam (Stratum II) with angular pebbles and cobbles fracturing off of the Stratum III bedrock substrate. No evidence was found from the testing that would alter our initial interpretation of this site as an historic structure probably associated with water collection, storage, or transport.



STRATUM I — DARK BROWN STONY SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM II — DARK YELLOWISH BROWN SILTY CLAY LOAM. ANGULAR PEBBLES AND COBBLES ABUNDANT. NO CULTURAL MATERIAL.

STRATUM III — SLIGHTLY WEATHERED BASALT BEDROCK.

BOULDERS, COBBLES AND PEBBLES.

BASALT BEDROCK.

Fig. 31 Site 50-50-13-2728. North Profile

CSH Site #: 26

State Site #: 50-50-13-2729
Site Type: Platform and associated features
Function: Agricultural
Probable Age: Historic
Condition: Fair
Dimensions: (See Description)

Description: Site 2729 consists of a prominent platform with an attached wall segment surrounded by small step-terraces. The platform is constructed primarily of piled and stacked boulders forming vertical facing on all four sides; it measures 7 m. (22.9') N/S by 4.5 m. (14.7') E/W with a maximum height of 3.1 m. (10.1'). The platform surface is uneven due to the presence of several large depressions; a collapsed area is present at the southeast corner.

A wall section is attached to the platform's southeast corner and extends roughly 7 m. (22.9') to the east or *makai*; it measures 2 m. (6.5') wide by 0.8 m. (2.6') high. Various small terraces are also attached to the *makai* side of the platform. The more prominent terrace runs parallel to the slope and retains a level soil area roughly 1 m. (3.2') wide east of the platform; this same terrace continues to the north roughly 5 m. (16.4') beyond the platform. Numerous natural soil terraces are also located upslope (*mauka*) of the platform.

Additional features are located to the south of the main platform feature. These include an indistinct partially subsurface alignment which runs due south from the platform's attached wall to a second wall located roughly 15-20 m. (49.2') south. The second wall is oriented parallel to the slope and extends downslope 4 m. (13'); these additional features in combination with the platform wall form a roughly U-shaped enclosure. This site probably represents the remnants of historic sweet potato cultivation, the platform possibly having functioned as a water tank/flume foundation.

CSH Site #: 27

State Site #: 50-50-13-2730
Site Type: Enclosure
Function: Habitation
Probable Age: Historic
Condition: Fair - Good
Dimensions: Interior: 11 m. (36') NE/SW by 4 m. 13.1 (42.9') NW/SE

Description: Site 2730 (Fig. 32) is situated on the bottom edge of an ESE facing slope at the *makai* edge of a large vegetation cluster (*hau*) surrounded by pastureland. The site is a rectangular enclosure with walls constructed of stacked cobbles and boulders rising 1.5 m. (4.9') high on the interior and 0.5 m. (1.6') exterior; these walls average 2.5 m. (8.2') wide.

The site encloses a level soil area covered by occasional boulders. The soil deposit

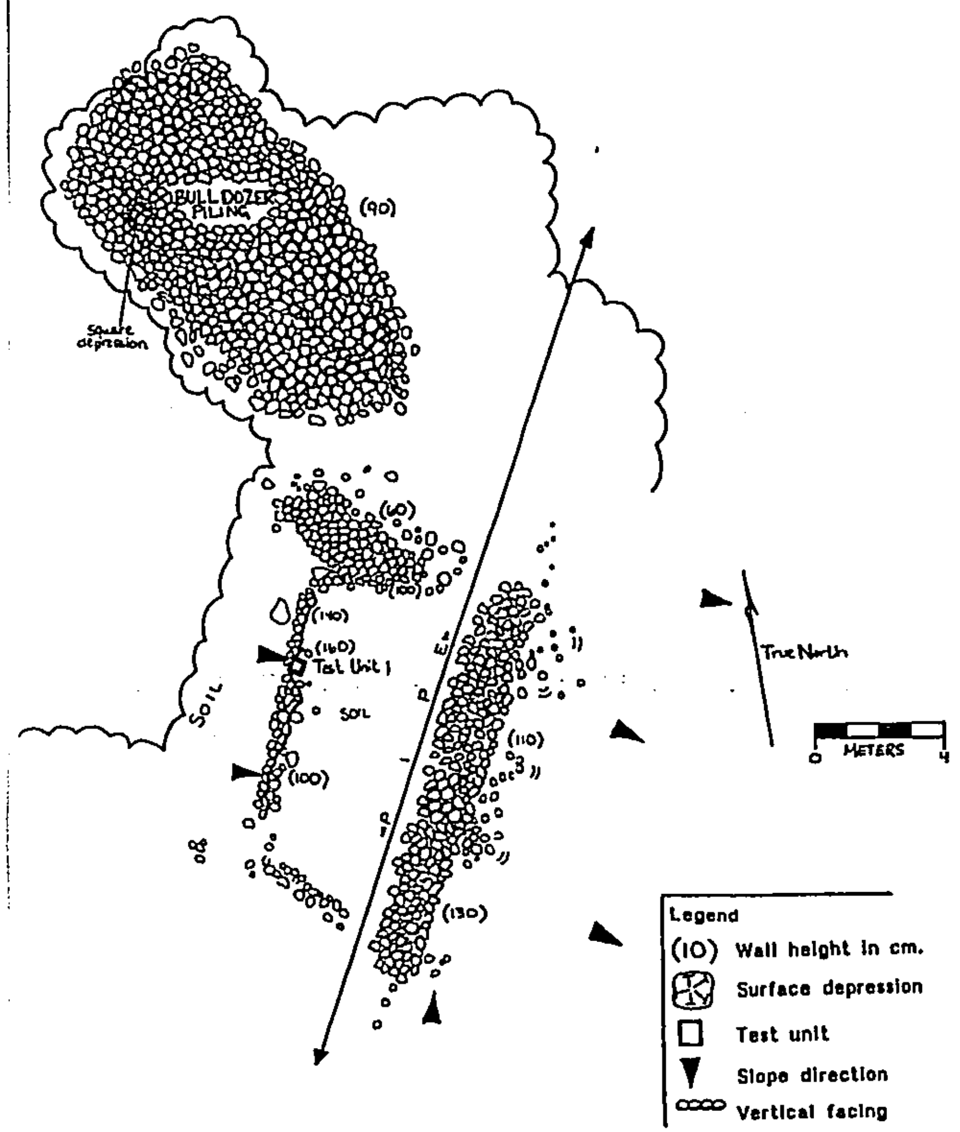


Fig. 32 Site 50-50-13-2730. Plan View

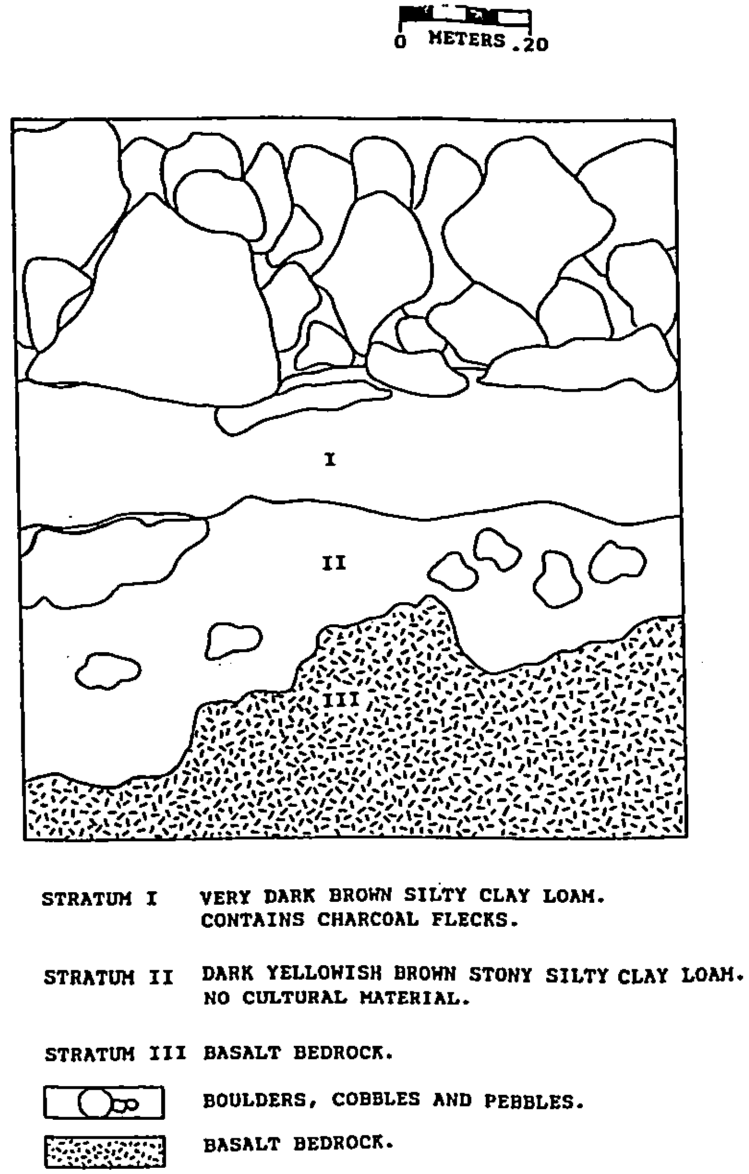


Fig. 33 Site 50-50-13-2730, Test Unit 1. West Profile

is roughly 25 cm. deep.

No artifacts or midden were observed at the site. A water pipe running along the *makai* wall of the enclosure coupled with the presence of red chili plants suggest a historic usage of the site. The presence of Papaya trees in the vicinity also suggests historic usage.

Test Results

One test unit was excavated in 50-50-13-2730. This test excavation contained only a very small quantity of charcoal flecks which were not collected. No other cultural material was observed. Three stratigraphic layers were present (Fig. 33);

Stratum I 0-20 cm. Very dark brown (10YR2/2) loose, fine, silty clay loam containing charcoal flecks. Stacked boulder wall at the location of the test unit is constructed upon Stratum I.

Stratum II 20-50 cm. Dark yellowish brown (10YR3/3) silty clay loam. Abundant slightly weathered angular pebbles and cobbles. No cultural material.

Stratum III Slightly weathered basalt bedrock

CSH Site #: 28

State Site #: 50-50-13-2731
Site Type: Platform
Function: Sugarcane Plantation Infrastructure
Probable Age: Historic
Condition: Good
Dimensions: 6 m. (19.7') N/S by 6.5 m. (20.8') E/W

Description: Site 2731 is a semi-circular platform constructed of stacked cobbles and boulders forming vertical facing along the circular side; the *mauka* or west side is squared-off with a sloped facing interrupted by areas of collapse. The platform is roughly 6 m. (19.7')in diameter and rises a maximum of 2.1 m. (6.8') along its downslope(*makai*) side. The platform surface is relatively level with several depressions; these are probably the result of settling.

A piece of rusted cable-like wire was observed on the squared-off edge of the platform. This was the only historic artifact found on any of the large platforms in this area. Informant information and plantation maps indicate the probability of a water tank foundation or flume foundation in this location.

CSH Site #: 29

State Site #: 50-50-13-2732
Site Type: Lava Tube
Function: Non-cultural
Dimensions: Extent undetermined

Description: Site 2732 is a lava tube with a 1 m. (3.2') high and 0.7 m. (2.2') wide opening. The interior of the lava tube is roughly 3.5 m. (11.4') deep by 1.5 m. (4.9') wide with a maximum ceiling height of 0.8 m. (2.6'). The floor of the lava tube drops steeply 1.5 m. (4.9') below the entrance; the floor consists primarily of exposed bedrock. The lava tube continues into two narrow chambers heading *mauka* or northwest and *makai* or southeast.

The present entrance to the lava tube is suspected to be the result of bulldozing activity. This action is suggested by the presence of impact scars on the exterior bedrock. Thus, this lava tube may not have been accessible prior to the development of bulldozing machinery.

No artifacts or midden were observed around the entrance to the tube or on the tube floor; cow bones were present on the lava tube floor.

CSH Site #:30

State Site #: 50-50-13-2733
Site Type: Modified Outcrop
Function: Agricultural
Probable Age: Historic
Condition: Fair
Dimensions: 5 m. (16.4') diameter

Description: Site 2733 is characterized by minimal modification of a natural C-shaped outcrop ridge. The modification includes a rough piling of cobbles along the vertical edge and surface of the raised outcrop formation. A possible alignment in a semi-circular configuration is present *makai*; the possible alignment and outcrop modification may at most represent an enclosure.

No artifacts or midden were observed at this site.

CSH Site #: 31

State Site #: 50-50-13-2734
Site Type: Terrace
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: 5 m. (16.4') N/S

Description: Site 2734 is a terrace remnant constructed along the *makai* edge of a vegetation cluster surrounded by pastureland. The terrace is constructed of piled boulders cross-cutting the slope of the terrain. It measures minimally 5 m. (16.4') by 1 m. (3.2') wide with a maximum height of 1 m. (3.2'). Evidence of bulldozing disturbance is present on both ends of the terrace.

No artifacts or midden were observed at the site.

State Site #: 50-50-13-2735 **CSH Site #:** 32
Site Type: Pavement/Wall
Function: Habitation
Probable Age: Prehistoric
Condition: Remnant
Dimensions: Pavement: 2 m. (6.5') diameter

Description: Site 2735 of a remnant pavement and rough wall construction located within and adjacent to a bulldozed swath which was done for the installation of a presently existing electric fence line. The wall extends to the south from the edge of the trail-cut for approximately 5 m. (17'). It is constructed of roughly piled cobbles and boulders rising a maximum height of approximately 0.7 m. (2.2'). On the opposite (north) side of the trail-cut is a linear pile of boulders 2.5 m. (8.3') long which, most likely, was pushed into this configuration as a result of the bulldozing. Even so, this pile is oriented roughly in the same direction and continues directly opposite the discontinuous wall section in the south, suggesting that it may represent a disturbed remnant of the northern portion of the wall.

The pavement - located 5 m. (16.4') *mauka* or west of the wall sections - is characterized by a surface scatter 2 m. (6.5') in diameter of water-rounded pebbles (*'ili'ili* stones). The remnant pavement is situated on moderately sloped terrain within the trail-cut.

State Site #: 50-50-13-2736 **CSH Site #:** 33
Site Type: Enclosure/Terrace
Function: Agricultural
Probable Age: Historic
Condition: Poor
Dimensions: 5 m. (16.4') E/W by 8 m. (26.2') N/S

Description: Site 2736 is a rectangular enclosure with an attached terrace serving as one of its four sides. The enclosure is constructed of three wall sections of stacked and roughly faced boulders rising 0.7 m. (2.2') high and 1 m. (3.2') wide. The overall enclosure measures 3.5 m. (11.4') N/S by 5 m. (16.4') E/W.

The terrace - which is incorporated into the *makai* or west side of the enclosure - is constructed of a rough facing of cobbles and boulders cross-cutting the natural slope of the terrain; it measures 8 m. (26.2') long (N/S) by 2 m. (6.5') wide (E/W) and rises a maximum of 1 m. (3.2') high.

The enclosure contains a grassy, level ground surface. No artifacts or midden were observed at the site.

State Site #: 50-50-13-2737 **CSH Site #:** 34
Site Type: Terraces/Walls/Pits
Function: Agricultural
Probable Age: Prehistoric
Condition: Fair
Dimensions: Covers an area approximately 22.9 m. (75') by 70.1 m. (230')

Description: Site 2737 consists of numerous agricultural features situated within talus accumulated along the south face of a prominent cliff in the southwest corner of the project area. These features include step-terraces cross-cutting the natural slope of the terrain, terrace wall segments, and probable circular pit features. This site area was designated "waste land" on a 1930s plantation map, indicating non-cane cultivation land. This suggests that these areas are possibly prehistoric and agricultural features. The pit features associated with this site were probably utilized either for tree growth or sweet potatoes.

State Site #: 50-50-13-2738 **CSH Site #:** 35
Site Type: Terraces
Function: Agricultural
Probable Age: Historic
Condition: Poor-Remnant
Dimensions: 61 m. (200') by 91.4 m. (300')

Description: Site 2738 refers to a series of terraces cross-cutting a relatively steep sloped terrain. The terraces are characterized by linear piles of boulders and minimal modification of outcrop ridges. The site area is approximately 30 m. *mauka* of Site 2742 railroad bed. This site area includes large Breadfruit, Kukui, and Mango trees as well as some red chili plants. The proximity to the railroad bed suggests that this site was possibly utilized for gardening by cane workers; however, this site also correlates to the southwest corner of LCA 2865 to Puau and the trees and terraces may be the remains of gardening associated with use of the LCA.

CSH Site #: 36

State Site #: 50-50-13-2739
Site Type: Enclosure
Function: Habitation/Agricultural
Probable Age: Prehistoric
Condition: Fair
Dimensions: Interior: 3 m. (9.8') by 5 m.(16.4')

Description: Site 2739 is an oval-shaped enclosure constructed of stacked boulders and cobbles. The interior of the enclosure is like a pit feature, thus resembling more of an agricultural feature than an habitation feature. This site, like Site 2737, is situated in the area labeled "waste land" on a 1930s plantation map. This waste land correlates fairly closely to soil classification HKMD or extremely stony silty clay loam (Foote et al., 1973:37) in areas of up to 25% slope. The percentage slope and rockiness made this area too difficult to incorporate into long-term mechanized cane cultivation.

CSH Site #: 37

State Site #: 50-50-13-2740
Site Type: Terraces
Function: Agricultural
Probable Age: Historic
Condition: Poor - Remnant
Dimensions: Covered an area approximately 75 m. (240') by 30.5 (100')

Description: Site 2740 refers to a series of short terraces constructed of piled boulders and cobbles cross-cutting the natural slope of the terrain. These terrace remnants are in very poor condition.

No artifacts or midden were observed at the site. On the downslope side of the vegetated area is a metal water pipe that traverses the entire project area. This is the same 4-inch water line as noted in Site 2730.

CSH Site #: 38

State Site #: 50-50-13-2741
Site Type: Enclosure/Terraces
Function: Habitation/Agricultural
Probable Age: Prehistoric
Condition: Fair
Dimensions: Covers an area of approximately 30.5 m. (100') by 45.7 m. (150')

Description: The main feature of Site 2741 (Fig. 34) is a rectangular enclosure

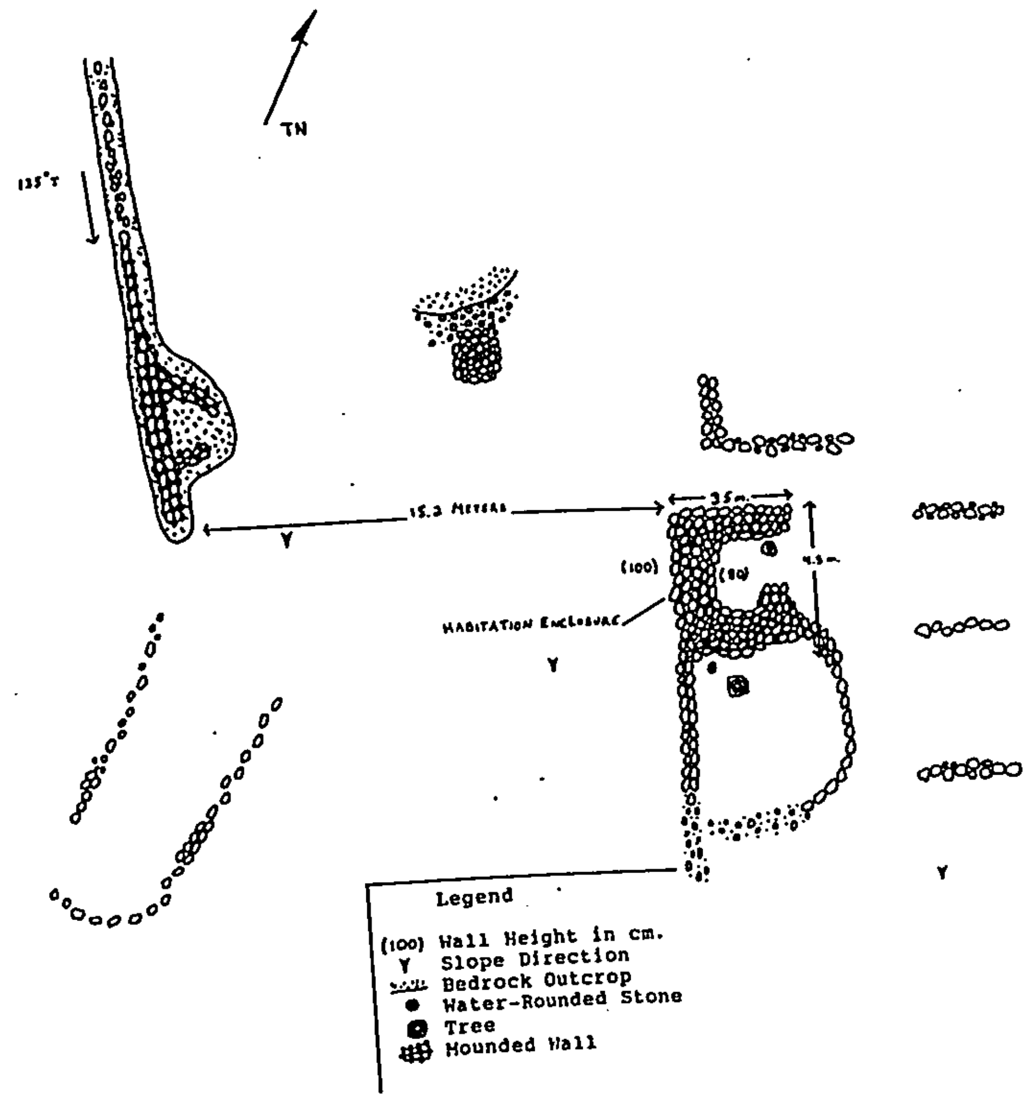


Fig. 34 Site 50-50-13-2741, Plan View.

that measures 3.5 m. (11.5') by 4.5 m. (14.7') with an interior of 2 m. (6.5') by 1.5 m. (5'). The walls are constructed of stacked boulders and cobbles and are generally 1 meter (3') in height and width. Adjacent to the downslope wall is a waterworn boulder with a shallow depression, possibly a mortar stone for pestle pounding. Surrounding the enclosure, mainly to the west, are probable agricultural terraces. The terraces extend across the slope from a *mauka/makai* oriented wall/outcrop. This site probably represents a temporary habitation feature and associated agricultural features that may be prehistoric.

State Site #:	50-50-13-2742	**CSH Site #:** 39
Site Type:	Grade	
Function:	Railroad Bed	
Probable Age:	Historic	
Condition:	Poor - Good	
Dimensions:	Extends across the eastern lowlands of the project area	

Description: The railroad alignment (See Fig. 5) consists of raised berms, cuts, and bridge foundations. Some sections have recently been improved with red cinder pavement and, at Mo'omo'onui and Mo'omo'oiki Gulches, new foot bridges have been added. The railway system began ca. 1880 and was continually upgraded during the late 1880s and early 1900s. By the 1920s there was some 12 miles of permanent track. The railway was apparently utilized until the 1940s when Hana Plantation shut down. The construction of the rail system in Hāna was initiated by August Unna. August Unna was a special proponent of the narrow (20 inch) gauge railway for sugar plantations. Condé and Best say that many Hawaiian plantation managers were skeptical of the small gauge railroad and a Mr. R. H. Fowler, of John Fowler & Co. (railroad and engine manufacturer) responds to their skepticism by saying he has always recommended the 20 inch narrow gauge for operations in Hawaii for the following reasons:

> These are cheapness, portability, lightness and strength. A gauge of 20 in. is as narrow as can be conveniently used for carrying sugar cane. Therefore I should advise that gauge for mills of a capacity up to 120 tons. At Hana Mr. Unna has carried during the last season an average of 3000 lbs of cane in each car upon a 20 in. gauge line, and he informs me that none of his cars have overturned. This fact, I submit, proves the capacity of a 20 in. gauge line. I may add that he has run trains of 7 cars down an include of 3 feet in 100 feet, a distance of 1 ½ miles, around sharp curves of 60 feet radius, in 4 ½ minutes, without accident of any kind.
>
> In hilly country, by the adoption of the 20 in. gauge, curves of 50 feet radius may be used with greater safety ...This enables the engineer laying the line to follow the lay of the land, and dispense with cuttings and embankments to a great extent, and those that are necessary in any case, are much narrower and consequently less expensive.
>
> ...I believe Mr. Unna's cars of the narrow gauge of 20 inches carry as much weight as any cars used on broader gauges in these islands, and the weight of his wagons is 700 or 800 lbs. less than others of similar capacity
> (Condé and Best: p. 247)

The Unna brothers were also instrumental in founding the organization that became known as the Hawaiian Sugar Planters Association (*op. cit: p.46*). The purpose of this association was to lobby the legislature and to bring the latest information about sugar cane, plantation housing, machinery, etc. to the various plantations around Hawaii.

It is because of the importance of Mr. August Unna to the Hana Plantation and because he was an early proponent for the use of the 20 inch narrow gauge railroad on sugar plantations and because the plantation and railroad and the Unna brothers are part of a broader pattern of Hawaiian history which includes the founding of the Hawaiian Sugar Planters Association (HSPA) that we believe State Site # 2742 has significance with regard to its connection to August and Oscar Unna, and to August Unna in particular.

State Site #:	50-50-13-2743	**CSH Site #:** 40
Site Type:	Terraces/Alignments	
Function:	Agricultural	
Probable Age:	Historic	
Condition:	Poor - Fair	
Dimensions:	Covers an area of approximately 22.9 m. (475') by 45.72 m. (150')	

Description: This site area consists of fairly indistinct terraces and alignments within Haneo'o Gulch adjacent to Pu'u Pahuolona. The area is a side channel of Hāneo'o Gulch with the main flow of water carried in the channel to the northwest. Local informant Clifford Hashimoto indicated that his family grew taro at this location. Lynn Nakkim also describes this area as having "several taro terraces" and refers to it as Site H-2 Haneo'o (Nakkim, 1970, Site H2).

State Site #:	50-50-13-2744	**CSH Site #:** 41
Site Type:	Wall	
Function:	Agricultural/Boundary	
Probable Age:	Historic	
Condition:	Fair - Good	

Dimensions: Approximately 609.6 m (2,000') long

Description: This site is a well constructed stacked boulder wall. The wall runs along the northern side of Haneo'o Gulch. The wall is discontinuous and is eventually replaced by a wire fence as it reaches Hana Highway. Intact portions range from .75 m. (2.5') to 1.5 m. (5') in width and 1 m. (3.3') to 1.5 m. (5') in height. The wall and fence undoubtedly functioned for livestock management during the sugar cane and ranching eras but also as a boundary wall. The wall and/or Haneo'o Gulch is the boundary between Aleimai *ahupua'a* to the north and Haneo'o *ahupua'a* to the south.

State Site #:	50-50-13-2745	**CSH Site #: 42**
Site Type:	Wall/Terraces/Mounds	
Function:	Agricultural	
Probable Age:	Historic	
Condition:	Poor - Remnant	
Dimensions:	Covers an area of approximately 30.5 m. (100') by 45.7 m. (150')	

Description: Site 2745 consists of a stacked boulder and cobble terrace, soil terrace(s), and four roughly faced cobble and pebble mounds (Fig. 35). The mounds are designated Features A-D.

Feature A measures 1.5 m. (5') E/W by 3 m. (10') N/S and is a maximum of .75 m. (2.3') in height. The mound which is mostly cobbles, has a barely discernable boulder alignment delineating the downslope or eastern side. There is a small tree growing out of the center of Feature A.

Feature B measures 2 m. (6.5') square by a maximum of 1 m. (3') high. Small boulders delineate the four sides of the mound and, like Feature A, there is a small tree growing out of the mound.

Feature C mound measures 2 m. (6.5') N/S by 3 m. (10') E/W with a maximum height of 1 m. (3'). Like Features A and B, Feature C is delineated on four sides by small boulder facings. Two small Java plum trees are growing out of the SE corner of Feature C.

Feature D is 2 m. (6.5') square and 1 m. (3') high and is constructed mainly of cobbles and small boulders.

Extending NNE from Site 2745 is an area of similar rock formations but with no discernable alignments or mounds other than bulldozer pushed linear piles.

It is hard to determine the function and age of this site based on the visible remains. The site and the heavily impacted area to the north could be remnants of large structures but presently they appear to represent historic features associated with sugar plantation activities. Site 2745 is immediately adjacent to the railway bed (Site 2742) and in close proximity to the railway bridge foundation, the mounds (Features A-D) being remnants of piles with sorted rock sizes utilized during construction.

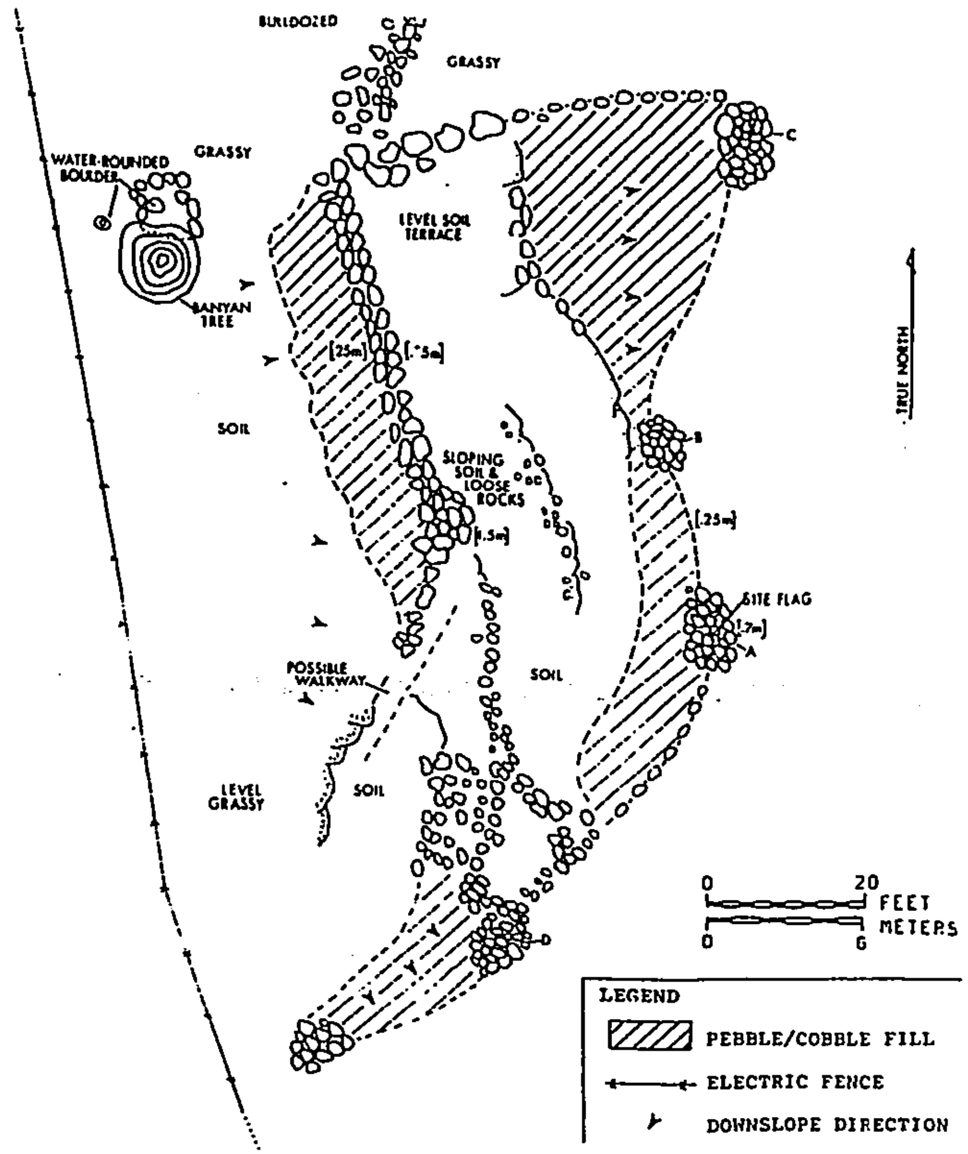


Fig. 35 Site 50-50-13-2745, Plan View

Another possibility is that Site 2745 represents the remains of large prehistoric structures, such as *heiau(s)*. Winslow Walker (1930), Inez Ashdown (1971) and Lynn Nakkim (1970) discuss four *heiau* within Pa'auhau (or Papa'auhau) *ahupua'a* that were destroyed by cane operations. Site 2745 is within Pa'auhau *ahupua'a* and because the mounds (i.e., Features A-D) resemble burial features this site is listed (Table 1) as prehistoric with significance assessments D and E.

This site is situated just outside of the petition area and is recommended for preservation.

State Site #: 50-50-13-2746 — **CSH Site #: 43**
Site Type: Roadway(s)
Function: Plantation Roads
Probable Age: Historic
Condition: Poor - good
Dimensions: 2133.6+ linear meters (7,000 linear feet) are within the project area.

Description: Site 2746 is the old plantation road system that traverses the project area. The roadway is constructed of laid basalt boulders and cobbles and measures from 3 m. (10') to 5 m. (16.5') wide and up to .25 m. (almost 1') high. The road system was utilized for sugar plantation operations and may have at one time been the bed for portable rail tracks used in hauling cane to the mill and to the permanent track (Site 2742). The road system is presently utilized as ranch roads and includes cemented troughs through the gulches allowing for vehicular crossings.

State Site #: 50-50-13-2747 — **CSH Site #: 44**
Site Type: Mound
Function: Habitation
Probable Age: Historic
Condition: Remnant
Dimensions: 5 m. (16.5') E/W by 9.5 m. (31.3') N/S

Description: Site 2747 is a low (maximum height .75 m.(2.3')) roughly rectangular mound that contains approximately 20 water-rounded boulders. The mound, possibly the foundation of a heavily impacted platform or terrace, is generally one boulder in height. Though this mound appears like a cane field boulder pile, the 20 water-roundeds indicate manuport selectivity. No other artifacts or midden were observed at the site. Site 2747 may represent a remnant habitation feature associated with LCA 3037 (to Kaleleike) or LCA 4839 (Napuanui) which were formerly located in this portion of the project area.

State Site #: 50-50-13-2748 — **CSH Site #: 45**
Site Type: Wall Section
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: Approximately 35 m. (116') long

Description: This wall probably was part of a complex of walls related to LCAs, cane cultivation, and cattle management during the time of intensive use of the project area: during the mid- 19th Century to the early 20th Century. As cane cultivation became more mechanized and cattle were more controlled, this wall system became defunct; only discontinuous remnant sections remain scattered throughout the project area.

State Site #: 50-50-13-2749 — **CSH Site #: 46**
Site Type: Structural Remnants
Function: Habitation/Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: Covers an area of approximately 35 m. (116') square.

Description: Site 2749 consists of a number of low, heavily impacted, structural remnants on the top edge of a natural break in a slope (Fig. 36). The remnants consist of rock-faced terraces, a linear mound (possible wall remnant), mounds, and an enclosure. The enclosure is the most discrete of all the features within this site area. It has exterior measurements of 5 m. (16.5') E/W by 8 m. (26') N/S and interior measurements of 2 m. (6.5') by 4 m. (13'). Wall heights range from .5 m. (1.5') to .75 m. (2.7'). there is a short section of interior facing on the northern wall. The interior of this enclosure is rocky, probably due to the pushing over of the enclosure walls. The terraces are discernable as boulder alignments with level soil areas on the *mauka* sides, all of which are overgrown with pasture grass. At the northeast end of the site area is a trig point with a spray pointed rock labeled "cow ridge." Also within the site area is a small sized metal pipe, probably a cattle trough.

Test Results

A four meter long trench was excavated in the interior of Site -2749 Feature A (Fig. 37) Three stratigraphic layers were encountered in the excavation. These are

Stratum I 0-40 cm. Very dark brown to very dark grayish brown silty clay loam.

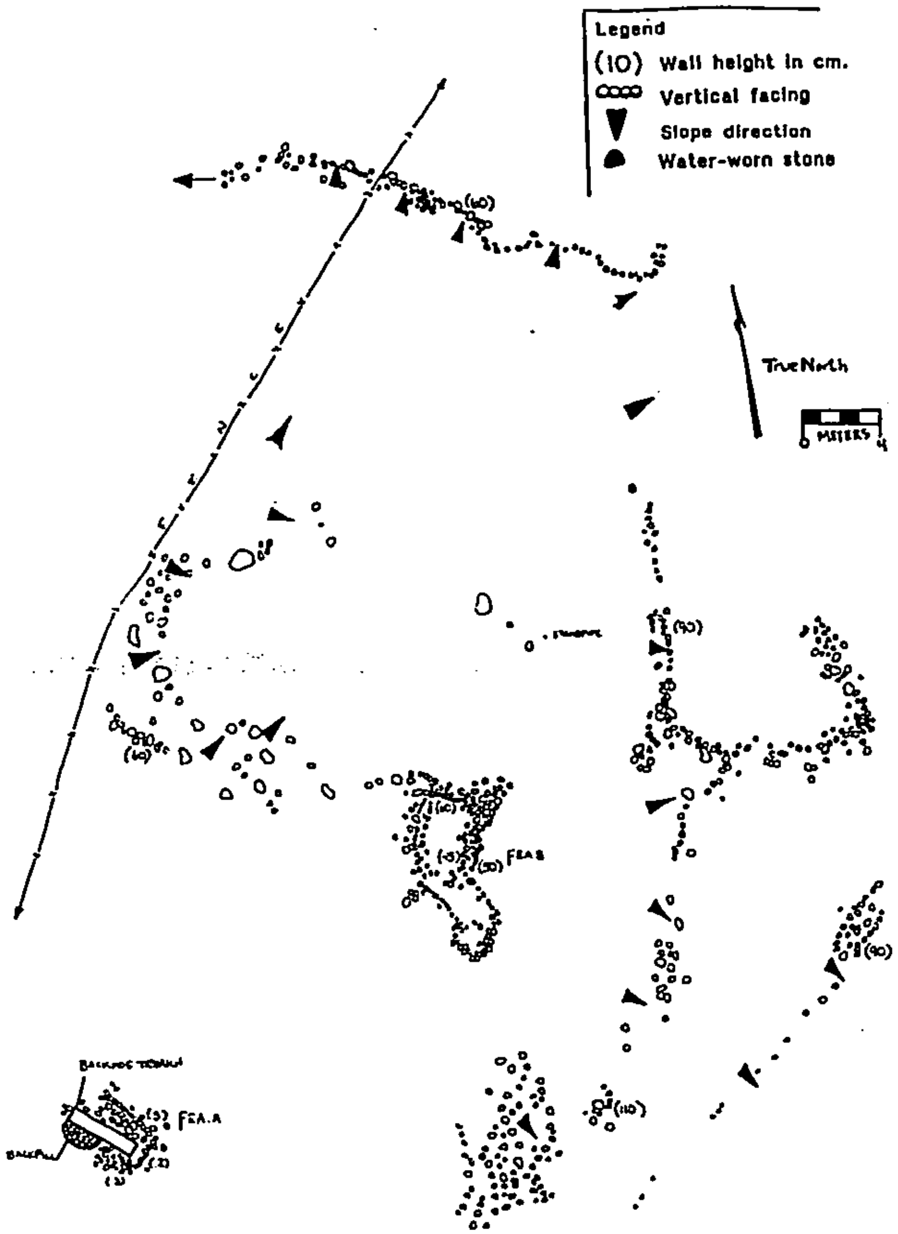
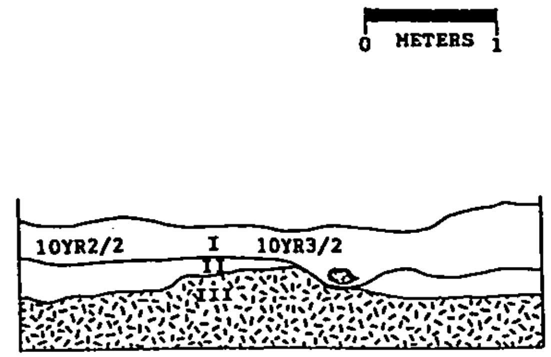


Fig. 36 Site 50-50-13-2749. Plan View



STRATUM I — VERY DARK BROWN TO VERY DARK GREYISH BROWN SILTY CLAY LOAM. CONTAINS HISTORIC ERA AND TRADITIONAL HAWAIIAN CULTURAL MATERIAL.

STRATUM II — DARK YELLOWISH BROWN SILTY CLAY LOAM. NO CULTURAL MATERIAL.

STRATUM III — SLIGHTLY WEATHERED BASALT BEDROCK.

CHARCOAL SAMPLE.

BASALT BEDROCK.

Fig. 37 Site 50-50-13-2749, Feature A. South Profile

Contains historic era artifacts including metal, and ceramic and glass fragments. Shell and bone midden is also present. A charcoal sample from this cultural layer was sent for age analysis.

Stratum II 30-60 cm. Dark yellowish brown, stony, silty clay loam. No cultural materials.

Stratum III Basalt Bedrock.

Site 2749 may represent a habitation area associated with LCA 4834 (to Manu) which is located within this portion of the project area.

State Site #: 50-50-13-2750 **CSH Site #: 47**
Site Type: Wall
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: Roughly 61 m. (200') long

Description: Site 2750 is a north/south-oriented wall remnant consisting of what appears to be just the lower course of a once more substantial wall. Presently, the wall remnant ranges in width from 1-2 m. (3-6.5') and in height from .5-1 m. (1.5-3'). This wall remnant is somewhat terrace-like in that the upslope side is nearly level to the ground surface with the downslope side having a drop-off. This wall remnant appears to have been part of a former wall system (pre-1900) associated with early cane cultivation and cattle control, and possibly LCAs (Land Commission Awards) within the project area.

State Site #: 50-50-13-2751 **CSH Site #: 48**
Site Type: Terrace
Function: Agricultural
Probable Age: Historic
Condition: Remnant
Dimensions: 6 m. or 20' section

Description: Site 2751 refers to a short 6 m. (20') section of what was once either a long wall or terrace. Presently, it appears as a boulder and cobble faced terrace with a maximum height of .8 m. (2.5'). The facing retains a narrow 1 m. (3') wide, sloping soil terrace on the upslope side.

The slope on which this terrace is situated contains other nondescript boulder and cobble pilings that were probably associated with a more formal wall or terrace structure(s). However, these pilings now appear like bulldozer pushed loose tailings on a relatively steep slope.

State Site #: 50-50-13-2851 **CSH Site #: 49**
Site Type: Faced mound
Function: Agriculture
Probable Age: Prehistoric
Condition: Fair
Dimensions: 8.75 m. (94.5') square

Description: Site 2851 is a faced mound, triangular in shape, constructed of a'a boulders and cobbles located on a gentle sloping pastureland (Fig. 38). The vegetation consists of grasses, lantana, christmas berry, and ferns. Downslope of the faced east side of the mound is the partially buried metal pipe of the 4-inch waterline that traverses through the project area in a northeast/southwest orientation. No artifacts or midden was observed. The site is in fair condition with a fair excavation potential.

State Site #: 50-50-13-2852 **CSH Site #: 50**
Site Type: Terrace
Function: Agriculture
Probable Age: Prehistoric
Condition: Fair
Dimensions: 16 m. (53') square

Description: Site 2852 (Fig. 39) measures 24 m N/S x 32 m E/W. It consists of an approximately 16 m square terrace with facing on its *makai* end, and a 20 m N/S x 10 m E/W area of boulder fill and stacking.

The terrace is built to a height of 1.4 m with facing remaining on its eastern and southern sides. The top surface is soil and grass. The terrace appears to be built on a natural outcrop terrace.

Below the terrace is a soil area through which the water pipe runs. Below this is a boulder filled area with a small, possibly man made terrace built on its southern side, with a maximum wall height of 0.8 m. Another section of wall stacking is on the NE edge of the site with a maximum wall height of 1 m.

No artifacts or midden was observed. The site is in poor condition with the excavation potential being poor.

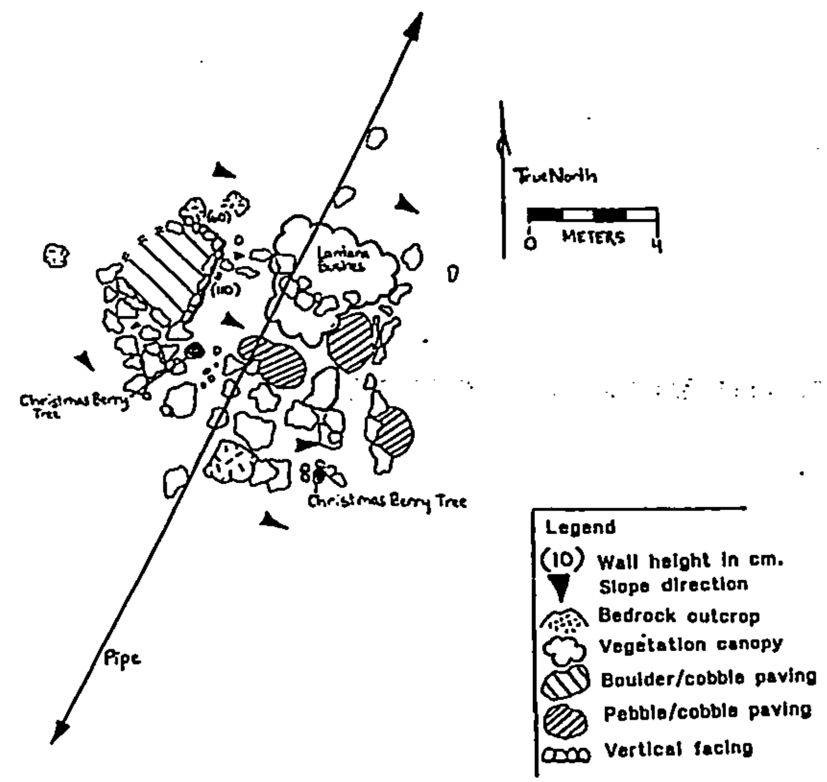


Fig. 38 Site 50-50-13-2851. Plan View

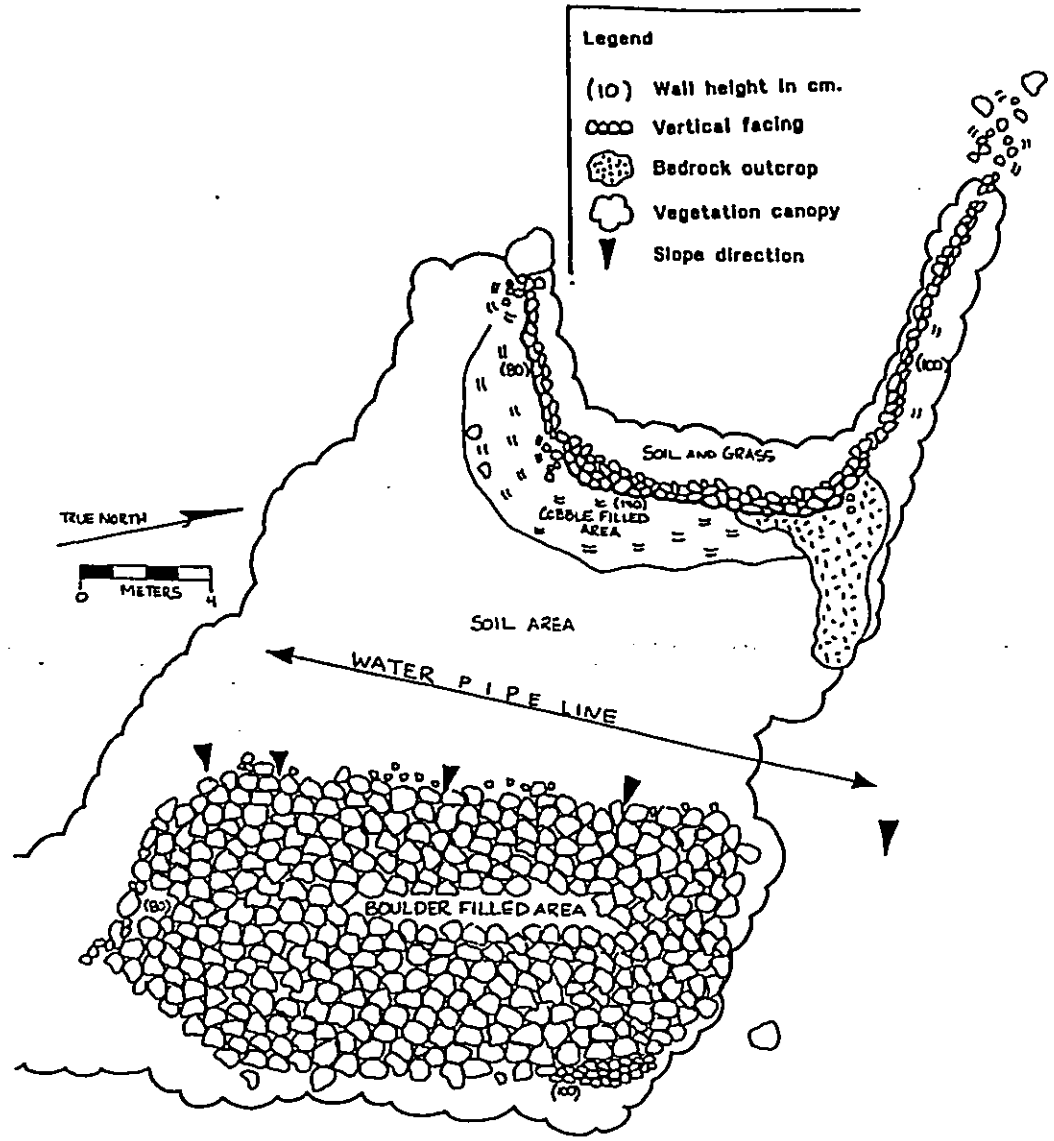


Fig. 39 Site 50-50-13-2852. Plan View

State Site #:	50-50-13-2853
Site Type:	Mound
Function:	Habitation
Probable Age:	Prehistoric
Condition:	Poor/Remnant
Dimensions:	45 m. (149') E/W x 40 m. (132') N/S

CSH Site #:117A

Description: Site 2853 (Fig. 40) is a remnant habitation site located on the *makai* end of an ancient *'a'ā* flow, thus *mauka* of the site the land is very gently sloping to level and was previously used for sugar cane growing. The *makai* edge of the site remnant drops abruptly and steeply as an exposed bedrock outcropping. The vegetation is comprised mostly of grasses with christmas berry and guavas occurring on the outcrops.

The sites dimensions are outlined by basalt boulders being stacked and ranging inheight from 0.8 m (2.5') to 1.4 (4.5') m. , thus the site surface is raised above the surrounding ground This raised character and the presence of large, oblong, water-rounded basalt boulders (Kū'ula stones) were the first indications that this was a former traditional site. A total of nine Kū'ula like stones was observed around this site. A clustering of four of these stones was noted in a rock terrace feature at the SE edge of the site.

Test Results

One Test unit was excavated in association with site -2853. Two stratigraphic layers were identified in the excavation as follows (Fig. 41);

Stratum I 0-70 cm. Brown (10YR3/3) very fine silty clay loam with approximately 40 percent pebbles and cobbles per volume in the uppermost 10 cm. decrease to approximately 15 percent rock and 85 percent soil from 10 to 70 cm. in Stratum I. Abrupt smooth lower boundary. This layer contained traditional Hawaiian cultural material including a basalt flake of poor quality, a few bird and unidentified bone fragments, and burnt kukui nut shell and charcoal bits.

Stratum II 70-90 cm. Reddish brown (5YR3/3) fine loose silty clay loam. No culture materials present. Excavation stopped at 90 cm. depth due to the absence of cultural materials and restricted area in the trench.

Material, although very sparse, recovered in the excavation suggests a prehistoric age for the site. A charcoal sample from the 50 cm. to 60 cm. level of Stratum I was sent for age analysis (calendric range AD 1425-1550).

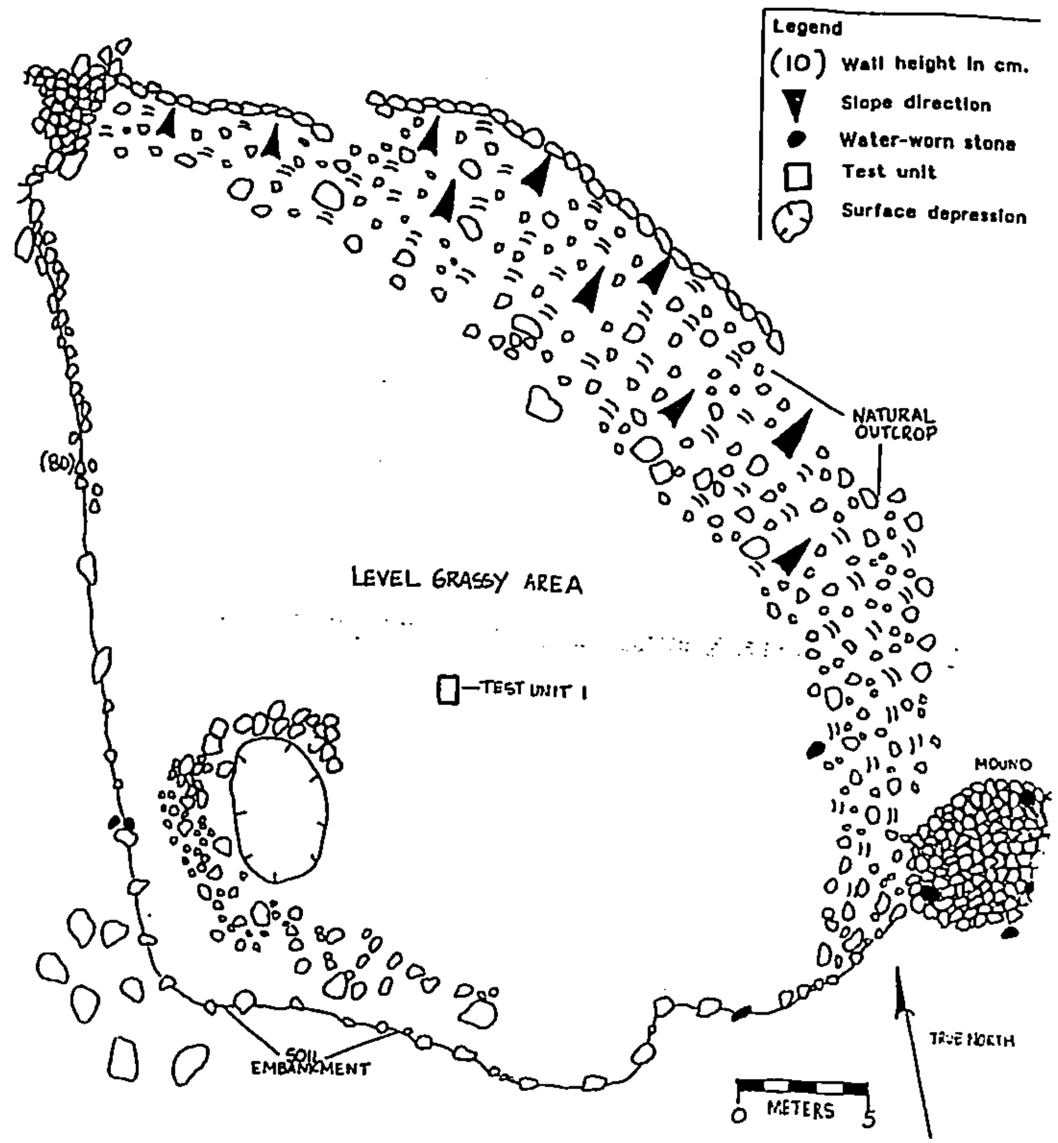


Fig. 40 Site 50-50-13-2853. Plan View

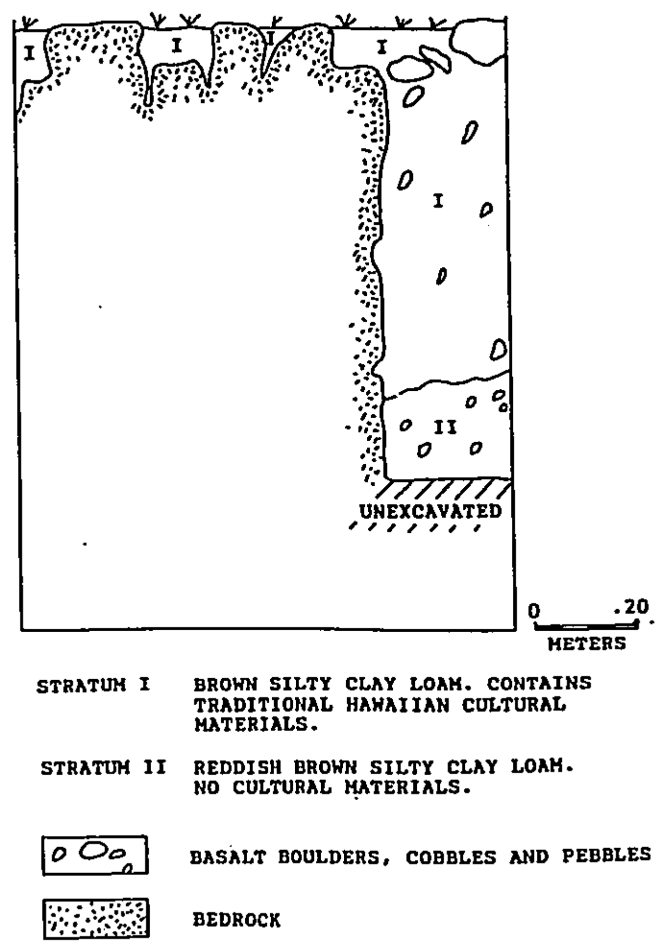


Fig. 41 Site 50-50-13-2853, Test Unit 1. East Profile

State Site #: 50-50-13-2854 **CSH #: 52**
Site Type: Terrace
Function: Agriculture
Probable Age: Prehistoric
Condition: Fair
Dimensions: 40 m. (132') W/E x 25 m. (83') N/S

Description: Site 2854 (Fig. 42) comprises a level sink, with a wall situated on a gentle slope. The sink appears to have been cleared and leveled with the rock being piled on the existing outcrop. The wall is constructed of stacked medium to small boulders with facing intact on both the N and S sides. It appears to have been a planting area in which they used existing outcrop to maximize water containment.

No artifacts or midden was observed. The site is in fair condition with the excavation potential being fair.

State Site #: 50-50-13-2855 **CSH Site #: 53**
Site Type: Enclosure
Function: Agricultural
Probable Age: Prehistoric
Condition: Fair
Dimensions: 25 m (83') N/S x 20 m (66') E/W

Description: Site 2855 consists of a remnant enclosure with an associated mound in the mauka, central exterior of the enclosure (Fig. 43). The site is located on a gentle slope heading *makai* with the vegetation consisting of pasture grasses, christmas berry, guava, lantana, and laua'e. The interior of the enclosure is level soil which is a substantial base on an old pahoehoe flow.

No artifacts or midden was observed. The site is in fair condition and the excavation potential is poor.

State Site #: 50-50-13-2856
Site Type: Platform
Function: Burial
Probable Age: Prehistoric
Condition: Good
Dimensions: Maximum 3.5 m.by 3 m. by .5 m. high

Description: Site -2856 (Fig. 44) is comprised of two low platforms separated by about one meter of open space. The platforms are constructed of small boulders stacked as walls forming the perimeter of the structures. The platform surfaces are primarily of pebble and cobble sized stones with few small boulders. Both platforms are marked by large 'a'ā slab shaped boulders stood up on edge. The platforms are located along the southern edge of one of the major drainages from Pahuolona cinder cone.

Test Results

The larger of the two platforms was excavated to test for the presence or absence of burials. A single hand excavated pit was dug into the center of the platform. Beneath the platform a loose dark reddish brown, stony deposit was excavated to a depth of 70 cm. where a human interment was identified. Upon discovering the remains excavation was stopped. The soil beneath the platform and the boulders, cobbles and pebbles of the platform were replaced to preserve the integrity of the site.

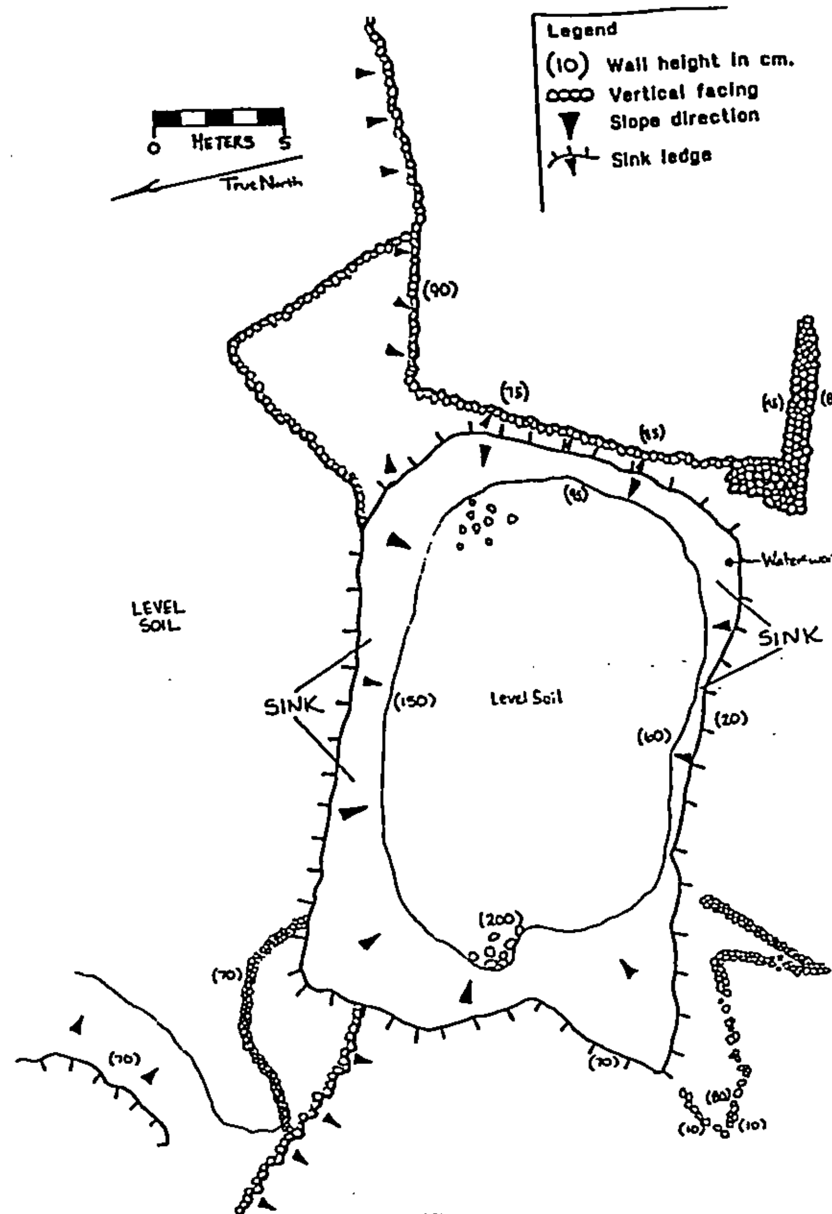


Fig. 42 Site 50-50-13-2854. Plan View

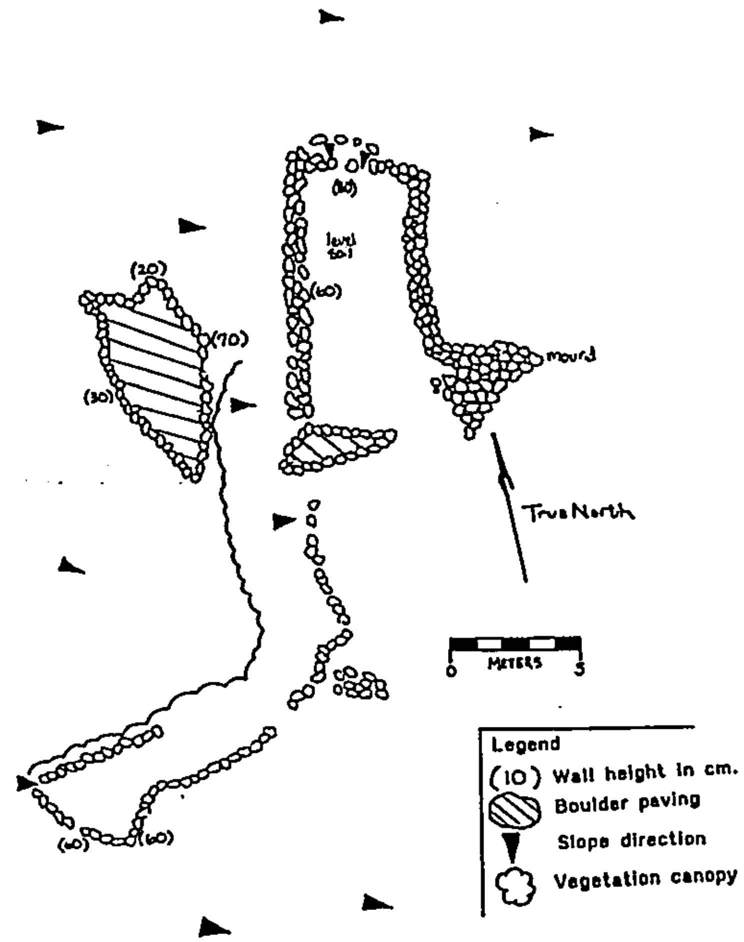


Fig. 43 Site 50-50-13-2855. Plan View

98

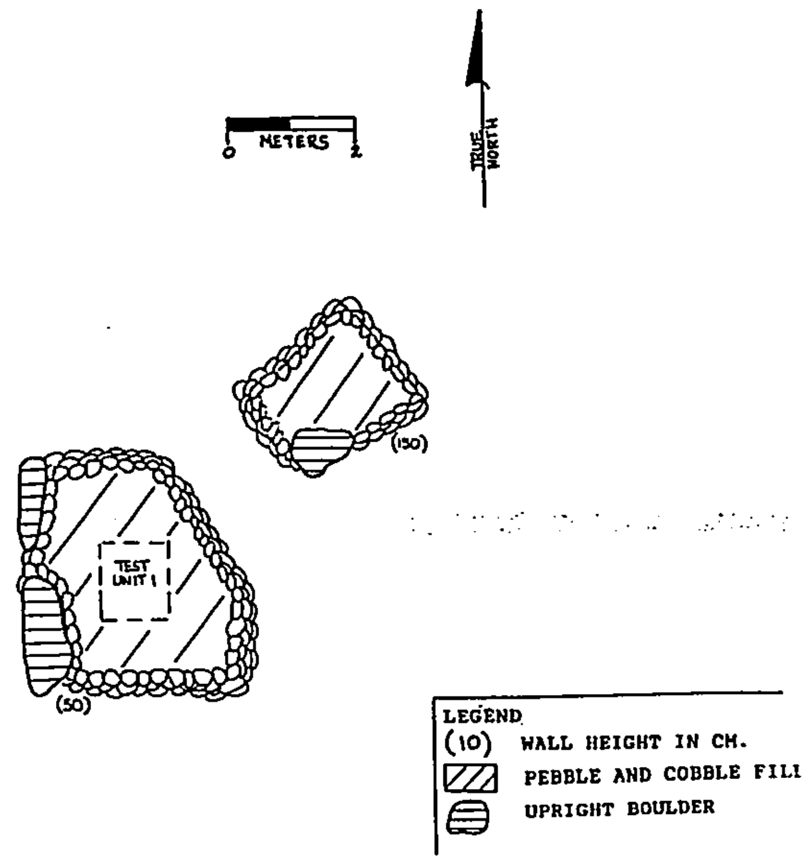


Fig. 44 Site 50-50-13-2856. Plan View

99

State Site #:	50-50-13-2857
Site Type:	Terrace
Function:	Habitation
Probable Age:	Prehistoric
Condition:	Remnant
Dimensions:	26 m. (86') N/S x 14 m. (46') E/W

CSH Site #: 117B

Descriptions: Site -2857 (Fig. 45) consists of two wall alignments which forms a Y-shape. The site is located on a rolling hill which slopes steeply to the NE. The vegetation consists mainly of grasses with christmas berry occurring on the outcrops. The eastern wall has formal construction with wall facing present. The wall is stacked and ranges in height from 0.6 m (2') to 1.15 m (4'). Two oblong, water-rounded boulders ("godstones") were observed at this site. The northern most portion of the site has been disturbed by the placement of an underground waterpipe.

Test Results

One test unit was excavated in association with Site -2857. Test Unit 1 contained two stratigraphic layers.

Stratum I 0-20 cm. Dark brown silty clay loam, contained cultural materials including four poor quality basalt flakes, a hammerstone, a mammal tooth, burnt kukui nut shell and charcoal bits.

Stratum II 20-50 cm. Dark yellowish brown, very stony, silty clay loam. No cultural materials. Excavation was discontinued at 50 cm. depth due to the absence of cultural material and the *in situ* character of the rock component of the layer.

The excavation suggests a prehistoric occupation site remnant heavily impacted by early historic period sugar plantation activity in the proximity.

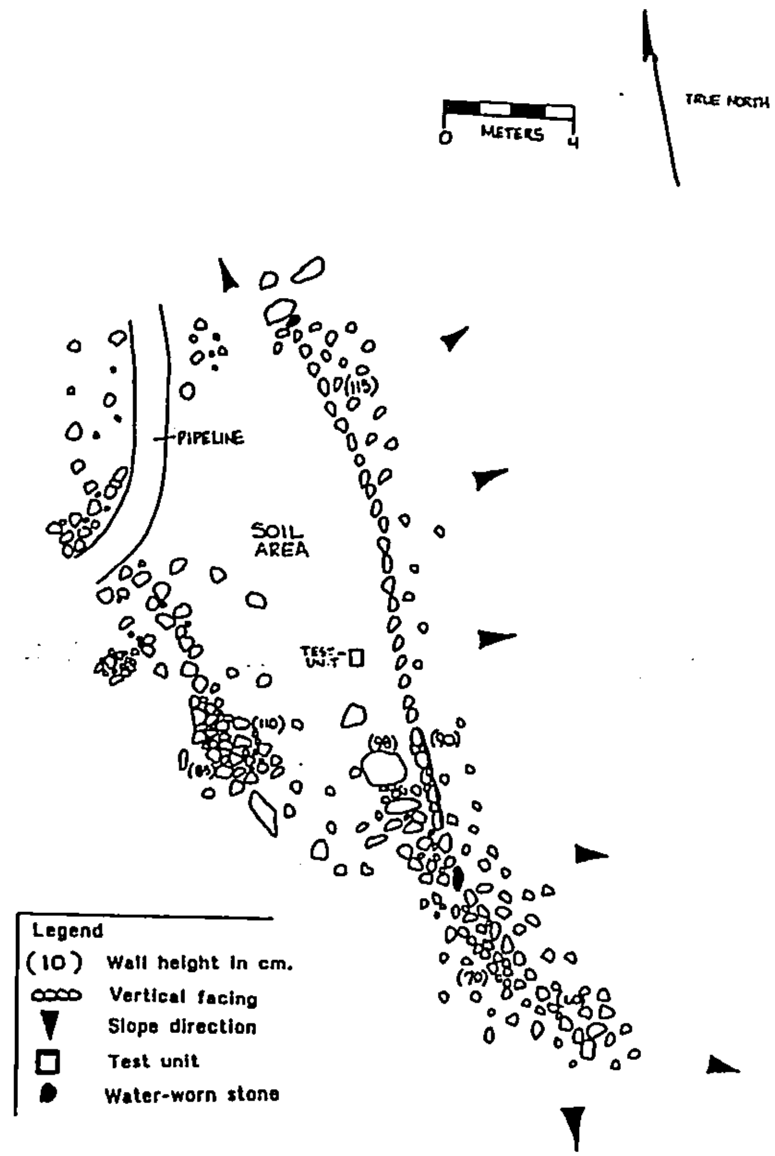


Fig. 45 Site 50-50-13-2857. Plan View

State Site #:	50-50-13-2858	**CSH Site #: 56**
Site Type:	Enclosure with possible terrace	
Function:	Habitation	
Probable Age:	prehistoric	
Condition:	Remnant	
Dimensions:	16 m. (53') N/S x 20 m. (66') E/W	

Description: Site 2858 (Fig. 46) measures approximately 16 m N/S by 20 m E/W. The site is a remnant of an occupation terrace with wall remnants of an enclosure. The enclosure lies *makai* of a narrow ranch or plantation road running N/S, and has a wall height ranging from about 0.6 m (2') to 1.3 m (4.25').

The remainder of the site consists of boulder fill which may have acted as a terrace at one time. (Due to its remnant status, only generalizations can be made). The*makai* end of the boulder fill is roughly stacked to a height of .9 m (3').

No artifacts or midden was observed. The site is only a remnant with the excavation potential being zero.

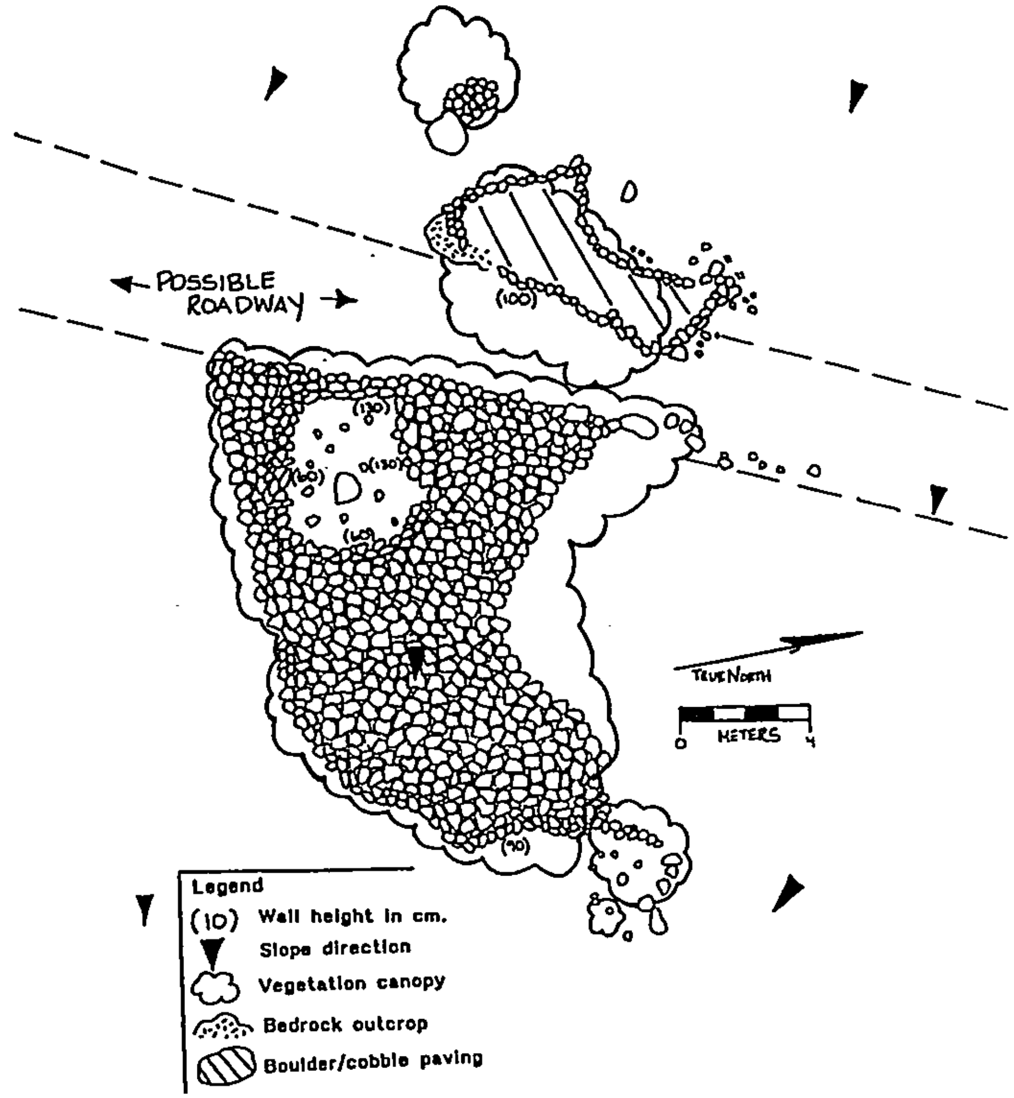


Fig. 46 Site 50-50-13-2858. Plan View

C. Radiocarbon Dating Results

Sixteen samples of charcoal were collected from seven different sites during the archaeological survey and test excavations reported on herein. Sorting the samples in the laboratory showed that many of them contained less than four grams of charcoal. Three of the sixteen samples were sent to Beta Analytic Inc. radiocarbon dating analysis. The results of this analysis provides a firm prehistoric date of A.D. 1345 to A.D. 1650 for the 40 to 50 cm. depth range of Stratum I at Site -2711 (Beta-52115). The other two samples from the disturbed Site -2853 and historic era Site -2749 yielded dates of A.D. 1425 to 1950 and A.D. 1640 to 1950 respectively.

Although these dates are few in number and only one is indisputably prehistoric they are important as the first radiocarbon dates from domestic sites of the Hawaiian farmer in the Hana district. Together with the recently obtained dates from Pi'ilanihale and other Heiau in Hana (Kolb 1992) these dates represent the beginning of a chronological sequence for the development of Hawaiian culture in the Hana district.

VI. Summary and Recommendations

The project area has been extensively modified by commercial sugar cane and cattle operations but scattered site remnants were located and described during this survey. The historical background research concerning the project area - and the Hana area in general - indicated long-term intensive habitational and agricultural usage during early historic and prehistoric times.

Sites

Fifty-one (51) sites were located and described. Table 1 lists each site by type, probable function and age, significance assessments and tentative recommendations. The basic site function categories include: habitation, agricultural, and religious.

Habitation Sites

Thirteen sites scattered across the project area suggest, to varying degrees, habitational use. Not included in this number is Heiau Site 117 which test excavations indicated continued to be used historically, possibly as a habitation site. Based on excavations, historic research and observable characteristics, three historic (3) and ten prehistoric (10) sites are represented.

The only intact habitation sites (other than site 117) are located in the south central portion of the project area, which has not been modified by cane activities. These sites (2739 and 2741) may represent the only undisturbed prehistoric habitation sites in the overall project area. Based on size and associated features these two sites appear to be temporary habitation sites associated with agricultural pursuits. These two sites are outside the petition area and are recommended for preservation.

The other habitation sites are remnant-type features with a habitation function suggested by the presence of manuports and, in some cases, by their locations within former LCAs.

Testing of Sites 2711, 2712 and 2749 tended to confirm these general observations. Sites 2711 and 2712, based on surface observations, were suggested to be prehistoric habitation site remnants. Excavations revealed indigenous midden and artifact components and a charcoal sample from 2712 had a date range of A.D. 1345 to 1650, the only clearly prehistoric date of these analyzed samples.

The testing also confirmed historic habitational use of Site 2749, which was probably associated with LCA 4834 to Manu. Recovered from the testing were butchered cow bone, ceramics, and bottle glass. Also collected from the base of the observed cultural layer, was a charcoal sample with a date range of A.D. 1640 to 1950.

Agricultural Sites

Agricultural sites include thirty-six (36) - being solely, or including agricultural features - of the total 51 sites. The majority are of probable historic age with only the sites at the southern edge and the central portion of the project area being of possible prehistoric age. The range of agricultural sites includes: historic infrastructure-type features (i.e. railroad bed and water tank foundation); walls which probably relate to early (ca. 1850s-1880s) cane cultivation and cattle exclusion; and terraces and mounds associated with sweet potato and taro cultivation which took place in the Haneo'o portion of the project area until the 1930s. The historic cultivation of sweet potato and taro maywell have been a continuation of pre-historic agriculture, however the focus of these sites has been historic modification for farming within cane fields and thus these sites are designated as historic. Additional evidence included the excavation of three platform/mounds (-2721, -2727, and -2728) in this area of Haneo'o, where no cultural material of any kind was observed and, based on informant information and construction style, these platforms are presumed historic and related to rock consolidation to maximize field areas. The possible prehistoric agricultural features include the cluster of Sites -2851, -2852, -2853, -2854, -2855 and -2858. These sites differ in construction style

by having generally smaller (cobbles to pebbles), well-sorted rocks. Also a lack of informant and historic based information on the use of this area for supplemental subsistence farming suggests that this is a cluster of pre-historic agricultural feature remnants not historically modified but left as rock piles among the cane fields.

Religious Sites

There are three sites which we have categorized as having religious connotations. These include Koahaepali Heiau, a burial site, and a possible burial site.

Koahaepali Heiau (Site 117) was recorded in the late 1920s by Winslow Walker. However, earlier listings of Hana *heiau* (i.e., T. Thrum) did not mention this *heiau*. Testing of this site suggests that it was utilized historically for habitation. The main structure of Site 117 is the largest remaining feature within the project area.

The other features with religious connotations are a confirmed burial site (-2856) consisting of two adjoining, low, paved platforms and a possible burial site (-2745). These two sites are outside of the proposed golf course petition area.

Sites -117 (Koahaepali Heiau), -2656, and -2745 are both recommended for preservation.

Historical Research

The cultural setting section of this report included examples of the legendary and traditional accounts concerning Hana. These accounts affirm the importance of the Hana area during the pre-contact period (pre-A.D. 1776). The sheer number of legends and the preeminence of the gods and goddesses mentioned (i.e. Pele, Kāne, Kanaloa, Māui, and Kū'ula) suggests a special status for the area. This holds true for the traditional accounts as well. The most prominent of Maui and Hawaii Island chiefs are associated at specific times with Hana. They include Pi'ilani and his sons Kiha'api'ilani and Lonopi'ilani, and Kahekili of Maui; 'Umi, Kalani'ōpu'u and Kamehameha of Hawaii. Evidence of this chiefly heritage is the large number of *heiau*, (some still in existence) reported in the Hana area. These clues attest to the desirability of the Hana area and the socio-political importance associated with it. Abundant ocean resources (enhanced by fishponds) and fertile, well-watered (by rain) volcanic soils would have made Hana one of the preeminent areas in the Hawaiian Islands.

All of this information indicates a substantial population within the Hana region: a population that was probably settled along or near the coast in a broad strip of land and that was not necessarily dependent on irrigation for food resource development. This is comparable to the non-irrigated field systems of Hawai'i Island (North Kohala and Kona Field Systems) (M. Tomonari-Tuggle, 1980:18-23). These non-irrigated field systems were generally located between the 20 inch isohyet and the 40 to 60 inch isohyet. Like the Hana area these portions of Hawai'i Island have relatively gently sloping, slightly dissected landscapes. However, rainfall there is dependent on elevation: the non-irrigated field system and the associated cultural landscape ranged from the 200-foot elevation up to the 2000- to 3,000-foot elevation dependent on the optimal isohyet range. In Hana by contrast, there is no need to extend agriculture to the higher elevations since rainfall at the coast is sufficient. In fact, the higher elevations in Hana would have the added problems of insufficient sunshine, excessive rainfall, and the difficulties with forest clearing and management. Further research into the comparability of the agricultural systems of Hana and Hawai'i Island may develop further insights.

The archival information concerning Land Commission Awards within the project

area appears to corroborate this settlement pattern. The relatively large size of the *kuleana* awards and the fact that they were mostly single *apana* awards suggest that awardees were living and working on the same plots of land. This is in the near-coastal zone, below the 600-foot elevation in the project area. This is in contrast to the general pattern of the Kona field system on Hawai'i Island where in response to environmental factors (specifically rainfall), house lots were awarded near or on the coast with the awardee having "upland plots" for agricultural purposes.

The advent of commercial sugar cane operations and associated land consolidation changed land tenure dramatically in Hana. Though, for the most part, the people continued to live in the same near-coastal zone, population concentrations would have shifted to mill locations. Also the change from subsistence farming to a market-based economy was essentially completed by the land consolidation process associated with commercial activities.

Initial Significance Assessment:

Of the 51 sites located and described, thirty-six (36) are assessed significant for their informational content (criterion D) only, seven (7) are assessed under multiple criteria, and eight (8) have undergone sufficient information retrieval to be cited as no longer significant (Table 1).

Of the thirty-six (36) sites assessed solely under criterion D seventeen (17) are within the petition area. Additionally, two of the seven multiple criteria sites and four of the "no longer significant" sites are within the petition area. Thus, within the petition area nineteen (19) of the total twenty-three (23) sites are assessed as having varying degrees of significance and four (4) are assessed as needing no further archaeological research.

The seven multiple criteria sites include three assessed under criteria D and E, two C and D, one A and D, and one A, B, C, and D (see Table 1 for criteria definitions). The three sites listed with criteria D and E include *Koahaepali Heiau* (Site 117), a confirmed burial (Site 2856) and, a site complex (Site 2745) which contains possible burial features. Neither of these sites are within the petition area.

The two sites listed with multiple criteria C and D include a probable prehistoric habitation site (Site 2730) and a historic water tank foundation (Site 2731). Criterion C refers to an excellent example of a site type and we are using it here in reference to the specific project area. Site 2730 is in good condition compared to other probable habitation sites and Site 2731 stands out in terms of condition and representative of historic dry masonry (ie. boulder construction). These sites are also outside the petition area.

Site 2742, the railroad grade, is listed with criteria A, B, C, and D because its construction and use "reflects major trends or events in the history of the state" (ie. criterion A); it was "associated with the lives of persons (August and Oscar Unna) significant in our past" (ie. criterion B); it "is an excellent example of a site type" (ie. criterion C); and it is "likely to yield information important in prehistory or history" (ie. Criterion D). Short sections of the railroad grade are within the petition area, including two bridges which are recommended for preservation. The other site associated with commercial sugar cane cultivation transportation is the road system (site 2746) which is

assessed as significant under criteria A and D. The roadways indicate an evolution from train oriented cane hauling to vehicular (truck) hauling. The evolution to trucks was a major trend (ie. criterion A) in the sugar industry throughout Hawaii. Portions of the roadway system are also within the petition area and preservation of intact portions (ie. selective preservation) is recommended.

The significance assessments just presented should be viewed as initial assessments. The State Historic Preservation Division of the Department of Land and Natural Resources, after review of this and other documentation, makes the actual significance assessments on a per site basis.

Recommendations:

General recommendations (refering to all 51 sites) include the preparation of a data recovery plan that would deal with further investigation of the variety of sites present within the project area. Data recovery should include excavations of both probable historic and prehistoric sites. Data recovery should emphasize recovery of datable samples for a range of sites, thus providing a basis for Hana-area chronology. Presently, this data base is not available because of the lack of systematic excavations within the Hana area.

Excavations should include both habitational and agricultural sites to better define function. Presently, function is based on observable characteristics of the individual sites and limited sub-surface testing. Also there is a distinct possibility that certain historic habitation sites may contain evidence of prehistoric usage.

Historical research within Hana itself should be part of a data recovery plan.

Sugar plantation records and maps are available only in Hana as are more recent Hana Ranch records. The historic research should also include an oral history project conducted by qualified personnel. The oral history information could then be incorporated with the archaeological data, providing a more complete historical overview of the Hana area in general.

The recommendations above should be formulated into a Data Recovery Plan in coordination with the State Historic Preservation Division (SHPD), Department of Land and Natural Resources (DLNR). In part this plan should include specifics as to types and percentages of sites to be excavated based on scientific and community concerns.

Preservation of certain sites is also recommended. These sites include Koahaepali *heiau* Site 117, burial platforms (Site -2856), portions of the railroad grade (Site 2742), portions of the boundary wall (Site 2744) between Haneo'o and Aleamai *ahuapua'a*, and portions of the sugar cane road system (Site 2746). Also sites that were included in the overall survey area but are outside of the proposed golf course area are recommended for preservation. Keola Hana Maui has also indicated that it is their desire to incorporate (preserve) virtually all sites within the golf course area itself. To facilitate such incorporation of sites into the golf course design, we recommend that this issue be part of a formalized data recovery and preservation plan.

An interim preservation plan would include protective measures during construction provisions including fencing off buffered zones, and meeting with the construction crew before construction starts to detail what areas are to be protected. A long-term preservation plan would detail site interpretation based on the data recovery

research and will make arrangements for a repository for any artifacts located. This plan will be submitted to the State Historic Preservation Division and Maui County Department of Planning for their comments and approval. Additionally, the preservation plan should include specifics as to buffer zones. This survey report should be viewed as the initial step in a process in which archaeological information is cumulative leading to a much broader understanding of Hana's cultural heritage.

VIII. References Cited

Andersen, Johannes C., F.N.Z. Inst.
1969 *Myths and Legends of the Polynesians.* Tokyo, Japan: Charles E. Tuttle Company.

Armstrong, Warwick, Ed.
1973 *Atlas of Hawaii.* U.H. Press, Honolulu.

Ashdown, Inez
1971 *Ke Ala Loa o Maui*, Ace Printing Col, Wailuku, Maui.

Beckwith, M.
1970 *Hawaiian Mythology*, University of Hawaii Press, Honolulu, Archaeological Research Center Hawaii, Inc.

Chinen, Jon
1958 *The Great Mahele, Hawaii's Land Division of 1848*, U.H. Press, Honolulu.

Cleghorn, Paul L.
1987 *A Reconnaissance Survey of a Portion of Hana Ranch lands, Maui, Hawaiian Island*, Bishop Museum.

Cleghorn, Paul L., and Kathie Rogers
1987 *Preliminary Historical and Archaeological Investigations Hana Ranch Lands, Maui, Hawaiian Islands*, Dept. of Anthropology, Bishop Museum, Honolulu, Hawaii.

Condé, Jesse C. and Gerald M. Best
1973 *Sugar Trains: Narrow Gauge Rails of Hawaii*, Glenwood Publishers, Felton Calif.

Elbert, Samuel L.
1959 *Selections from Fornander's hawaiian antiquities and Folklore*, Honolulu: University of Hawaii Press.

Foote, Donald E., E.L. Hill, S. Nakamura and F. Stephens
1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii*, U.S. Dept. of Agriculture, U.S. Government Printing Office, Washington, D.C.

Fornander, Abraham
1917-1918 *Hawaiian Antiquities and Folklore* (Vols. IV and V). Honolulu: Bishop Museum Press.

Fornander, Abraham
1969 *An Account of the Polynesian Race, Its Origin and Migrations and the Ancient History of the Hawaiian People to the Time of Kamehameha I*, Tuttle and Co., Rutland, Vermont.

Griffin, Agnes
1987 *Report on a Field Inspection of a Hana Ranch Inc. Construction Site, Wananalua, Hana, Island of Maui*, DLNR, Honolulu.

Kalākaua, David
1888 *The Legends and Myths of Hawaii*, New York: Charles L. Webster. (Reprint of three volumes published in 1877-85).

Kamakau, Samuel Manaiakalani
1961 *Ruling Chiefs of Hawaii*, Kamehameha Schools Press, Honolulu.

Kolb, Michael J.
1992 *The Development of Social Power and Chiefly Authority Through The Use of Ceremonial Architecture in the Island Polity of Maui*, Paper Presented at Society for Hawaiian Archaeology Symposium, Kauai Community College, Puhi, Kauai.

Kuykendall, Ralph S.
1928 *The Hawaiian Kingdom*, Vol. 1, U.H. Press, Honolulu.

Kuykendall, Ralph S.
1938 *The Hawaiian Kingdom*, Vol. 2, U.H. Press, Honolulu.

Maui News
1905 "Hana Plantation Company Reincorporated as Ka'eleku Sugar Company." *Maui News* 12-16-05, p. 4.

McCall, Kathleen
1940 "A History of Sugar in Hana." *Pan Pacific* 4 (April-June): 11-13, 41. Honolulu.

Nakkim, Lyn Boerner
1970 Hana, Maui: An Archaeological Survey, January, August 1970, Unpublished MS.

Speakman, Cummins E.
1981 *Mowee: An Informal History*, San Rafael, CA: Pueo Press.

Sterling, Elspeth P.
n.d. "Sites of Maui," (Vol. A, Hana), MS notes in Dept. Anthropology, Bishop Museum, Honolulu.

Thrum, Thomas G.
1917 "Maui's Heiaus and Heiau Sites Revised", *Hawaiian Almanac*, Honolulu.

Tomonari-Tuggle, M.J.
1981 *North Kohala: Perception of a Changing Community. A Cultural Resource Management Study*, Submitted to DLNR, Division of State Parks, Honolulu.

Walker, Winslow
1931 *Archaeology of Maui*, Manuscript at B.P. Bishop Museum, Honolulu.

Youngblood, Ron
1983 *On the Hana Coast*, Honolulu: Emphasis International Ltd. and Link 21

Appendix A

1. Master Artifact Catalog
   a. Indigenous
   b. Historic
2. Midden Catalog
3. Charcoal Catalog

INDIGENOUS ARTIFACTS

CULTURAL SURVEYS HAWAII
Project: Hana Ranch 50-50-13-

Acc #	Site/ Feature	Trench	Stratum	Depth (cm)	# pcs	Length (cm)	Width (cm)	Thickness (cm)	Weight (gm)	Material	Function	Comments
1	117	2	I	0-10	1	2.0	1.4	0.2	1.0	Basalt	flake	
2	117	2	II	10-20	1	7.3	3.4	2.3	79.3	Basalt	hammerstone	fragment
3	117	2	II	10-20	1	4.9	3.4	1.8	48.2	Basalt	manuport	water-rounded pebble
4	117	2	II	10-20	2	3.5/4.8	2.3/3.8	0.4/1.2	31.0	Basalt	flakes	
5	117	2	II	20-30	1	6.1	4.7	3.2	152.5	Basalt	hammerstone	
6	2853	TT1	I	10-20	1	2.9	1.9	0.6	2.5	Basalt	flake	
7	2857	TT1	I	0-10	1	7.8	4.6	2.9	177.5	Basalt	hammerstone	
8	2857	TT1	I	0-10	2	3.3/4.7	2.3/2.9	0.6/1.7	24.7	Basalt	flakes	
9	2857	TT1	I	10-20	2	2.1/7.4	1.1/5.3	0.4/1.1	37.0	Basalt	flakes	
10	2710E	TT1	I	0-10	1	2.3	1.8	0.7	1.9	Basalt	flake	
11	2710E	TT1	I	0-10	24	0.5/1.1	0.4/0.9	0.1/0.2	1.7	V-glass	flakes	
12	2710E	TT1	I	10-25	12	0.4/0.9	0.2/0.7	0.1/0.4	0.8	V-glass	flakes	
13	2710E	TT1	I	25	2	6.4	3.1	2.0	47.3	Basalt	flake	
14	2710E	TT1	II	35	3	1.3/3.1	0.8/3.2	0.6/1.9	19.9	Coral	manuports	
15	2710E	TT2	I	0-10	12	0.5/1.2	0.3/0.8	0.1/0.4	1.5	V-glass	flakes	
16	2710E	TT2	I	10	1	2.7	2.2	0.7	4.4	Basalt	flake	
17	2711	TT1	I	0-10	6	0.9/2.2	0.6/1.5	0.3/0.5	4.6	Basalt	flakes	
18	2711	TT1	I	15-23	1	8.2	6.6	4.3	366.0	Basalt	hammerstone	
19	2712				1	2.9	2.2	1.3	11.7	Basalt	manuport	water-rounded pebble fragment
20	2712	TT1	I	0-10	1	6.0	4.1	1.5	31.8	Basalt	flake	
21	2712	TT1	I	10-20	1	2.1	0.5	0.5	0.5	Basalt	flake	
22	2712	TT1	I	20-30	1	0.9	0.7	0.1	0.1	V-glass	flake	
23	2712	TT1	I	20-30	2	1.5/2.5	0.9/1.9	0.6/0.7	4.6	Basalt	flakes	
24	2712	TT1	I	30-40	3	0.9/1.0	0.4/0.6	0.1/0.3	0.5	V-glass	flakes	
25	2712	TT1	I	30-40	11	0.8/4.1	0.4/2.0	0.2/1.1	10.3	Basalt	flakes	
26	2712	TT1	I	40-50	17	1.2/5.5	0.9/3.6	0.7/1.9	143.4	Basalt	manuports	water-rounded pebbles

HISTORIC ARTIFACTS

CULTURAL SURVEYS HAWAII
Project: Hana Ranch 50-50-13-

Acc #	Site/ Feature	Trench	Stratum	Depth (cm)	# pcs	Length (cm)	Width (cm)	Thickness (cm)	Weight (gm)	Material	Function	Comments
H-1	117	2	I	0-10	5				21.8	Ceramic	bowl	fragments, white w/ blue on outside edge
H-2	117	2	II	10-20	1				0.7	Ceramic	bowl	fragment, white, part of bowl in 0-10 cms.
H-3	2749	Back dirt			2	2.1/8.7	2.2/4.4	0.5/0.5	36.3	Porcelain	plate	fragments
H-4	2749	Back dirt			7	2.0/8.0	1.4/5.8	0.3/0.5	96.0	Porcelain	plate	fragments
H-5	2749	Back dirt			2	2.7/6.0	1.9/4.4	0.3/0.4	21.9	Glass	bottle	fragments
H-6	2749A	Back hoe			5	1.5/3.5	1.3/1.0	0.4/0.8	11.4	Metal	fragments	
H-7	2749A	Back hoe			3	1.8/2.0	0.7/1.1	0.1/0.2	0.8	Glass	fragments	
H-8	2749A	Back hoe		0-25	1	2.2	2.2	0.2	1.3	Glass	fragment	
H-9	2749A	Back hoe		0-25	6	1.8/5.4	0.8/4.5	0.7/0.8	53.7	Porcelain	plate	fragments

MIDDEN CATALOG

CULTURAL SURVEYS HAWAII

Project: Hana Ranch 50-50-13-

Site #/Feature	117	117	117	117	2853	2853	2857	2710E	2712	2712	2749
Trench	TT2	TT2	TT2	TT2	TT1	TT1	TT1	TT2	TT1	TT1	Back Hoe
Depth/Stratum	0-10/I	10-20/II	20-30/II	0-30/SB	50-60/I	60-70/I	0-10/I	0-10/I	30-40/I	40-50/I	
Cellana sp.										0.4	1.9
Cypraea maculifera											44.8
Thaididae sp.											8.5
Unident./Other species	0.5	0.5						0.1	0.1		1.6
Total Mollusca	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	56.8
Bird bone					2.3						
Dog bone				0.5							
Mammal bone	4.4	0.8		0.8							125.9
Mammal teeth							0.4				
Unidentified vertebrate			0.8			0.2			0.4		
Mongoose	0.8										
Total Terrestrial Midden	5.2	0.8	0.8	1.3	2.3	0.2	0.4	0.0	0.4	0.0	125.9
Total Midden	5.7	1.3	0.8	1.3	2.3	0.2	0.4	0.1	0.5	0.4	182.7
Kukui nut									0.1		
Coral	1.9	0.8									

CHARCOAL CATALOG

CULTURAL SURVEYS HAWAII

Project: Hana Ranch 50-50-13-

Acc # (C)	Site/Feature	Trench	Stratum	Depth (cm)	Weight (gm)	Comments
1	2853	TT1	I	20-30	0.8	Charcoal
2	2853	TT1	I	30-40	1.0	Charcoal
3	2853	TT1	I	40-50	3.3	Charcoal
*4	2853	TT1	I	50-60	4.6	Charcoal & burned kukui
5	2853	TT1	I	60-70	4.1	Charcoal
6	2853	TT1	II	70-80	1.5	Charcoal & burned kukui
7	2857	TT1	I	0-10	0.3	Charcoal
8	2857	TT1	I	10-20	0.6	Charcoal & burned kukui
9	2710C	TT2	I	20	2.7	Charcoal w/ seeds
10	2710B	TT1	I	10-25	2.7	Charcoal
11	2711	TT1	I	15-23	2.5	Charcoal
12	2712	TT1	I	20-30	2.3	Charcoal
*13	2712	TT1	I	30-40	4.6	Charcoal
14	2712	TT1	I	40-50	3.0	Charcoal
15	2712	TT1	II	50-70	1.4	Charcoal
*16	2749A	Backhoe		30-40	38.0	Charcoal w/ wood chips

* = sample sent to Beta Analytic Inc. for dating

BETA ANALYTIC INC. RESULTS

Acc#	Beta#	C14 (years)	C13 (adjusted)	Calendric Range
4	52114	270+80BP	250+80	1425-1950
13	52115	410+80BP	410+80	1345-1650
16	52116	110+80BP	110+80	1640-1950

Appendix B: Photo Appendix

Fig. 47 Site 50-50-13-2710, Feature A, Faced Wall Section Portion of Large Enclosure (view to southwest)

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Fig. 58 Site 50-50-13-2746, Portion of Plantation Road System (view to northeast)

Fig. 59 Site 50-50-13-2856, Burial Platform Showing Large Upright (view to northwest)

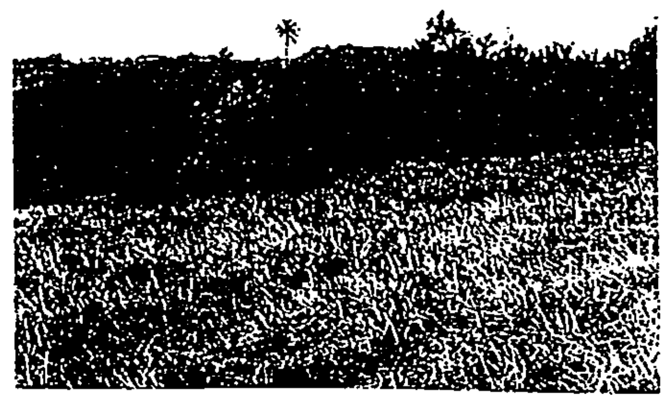

Fig. 60 Site 50-50-13-2858, Agricultural Site Remnant (view to southeast)

APPENDIX H

AIR QUALITY STUDY FOR THE PROPOSED HANA RANCH COUNTRY CLUB PROJECT

Prepared by B. D. Neal & Associates, July 1992

AIR QUALITY STUDY
FOR THE PROPOSED
HANA RANCH COUNTRY CLUB PROJECT

HANA, MAUI, HAWAII

Prepared for:

Pacific Planning & Engineering, Inc.

July 1992

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1.0 SUMMARY

Keola Hana Maui, Inc. is proposing to develop an 18-hole golf course, driving range and clubhouse on about 201 acres of land at a site located mauka of Hana Highway about 1 mile south of Hana Town on the island of Maui. Construction is presently scheduled to be completed by 1995. This study examines the potential air quality impacts that could occur as a result of the construction and use of the proposed facilities. Mitigative measures to lessen project impacts are suggested where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, six parameters are regulated including: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii state air quality standards are more stringent than the comparable national limits except for the standards for sulfur dioxide. State and national standards for sulfur dioxide are equivalent.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Hana area is very much affected by its windward and coastal situation. Much of the time the area is exposed to the trade winds, although winds are somewhat lighter and tend to be deviated more toward the north compared to other windward locations in the state due to the nearby presence of Haleakala. Kona storms generate occasional very strong winds from the south during winter. When the larger scale trade winds or Kona winds are weak or absent, small scale landbreeze-seabreeze and/or mountain-induced circulations may develop. Wind speeds typically vary between 5 and 15 miles per hour, although there can be prolonged periods of higher or lower wind speeds. Average daily temperatures at nearby Hana Airport range from about 66 to 81°F.

Average annual rainfall at the project is estimated to amount to about 65 to 75 inches.

The present air quality in the vicinity of the project is mostly affected by emissions from natural, agricultural and/or vehicular sources. The dominant natural air pollution factor for the past several years has been the volcanic haze (vog) from Kilauea Volcano which occasionally drifts into the area from more than 100 miles away. Other natural sources of air pollution that may affect the air quality of the site on a more regular basis include the ocean, plants and wind-blown dust. Agricultural emissions are relatively minor consisting mostly of fugitive dust associated with cattle grazing operations. Hana Highway, adjacent to the project site, is the only roadway through the area, but traffic is relatively light much of the time, causing little air quality degradation.

Virtually no air quality monitoring data are available from the State Department of Health for the Hana area. Based on what little data are available and considering the absence of significant sources of air pollution in the area, it is likely that both state and national ambient air quality standards are currently being met.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the

property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, use of wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, depending on the volume of traffic generated and the capacity of area roadways, long-term impacts on air quality could potentially occur indirectly as a result of emissions emanating from vehicular traffic coming to and from the development. Access to the project will be accomplished via a project access road intersecting with Hana Highway at Haneo'o Road. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current maximum ambient concentrations of carbon monoxide along roadways leading to and from the project area and to predict future levels of this contaminant both with and without the proposed project. Carbon monoxide is the major pollutant from automobiles that affects local air quality. Based on the modeling results, present carbon monoxide concentrations were estimated to be well within both state and national ambient air quality standards. In the year 1995 without the project, the highest concentrations in the project area were predicted to decrease slightly due to the attrition of older, more-polluting vehicles. In the 1995 with project scenario, added project traffic will offset the slight improvement that would otherwise occur, but concentrations will remain relatively low and well within both state and national standards. Due to the minimal air quality impacts from project traffic that were predicted, no mitigation measures other than the roadway improvements recommended by the traffic consultant appear to be warranted.

Pesticides and fertilizers will be used to maintain golf course grasses. If applied during low wind conditions using proper application techniques, contamination of nearby, downwind areas by airborne drift should not be a problem. Maintaining a safe buffer distance between target spray areas and populated locations and planting vegetation screens along the golf course perimeters will provide added measures of protection.

2.0 INTRODUCTION AND PROJECT DESCRIPTION

Keola Hana Maui, Inc. is proposing to construct an 18-hole championship golf course, a driving range and a clubhouse on a 201-acre site at Hana on the island of Maui. Figure 1 shows the general project location, while Figure 2 indicates the specific site of the proposed project. The project site is currently owned by the developer and consists largely of pastureland that is used for cattle grazing. Formerly, this site as well as several others in the Hana area were used for sugarcane cultivation. As indicated in Figure 2, the entire project site lies mauka of Hana Highway near the north intersection with Haneo'o Road. Access to the site will be achieved by developing a project access road leading from the clubhouse to the existing T-intersection of Haneo'o Road and Hana Highway, thereby creating a cross intersection with Hana Highway. It is expected that construction would begin by 1993 and be fully completed by 1995. After completion, use of the proposed facilities will be available to guests of the Hotel Hana-Maui and the public.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from the construction and use of the proposed development as planned. Measures to mitigate probable impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six air pollutants. These regulated air pollutants include: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

The State of Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the national 1-hour limit, and the state 1-hour standard for ozone is less than one-half of the federal standard.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide

standards to the national levels, but at present there are no indications that such a change is being considered.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout the state most of the year, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Over the open water and on the windward coasts of the islands, the trade winds blow with great regularity, occurring about 90 percent of the time in summer and about 50 percent of the time in winter. During trade wind conditions, afternoon winds on the windward sides of the islands typically reach about 15 to 20 mph, while during the nighttime the winds calm to about 5 to 10 mph. In winter, strong southerly or southwesterly winds occasionally occur in association with passing Kona storms. At other times when both trade winds and Kona winds are absent, winds become weak and variable and are dominated by local effects such as land/sea breezes or upslope/downslope winds.

Hana is located on the windward coast of Maui at the eastern extremity of the island just outside the Alenuihaha Channel. It lies on the lower eastern slope of Haleakala which rises to more than 10,000 feet just a few miles to the west. Wind speed and direction are measured at Hana Airport, located a few miles northwest of the project site, but these data are not summarized and reported in routine climatological reports for the state. However, wind conditions for the area can be surmised based on Hana's situation with respect to the trade winds and the surrounding topography. The nearby presence of Haleakala causes the trade wind streamlines to separate in the Hana area, and consequently winds tend to be lighter compared to many other windward locations in the state. During the daytime, winds are mostly from the northeast with some deflection toward the north due to the deviation of the trade winds caused by Haleakala. During the nighttime, winds are predominantly downslope from the west.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's windward location and low-level elevation results in a relatively moderate temperature profile compared to other leeward or higher level locations. At nearby Hana Airport, average daily minimum and maximum temperatures are 66°F and 81°F, respectively [3]. The extreme minimum temperature on record at this location is 50°F, and the extreme maximum is 91°F. Temperatures at the project site may be a few degrees cooler than at the airport due to the slightly higher elevation.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. For air pollution modeling turbulence is usually measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates best during stability class 1 conditions and worst when stability class 6 prevails. In the Hana area, stability class 5 or 6 could occur during clear, calm nighttime or early morning hours when temperature inversions form either due to radiational cooling or to downslope winds that push warmer air aloft. Stability classes 1 through 4 should prevail during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of sea breeze conditions.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas may also experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Although there are no mixing height data for Hana, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in the Hana area probably tend to be somewhat lower due to the fact that lighter winds often prevail and also because local sea breeze conditions may develop during the daytime causing temporary low-level mixing conditions.

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it may also "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. Hana is located near sea level on the fringe of the windward coast of East Maui. Within a few miles of Hana, annual rainfall ranges from more than 350 inches on the upper, windward slopes of Haleakala to only about 30 inches on the leeward coast. At Hana Airport, average annual rainfall is about 80 inches; within Hana Town itself, average annual rainfall is only about 59 inches [4]. During the past few years, unofficial annual rainfall data collected at Hana Ranch have ranged from 52 to 87 inches [5]. Annual rainfall at the project site will likely range from about 40 to 50 inches during a dry year to about 90 to 100 inches during a wet year. Insofar as the annual distribution of rainfall is concerned, winter months tend to be the wettest and summer months the driest. Winter rainfall occurs mostly in association with Kona storms, whereas summer rainfall occurs primarily as a result of warm, moisture-laden marine air moving onshore and upslope.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural, agricultural and/or vehicular sources. Natural sources of air pollution emissions which may affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and volcanoes. Of these natural sources of air pollution, volcanoes are the most significant. Volcanic emissions periodically reach the Hana area from the island of Hawaii. There have been several episodes of statewide volcanic haze since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from

the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates. Although emissions from Kilauea are vented more than 100 miles southeast of the project site, periodic southerly winds in conjunction with a lower than normal temperature inversion level can spread these emissions throughout the island chain. The American Lung Association is currently studying the character and concentrations of volcanic air pollution on the island of Hawaii. Preliminary results indicate that sulfate levels are up to five times higher in the West Hawaii area compared to locations near Hilo. Potential impacts on human health from the vog are still inconclusive and remain under study. Federally-funded programs to better research its effects are expected to be implemented within the next year.

Before World War II, the lands surrounding Hana were used for sugar cane cultivation. Today, agricultural lands in the Hana area are used primarily for grazing. Except for occasional and minor emissions of fugitive dust, this activity causes little if any degradation of air quality.

Hana Highway is the only roadway to, from and through the Hana area. This is a two-lane, paved roadway that passes the project site about a quarter mile makai. A few miles beyond Hana heading toward the Seven Pools National Park area, the paved highway ends at Kipahulu and becomes a narrow, unpaved road. Although some contamination of the air in the project vicinity from the exhausts of motor vehicles using this roadway is possible during peak traffic periods, significant levels of air pollution are unlikely because of the low volume of traffic.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very little such data exist for the island of Maui, and virtually none are available for the Hana area specifically. As indicated in Table 2, the only existing monitoring data any where near the project site consist of sulfur dioxide, particulate and PM-10 measurements that were made about 30 miles to the west at Kihei. Long term measurements of 24-hour average sulfur dioxide concentration at this location ranged from 11 to 107 $\mu g/m^3$ during 1987 but were consistently less than 5 $\mu g/m^3$ during 1988 and 1989. No exceedances of the state/national 24-hour AAQS for sulfur dioxide were recorded between 1987 and 1989. In 1985 24-hour particulate concentrations at Kihei ranged from 16 to 190 $\mu g/m^3$ with four exceedances of the state AAQS and two exceedances of the national AAQS then in effect. By 1986 the number of AAQS exceedances had decreased to only one, and in 1987 the monitor was changed to record only PM-10 (particulate matter under 10 microns in diameter) with an annual range of 11 to 107 $\mu g/m^3$. PM-10 measurements ranged from 8 to 48 $\mu g/m^3$ in 1988 and 9 to 51 $\mu g/m^3$ in 1989. These levels are within the allowable national standard and the State of Hawaii has no comparable limit. Kihei is much more developed than the Hana area, and thus air pollution levels in the project area probably are lower than those measured at Kihei.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems; concentrations of these contaminants generally have not been found to exceed AAQS elsewhere in the state. Carbon monoxide air pollution, on the other hand, typically is a microscale problem caused by congested motor vehicle traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present maximum

concentrations of carbon monoxide in the project area are estimated later in this study based on mathematical modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions which could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there could also be short-term impacts from exhaust emissions emanating from slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers.

Fugitive dust emissions may arise from grading and dirt-moving activities associated with site preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because it varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [6] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. With an average annual rainfall of about 60 to 80 inches in the Hana area, uncontrolled fugitive dust emissions from the proposed project would probably be somewhat lower than this level. In any case, State of Hawaii Air Pollution Control Regulations [7] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant dust generators. Mulching or otherwise stabilizing inactive work areas, using wind screens and/or limiting the area that can be disturbed at any given time are additional control measures that may be necessary. Control regulations require that open-bodied trucks be covered at all times when in motion if they are transporting materials that are likely to be eroded by the wind. Paving of parking areas and/or establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy

construction equipment during periods of low traffic volume. To mitigate the impact from importing construction workers for the project, the developer is proposing to fly in the non-local workers each day and transport them to and from the job site by hotel shuttle vans. Consequently, traffic from commuting construction workers should be minimal. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

By serving as an attraction for increased motor vehicle traffic on nearby roadways, the proposed project is considered to be an indirect air pollution source. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides, and those burning leaded gasoline contribute lead to the atmosphere. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. Just recently, the President signed into law the Clean Air Act Amendments of 1990. This new legislation requires further emission reductions be phased in beginning in 1994. Even without the new restrictions on motor vehicle emissions, current emission standards for new vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. Carbon monoxide emissions, for example, will go down by about 25 percent on the average during the next 5 years compared to the amounts now emitted due to the replacement of older vehicles with newer models [8].

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1990 with present conditions, year 1995 without the project, and year 1995 assuming the project is built and complete. To begin the modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. Based on the traffic impact assessment for the project [9], the only intersection that is expected to be significantly affected by traffic from the proposed project is the intersection of Hana Highway with the north loop of Haneo'o Road. As described in the traffic study,

both Hana Highway and Haneo'o Road are narrow two-lane roadways that presently form a T-intersection. All traffic entering onto Hana Highway from Haneo'o Road must stop. In the future with project case, the project access road will connect with Hana Highway at Haneo'o Road, thus transforming the T-intersection into a cross intersection. Haneo'o Road will continue to be stop-controlled as will the project access road. The project traffic study referenced above describes the present and future conditions and configurations of these roadways in more detail.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentrations which could then be directly compared to the national and state AAQS. Although worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations, the traffic impact assessment report indicates that traffic volumes are and will be higher during the afternoon peak period. Thus, for this case, afternoon meteorological conditions were assumed to prevail during the peak traffic hour, and worst-case concentrations were computed for that time of day.

The EPA computer model MOBILE4.1 [10] was used to calculate vehicular carbon monoxide emissions for each of the years studied. One of the key inputs to MOBILE4.1 is vehicle mix. Based on recent vehicle registration figures, the present and projected vehicle mix in the project area is estimated to be 91.9% light-duty gasoline-powered vehicles, 4.2% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 1% diesel-powered trucks and buses, and 1% motorcycles.

Other key inputs to the MOBILE4.1 emission model are the cold/hot start fractions. Motor vehicles operating in a cold- or hot-start mode emit excess air pollution. Typically, motor vehicles reach stabilized operating temperatures after about 4 miles of driving. For Hana traffic it was assumed that about 25 percent of all vehicles would be operating in the cold-start mode and that about 5 percent would be operating in the hot-start mode. These operational mode values were estimated based on a report from the California Department of Transportation [11] and taking into consideration the likely origins of traffic operating through the intersection studied.

An ambient temperature of 68 degrees F was used for afternoon peak-hour emission computations. This is a conservative assumption since afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE4.1 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4.1, these data were then input to the latest version of the computer model CALINE4 [12]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study for the project. Traffic volumes for the future scenario include project traffic as well as traffic from other growth that is expected to occur in the area by the year 1995. Traffic queuing estimates were made based on the project traffic study, Transporta-

tion Research Board procedures [13], U.S. EPA guidelines [14], and traffic observations at the subject intersection.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. There are no sidewalks along the roadways near the project. Model receptor sites were thus located 10 meters from the edges of the roads near the intersection studied. This represents the approximate boundary of the right-of-way. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone. Traffic on Hana Highway was assumed to move at the posted speed limit, 35 mph, with acceleration and deceleration times of 20 and 15 seconds, respectively, while vehicles using Haneo'o Road were assumed to accelerate to 25 mph in 12 seconds and decelerate to a stop in 10 seconds.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 4 was assumed. This is the most conservative stability category that can be used for estimating pollutant dispersion during the afternoon. A surface roughness length of 100 cm was assumed with a mixing height of 300 meters. Worst-case wind conditions were defined as a wind speed of 1 meter per second (2 miles per hour) from whichever wind direction that resulted in the highest predicted concentration.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be minimal. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.1 ppm to all predicted concentrations for both the 1990 and 1995 scenarios.

Table 3 summarizes the results of the carbon monoxide air quality modeling study based on the modeling approach described above. The worst-case 1-hour ambient carbon monoxide concentration in the project vicinity for the present year is estimated to be 0.9 mg/m^3. This is predicted to occur during the afternoon peak traffic hour near the intersection of Hana Highway and the north loop of Haneo'o Road. In the year 1995 without the proposed project, the worst-case 1-hour concentration is projected to decrease slightly at this location to about 0.8 mg/m^3. With the project, the predicted worst-case 1-hour concentration in 1995 would remain about the same as the present value (0.9 mg/m^3). Thus, with or without the project, worst-case 1-hour carbon monoxide concentrations in the project area should remain well within state and national AAQS.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a conversion factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on <u>monitoring</u> data, 1-hour to 8-hour concentration ratios for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One recent study based on <u>modeling</u> [15] concluded that 1-hour to 8-hour concentration ratios could typically be expected to range from 0.4 to 0.5. EPA guidelines [14] recommend using a value of 0.6 to 0.7 unless a locally derived conversion factor is available. Recent monitoring data for Honolulu reported by the Department of Health [16] suggests that this factor may range between about 0.35 and 0.55 depending on location and traffic variability. Considering the location of the

project and the traffic pattern for the area, a 1-hour to 8-hour conversion factor of 0.5 is probably most appropriate for this application.

As indicated in Table 3, the resulting estimated worst-case 8-hour carbon monoxide concentration was 0.4 mg/m^3 for the 1990 scenario. With or without the project, the worst-case 8-hour concentration in 1995 is predicted to remain near the existing level. Comparing these predicted values to the AAQS, it can be concluded that both the state and the national 8-hour standards will easily be achieved in the project vicinity both during the present year and during 1995 with or without the project.

The results of this study reflect several assumptions that must be made concerning traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and it may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

7.2 Golf Course Fertilizer and Pesticide Usage

Once the project is completed and the golf course is in use, it will be necessary to regularly apply various chemical fertilizers and pesticides to maintain grass quality. Fertilizers will be applied to the greens, fairways, tees and practice range. Herbicides will also be applied to these areas and also perimeter locations. Insecticides and fungicides will be used on greens and tees and for spot treatment of the fairways and practice range. Products specifically recommended for use at the proposed facility are identified in the environmental risk assessment and integrated golf course management plan [17].

Most of the fertilizers recommended for use are in pelletized form and will be applied using fertilizer spreading equipment. Some minor emissions of fugitive dust may occur during application, but the potential for serious impacts on air quality will be minimal. Fertilizers applied in liquid form using ground-spray equipment could potentially drift onto non-target areas if applied improperly. Any liquid fertilizer proposed for use, however, will likely be comprised largely of nitrogen, and thus should not pose a significant threat to human health or welfare. Potential impacts from the application of liquid-type chemicals are discussed below in more detail in conjunction with chemical pesticide usage.

Golf course pesticides are generally applied in liquid form using ground-spray equipment. Typically, this includes tractor-mounted spray bars for fairways and perimeter areas and portable sprayer units for greens and tees and spot treatment of fairways. Pesticide chemicals are diluted with water in a mixing compartment, and the solutions are then typically applied under 20 to 40 pounds per square inch (psi) pressure to the target area by flat-fan type nozzles at about 1 to 3 feet above ground.

Drift from spray equipment can occur by two different means. Vapor drift occurs when a chemical vaporizes after being applied to the target area. The vapors may then be carried downwind to adjacent locations. The amount of vaporization that occurs depends mostly on the ambient temperature and the volatility of the pesticide being used. Higher ambient temperatures promote more vaporization

to take place. Ambient temperatures at Hana are relatively moderate, normally ranging between about 65°F and 80°F. Warmer nighttime and morning temperatures will tend to promote more evaporation to occur, while moderate daytime temperatures will cause less. In any case, the chemicals which will likely be used will have a low volatility within the temperature range that occurs at Hana. Thus, vapor drift from the application of pesticides at the proposed golf course should not be a problem.

Physical droplet drift occurs when the wind moves spray particles away from the target spray area during application. This is generally the major concern. Pesticide solutions from spray equipment vary in size from large rain-drop size droplets down to small fog-sized mists. Table 4 shows the droplet size range distribution by volume for a flat-fan nozzle sprayer such as is typically used on a golf course. As indicated in the table, about 85 percent of the spray volume is typically larger than about 100 microns diameter when applied at 20 psi; this percentage reduces to about 70 percent when applied at 40 psi.

Large droplets are deposited on or very near the target area, while small droplets can drift significant distances downwind before being deposited. Figure 3 shows the approximate drift distances for various sizes of droplets from spray equipment falling 10 feet in a 3 mph wind. Droplets smaller than about 100 microns diameter can drift from several hundred to several thousand feet downwind when applied under these conditions. Normally, as mentioned above, the drop distance from a golf course sprayer will be about 3 feet or less, and thus the potential drift distances will be much smaller than those shown in the figure.

Table 5 compares downwind distances for droplet drift from nozzle spray equipment to diminish to 1 percent when spraying is performed using various types of nozzles and under various spray height, pressure and wind speed conditions. These tests were performed using agricultural spray equipment at a location in North Dakota. As can be seen from the table, 99 percent of the spray was deposited within 17 feet even under wind speeds up to 10 mph. Lower spray heights, lower application pressures, use of thickeners and use of nozzles producing larger droplets all reduced the distance to the 1 percent value.

AAQS have not been established for any of the pesticides presently in use, although occupational safety and health standards have been established for some of the chemical ingredients. Most pesticide products carry warning or caution labels on their containers. The primary purpose of these labels is to provide occupational safety and health guidance regarding proper handling and application. The chief risk of using these chemicals is to the applicator rather than to individuals at possible receptor sites downwind, since these individuals should encounter airborne concentrations of these chemical substances only in greatly diluted form if at all when applied properly. Measures available to control drift from pesticide application include:

1) using coarse nozzle and low pressure spray equipment;

2) using shielded or shrouded sprayers;

3) using thickener additives;

4) using non-volatile or low-volatile chemicals;

5) applying at lowest possible height and during low wind speed conditions when the wind direction will carry any drift away from populated areas;

6) applying during periods when temperatures are cooler and humidities are higher and when ground-based temperature inversion conditions are absent;

7) maintaining adequate buffer distance (at least 100 feet) between sprayer and populated areas;

8) planting trees and shrubs around golf course perimeter to intercept drift at property boundary.

Use of at least several of the above control measures should effectively mitigate air quality impacts from chemical drift.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major short-term air quality impact will be the potential emission of significant quantities of fugitive dust during project construction phases. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to less than 1.2 tons per acre per month. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice a day on days when rainfall does not occur. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto Hana Highway.

Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

The primary potential long-term air pollution impact from the project will arise indirectly from increased motor vehicle traffic associated with the project. Potential increased levels of carbon monoxide concentrations along roadways leading to and from the proposed development will be the primary concern. Based on mathematical modeling of projected vehicular traffic and on atmospheric dispersion estimates of project-related vehicular emissions, maximum carbon monoxide concentrations along roadways in the project vicinity in the year 1995 (at the time of project completion) will be only slightly higher than existing levels and should remain well within both state and national ambient air quality standards. Without the project, concentrations in 1995 will likely decrease slightly compared to 1990 levels. Due to the negligible impact that is predicted from project-related automobile emissions, no mitigative measures appear to be necessary.

Compliance with application guidelines for the spraying of chemicals for golf course maintenance should mitigate any potential air quality impacts from this activity. Measures available to mitigate impacts from pesticide drift include: spraying chemicals

using coarse-droplet, low-pressure spray equipment; using shielded or shrouded sprayers; using thickener additives and/or low- or non-volatile chemicals; spraying from low heights during favorable wind, temperature and humidity conditions; maintaining a safe distance from sensitive receptor sites; and planting vegetation screens around the golf course boundary.

REFERENCES

1. U.S. Congress. Clean Air Act Amendments of 1977 (P.L. 95-95), Section 109, National Ambient Air Quality Standards, August 1977.

2. U.S. Environmental Protection Agency. Revisions to National Ambient Air Quality Standards for Particulate Matter, Federal Register, Vol. 52, p. 2463, July 1, 1987.

3. National Oceanic and Atmospheric Administration, Environmental Data Service, National Climatic Center, "Climatography of the United States No. 60, Climate of Hawaii", Asheville, NC, July 1978.

4. U.S. Department of Commerce, Weather Bureau, "Climatography of the United States No. 86-44, Decennial Census of the United States Climate, Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", Washington, D.C., 1965.

5. Personal communication, John B. Hanchett to B.D. Neal, precipitation records for Hana Ranch, 1987-89.

6. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fourth Edition Including Supplements A, B and C, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1990.

7. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

8. Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources, Fourth Edition Including Supplement A, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1991.

9. Pacific Planning & Engineering, Inc., Draft Traffic Impact Assessment Report for the Proposed Hana Ranch Golf Course Project, March 1992.

10. User's Guide to MOBILE4.1 (Mobile Source Emission Factor Model), EPA-AA-TEB-91-01, U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Mobile Sources, Emission Control Technology Division, Test and Evaluation Branch, Ann Arbor, Michigan, July 1991.

11. Benson, Paul E., "Corrections to Hot and Cold-Start Vehicle Fractions for Microscale Air Quality Modeling", California Department of Transportation, Transportation Laboratory, Sacramento, California.

12. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

13. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., Special Report 209, 1985.

14. Guidelines for Air Quality Maintenance Planning and Analysis: Indirect Sources, Volume 9 Revised, U.S. Environmental Protection Agency, September 1978.

15. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

16. Hawaii Air Quality Data for the Period of January 1985 to December 1987, State of Hawaii Department of Health.

17. "Environmental Risk Assessment and Integrated Golf Course Management Plan for the Proposed Golf Course at Hana, Maui", Environmental & Turf Services, Inc., Draft, April 30, 1992.

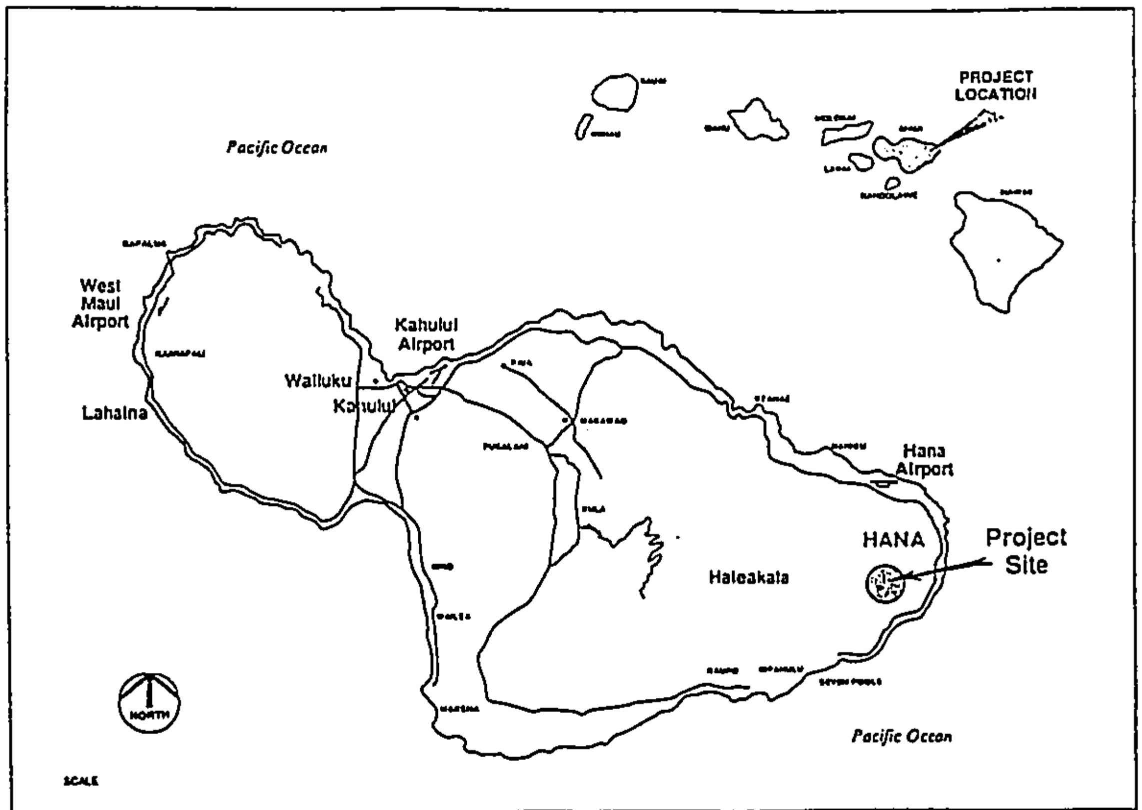

Figure 1. PROJECT LOCATION MAP

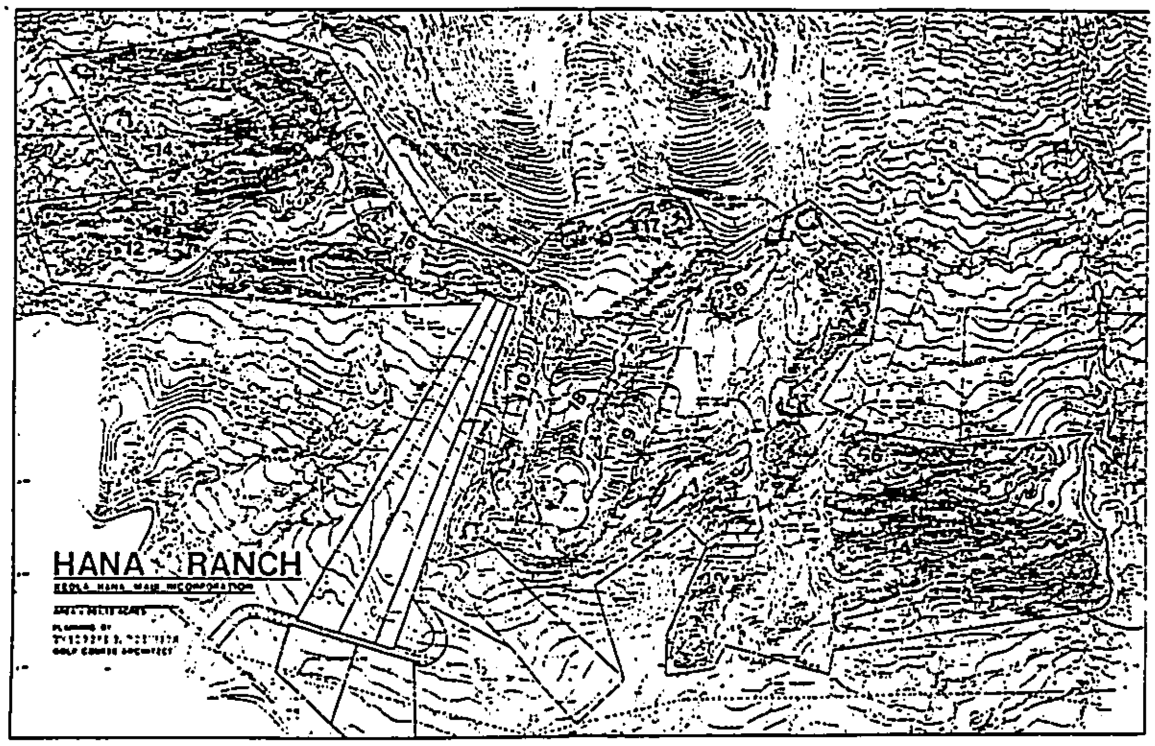

Figure 2
PROJECT SITE MAP

DROPLET SIZE VERSUS DRIFT DISTANCE
(BASED ON 10-FT FALL IN A 3 MPH WIND)

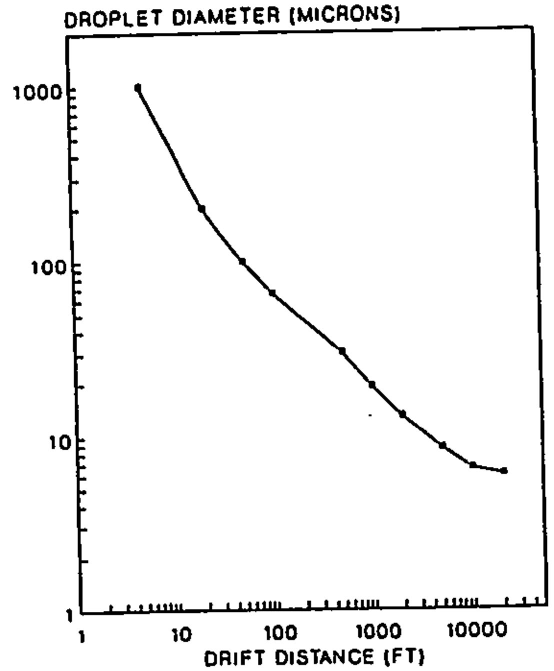

Figure 3

Source: "Spray Equipment and Calibration", V. Hofman, et al., Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, Report No. AE73, Revised, January 1986.

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

			Maximum Allowable Concentration		
Pollutant	Units	Averaging Time	National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	$\mu g/m^3$	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	$\mu g/m^3$	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	$\mu g/m^3$	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	$\mu g/m^3$	1 Hour	235[b]	235[b]	100[b]
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5

[a]Geometric mean

[b]Not to be exceeded more than once per year

[c]Particles less than or equal to 10 microns aerodynamic diameter

Table 2

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST HANA RANCH GOLF COURSE PROJECT

Parameter / Location	1985	1986	1987	1988	1989
Sulfur Dioxide / Kihei					
No. of 24-Hr Samples	-	-	38	29	38
Range of 24-Hr Values (µg/m3)	-	-	11-107	<5-<5	<5-5
Average Daily Value (µg/m3)	-	-	28	<5	<5
No. of State AAQS Exceedences	-	-	0	0	0
No. of National AAQS Exceedences	-	-	0	0	0
Particulate / Kihei					
No. of 24-Hr Samples	34	11	-	-	-
Range of 24-Hr Values (µg/m3)	16-190	32-167	-	-	-
Average Daily Value (µg/m3)	54	61	-	-	-
No. of State AAQS Exceedences	4	1	-	-	-
No. of National AAQS Exceedences	2	1	NA	NA	NA
PM-10 / Kihei					
No. of 24-Hr Samples	-	-	38	31	34
Range of 24-Hr Values (µg/m3)	-	-	11-107	8-48	9-51
Average Daily Value (µg/m3)	-	-	28	27	26
No. of State AAQS Exceedences	NA	NA	NA	NA	NA
No. of National AAQS Exceedences	-	-	0	0	0

Source: State of Hawaii Department of Health

Table 3

ESTIMATED WORST-CASE CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR HANA RANCH GOLF COURSE PROJECT (milligrams per cubic meter)

	Averaging Time	
Year/Scenario	1-Hour	8-Hours
1990/Present	0.9	0.4
1995/Without Project	0.8	0.4
1995/With Project	0.9	0.4
Air Quality Standard:		
National	40.0	10.0
State	10.0	5.0

Table 4

DROPLET SIZE RANGE DISTRIBUTION BY VOLUME FOR FLAT FAN NOZZLE SPRAY EQUIPMENT

Droplet Size Range (microns)	Percent of Total Volume	
	@20 PSI	@40 PSI
0-21	0.1	0.4
21-63	3.0	10.4
63-105	10.7	20.1
105-147	16.2	25.4
147-210	36.7	35.3
210-294	27.5	7.7
>294	5.8	0.7

Source: "Spray Equipment and Calibration", V. Hofman, et al., Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, Report No. AE73, Revised, January 1986.

Table 5

DOWNWIND DISTANCES FOR DRIFT FROM NOZZLE SPRAY EQUIPMENT TO DIMINISH TO 1 PERCENT

Run Number and Comparison	Pressure (PSI)	Wind Speed (mph)	Downwind Distance (ft)
1. Regular flat fan at 14" height	40	3.5	7
Regular flat fan at 27" height	40	3.5	13
2. Regular flat fan at low pressure	25	9.9	15.5
Regular flat fan at high pressure	40	9.9	17
3. Regular flat fan at 18" height	30	5.3	14
Low pressure flat fan at 18" height	15	5.3	11
4. Regular flat fan with thickener	30	8.2	7
Regular flat fan w/o thickener	30	8.2	16.5
5. Flooding flat fan at 13" height	10	4.2	5.5
Regular flat fan at 18" height	30	4.2	9
6. Raindrop nozzle at 18" height	40	10.3	7
Regular flat fan at 18" height	30	10.3	16

Source: "Spray Equipment and Calibration", V. Hofman, et al., Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, Report No. AE73, Revised, January 1986.

APPENDIX I

NOISE STUDY FOR THE HANA RANCH COUNTRY CLUB

Prepared by Y. Ebisu & Associates, March 1992

NOISE STUDY
FOR
THE HANA RANCH COUNTRY CLUB
HANA, MAUI, HAWAII

Prepared for:
PACIFIC PLANNING & ENGINEERING, INC.

Prepared by:
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MARCH 1992

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Hana Ranch Country Club Project in Hana, Maui were evaluated for their potential impact on present and future noise sensitive areas. The future traffic noise levels along the primary access roadways to the project were calculated for the Year 1995. In addition, the potential noise impacts from the planned, daily transportation of construction workers to and from the job site in Hana were also evaluated. The evaluation of potential noise impacts from additional aircraft flights to and from Hana Airport during the construction period was also included in the acoustical study.

Along Hana Highway, traffic noise levels are expected to increase by 1.5 to 2.2 Ldn between CY 1990 and CY 1995 as a result of both project and non-project traffic. Along Haneoo Road, traffic noise levels are expected to remain unchanged. Traffic noise increases due to non-project traffic are predicted to be greater than the noise increases caused by project traffic along Hana Highway between the project site and Hana Town. The increases in noise levels associated with project traffic are considered to be moderate, and are predicted to be in the order of 1.0 Ldn. Along Hana Highway and south of the project site, increases in noise levels are not expected to occur as a result of project traffic.

Based on CY 1989 noise contours for Hana Airport which were developed during this current study, existing noise sensitive properties are located outside of the existing 55 Ldn noise contour, and are considered to be in the "Minimal Exposure, Unconditionally Acceptable" noise exposure category. During the construction period for the proposed golf course project, as many as six DASH 7 aircraft flights per workday will be required to transport workers to and from Hana. A maximum of three early morning (before 7:00 AM) DASH 7 arrivals are expected to be necessary on each workday.

Departures of these aircraft are not expected to occur after 10:00 PM. The addition of these extra flights during the two year construction period is predicted to expand the aircraft noise contours by 5 to 10 Ldn. However, the 55 Ldn noise contour is not expected to extend into noise sensitive properties during the construction period, and for this reason, the risks of adverse health and welfare effects from the increase in airport operations during the construction period are considered to be low.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future background noise levels in the environs of the proposed Hana Ranch Country Club Project in Hana on the island of Maui. Traffic noise level increases and impacts associated with the proposed development were to be determined along the public roadways which were expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Additionally, potential noise impacts from operations on the golf course and from clubhouse activities were also evaluated. Assessments of possible short term noise impacts during the construction period were also performed. Construction workers will be commuting by air to and from Hana Airport, and by van between Hana Airport and the project job site. The increased noise resulting from additional fixed wing aircraft operations at Hana Airport and from additional van trips along Hana Highway were also included in the evaluation of short term noise impacts during the construction period. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

TABLE 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in FIGURE 1. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 Ldn lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (Reference 2), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-

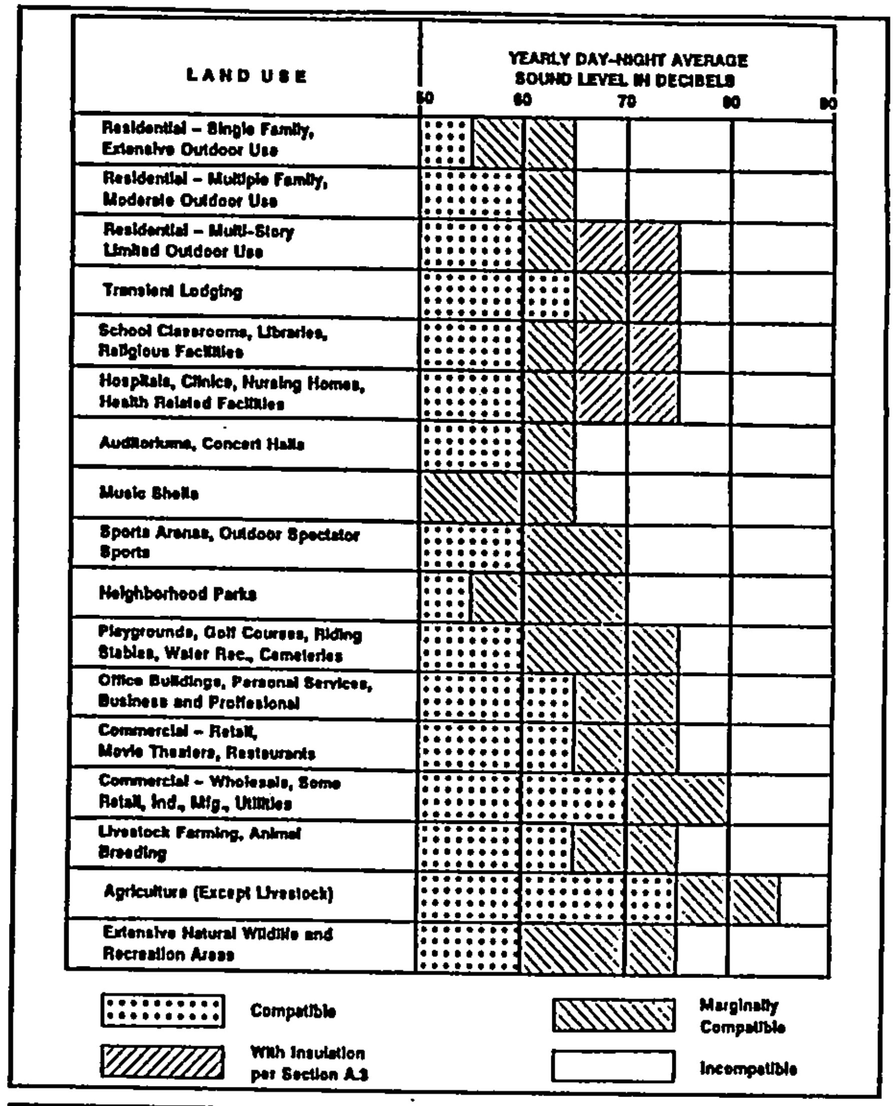
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL(1) STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable(2)
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the L_{eq} instead of the L_{dn} descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.



LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE 1

interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 3, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

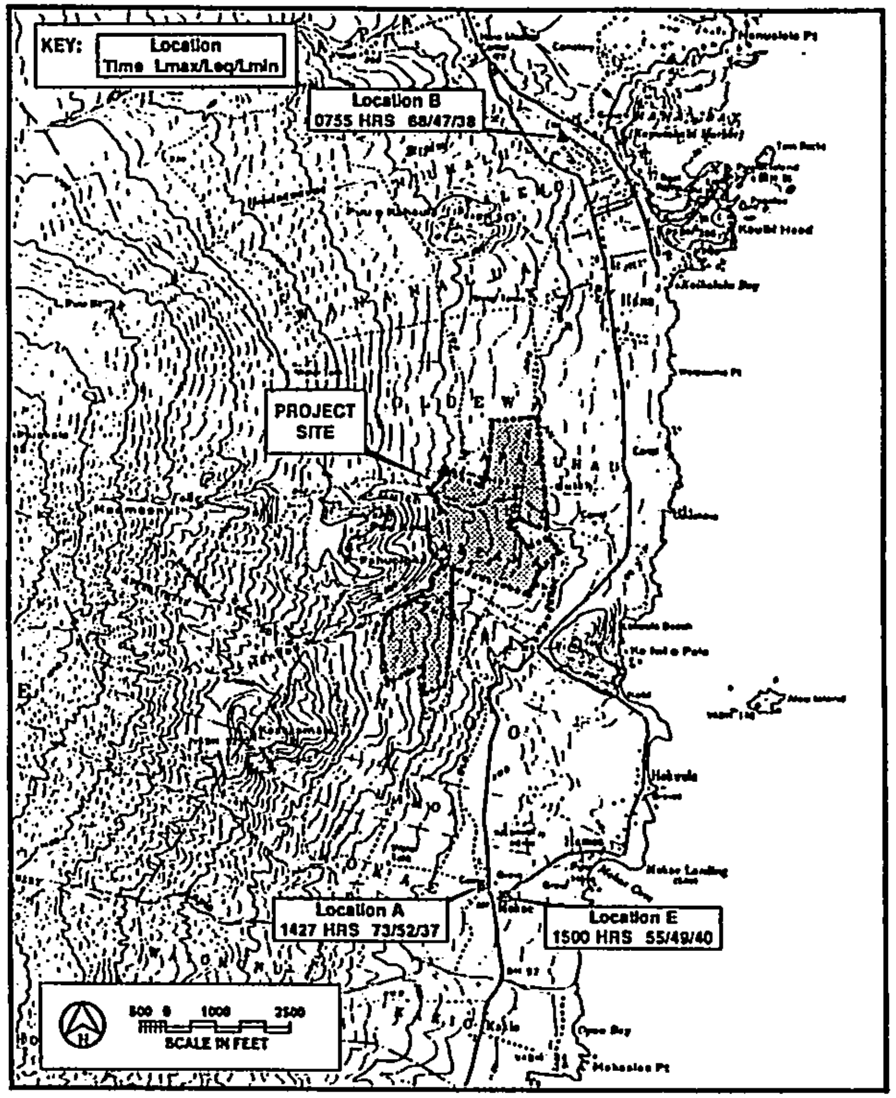
For aircraft noise, the State Department of Transportation, Airports Division, has recommended that 60 Ldn be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. In addition, for those noise sensitive land uses which are exposed to aircraft noise greater than 55 Ldn, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 4 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic, aircraft, and background ambient noise levels were measured at 7 locations along Hana Highway and near Hana Airport. These measurements were used to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development, for developing aircraft noise levels at Hana Airport, and for describing the existing background noise levels in Hana. The locations of the measurement sites are shown in FIGURE 2. Indicated at the measurement sites were the maximum (Lmax), minimum (Lmin), and average (Leq) noise levels recorded at each of the sites. Noise measurements were performed in June 1989 and September 1990. The traffic noise measurement results at Sites "A" and "I" and their comparisons with computer model predictions of existing traffic noise levels are summarized in TABLE 2. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

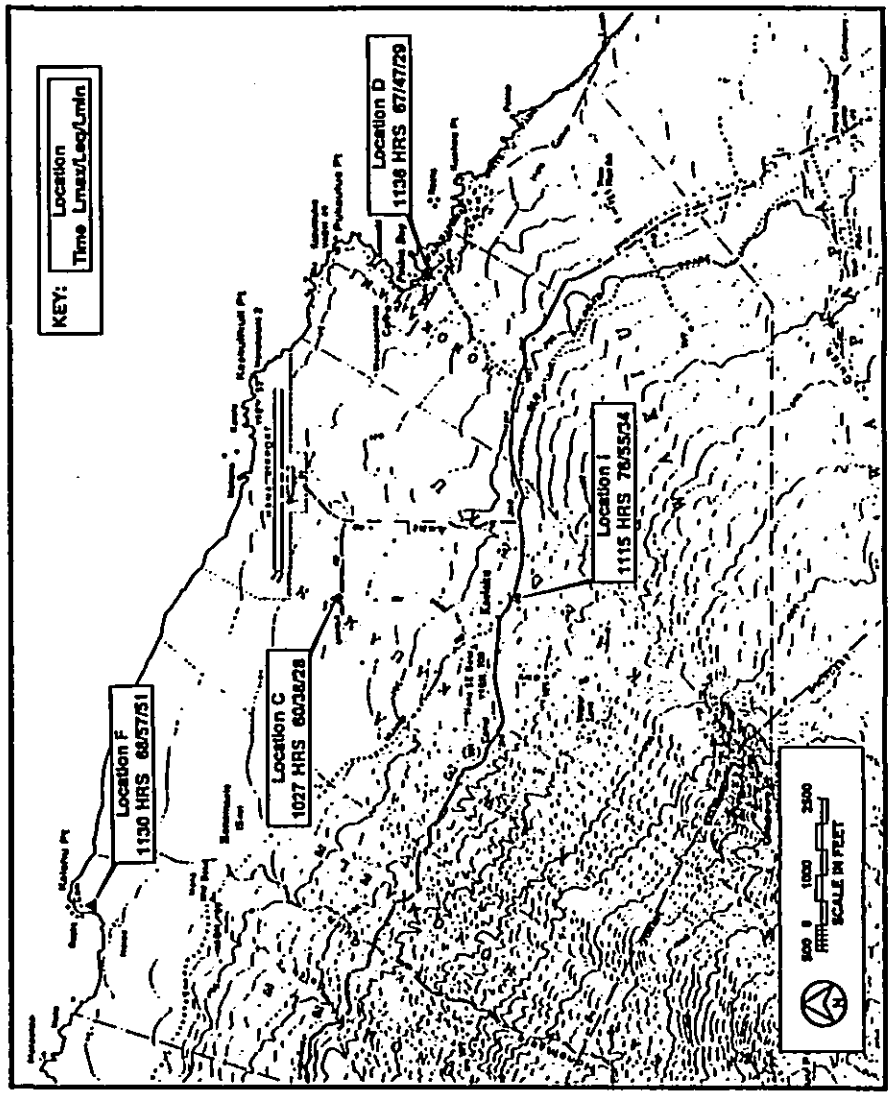
Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 5). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. The traffic study for the project (Reference 6) and Hawaii State Department of Transportation counts on Hana Highway (Reference 7) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 1 dB greater than the 24-hour Ldn along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Hana Highway and Uakea Road (see FIGURES 3 thru 5).

Traffic noise calculations for both the existing and future



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2 (CONTINUED)

TABLE 2

TRAFFIC NOISE MEASUREMENTS

Location	Time of Day (HRS)	Ave.Speed (MPH)	—Hourly Traffic Volume— Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
A. 35 FT from the center-line of Hana Highway at Hasegawa Parking Lot (4/8/91).	1000 TO 1100	30	123	11	0	57.4	57.0
E. 25 FT from the center-line of Hana Highway at Hauoli St. (4/8/91).	1345 TO 1445	23	326	23	4	60.5	60.6
I. 50 FT from the center-line of Hana Highway at Kaelaku (6/04/89).	1015 TO 1115	35	135	3	0	55.0	55.1

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF UAKEA ROAD AT HANA HIGHWAY (May 17-18, 1989)

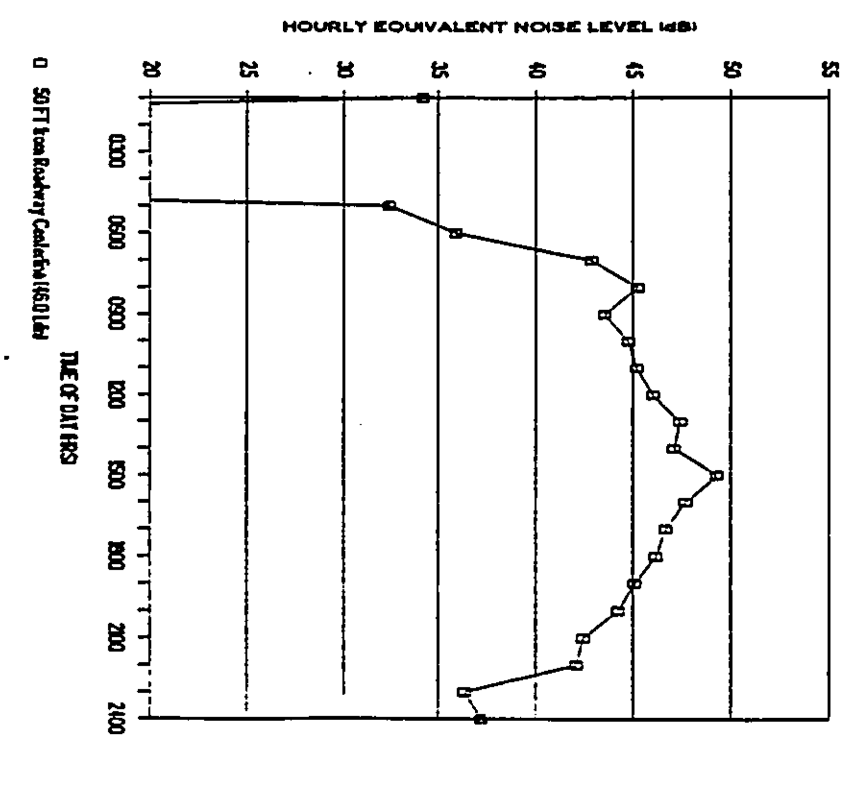


FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF HANA HWY AT UAKEA RD (TOWARD WAILUA) (May 17-18, 1989)

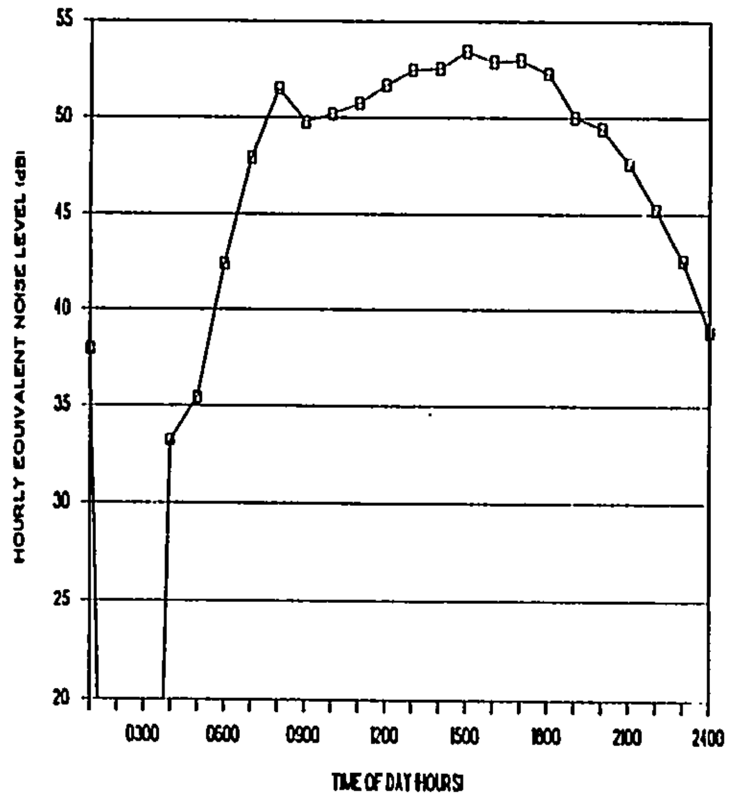
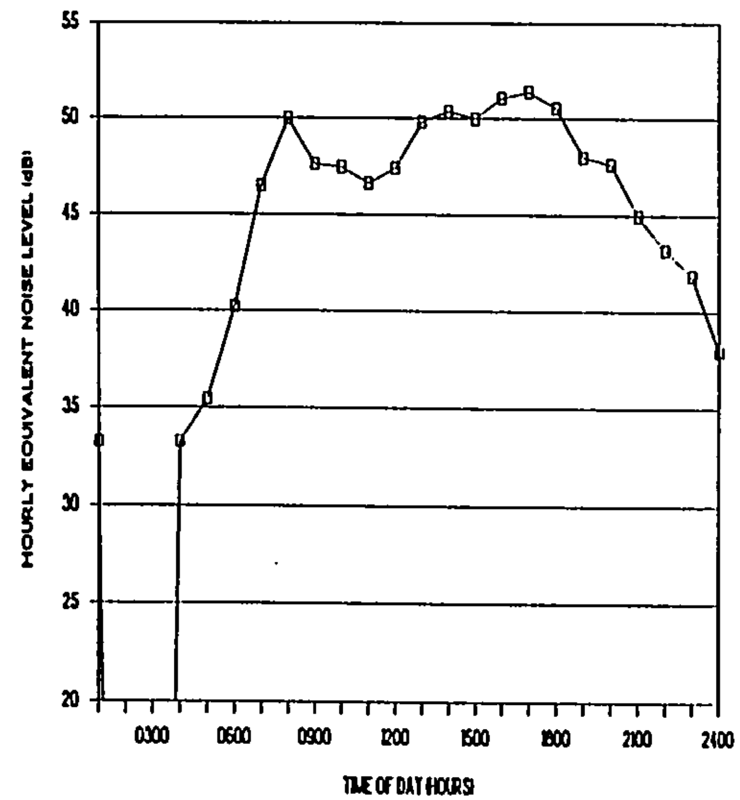


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF HANA HWY AT UAKEA RD (TOWARD KIPAHULU) (May 17-18, 1989)



conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic study (Reference 6). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

Aircraft noise measurements were obtained at Sites "C," "D," and "F" (see FIGURE 2). Aircraft noise measurements were made to confirm that single event noise levels associated with aircraft operations at Hana Airport were consistent with the noise level predictions of the Federal Aviation Administration Integrated Noise Model (FAA INM), which was used to describe existing and future aircraft noise levels at Hana Airport.

Reference 8 indicated that construction workers would fly to and from Hana Airport using chartered DHC-6 (Twin Otter) and/or DHC-7 (DASH 7) type aircraft in the early morning and in the evening. The number of flights per workday would vary from two DHC-6 flights during the initial phases of the construction, to a maximum of six DASH 7 flights during the middle and later phases of construction. A total of three to twenty four van trips per workday would be required to transport workers between Hana Airport and the job site. The potential noise impacts during the construction period from the additional aircraft operations at Hana Airport were evaluated by comparing the aircraft noise contours at Hana Airport with and without the additional charter flights to the minimal noise impact level of 55 Ldn. The potential noise impacts during the construction period from additional van traffic along Hana Highway were evaluated by comparing predicted traffic noise levels with and without the additional van shuttles using the peak hour Leq(h) and 24-hour Ldn noise descriptors.

Expected noise levels from golf course play, maintenance ac-

tivities, and clubhouse activities were also described. Potential noise impacts at the nearest noise sensitive properties were evaluated. Possible noise mitigation measures were also described for minimizing noise impacts at noise sensitive properties near the proposed golf course.

CHAPTER V. EXISTING NOISE ENVIRONMENT

<u>Background Noise</u>. Because Hana can be characterized as a rural area, background noise levels are relatively low. As indicated in FIGURE 2, average background noise levels in Hana are typically less than 45 dB in areas removed from the surf or major roadways. FIGURE 6 describes the relationship of typical background noise levels in rural areas such as Hana to the higher background noise levels which are typical of urban communities on Oahu. As indicated in the figure, background noise levels in Hana are generally less than 55 Ldn, and as low as 40 to 45 Ldn.

<u>Traffic Noise</u>. The existing traffic noise levels in the project environs vary from levels of approximately 55 Ldn along Hana Highway, to less than 45 Ldn at the interior locations of the project site. Existing traffic noise levels along Hana Highway are less than 55 Ldn at 42 FT or greater setback distances from the highway centerline.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in TABLE 3. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 50, 55, and 60 Ldn contours were also calculated as shown in TABLE 4. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of TABLE 4, it was concluded that the existing 55 Ldn traffic noise contour is located approximately 50 FT from the centerline of Hana Highway along sections north of the project, and 42 FT from the centerline along sections south of the project.

Existing traffic noise levels at the interior portions of the project site are low (less than 45 Ldn) due to their large setback distances from the highway. At these interior locations on the

FIGURE 6

RANGE OF EXTERIOR BACKGROUND AMBIENT NOISE LEVELS

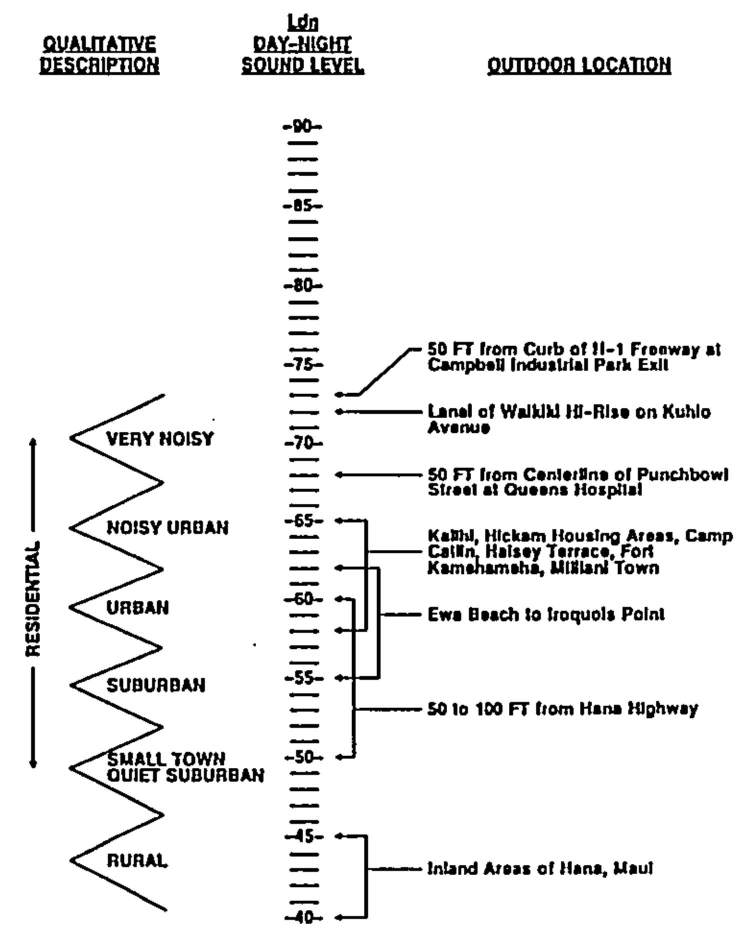


TABLE 3

COMPARISONS OF EXISTING AND CY 1995 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING (CY 1990) PM PEAK HR. TRAFFIC:						
Hana Highway Toward Hana	32	240	54.8	49.7	0.0	56.0
Hana Highway Toward Hokae	32	185	53.7	48.6	0.0	54.8
Hancoo Road @ Hana Highway	27	65	46.3	41.5	0.0	47.6
CY 1995 PM PEAK HR. TRAFFIC WITH THE PROJECT:						
Hana Highway Toward Hana	32	395	57.0	51.8	0.0	58.1
Hana Highway Toward Hokae	32	261	55.2	50.0	0.0	56.3
Hancoo Road @ Hana Highway	27	65	46.3	41.5	0.0	47.6
Project Entrance Road	30	84	49.2	44.2	0.0	50.4

Note:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

98% autos, 2% medium trucks, and 0% heavy trucks and buses.

TABLE 4

EXISTING AND CY 1995 DISTANCES TO 50, 55, AND 60 Ldn CONTOURS

STREET SECTION	50 Ldn SETBACK (FT) EXISTING	CY 1995	55 Ldn SETBACK (FT) EXISTING	CY 1995	60 Ldn SETBACK(FT) EXISTING	CY 1995
Hana Highway Toward Hana	107	149	50	69	23	32
Hana Highway Toward Hokae	90	113	42	53	19	24
Haneoo Road @ Hana Highway	30	30	14	14	6	6
Project Entrance Road	N/A	45	N/A	21	N/A	10

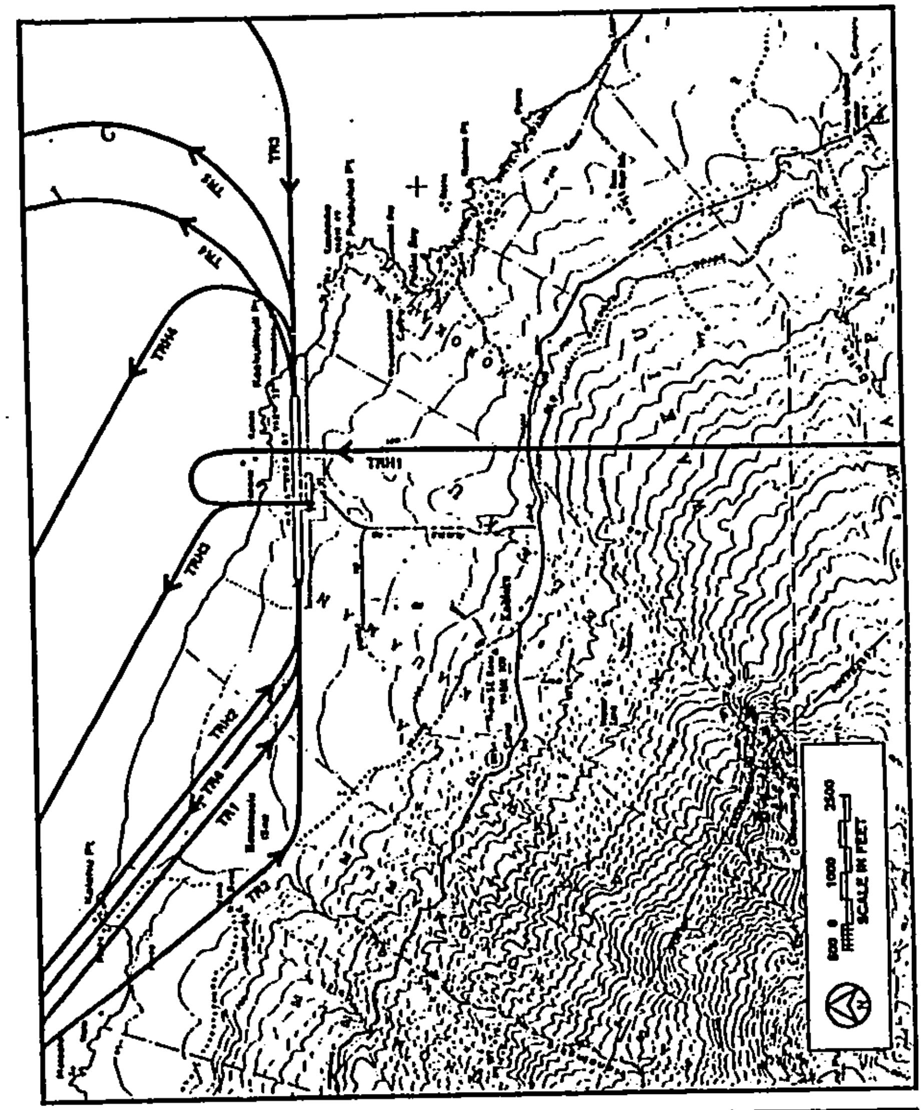
Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be 1 dB less than PM Peak Hour Leq on all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

project site, helicopter noise and natural sounds of foliage and birds are the dominant noise sources. Between helicopter noise events, background ambient noise levels drop to a range of 40 to 45 dB. During calm wind periods, background ambient noise levels decrease to levels which are less than 40 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic and wind noise.

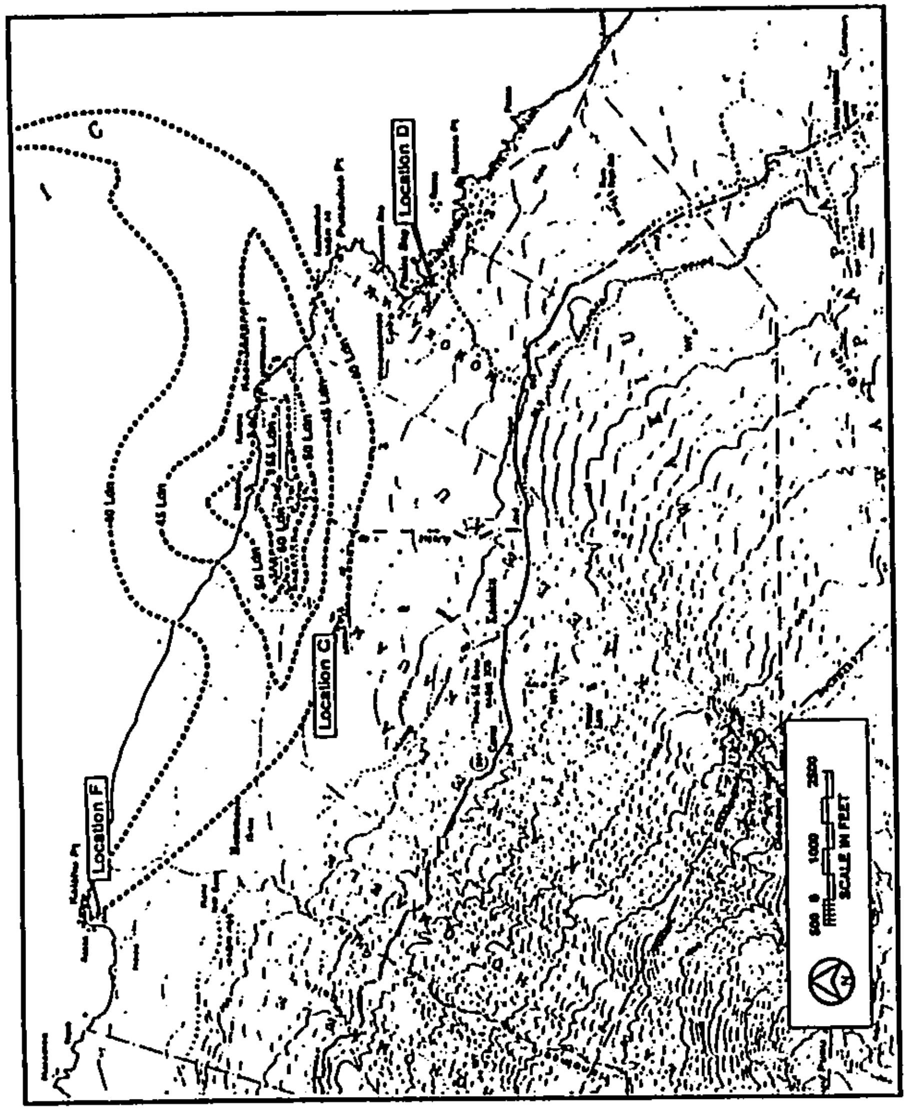
Aircraft Noise. Aircraft noise sources in the vicinity of Hana Airport are associated with fixed and rotary wing aircraft operations at Hana Airport. FIGURE 7 depicts the assumed aircraft flight tracks at Hana Airport during CY 1989 and 1990. The typical fixed wing commuter aircraft, such as the DASH 6 or Cessna 402, normally remain makai (seaward) of the airport and extended runway centerline, and travel between Hana Airport and Kahului Airport. These types of commuter aircraft, or the larger DASH 7 aircraft, would probably service the special charter flight requirements during the construction period of the project, and would probably use the fixed wing aircraft flight tracks shown in FIGURE 7, which are designated as tracks TR1 thru TR6. Helicopter flights at Hana Airport operate from a grassed area inland (mauka) of the runway and west of the airport terminal. The typical helicopter flight tracks in and out of the airport are also shown in the figure as tracks TRH1 thru TRH4. Existing helicopter operations at Hana Airport are not expected to increase as a result of the need for special charter flights for construction workers during the project construction period. The flight tracks of the planned tow glider operations at Hana Airport and the flight tracks of local training operations were not described in the figure. These aircraft operations during CY 1989 were included, however, as itinerant aircraft flights on the fixed wing aircraft flight tracks shown in FIGURE 7.

FIGURE 8A depicts the locations of the 40 thru 60 Ldn aircraft noise contours during the CY 1989 period. These noise contours were developed using CY 1989 operational data from the State



LOCATIONS OF EXISTING FLIGHTS TRACKS AT HANA AIRPORT

FIGURE 7



AIRCRAFT NOISE CONTOURS IN CY 1989, HANA AIRPORT

FIGURE 8A

Department of Transportation, Airports Division (Reference 9). As indicated in **FIGURE 8A**, the 55 Ldn contour does not enclose noise sensitive properties around Hana Airport, and airport noise levels are therefore considered to be in the "Minimal Exposure, Unconditionally Acceptable" category.

TABLE 5 summarizes the results of the aircraft noise measurements obtained at Sites "C," "D," and "F." From the table, maximum (Lmax) aircraft noise levels were typically less than 70 dB. Noise from the fixed wing commuter aircraft will tend to be highest directly below the aircraft flight paths between the airport and Kalahu Point or over the coastal areas east of the airport (see **FIGURES 7** and **8A**). Fortunately, the lands directly under the flight paths used by fixed wing aircraft are relatively vacant, and overflights of noise sensitive residences by fixed wing commuter aircraft should not be causing widespread problems at Hana Airport. Additionally, average aircraft noise levels as measured by the Ldn descriptor are very low, and aircraft noise levels are well below those which could result in adverse noise impacts.

TABLE 5

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS

MEASUREMENT SITE	AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)
C	Helicopter	57.2
C	DHC-6	59.3
C	GA-2	56.5
C	DHC-6	62.2
D	DHC-6	48.0
D	Helicopter	60.2
D	GA-2	56.0
F	Helicopter	71.0
F	Helicopter	66.6
F	Helicopter	67.8
F	DHC-6	67.0

CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 6 for CY 1995 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in TABLE 3 for the PM peak hour of traffic. As indicated in TABLE 3, by CY 1995 and following complete project build-out, traffic noise levels on Hana Highway at the project site are predicted to increase by 1.5 to 2.2 dB, which are considered to be moderate increases. Along Hana Highway and south of the project site, traffic noise levels are predicted to increase by 1.5 dB. North of the project site, traffic noise levels on Hana Highway are predicted to increase by 2.2 dB. The predicted increases in traffic noise levels along Haneoo Road are expected to be insignificant.

TABLE 4 summarizes the predicted increases in the future setback distances to the 50, 55, and 60 Ldn traffic noise contour lines along the roadway sections which are expected to service the project. The increases in setback distances to the three noise contour levels are attributable to both project plus non-project traffic in CY 1995. The setback distances in TABLE 4 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in TABLE 4, the increases in setback distances to the 55 Ldn contour are predicted to range from 11 to 19 FT from the centerline of Hana Highway south and north of the project site following project build-out in CY 1995.

TABLE 6 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 1995, and as measured by the Ldn descriptor system. As indicated in TABLE 6, the increases in traffic noise along the north section of Hana Highway and due to project traffic are slightly lower than

TABLE 6

CALCULATIONS OF PROJECT AND NON-PROJECT
TRAFFIC NOISE CONTRIBUTIONS (CY 1995)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Hana Highway Toward Hana	1.2	1.0
Hana Highway Toward Mokae	1.5	0.0
Haneoo Road @ Hana Highway	0.0	0.0
Project Entrance Road	N/A	49.3

those associated with non-project traffic. These incremental increases in traffic noise will be difficult to measure due to their relatively low levels. South of the project along Hana Highway, project traffic should not cause increases in noise levels. Along Haneoo Road, both project and non-project traffic are not expected to cause increases in noise levels. The largest increases in traffic noise levels attributable to project traffic are expected to occur along the entrance road to the project site. Overall, the increases in noise levels associated with project traffic are expected to be moderate to very low along Hana Highway, and are not expected to cause adverse noise impacts.

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. The increases in traffic noise levels attributable to the project from the present to CY 1995 are predicted to range from 0 to 1.0 Ldn along Hana Highway. This degree of increase in traffic noise levels attributable to the project is not considered to be significant. The section of Hana Highway north of the project, where traffic noise increases are expected to be the highest and where vehicle speeds are relatively high, is currently undeveloped. Project traffic is not expected to cause significant increases in noise along sections of Hana Highway south of the project or along Haneoo Road. For these reasons, traffic noise impacts along Hana Highway and resulting from project traffic are not considered to be significant, and mitigation measures are not required.

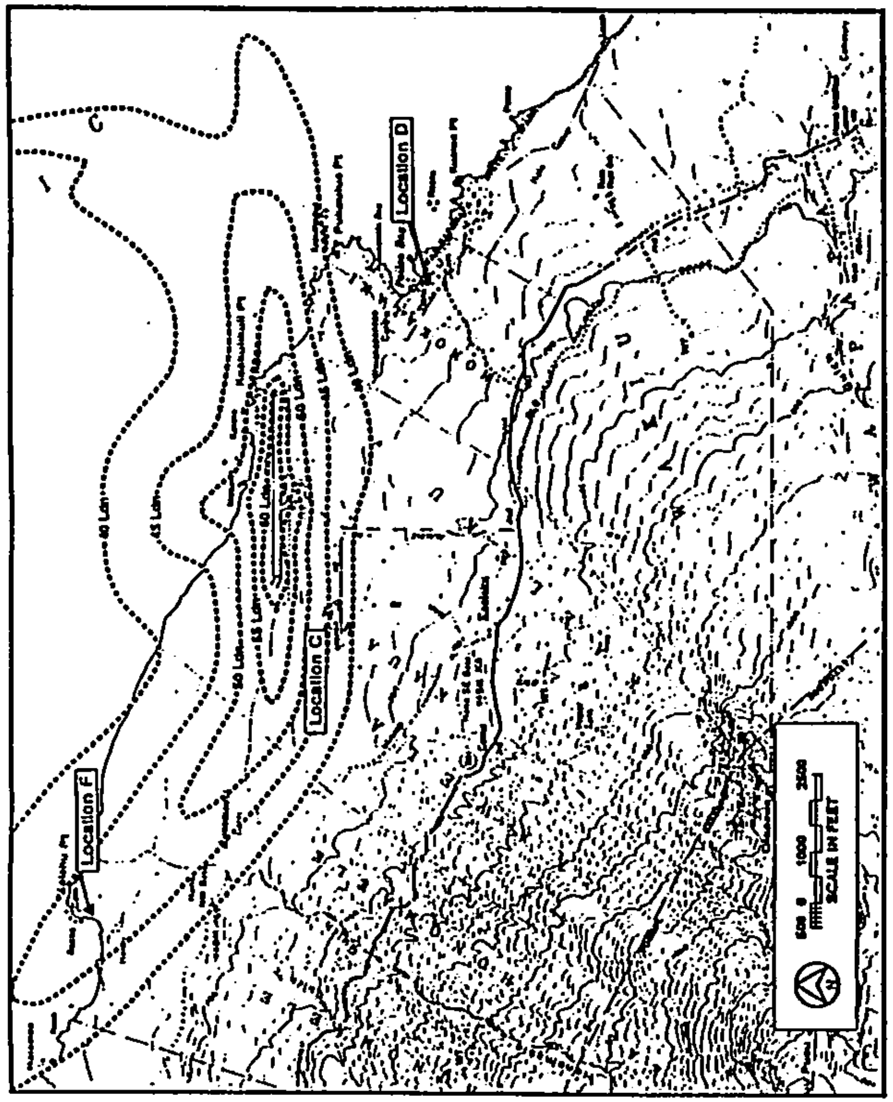
Relatively small and temporary increases in traffic noise levels along the Hana Highway are expected to occur during the construction period as a result of the additional van shuttle traffic between Hana Airport and the proposed project. The additional 3 to 24 daily van trips on Hana Highway are expected to increase traffic noise levels along Hana Highway by a maximum of 2 Leq(h) during the peak hours of traffic, with negligible increase of the 24-hour Ldn expected during the construction period. This level of increase is not considered to be significant, particularly due to its relatively short term duration, and traffic noise impacts resulting from the van shuttles during the construction period are not expected.

Because traffic noise along public roadways are generated by non-project as well as project traffic, mitigation of off-site traffic noise impacts are generally performed by individual property owners fronting the roadways' Right-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound

attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 Ldn noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. Whenever mitigation of traffic noise at the upper floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more effective sound attenuation measures.

Aircraft Noise. Aircraft noise levels will increase during the project construction period due the planned use of charter aircraft services to transport construction workers to and from Hana Airport on a daily basis. Under worst case conditions, it was assumed that six daily DASH 7 aircraft flights, carrying as many as 50 passengers per flight, would be required to transport construction workers in and out of Hana. The effect of these six daily DASH 7 flights on the CY 1989 aircraft noise contours at Hana Airport is shown in FIGURE 8B. Comparing FIGURES 8A and 8B, the greatest increase in the noise contours are expected to occur under the aircraft flight tracks northwest and east of the airport. The magnitude of the increase is in the order of 5 to 10 Ldn, which are significant. However, noise sensitive properties should not be exposed to aircraft noise levels greater than 55 Ldn as a result of these charter flights. For this reason, it was concluded that although aircraft noise levels are expected to be significantly higher during the project construction period, the elevated noise levels should remain within the existing "Minimal Exposure, Unconditionally Acceptable" category at noise sensitive properties near Hana Airport.

Golf Course and Clubhouse Noise. Risks of adverse noise impacts from the proposed golf course are expected to be low due to the large distances (half mile) between the golf course and neighboring communities (Hana, Hamoa, etc.). The loudest noise source associated with the proposed golf course operation is the



AIRCRAFT NOISE CONTOURS WITH ADDED CHARTER FLIGHTS DURING CONSTRUCTION, HANA AIRPORT

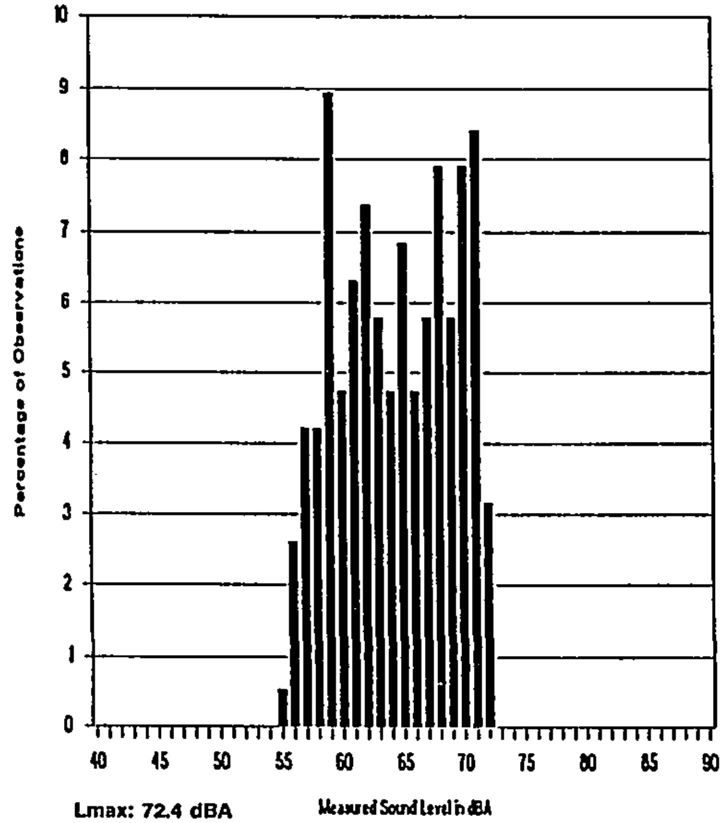
FIGURE 8B

tractor which is expected to be used for grounds keeping operations and also to recover golf balls on the driving range. Measured noise levels from tractors used on golf courses are shown in FIGURES 9 and 10. Typical noise levels of these tractors range from 66 to 74 dB at 50 FT distance. At half mile distance, predicted noise levels from these tractors are expected to range from 30 to 40 dB, which are equal to or less than existing daytime background ambient noise levels at the quietist inland locations in Hana. A few residences may be within 500 to 1,500 FT of a proposed golf tee, fairway or green. Typical tractor noise levels at these distances are 57 to 68 dB, and will probably be audible at the nearest residences. The use of landscaped berms and golf course features to attenuate tractor noise by 10 to 20 dB is a possible noise mitigation measure. The use of properly muffled and maintained tractor equipment is also recommended within the entire golf course project to minimize potential noise impacts from these tractors.

The group functions at the proposed clubhouse may be audible at the nearest noise sensitive neighbors if amplified voice and music are used during these events at the facility's dining and social function areas. A relatively large buffer distance of approximately a half mile is planned between the facility and its nearest noise sensitive neighbors, so predicted sound levels from these functions are expected to range from 29 to 41 dB, which are considered to be low. However, due to the low nighttime ambient noise levels in the Hana area, these activities may be audible during the night. Partial mitigation of audible clubhouse sounds from amplified voice and music may be achieved by placing solid walls or other natural or man-made barriers between the function areas and nearest noise sensitive neighbors. Total mitigation of audible clubhouse noise is possible, but will require total closure and air conditioning during the louder events. Sound attenuation treatment of the clubhouse facility and the mechanical equipment (air conditioning equipment, exhaust fans, etc.) associ-

FIGURE 9
NOISE LEVELS FROM TRACTOR/MOWER
AT 50 FT DISTANCE
(Jacobsen 535)

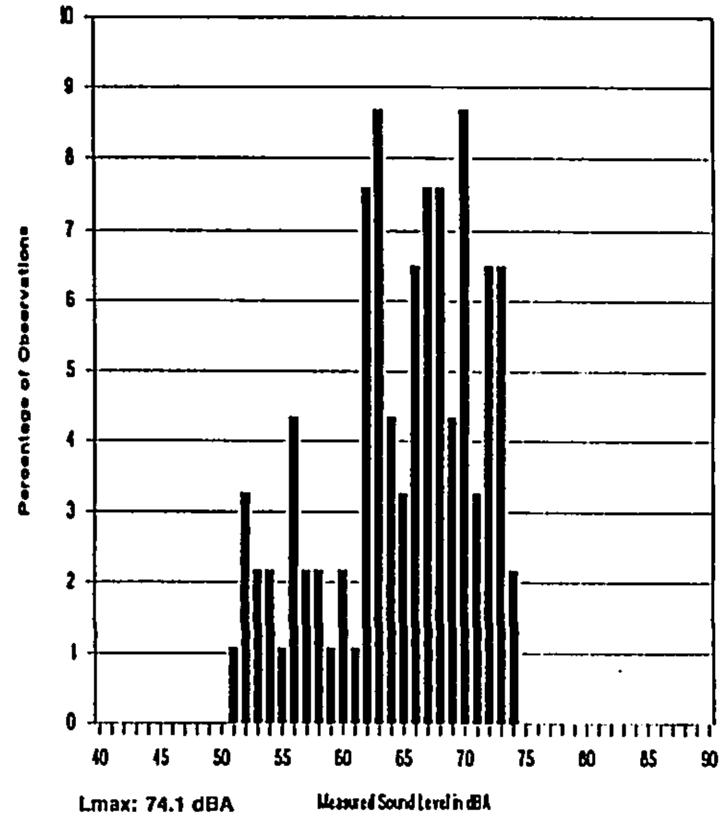
DATE: October 10, 1990 METER RESPONSE: Slow



Lmax: 72.4 dBA
L10: 71.0 dBA
Leq: 66.4 dBA
Lmin: 55.0 dBA

FIGURE 10
NOISE LEVELS FROM TRACTOR/MOWER
AT 50 FT DISTANCE
(Kubota L-3750)

DATE: October 10, 1990 METER RESPONSE: Slow

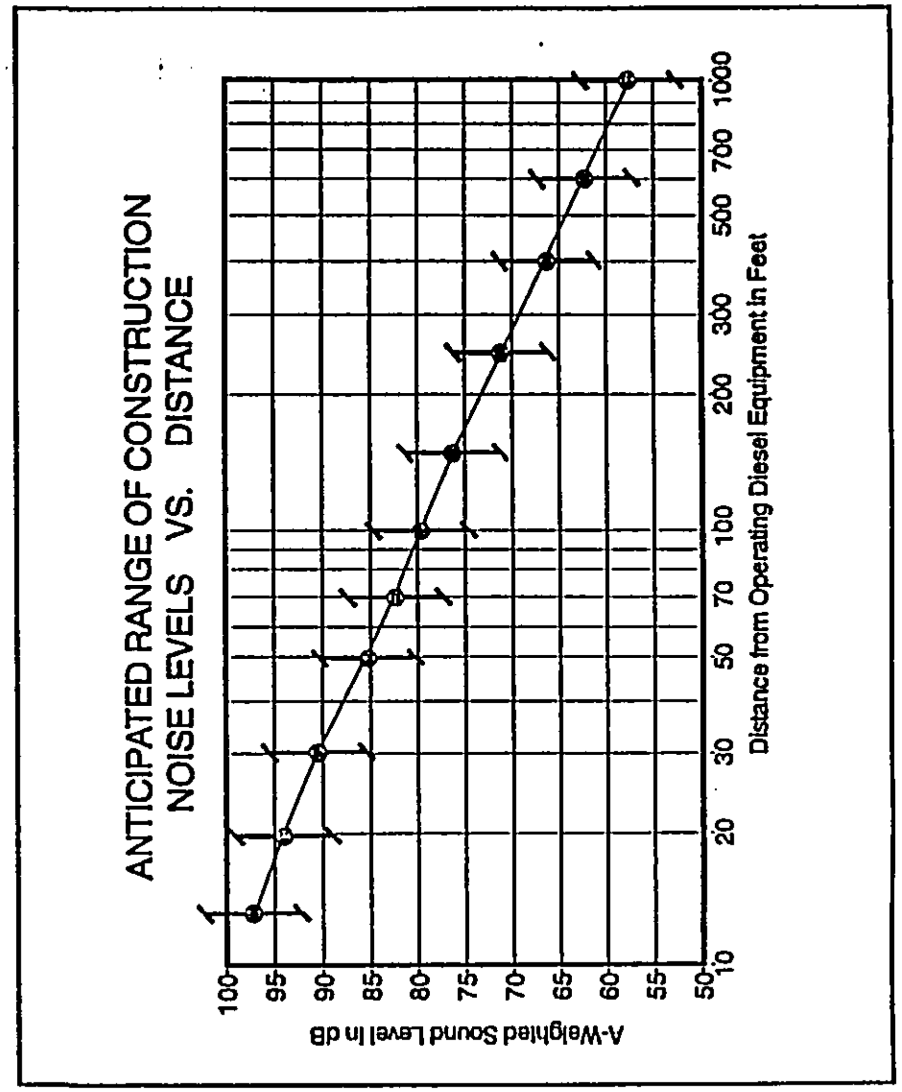


Lmax: 74.1 dBA
L10: 72.0 dBA
Leq: 67.8 dBA
Lmin: 51.8 dBA

ated with the clubhouse may also be required to minimize adverse noise impacts on other activities within the golf course property. These noise abatement treatments are not unusual or extraordinary for this type of facility, and can be implemented as required.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is two years, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in FIGURE 11. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing residences along Hana Highway near the Hasegawa General Store and near the south intersection of Haneoo Road with Hana Highway. Noise levels during construction at these residences should not exceed 50 dB, which is well below levels which could interfere with speech communication or other indoor activities. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise



CONSTRUCTION NOISE LEVELS VS. DISTANCE

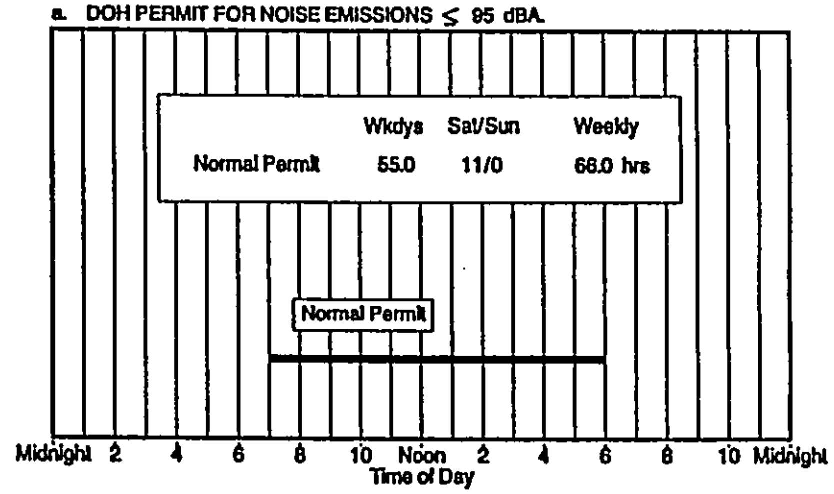
FIGURE 11

limits and curfew times, which are applicable on the island of Oahu (Reference 10), is another noise mitigation measure which can be applied to this project. TABLE 7 depicts the allowed hours of construction for normal construction noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

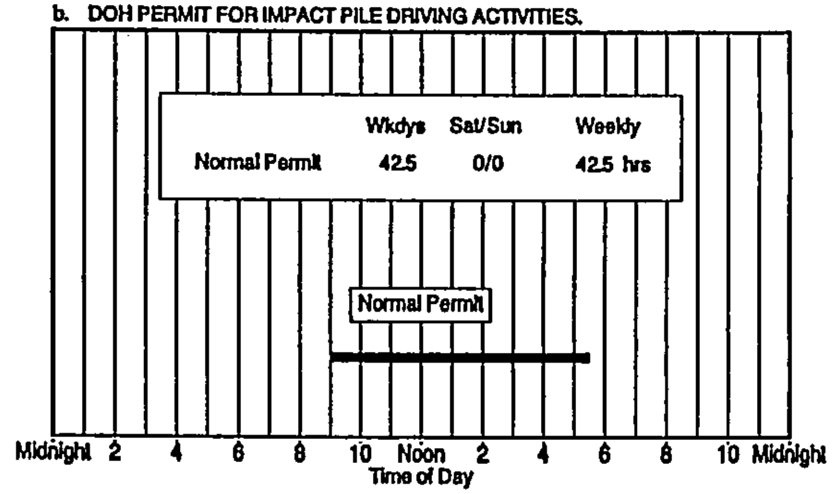
TABLE 7

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤ 95 dBA.



b. DOH PERMIT FOR IMPACT PILE DRIVING ACTIVITIES.



APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control"; Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B"; U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety"; Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) Act 208, Session Laws of Hawaii 1987; Fourteenth Legislature, State of Hawaii; June 7, 1987.

(5) Barry, T. and Reagan, J., "FHWA Highway Traffic Noise Prediction Model"; FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(6) Traffic data and forecasts for the Hana Golf Course Project; Pacific Planning & Engineering, Inc.; March 1992.

(7) 24-Hour Traffic Counts; Station 33-D, Hana Highway at Uakea Road; Hawaii State Department of Transportation; May 17-18, 1989.

(8) "Hana Ranch Contry Club Project - Construction Employee Transportation Program;" Ronald M. Knoll Consulting Group; December 3, 1990.

(9) State Landing Reports for Hana Airport - CY 1989; Hawaii State Department of Transportation.

(10) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu"; Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "Lepn" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE(1) A-WEIGHTING	OTHER(2) WEIGHTING	UNWEIGHTED
1. Sound (Pressure) (3) Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level (4) Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX J

BOTANICAL SURVEY HANA RANCH COUNTRY CLUB

Prepared by Char & Associates, December 1990

BOTANICAL SURVEY
HANA RANCH COUNTRY CLUB
HANA DISTRICT, ISLAND OF MAUI

by

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Prepared for: PACIFIC PLANNING & ENGINEERING, INC.

December 1990

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BOTANICAL SURVEY
HANA RANCH COUNTRY CLUB
HANA DISTRICT, ISLAND OF MAUI

INTRODUCTION

The proposed Hana Ranch Country Club golf course project site consists of approximately 201 acres of land. The site is bounded by the Hana Highway (Highway 31) to the east; by forested lands and Pu'u Kolo to the west; and by pasture lands to the north and south. Elevation ranges from slightly under 200 ft., near the Hana Highway, to about 550 ft. at its mauka end, near Pahuolona and Pu'u Kolo. The site is presently used for grazing cattle, although, at one time, it was under sugar cane cultivation.

Field studies to assess the botanical resources found on the proposed golf course site were conducted on 27 and 28 October 1990; a team of four botanists was used to gather the technical data contained in this report. The primary objectives of the survey were to 1) describe the major vegetation types; 2) inventory the flora; and 3) search for threatened and endangered plant species protected by Federal and State laws.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Recent colored aerial photographs and soil and topographic maps were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

Access was from the Hana Highway onto a four-wheel drive road (4-WD); the road runs from the highway and up mauka towards the base of Pahuolona and Pu'u Kolo. From this 4-WD road a number of other 4-WD roads branch off. This system of roads provided access to all points on the property.

A walk-through botanical survey method was used. Areas most likely to harbor native plant communities or rare species, as the gulches, rocky outcroppings, and shrubland, were more intensively examined. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Plant identifications were made in the field; plants which could not be positively determined were collected for later identification in the herbarium and for comparison with the recent taxonomic literature.

DESCRIPTION OF THE VEGETATION

Two major vegetation types are found on the property and are easily picked up on the aerial photographs. Pasture land dominated by various grass and sedge species covers the majority of the site. On the more stony portions of the property, especially on the south half, a mixed shrubland composed primarily of guava along with Christmas berry is found. Kaholopo'o and Mo'omo'onui Gulches as well as two unnamed gulches run through the site. Mixed shrubland vegetation is found in these gulch areas; also abundant in some gulches are stands of large kukui trees. Portions of the site were in sugar cane cultivation at one time and an old railroad grade which was used by the plantation follows along the makai portion of the property near the highway (L. Landgraf, pers. comm.).

A more detailed description of the vegetation on the project site follows. A checklist or inventory of all the vascular plants found during the field studies is presented at the end of the report.

Pasture Land

On the north half of the property, the soil type is largely Hana silty clay loam (HKNC) which is a moderately deep varient of the Hana soil series; slopes are gentle, 3 to 15% (Foote et al. 1972). This deeper soil does not have many small rocks on its surface and thus supports a better mix of pasture grasses. Pangolagrass (Digitaria decumbens) is the dominant pasture grass on this portion of the property and forms a rather smooth, rolling, matted cover. Smaller, localized areas support California grass (Brachiaria mutica). Locally common are patches of African dropseed (Sporobolus africanus).

On the south half of the property, the soils are Hana extremely stony silty clay loam, moderately deep varient, 3 to 15% slopes (HKOC); Hana extremely stony silty clay loam, 3 to 25% slopes (HKMD); and Hana very stony silty clay loam, 3 to 25% slopes (HKLD). Both HKLD and HKMD soils have many rocks on their surface and workability is very difficult. Much of these areas support mixed shrubland vegetation. On the HKOC soil and portions of the HKMD and HKLD soils, the primary pasture grass is African dropseed. African dropseed is a wiry, clumping grass which does not provide good forage except while young. The grass cover tends to be course, uneven, rough hummocky. Smaller patches of other grasses which include California grass, carpet grass (Axonopus fissifolius), Dallis grass (Paspalum dilatatum), ricegrass (Paspalum scrobiculatum), and Hilo grass (Paspalum conjugatum) are also occasionally found.

Common throughout the pastures on the property are sedges such as Fimbristylis dichotoma, Pycreus polystachyos, and green kyllinga (Kyllinga brevifolia). False elephant's foot (Elephantopus spicatus), a member of the sunflower family, is also frequently encountered. Scattered through the pastures are small clumps of

guava (Psidium guajava) and other woody shrubs. A few trees of mango (Mangifera indica), 'ulu or breadfruit (Artocarpus altilis), and at least three species of banyan (Ficus) can also be found.

Mixed Shrubland

This vegetation type occurs on the rockier, steeper portions on the south half of the project site. The shrubs form a dense, tangled cover, from 6 to 15 ft. tall, which is almost impenetrable in places. Typically the mixed shrubland is composed of guava shrubs with Christmas berry (Schinus terebinthifolius) codominant in places and with scattered trees of various species emerging above the shrubs. Strawberry guava (Psidium cattleianum) is locally common in some areas. The seabean or ka'e'e is one of the more abundant vines found in this vegetation type often draping over a large part of the shrubland.

Ground cover consists of only the more shade-tolerant species which include 'awapuhi kuahiwi or shampoo ginger (Zingiber zerumbet), hairy sword fern (Nephrolepis multiflora), wood fern (Christella parasitica), laua'e (Phymatosorus scolopendria), Hilo grass, and basket grass (Oplismenus compositus). In many places though, moss-covered rocks and leaf litter predominate.

These rockier areas have a number of archeological features associated with them and also support plants of Polynesian introduction. These include ti (Cordyline fruticosa), noni (Morinda citrifolia), bitter yam (Dioscorea bulbifera), 'awapuhi kuahiwi, 'ulu, and coconut (Cocos nucifera).

A few varients of this shrubland vegetation can be recognized on the site. Along the rocky bottoms of some gulches are dense stands of kukui trees (Aleurites moluccana). Dense thickets of hau (Hibiscus tiliaceus) can also be found in some of these gulches or in low-lying areas on the property. Where the proposed golf course abuts the lower slopes of Pu'u Kolo, the mixed shrubland is dominated by large groves of bamboo (Bambusa sp.) or by a dense guava - Java plum (Syzygium cumini) - shoe button ardisia (Ardisia elliptica) shrubland.

DISCUSSION AND RECOMMENDATIONS

The vegetation on the proposed golf course project site consists primarily of pasture land dominated by introduced grass and sedge species. Stony portions of the site as well as gulch areas support a mixed shrubland composed of guava and Christmas berry along with other introduced tree and shrub species. Of a total of 126 plant species occurring on the site, 100 (79%) are introduced or alien; 10 (8%) are originally of Polynesian introduction; and 16 (13%) are indigenous, that is, native to the Hawaiian Islands and elsewhere throughout the Pacific. No endemic plants, i.e native only to the Hawaiian islands, occur on the site. No officially listed threatened and endangered plants (U. S. Fish and Wildlife Service 1989) are found on the site; nor do any plants proposed or candidate for such status (U. S. Fish and Wildlife Service 1990) occur on the property.

No wetlands occur on the site. The term wetlands as used in this discussion refers to the jurisdictional wetlands for use by Federal agencies and as defined by the Federal Interagency Committee for Wetland Delineation in their publication of 1989, Federal Manual for Identifying and Delineating Jurisdictional Wetlands. Three essential criteria must be met for an area to be identified as wetland; these characteristics are (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. The gulches which cross the property do contain streams, however, the streams are intermittent. Vegetation along the gulch bottoms is mixed shrubland, primarily guava and Christmas berry; there are no areas dominated by hydrophytic vegetation. The stream beds have been eroded down to bed rock and are largely boulder-strewn. There may occasionally be small puddles of water left in rocky

depressions after heavy rains. The pasture areas are generally sloping and well-drained. They do not support any wetland areas.

Because the vegetation on the site consists primarily of pasture land and is dominated by introduced or alien plants, there is little of botanical interest or concern on the site. The proposed project is not expected to have a significant negative impact on the botanical resources.

Of some concern are the gulch areas which contain intermittent streams. Removal of vegetation and grading during golf course construction will increase soil erosion. It is recommended that a buffer zone of at least 50 ft. be kept along the edges of the gulches. Trees and shrubs in the gulch areas can be pruned back but not removed if portions of the course are sited to shoot across the gulches.

As much of the existing pasture land and mixed shrubland vegetation should be incorporated into the golf course landscaping and design. Use of the existing pasture grasses for portions of the fairway should be considered. This would continue the general pastoral theme and the golf course would more readily blend in with the surrounding pasture lands.

LITERATURE CITED

Foote, D. E., E. L. Hill, S. Nakamura, and F. Stephens. 1972. Soil survey of the islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii. U. S. Dept. of Agriculture, Soil Conservation Service. Washington, D. C.

Lamoureux, C. H. 1984. Checklist of Hawaiian Pteridophytes. Draft manuscript, unpublished.

Porter, J. R. 1972. Hawaiian names for vascular plants. Coll. of Tropical Agriculture, Univ. of Hawaii, Manoa. Dept. Paper No. 1. Honolulu.

St. John, H. 1973. List and summary of the flowering plants in the Hawaiian Islands. Pacific Tropical Botanical Garden Memoir No. 1. Lawai, Kauai.

U. S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12.

U. S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants. Review of plant taxa for listing as Endangered and Threatened Species; Notice of review. Federal Register 55(35): 6184-6229.

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. Univ. of Hawai'i Press and Bishop Museum Press. Honolulu.

PLANT SPECIES LIST -- Hana Golf Course

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns and Fern Allies, Monocots, and Dicots. Taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1984); the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (1990) for the most part. Common English and/or Hawaiian names follow St. John (1973) or Porter (1972).

For each species, the following information is provided:
1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   I = indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s)
   P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native.
   X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact; not native.
4. Presence (+) or absence (-) of a particular species within each of two major vegetation types recognized on the project site (see text for discussion):
   p = Pasture Land
   m = Mixed Shrubland

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	VEGETATION TYPE m
FERNS AND FERN ALLIES				
ADIANTACEAE (Maiden-hair Fern Family)				
Adiantum hispidulum Sw.	maiden-hair fern	X	-	+
BLECHNACEAE (Blechnum Family)				
Blechnum occidentale L.	blechnum fern	X	-	+
GLEICHENIACEAE (Vine Fern Family)				
Dicranopteris linearis (Burm.) Underw.	uluhe	I	-	+
LINDSAEACEAE (Lace Fern Family)				
Sphenomeris chinensis (L.) Maxon	pala'a, palapala'a	I	-	+
NEPHROLEPIDACEAE (Sword Fern Family)				
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern, kupukupu	X	+	+
POLYPODIACEAE (Common Fern Family)				
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X	+	+
Pleopeltis thunbergiana Kaulf.	pakahakaha, 'ekaha-'akolea	I	-	+
PSILOTACEAE (Psilotum Family)				
Psilotum nudum (L.) Beauv.	moa, pipi	I	-	+
THELYPTERIDACEAE (Wood Fern Family)				
Christella parasitica (L.) Levl.	wood fern, oak fern	X	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	VEGETATION TYPE m
MONOCOTS				
AGAVACEAE (Agave Family)				
Cordyline fruticosa (L.) A. Chev.	ti, ki	P	-	+
Furcraea foetida (L.) Haw.	Mauritius hemp	X	-	+
ARACEAE (Arum Family)				
Alocasia macrorrhiza (L.) Schott	'ape	P	-	+
ARECACEAE (Palm Family)				
Archontophoenix alexandrae (F. v. Muell.) H. A. Wendl. & Drude	king palm, Alexandra palm	X	-	+
Cocos nucifera L.	coconut, niu	P	+	+
Roystonea sp.	royal palm	X	-	+
COMMELINACEAE (Spiderwort Family)				
Commelina diffusa N. L. Burm.	honohono	X	+	+
CYPERACEAE (Sedge Family)				
Cyperus halpan L.		X	-	+
Cyperus rotundus L.	nutgrass, nut sedge	X	-	+
Cyperus sp.		X?	+	+
Fimbristylis dichotoma (L.) Vahl		I	+	+
Kyllinga brevifolia Rottb.	kyllinga, kili'o'opu	X	+	+
Pycreus polystachyos (Rottb.) P. Beauv.		I	+	+
DIOSCOREACEAE (Yam Family)				
Dioscorea bulbifera L.	bitter yam, pi'oi	P	-	+
LILIACEAE (Lily Family)				
Hippeastrum puniceum (Lam.) Voss	Barbados lily	X	-	+
ORCHIDACEAE (Orchid Family)				
Spathoglottis plicata Blume	Philippine ground orchid	X	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	VEGETATION TYPE m
PANDANACEAE (Screw Pine Family)				
Pandanus tectorius S. Parkinson ex Z	hala	I?	-	+
POACEAE (Grass Family)				
Axonopus fissifolius (Raddi) Kuhlm.	carpet grass	X	+	-
Bambusa vulgaris Schrad. ex Wendl.	feathery bamboo	X	-	+
Bambusa vulgaris var. auri-variegata Beadle	golden bamboo	X	-	+
Bambusa sp.	bamboo	X	-	+
Brachiaria mutica (Forssk.) Stapf	California grass	X	+	+
Digitaria decumbens Stent	pangolagrass	X	+	-
Digitaria setigera Roth	kukaipua'a	I	+	+
Eleusine indica (L.) Gaertn.	wire grass	X	+	-
Oplismenus compositus (L.) P. Beauv.	basket grass	X	-	+
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X	+	+
Paspalum dilatatum Poir.	Dallis grass, paspalum grass	X	+	-
Paspalum scrobiculatum L.	ricegrass	X	+	+
Pennisetum purpureum Schumach	elephant grass, Napier grass	X	-	+
Sacciolepis indica (L.) Chase	Glenwoodgrass	X	+	+
Sporobolus africanus (Poir.) Robyns & Tournay	African dropseed, rat-tail grass	X	+	+
ZINGIBERACEAE (Ginger Family)				
Hedychium flavescens N. Carey ex Roscoe	yellow ginger	X	-	+
Zingiber zerumbet (L.) Sm.	'awapuhi kuahiwi	P	-	+
DICOTS				
AMARANTHACEAE (Amaranth Family)				
Alternanthera sessilis (L.) DC.	sessile joyweed	X	+	-
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	VEGETATION TYPE m
ANACARDIACEAE (Mango Family)				
Mangifera indica L.	mango, manako	X	+	+
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X	+	+
APIACEAE (Parsley Family)				
Centella asiatica (L.) Urb.	Asiatic pennywort, pohe kula	X	+	+
ARALIACEAE (Ginseng Family)				
Schefflera actinophylla (Endl.) Harms	octopus tree	X	-	+
ASCLEPIADACEAE (Milkweed Family)				
Asclepias curassavica L.	butterfly weed, laulele	X	+	-
Asclepias physocarpa (E. Mey.) Schlechter	ballon plant	X	+	-
ASTERACEAE (Sunflower Family)				
Ageratina riparia (Regel) R. King & H. Robinson	pamakani	X	-	+
Ageratum conyzoides L.	ageratum, maile-hohono	X	-	+
Bidens pilosa L.	Spanish needle, ki	X	-	+
Conyza bonariensis (L.) Cronq.	hairy horseweed, ilioha	X	+	-
Elephantopus mollis Kunth	elephant's foot	X	+	-
Elephantopus spicata Juss. ex Aubl.	false elephant's foot	X	+	+
Emilia fosbergii Nicolson	red pualele	X	+	-
Erechtites valerianifolia (Wolf) DC.	fireweed	X	-	+
Sigesbeckia orientalis L.	small yellow crown-beard	X	-	+
Synedrella nodiflora (L.) Gaertn.	nodeweed	X	+	-
Vernonia cinerea var. parviflora (Reinw.) DC.	little ironweed	X	+	+
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur	X	+	-
Youngia japonica (L.) DC.	Oriental hawksbeard	X	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	m
BIGNONIACEAE (Bignonia Family)				
Spathodea campanulata P. Beauv.	African tulip	X	+	+
CARICACEAE (Papaya Family)				
Carica papaya L.	papaya, mikana	X	-	+
CARYOPHYLLACEAE (Pink Family)				
Drymaria cordata (L.) Willd. ex Roem.	pipili	X	+	+
CLUSIACEAE (Mangosteen Family)				
Clusia rosea Jacq.	autograph tree, copey	X	-	+
CONVOLVULACEAE (Morning Glory Family)				
Ipomoea alba L.	moon flower, koali-pehu	X	-	+
Ipomoea indica (J. Burm.) Merr.	koali-'awania	I	-	+
Ipomoea triloba L.	little bell	X	+	-
CRASSULACEAE (Orpine Family)				
Kalanchoe pinnata (Lam.) Pers.	air plant	X	+	+
CUCURBITACEAE (Gourd Family)				
Momordica charantia L.	wild bittermelon	X	+	+
EUPHORBIACEAE (Spurge Family)				
Aleurites moluccana (L.) Willd.	kukui, tutui	P	-	+
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	+	+
Ricinus communis L.	castor bean, koli	X	+	+
FABACEAE (Pea Family)				
Albizia lebbeck (L.) Benth.	Siris tree	X	+	+
Caesalpinia bonduc (L.) Roxb.	kakalaioa, hihikolo	I	-	+
Canavalia cathartica Thouars	mauna-loa	X	-	+
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	+	-
Crotalaria pallida Aiton	rattlebox	X	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	m
Desmodium incanum DC.	Spanish clover, ka'imi	X	+	+
Desmodium triflorum (L.) DC.	three-flowered beggar-weed	X	+	+
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	-
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X	+	+
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	sensitive plant, pua hilahila	X	+	-
Mucuna gigantea (Willd.) DC.	seabean, ka'e'e	I	-	+
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X	+	-
Senna septemtrionalis (Viv.) H. Irwin & Barneby	senna, kolomona	X	-	+
LAURACEAE (Laurel Family)				
Cassytha filiformis L.	kaunaoa-pehu	I	-	+
LYTHRACEAE (Loosestrife Family)				
Cuphea carthagenensis (Jacq.) Macbr.	tarweed, Colombian cuphea	X	+	+
MALVACEAE (Mallow Family)				
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X	+	-
Hibiscus tiliaceus L.	hau	I?	-	+
Sida rhombifolia L.	Cuba jute	X	+	-
Thespesia populnea (L.) Sol. ex Correa	milo	I?	+	-
MELIACEAE (Mahogany Family)				
Melia azedarach L.	China berry, neem	X	+	-
MORACEAE (Mulberry Family)				
Artocarpus altilis (Parkins. ex Z) Fosb.	breadfruit, 'ulu	P	+	+
Ficus microcarpa L. f.	Chinese banyan	X	+	+
Ficus cf. platypoda A. Cunn.	banyan	X	+	-
Ficus sp.	banyan	X	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	m
MYRSINACEAE (Myrsine Family)				
Ardisia elliptica Thunb.	shoe button ardisia	X	+	+
MYRTACEAE (Myrtle Family)				
Eucalyptus robusta Sm.	swamp mahogany	X	-	+
Eucalyptus sp.	eucalyptus	X	-	+
Psidium cattleianum Sabine	strawberry guava, waiawi 'ula'ula	X	-	+
Psidium guajava L.	guava, kuawa	X	+	+
Psidium littorale Fosb.	waiawi	X	-	+
Syzygium cumini (L.) Skeels	Java plum	X	-	+
ONAGRACEAE (Evening Primrose Family)				
Ludwigia octovalvis (Jacq.) Raven	primrose willow, kamole	P?	+	+
OXALIDACEAE (Wood Sorrel Family)				
Oxalis corniculata L.	yellow wood sorrel, 'ihi'ai	P?	+	+
PASSIFLORACEAE (Passion Flower Family)				
Passiflora edulis Sims	passion fruit, lilikoʻi	X	-	+
Passiflora subpeltata Ort.	white passion flower	X	-	+
PIPERACEAE (Pepper Family)				
Peperomia leptostachya Hook. & Arnott	'ala'ala-wai-nui	I	-	+
PLANTAGINACEAE (Plantain Family)				
Plantago major L.	common plantain, laukahi	X	+	-
ROSACEAE (Rose Family)				
Rubus rosifolius Sm.	thimbleberry	X	+	+
RUBIACEAE (Coffee Family)				
Coffea arabica L.	Arabian coffee	X	-	+

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SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE p	m
Morinda citrifolia L.	noni	P	-	+
Spermococe mauritiana Gideon		X	+	-
SCROPHULARIACEAE (Figwort Family)				
Lindernia sp.?		X	+	-
SOLANACEAE (Nightshade Family)				
Capsicum annuum L.	chili pepper, nioi	X	-	+
Solanum americanum Mill.	popolo	I?	-	+
Solanum linnaeanum Hepper & P. Jaeger	apple-of-Sodom, yellow kikania	X	+	-
TILIACEAE (Linden Family)				
Triumfetta semitriloba Jacq.	burbush	X	-	+
VERBENACEAE (Verbena Family)				
Clerodendrum philippinum Schauer	pikake hohono	X	-	+
Lantana camara L.	lantana, lakana	X	+	+
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	vervain	X	+	-
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X	+	+

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APPENDIX K

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS FOR A HANA GOLF COURSE E.A.

Prepared by Phillip L. Bruner, October 1990

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS FOR A HANA GOLF COURSE EA. HANA, MAUI

Prepared for
Pacific Planning and
Engineering, Inc.
by

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17 October 1990

INTRODUCTION

The purpose of this report is to summarize the findings of a two day (13,14 October 1990) bird and mammal field survey of lands proposed for a golf course at Hana, Maui (see Fig.1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the type of habitats available.

2- Provide some baseline data on the relative abundance of each species.

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property identify what if any features of the habitat may be essential for these species.

4- Determine if the property contains any special habitats that if lost or altered by developement might result in a significant impact on the fauna in this region of the island.

5- Note which aspects if any, of the proposed development pose the most significant concerns for wildlife and suggest what measures should be considered to avoid these problems.

GENERAL SITE DESCRIPTION

The proposed golf course property is located on the windward coast of Hana, Maui (Fig.1). The majority of the site is currently in pasture. The mauka boundary contains a dense second growth forest of predominantly introduced species. Several stream courses and gullies traverse the site. These drainage courses are apparently intermittent as no water was running in any of them at the time of the survey. The plunge pools and smooth water-worn lava, however, attest to the fact that significant water flow does occur during periods of high rainfall.

Weather during the survey was partly cloudy with an occasional brief passing shower. Winds were from the NE at 10-20 mph.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon.

At various locations and in all representative habitats (see Fig.1) eight minute counts were made of all birds seen or heard. Between these count stations walking tallys of birds seen or heard were also kept. These counts provide the basis for the relative abundance estimates given in this report. Unpublished

reports of birds known from similar habitats elsewhere on Maui were reviewed in order to acquire a more complete picture of possible avifaunal activity (Bruner 1988, 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution. One evening was devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinereus semotus).

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1989); A Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987) and Mammal Species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Birds:

Only one endemic species was recorded: the Short-eared Owl or Pueo (Asio flammeus sandwichensis). This species is listed by the State of Hawaii as endangered on Oahu but is still relatively common on Maui. Pueo hunt in grasslands and thus would be expected at this site. Only one Pueo was recorded on day two of the survey.

No other endemic birds were recorded on the survey nor would any likely occur given the location of the site and the nature of the habitats available to birds.

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay over the summer months as well (Johnson et al. 1981, 1983, 1989). Of all the shorebirds species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) is the most abundant. Plover prefer open areas such as mud flats, lawns, pastures, plowed fields and roadsides. They arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April (Johnson et al. 1981). Bruner (1983) has also shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years (Johnson et al. 1989). A total of 45 plover were recorded over the two days of the survey. Allowing for some birds being counted more than once this number of plover is about what might be expected given the amount of usable space. Much of the pature grass was too high to permit plover to forage and still keep watch for predators. Most plover were therefore confined to grazed areas or pasture roads. Bristle-thighed Curlew (Numenius tahitiensis) and Ruddy Turnstone (Arenaria interpres) are other migrants that utilize fields and pastures as well as intertidal habitat. None were found on this survey.

Resident Indigenous (Native) Birds:

This category includes only those species which are native, but not endemic, such as the Black-crowned Night Heron (Nycticorax nycticorax). The absence of permanent wetlands and streams on the property makes it unlikely that night herons or other waterbirds would occur. None were found on this survey.

Resident Indigenous (Native) Seabirds:

Two White-tailed Tropicbirds (Phaethon lepturus) were seen flying over the property as they made their way out to sea. This species nests on cliff faces in the interior and along the coasts of most high volcanic islands in the tropical Pacific (Hawaii Audubon Society 1989). No seabirds are likely to nest on this property due to the abundance of ground predators.

Exotic (Introduced) Birds:

A total of 11 species of exotic birds were recorded during the field survey. Table One shows the relative abundance of each species. In addition to these species some other exotic birds which potentially could occur on the property include: Common Barn Owl (Tyto alba), Black Francolin (Francolinus francolinus), Cattle Egret (Bubulcus ibis), Red-crested Cardinal (Paroaria coronata), Japanese Bush-warbler (Cettia diphone) and House Sparrow (Passer domesticus) (Pratt et al. 1987; Hawaii Audubon Society 1989; Bruner 1988, 1989).

<u>Feral Mammals</u>:

Several Small Indian Mongoose (<u>Herpestes auropunctatus</u>) were observed on both days of the survey. No rats, mice, or cats were recorded, however, it would be highly unusual if these ubiquitous animals did not occur on the property. Without a trapping program it is difficult to conclude much about the relative abundance of these species. However, the number of mongoose seen would indicate a sizeable population of this introduced predator. Evidence of feral pigs was abundant in the forest mauka of the property.

Maui records of the endemic and endangered Hawaiian Hoary Bat (<u>Lasiurus cinereus semotus</u>) are sketchy (Tomich 1986; Kepler and Scott 1990). None were observed on this field survey despite late evening observations. This species generally roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii. Kepler and Scott (1990) suggest that this bat may occur on Maui only as a "migrant, probably from the Big Island".

CONCLUSION

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations, the available literature and from reports by people familiar with the region. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite

obviously be an important part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the faunal community (Williams 1987; Moulton et al. 1990). Thus only long term studies can provide an in depth view of the bird and mammal populations in a particular area. However, when brief field studies are viewed in the light of data reported from other familiar habitats the values of the conclusions drawn can be significantly increased. The following are some general conclusions related to bird and mammal activity on this property.

1- This site contains a restricted array of habitats and thus supports a limited avifauna. Some species were abundant while others were uncommon. Most species that would be expected in this type of environment on Maui were found. The few species not recorded, but potentially possible, may be uncommon or even absent from this locality.

2- Native birds, such as Pueo and Pacific Golden Plover, are commonly found in pasture land. Their occurrence at this site was expected. No endangered species were found or would likely occur at this locality.

3- Data on feral mammals on the property were limited to observations. No endangered species were recorded.

4- Species which may decline in abundance at this site following development of the golf course and the loss of a tall grass pasture include: Ring-necked Pheasant (<u>Phasianus colchicus</u>), *Eurasian Skylark* (*Alauda arvensis*) and Nutmeg Mannikin (*Lonchura punctulata*). Species that will likely increase due to the presence of a golf course and urban facilities include: Pacific Golden Plover and House Sparrow. Plover particularly prefer lawn habitats over tall grass pasture.

5- No special or unique habitats were discovered on this property. A change in land use of the type proposed should have limited impact on the fauna in this sector of the island.

RECOMMENDATIONS

If any water features are to be a part of the proposed golf course they should be designed in such a way as to encourage their use for native waterbirds. This would involve providing cover in the form of emergent vegetation and islands where birds could nest in safety from mongooses and cats. In addition care must be taken to insure that these water features are not "death traps" due to pesticide and herbicide contamination.

Acknowledgments

Liebert Landgraf of Keola Hana Maui, Inc. graciously provided a driving tour of the site which greatly helped in determining the limits of the area to be surveyed.

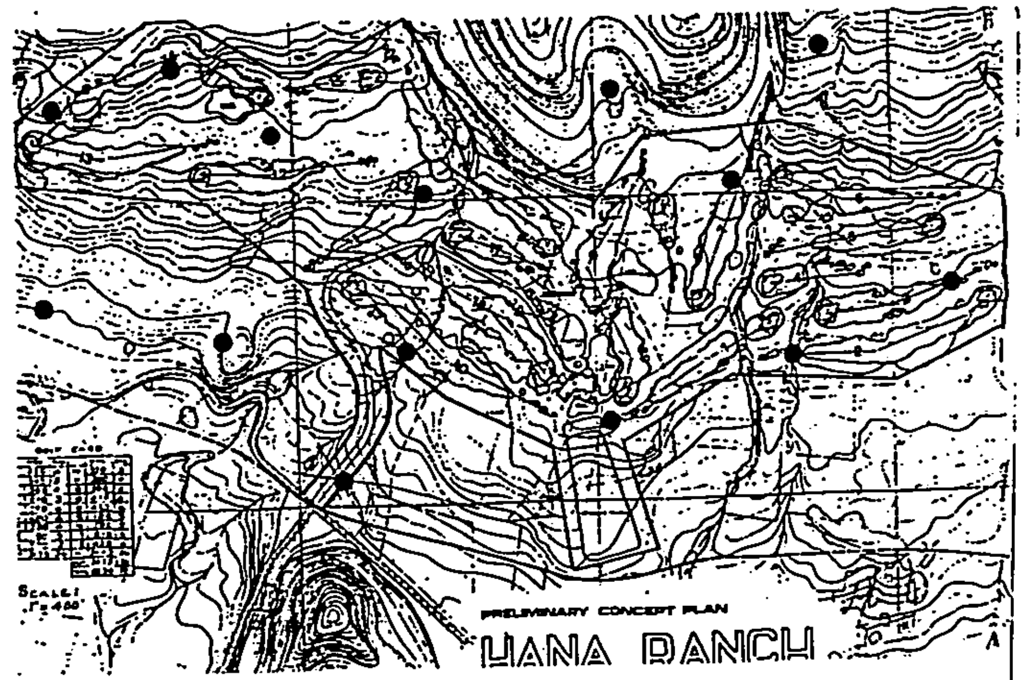

Fig. 1. Location of property where faunal survey was conducted. Solid circles indicate locations where census stations were established.

TABLE 1

Exotic species of birds recorded at the proposed Hana Golf Course property, Hana, Maui

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Ring-necked Pheasant	Phasianus colchicus	U = 4
Spotted Dove	Streptopelia chinensis	R = 3
Zebra Dove	Geopelia striata	U = 2
Hwamei	Garrulax canorus	C = 8
Common Myna	Acridotheres tristis	A = 17
Northern Mockingbird	Mimus polyglottus	R = 1
Northern Cardinal	Cardinalis cardinalis	U = 2
Eurasian Skylark	Alauda arvensis	A = 10
Japanese White-eye	Zosterops japonica	A = 11
Nutmeg Mannikin	Lonchura punctulata	C = 6
House Finch	Carpodacus mexicanus	U = 3

* (see page 11 forkey to symbols)

KEY TO TABLE 1

Relative abundance = number of times observed during survey or frequency on eight minute counts in appropriate habitat.

A = abundant (ave. 10+) number which follows is average of data from all survey days)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts. Number which follows is the total individuals seen or heard)

SOURCES CITED

American Ornithologist's Union 1983. Check-list of North American Birds. 6th edition. American Ornithologist's Union. Washington, D.C.

Bruner, P.L. 1983. Territorial behavior of wintering Pacific Golden Plover in Hawaii. ms. (Paper presented at 100th meeting of the Amer. Ornth. Union).

______ 1988. Survey of the avifauna and feral mammals at the proposed Waihee Golf Course site, Waihee, Maui. Unpubl. ms. Belt Collins and Associates.

______ 1989. Field survey of the avifaunal and feral mammals at Kapalua, Maui. Unpubl. ms. Belt Collins and Associates.

Hawaii Audubon Society. 1989. Hawaii's Birds. Fourth Edition Hawaii Audubon Society, Honolulu.

Honacki, J.H., K.E. Kinman and J.W. Koeppl ed. 1982. Mammal species of the world: A taxonomic and geographic reference. Allen Press, Inc. and the Association of Systematic Collections, Lawrence, Kansas.

Johnson. O.W., P.M. Johnson, and P.L. Bruner. 1981. Wintering behavior and site-faithfulness of Golden Plovers on Oahu. 'Elepaio 41(12):123-130.

Johnson, O.W. and P.M. Johnson. 1983. Plumage-molt-age relationships in "Over-summering" and migratory Lesser Golden-Plovers. Condor 85:406-419.

Johnson, O.W., M.L. Morton, P.L. Bruner, and P.M. Johnson. 1989. Winter range fat cyclicity in Pacific Golden-plovers (Pluvialis fulva) and predicted migratory flight ranges. Condor 91:156-177.

Kepler, C.B. and J.M. Scott. 1990. Notes on distribution and behavior of the endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus), 1964-1983. 'Elepaio 50(7):59-64.

Moulton, M.P., S.L. Pimm and M.W. Krissinger. 1990. Nutmeg Mannikin (Lonchura punctulata): a comparison of abundance in Oahu Vs. Maui sugarcane fields: evidence for competitive exclusion? 'Elepaio 50(10):83-85.

Pratt, H.D., P.L. Bruner, and D.G. Berrett. 1987. A field guide to the birds of Hawaii and the Tropical Pacific. Princeton Univ. Press.

Tomich, P.Q. 1986. Mammals in Hawaii. Bishop Museum Press. Honolulu.

Williams, R.N. 1987. Alien Birds on Oahu 1944-1985. 'Elepaio 47(9):87-92.

APPENDIX L

HANA RANCH COUNTRY CLUB UPDATED SOCIAL IMPACT ASSESSMENT

Prepared by Earthplan, May 1992

Hana Ranch Country Club

Updated Social Impact Assessment

Prepared for
Keola Hana, Inc.
by Earthplan

May 1992

Hana Ranch Country Club

Updated Social Impact Assessment

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Tables and Figures

Tables

Figures

1. Introduction And Background

1.1 Purpose Of This Report

Keola Hana Maui, Inc., proposes to develop an 18-hole golf course in Hana, Maui. Implementation of the proposed action requires an amendment to the Hana Community Plan. In January 1991, Earthplan prepared a social impact assessment for an environmental assessment for that action; the report was appended to and summarized in the environmental assessment. In early 1992, Keola Hana Maui, Inc. decided to prepare an Environmental Impact Statement (EIS).

This report updates and expands upon the 1991 social impact assessment. The scope of work for this project includes the following specific actions to update the initial report:

- **Update the demographic and housing information.**

  Since the publication of the 1991 SIA, information from two sources has been released which provides more recent information about the Hana community.

- **Research on Hawaiian culture and lifestyle.**

  In response to comments on the environmental assessment, this report includes an analysis of potential impacts of the golf course on Hana's Hawaiian community. Samples of existing works were analyzed, with emphasis placed on information specific to Hana.

  In addition to the literature research, Earthplan conducted focus group meetings with Hawaiian residents in Hana. Discussions focussed on questions regarding current lifestyle and expectations regarding golf course impacts on the present lifestyle.

- **Documentation of community negotiations.**

  Since the 1991 SIA was prepared, Keola Hana Maui, Inc. and the Hana community have been in negotiations. These efforts are documented in this report.

1.2 Report Preparation

This report was prepared by Earthplan, located at 81 South Hotel Street, Suite 211, Honolulu, Hawai'i. Berna Cabacungan, principal of Earthplan, was project manager, and principal researcher, facilitator and writer.

Assistance was provided by *Nancy Gilder*, an independent contractor. She assisted in the development of a social impact approach for assessing impacts on Hawaiian culture, and conducted the literature research on this topic. Further, she participated in the focus group discussions and helped analyze the results of these discussions.[1]

1.3 Project Description

Keola Hana Maui, Inc. owns about 4,750 acres in Hana, Maui. The company proposes to develop the Hana Ranch Country Club which will feature an 18-hole golf course. Designated Agriculture on the Hana Community Plan, the project site is used for cattle ranching and pasture lands.

The project site is located approximately 1.8 miles south of Hana Town. It is part of the Aleamai ahupua'a. Used as cattle pasture, the site is distinguished by the gently-sloping Pu'u Kolo. North and south of the site is more rolling pasture land. Rainforests are located mauka and the two-lane Hana Highway is located makai. Further makai is Ka-Iwi-o-Pele, a cinder hill where legend says Pele's bones were left after her battle with her older sister. East of Ka-Iwi-o-Pele is A-lau Island, and south of the hill is Koki Beach Park, Hamoa Village, and Hamoa Beach. Structures nearest the project site are houses located along the U-shaped road at Hamoa.

The main feature of the proposed Hana Ranch Country Club is an 18-hole championship golf course. Golf course patrons are expected to be club members, guests of the Hotel Hana-Maui, other visitors and residents. Ninety percent of the golfers will be Hotel Hana-Maui's guests, who would comprise both members and non-members. Ten percent will be off-resort patrons, including both visitors and residents. It is expected that approximately 1,000 memberships will be sold internationally.

Facilities supporting the golf course include a driving range, which will operate only during daylight hours, and a clubhouse. The clubhouse will include a pro shop, administrative offices, full-service restaurant, a lounge, community rooms, snack shop, kitchen, locker facilities, and golf cart storage areas. Able to accommodate up to 200 people, the restaurant will be open to the public seven days a week.

1.4 Report Organization

This introductory piece is followed by four sections. Section 2 provides a profile of the existing community. Contained in that section is a historical perspective, as well as information on population and housing trends, demographics, housing and households, and characteristics of Hawaiian people in Maui County.

[1] *In the preparation of the 1991 SIA, assistance was provided by two subconsultants. Michael P. Mays conducted research in demographics, including census information and socio-cultural studies, and community issues. Lani Nedbalek assisted in field interviews conducted in Hana.*

In Section 3, changes independent of the proposed Hana Ranch Country Club are discussed. This information extends the base information by looking at what could happen in Hana without the project.

Section 4 presents preliminary community issues on the project. Issues independent of the project are initially discussed, followed by community concerns specific to the proposed Hana Ranch Country Club.

Potential social impacts are presented in Section 5. That section opens with residential population and housing impacts. Section 5.3 discusses implications of the golf course for the overall Hana qualities and Section 5.4 presents impacts on Hana's Hawaiian community. Recommendations are presented in Section 5.5.

2. Description Of The Existing Community

2.1 Study Area Definition and Information Sources

The Hana District extends roughly from Mo-iki Point to Mana-wai-nui. Although the Hana District limits slightly vary from the boundaries of Census Tract 301, both include the same residential areas which include, from north to south:

- Ke-'anae / Wai-lua
- Na-hiku
- Ka-'eleku
- Wai-'anapanapa
- Wa-kiu
- Hana Town
- Hamoa
- Maka-'alae
- Pu'u-iki to Koali
- Koali to Wai-lua
- Ki-pahulu
- Kau-po

For the purposes of this report, Census Tract 301 and Hana District will be used interchangeably. The Hana Census Designated Place (CDP) is generally the area considered Hana Town and its environs.

The primary source of information in this section is the 1990 census. As of this writing preliminary information has been released regarding basic population characteristics (age and ethnicity), as well as selected housing information. Hence, the more detailed population information reported in the 1991 SIA from the 1980 census has not been released at the time of this writing.

Another source of information is **Housing in Hana, Maui: A Study of Housing Conditions and Needs**. This study was prepared by SMS Research in July 1991.

2.2 Historical Perspective

Hana is believed to have been a major entry point for many early settlers; they were attracted by the area's lush environment and abundant resources. Initially Hana was ruled by chiefs of the 'Ulu line; they maintained East Maui as a separate kingdom. Pi'i-lani united Hana Coast with the central and west portions of Maui in the 15th century. Pi'i-lani maintained a home in Hana and was responsible for the construction of fish ponds and irrigation systems for the taro fields. He began the building of stone-paved roads, and his son Kiha-a-pi'ilani extended the coastal road to West Maui and up Kau-po Gap. In the mid-1700s, Hana was captured by Ka-lani-'opu'u of the island of Hawai'i. Ka-hekili, the king of Maui at that time, seized Ka-'uiki, the hill on the south side of Hana Bay which served as the stronghold of Ka-lani-'opu'u.

The early system of land management has ramifications on project issues related to the proposed Hana Golf Course. The Hana District, extending from Ke-'anae to Kau-po, was one moku, which is a large geographic delineation. This moku had several ahupua'a (triangular land extending from the ocean to the mountain). The ahupua'a was divided into 'ili; mo'o were the sections of 'ili that could be cultivated. Land cultivated for the chiefs by the common people were ko'ele. Kihapai was a small parcel of land cultivated for a single family. The common people were free to move from one chief's land to that of another. The land a person farmed did not belong to that person, but was under his or her control during occupancy.

The Great Mahele of 1848 divided land equally among three groups: the crown, the chiefs and the common people. To establish free and clear title, individual claims were to be presented to the land commission with a commutation fee. Though some made their claims, many maintained their early relationship with the land and continued working their kihapai in the old style. In Hana, as in other parts of Hawaii, it was therefore easy for non-Hawaiians to acquire land which was neither cultivated by nor intended for them.

The first sugar operation came to Hana in the mid-1800s, when George Wilfong set up a sugar mill near Ka-'uiki. Many Hawaiians disliked the working conditions and lack of freedom of mobility, and Chinese laborers were imported in 1852. Many of them eventually set up small farms and businesses.

The Hana Plantation was setup in 1864 by August and Oscar Unna. The first Japanese laborers arrived four years later. With the Sugar Reciprocity Treaty with the United States, the Kingdom of Hawai'i became extremely competitive with the mainland sugar industry. By 1883 six sugar operations were active in Hana. Filipino laborers arrived in the 1930s.

Planters continued to try to obtain land, and leasing often became a convenient alternative. Though leasing was compatible with some of the Hawaiian land management concepts, record-keeping was inconsistent and often non-existent. Lease terms over many years were lost or forgotten the many small sugar plantations left a legacy of numerous and confusing land transactions. [2]

In 1930, when 4,000 people lived in Hana, Paul I. Fagan bought one-third interest of Ka-'eleku Sugar Company and C. Brewer and Co. Ltd bought two-thirds. Fagan bought out C. Brewer's interest in 1943. At this time the entire section was accessible only by inter-island boats delivering freight and passengers or by a narrow 55-mile trail from Wailuku.

At the height of Hana's sugar era, it is believed that 5,000 people lived within a 40-mile radius of Hana Town. There were seven schools, 14 churches, a tax office, a bank, three post offices, eleven merchandise stores, two liquor stores, five restaurants, two bakeries, three barber shops, two theaters, two pool halls, four service stations, one gym, two community halls, one police station, a jail and a five-room hotel. [3]

2 *Youngblood, etal., 1957.*
3 *Jetley, 1980.*

Technology and economics eventually caused the reduction of sugar operations throughout Hawaii and, in 1946, C. Brewer closed down the Ka-'eluku Plantation. Fagan's response was two-fold. He transformed the sugar lands into grazing land for cattle. He also built the Ka-'uiki Inn in the heart of Hana Town. These actions resulted in maintaining the open space quality of the area and providing a viable economic base. Eventually, Fagan built the Hana Ranch Center and a community center and set up a trust fund to fund the Hana Community Association.

The State paved the road to Hana Highway in 1962. Rent-a-car tourists began frequenting Hana and "the other side" became more accessible to Hana residents. The lands owned by Fagan began changing hands.

Few changes occurred until 1984, when the Rosewood Corporation bought the land and added 24 rooms to the then 73-room Hotel Hana-Maui. Rosewood officials developed a strong relationship with the Hana community over a period of five years. The community had reached some verbal agreements with Rosewood, but no written agreements were drawn. Rosewood's selling of Hana holdings embittered and disappointed Hana residents, particularly because many believed that workable agreements were in the making. [4] Keola Hana Maui, Inc. acquired Rosewood's Hana holdings in late 1989.

2.3 Population and Housing Trends

Maui County and Island are the fastest growing segments in the State of Hawai'i. Between 1970 to 1980, Maui Island's population grew by over 62 percent, with the fastest growing area being the Maka-wao District; it almost doubled in population. During that decade, Hana District's population grew by 47 percent, from 969 persons to 1,423 persons; this 47 percent increase was the second lowest in Maui Island.

There has been slightly less growth since 1980, with Maui Island's population increasing 42 percent for an estimated 1990 population of 91,369 persons. Hana District's growth is estimated as the lowest of the island's districts, with a 33 percent increase during the same nine-year period and an average annual growth rate of 2.9 percent. An estimated 1,900 persons resided in Hana District in 1990. [5]

Table 1 shows that during the 20-year period from 1970 to 1990, growth in Maui Island and Hana District occurred at a faster pace in the 1970s than in the 1980s. In terms of sheer numbers, the population of Maui Island increased 128 percent, or 2.3 times. In Hana District, the population almost doubled over twenty years.

On the average, the population on Maui Island increased four percent a year between 1970 and 1990. Hana's average annual growth rate during that 20-year period was lower at 3.4 percent.

4 *Jokiel, 1990.*
5 *This estimate may be low, as discussed in Section 2.5.2.*

Table 1
Population Count, Percent Change and Average Annual Growth Rate
Hana District, Maui County, Maui Island and Other Island Districts, 1970 to 1990

Area	Population Count			Percent Change			Average Annual Growth Rate		
	1970	1980	1990	1970–1980	1980–1990	1970–1990	1970–1980	1980–1990	1970–1990
Maui County	46,156	70,991	100,504	53.81%	41.57%	117.75%	4.4%	3.5%	4.0%
Maui Island	38,691	62,823	91,361	62.37%	45.43%	136.13%	5.0%	3.8%	4.4%
Hana District	969	1,423	1,895	46.85%	33.17%	95.56%	3.9%	2.9%	3.4%
Makawao District	9,979	19,005	29,207	90.45%	53.68%	192.68%	6.7%	4.4%	5.5%
Wailuku District	22,219	32,111	45,685	44.52%	42.27%	105.61%	3.8%	3.6%	3.7%
Lahaina District	5,524	10,284	14,574	86.17%	41.72%	163.83%	6.4%	3.5%	5.0%

For non-Hana districts, change between census years may be due to boundary changes as well as population changes

Source: Hawai'i State Department of Business and Economic Development, 1988, 1990; U. S. Census Bureau, 1991.

Housing counts are presented in *Table 2*. According to the U.S. Census, Maui Island's housing count increased 28 percent between 1980 and 1990, from 29,924 to 38,422 housing units. The Makawao District, which is adjacent to the Hana District, experienced the highest increase in housing units; its 1990 count of 11,526 units represents a 5,000-unit increase over the 1980 figure.

In Hana the increase in housing units was modest. Between 1980 and 1990, 247 housing units were added to Hana's supply. This represents a 48 percent increase.

2.4 Demographics

The Hana District and Hana Town has a significantly high proportion of Hawaiian residents. *Table 3* shows that, in 1990, the Hana District had proportionally three times more Hawaiians than Maui County. Hana Town had even a higher proportion; with 63 percent of residents being Hawaiian, Hana Town had four times more Hawaiians than the overall county.

In all areas, however, the proportion of Hawaiians decreased between 1980 and 1990. This proportional decrease appears to be related to increases in other ethnicities due to in-migration. In Maui County, there were an increase in Caucasians, Chinese and Filipinos. In the Hana District, there was a significant increase in Caucasians (from 26 to 39 percent) and a small increase in people of Chinese ancestry. Whereas Hawaiians increased by only 31 people between 1980 and 1990, there were 257 more Caucasians in 1990 than in the previous census. [6]

Age-wise, the overall Hana District is consistent with the national, statewide and county-wide trend of an aging population. While the median age in Maui County increased from 29.6 to 33.4 years from 1980 to 1990, Hana District's median age increased from 28 to 31.1 years.

Significantly, Hana Town's median age remained stable from 1980 to 1990; its 1990 median age of 26.3 was even lower than the county's 1980 median age.

In the specific age groups, Hana residents continue to be younger than the rest of Maui County. County-wide, about 27 percent of the population was 17 years old or younger. In Hana District and Hana Town, respectively 33 and 35 percent were youngsters. Further, Hana's elderly population is smaller than that of the County.

6 *In the 1991 SIA, community informants involved with public and social services believed that the proportion of full- and part-Hawaiian people might be more around 80 to 85 percent. The 1990 census information does not validate this estimate.*

Table 2
Housing Counts for Hana District,
Maui Island and Other Island Districts, 1980 and 1990

Area	Housing Count 1980	Housing Count 1990	Percent Change 1980-1990	Ave. Annual Growth 1980-1990
Maui Island	29,924	38,422	28.4%	2.5%
Hana District	516	763	47.9%	4.0%
Makawao District	7,235	11,526	59.3%	4.8%
Wailuku District	14,256	18,934	32.8%	2.9%
Lahaina District	7,917	7,739	-2.2%	-0.2%

For non-Hana districts, change between census years may be due to boundary changes, as well as housing counts.

Source: Hawai'i State Department of Business and Economic Development, 1988, 1990 U.S. Census Bureau, 1991.

Table 3
Population and Demographic Characteristics: 1980 and 1990

	Maui County 1980	Maui County 1990	Hana District 1980	Hana District 1990	Hana Town 1980	Hana Town 1990
Total Population	70,847	100,374	1,423	1,895	643	683
Ethnicity						
Hawaiian	17.3%	15.8%	58.2%	47.8%	65.9%	62.7%
Caucasian	33.6%	39.6%	25.7%	38.9%	16.0%	23.9%
Chinese	1.8%	2.2%	1.8%	3.3%	3.3%	4.1%
Japanese	22.1%	17.0%	3.8%	3.4%	5.0%	4.7%
Filipino	18.9%	20.3%	4.4%	4.0%	6.5%	3.7%
Other	6.2%	5.1%	6.1%	2.6%	3.3%	1.0%
Age						
Less than 5 years	8.3%	7.8%	11.0%	10.9%	10.7%	11.1%
5 to 17 years	21.3%	19.0%	25.6%	22.9%	28.5%	24.5%
18 to 64 years	60.5%	62.0%	54.3%	56.9%	54.7%	57.2%
65 or more years	9.9%	11.3%	9.1%	9.2%	6.1%	7.2%
Median Age	29.6	33.4	28.0	31.1	26.3	26.3

Source: State Department of Business and Economic Development, 1988, 1990; U. S. Census Bureau, 1991

2.5 Housing

2.5.1 Census Information

It is estimated that in 1990, Hana District contained 763 housing units; Hana Town contained 217 housing units. These housing counts represent modest increases in the housing stock. The overall District housing supply increased by 247 units from 1980; only two units were added to Hana Town's housing supply.

As shown on *Table 4*, while housing vacancies decreased in Maui County, the Hana District housing supply experienced a slight increase in vacancies. In 1980, 14.5 percent of Hana's housing supply were vacant; in 1990, 22.8 percent. The increase in vacant units occurred primarily in units built for occasional use, such as second homes, and for recreational purposes.

In the overall Hana District, the proportion of owner-occupied housing units decreased between 1980 and 1990. In 1990, 56 percent of Hana's housing units were occupied by their owners; this is slightly lower than the county-wide proportion.

Monthly rents experienced dramatic increases in the 1980s. Throughout Maui County, including the Hana District, median rents more than doubled between 1980 and 1990. In Hana Town, the median rent almost tripled in the ten-year period. 1990 median rents for Maui County, the Hana District and Hana Town were $658, $422 and $525, respectively.

While Hana residents were subject to higher rents, its homeowners enjoyed only modest increases in housing values. Unlike Maui County, where the housing median value increased by $88,500, Hana District's and Hana Town's median housing values increased by only $26,300 and $36,477, respectively.

Crowding[7] continued to be a problem in 1990 in Maui County and in Hana, as indicated in *Table 5*. In Maui County, crowding actually increased from 1980 to 1990; in 1990, 7.6 percent of the units contained 1.51 or more persons per room. Proportionally, Hana's crowding problem exceeded that of the county. In 1990, 16.1 percent were very crowded in the overall Hana District. In Hana Town 18 percent of the housing units were very crowded.

Census figures indicate that household sizes decreased in the overall Hana District. In 1990, there were an average of 3.1 persons per household in the Hana District. Within Hana Town, however, there continued to be large households, with an average of 3.6 persons in 1990.

[7] *One indicator of crowding in housing units is the number of persons per room. One to 1.5 persons per room indicates mild crowding. More than 1.5 persons indicates "very crowded" conditions.*

Table 4
Characteristics of Housing Units: 1980 and 1990

	Maui County		Hana District		Hana Town	
	1980	1990	1980	1990	1980	1990
Total Housing Units	32,728	42,160	509	763	215	217
Vacant units	31.2%	21.4%	14.5%	22.8%	16.7%	17.5%
For rent	0.8%	3.7%	0.0%	3.1%	0.0%	3.7%
For sale	12.0%	0.7%	4.9%	1.0%	9.3%	1.8%
Occasional use	2.8%	14.1%	9.0%	13.6%	6.5%	8.3%
other	15.6%	2.9%	0.6%	5.0%	0.9%	3.7%
Total Occupied Units	22,510	33,145	435	589	435	179
Owner-occupied	57.6%	57.6%	60.2%	56.4%	60.2%	61.5%
Renter-occupied	42.4%	42.4%	39.8%	43.6%	39.8%	38.5%
Median Cash Rent Of Occupied Units	$305	$658	$188	$422	$178	$525
Median Value Of Occupied Units	$113,600	$202,100	$111,200	$137,500	$93,900	$130,377

Source: U.S. Bureau of the Census, 1981a, 1981b, 1991

Table 5

Household Characteristics: 1980 and 1990

	Maui County		Hana District		Hana Town	
	1980	1990	1980	1990	1980	1990
Total Households	22,510	33,145	435	589	179	179
Family households	74.8%	71.0%	71.5%	65.7%	76.5%	68.7%
Married Couple Families	61.5%	56.2%	59.5%	50.1%	64.8%	54.2%
Nonfamily households	25.2%	29.0%	28.5%	34.3%	23.5%	31.3%
Persons per household	3.1	3.0	3.6	3.1	3.6	3.6
Persons per room						
1.00 to 1.50 persons	9.1%	8.7%	11.0%	9.7%	10.1%	12.8%
more than 1.5 persons	7.3%	7.6%	20.7%	16.1%	25.1%	17.9%

Source: U.S. Bureau of the Census, 1981a, 1981b, 1991.

2.5.2 Hana Housing Study

Keola Hana Maui, Inc. commissioned a 1991 study of Hana's housing needs. SMS Research (1991) conducted a housing needs survey and the Research and Consulting Division of Locations, Inc., conducted an independent market analysis. Both efforts received guidance and assistance from the Hana Affordable Housing Community Advisory Committee.

The study area for the housing study extended from Nahiku to Kipahulu and includes all the villages therein and Hana Town. Some employees of Keola Hana Maui, Inc. who lived outside of this area were also surveyed. The Advisory Committee felt that this population appropriately represented the Hana community.

The survey included 427 households and 484 families.[8] The study assumes that those interviewed represented 80 percent of the total study area population, which is estimated at 2,000 persons. This estimated population suggests that the actual population in the Hana District, as presented in Section 2.3, may be higher than 1990 census figures, although for the purposes of this study, the 1990 census information remains the basis for quantitative analysis.[9]

Highlights of study findings are as follows:

- **Current low level of homeownership and high level of rent-free situations.**

  Thirty-nine percent of the households were represented by homeowners and 34 percent by renters. Twenty-seven percent were living rent-free. Compared to Maui and the State, this is a low rate of homeownership and high rate of living rent-free.

- **Large households.**

  The average household size among the study group was 4.04. This is very high when compared to Maui's 2.99 persons. It is also significantly higher than information reported by the 1990 census.

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8 *More than one interview per household was conducted.*

9 *Since the study area is smaller than Census Tract 301, the housing study estimated population suggests that the overall Hana District population may be higher than that indicated in the 1990 census. The 1990 census indicates a population of 1,900 in 763 households in Census Tract 301 in 1990. If the number of households is accurate and you apply the housing study household size of 4.04 persons, then the overall Hana District population may be as high as 3,100 persons. Verifying the actual population count was beyond Earthplan's scope of work, and the 1990 census information was used for quantitative analysis.*

- **Substandard housing units.**

  The housing units were generally smaller than other areas of Maui. The median size of a single family home in Hana was 865 square feet, compared the islandwide median of 1,350 square feet. Further the physical condition of housing units in Hana was found to be below average compared to many areas in Maui.

- **Significant crowding.**

  Table 6 presents information on crowding in Hana's housing units. Three criteria were used to examine how Hana's crowding conditions compare to those of Maui: persons per room, doubling up, and the presence of unrelated household members. In all of these criteria, Hana's proportions were more than double the Maui proportions. Further, it was estimated that 40 percent of Hana's housing stock was crowded, as compared to 24 percent islandwide.

- **Estimated housing need.**

  The study estimated that 188 new housing units would be needed to accommodate those who wish or need to move to another unit.

- **Who expressed a desire or need to move?**

  - 49 percent lived in crowded units
  - 70 percent had family incomes below the County median of $39,000
  - 56 percent have incomes below 80 percent of the median income
  - 81.3 percent were either renters or live rent free
  - 91.1 percent had less than $10,000 in savings
  - 31.1 percent owned real estate or are part of the real estate hui
  - ten percent were on the waiting list maintained by the State Department of Hawaiian Home Lands

- **Focus of housing planning efforts.**

  Only two families qualified for market-priced housing; eight qualified for market-priced rentals. Thus, the focus in planning for Hana's housing needs should be assisted home ownership. This will require both home ownership programs and self-help housing programs. Elderly housing also needs to be provided.

Table 6

Indicators of Crowding in Hana's Housing Units, 1991

	Hana Study Area	Interested in moving to own unit	Maui Island
More than 1.5 persons/room	16%	not available	7%
Two or more families in one unit — doubling up	25%	34%	12%
Presence of one or more individuals unrelated to the members of the primary household	30%	63%	13%
Overall crowding	40%	82%	24%

Source: SMS Research, 1991.

Assisted rental housing, while it was not preferred by the majority who want to move, can still play an important role. Such housing will provide for temporary housing for those who need time to prepare for home ownership and can reduce crowding.

Section 3.2 discusses the status of follow-up on the housing study findings.

2.6 Other Characteristics

This report presents 1980 census information specific to the Hawaiian community in Maui County. Because of the high proportion of Hawaiians in Hana, this information provides some indication of characteristics which may be present in Hana. Neither information specific to Hawaiians from 1990 census nor in Hana were available at the time of this writing.

- **Age and Sex Distribution.**

  Whereas the general sex distribution in Maui County indicates more males (51 percent) than females, there were more Hawaiian females (52 percent) than Hawaiian males. Hawaiian residents in Maui County tended to be younger in that 46 percent of Hawaiians were under the age of 20, as compared to 33 percent of the county. There were also more people over the age of 60 in the County population than in the Hawaiian population.

- **Household Size.**

  Hawaiian households were larger than other Maui households. Forty-three percent of Hawaiian families had five or more members living together, compared to 25 percent for County families.

- **Family Type.**

  In Maui County, 82 percent of the families were married couple families and 14 percent were female households with no husband present. About 77 percent of the Hawaiian families were married couple families and 21 percent were female households with no husband present.

- **Residential Mobility.**

  Hawaiians were less mobile than the County population. An estimated 86 percent of the Hawaiian population in Maui County lived there five years before the census, which is a higher proportion than the county-wide 75 percent.

- **Education.**

  Proportionally, slightly less Hawaiians were enrolled in an educational institution (21 percent compared to the county-wide 25 percent). There was also a slightly lower median educational attainment.

- **Income.**

  The mean household income in the County was $22,031, whereas the median income for Hawaiians was $19,417. Hawaiians also had lower mean income for interest and dividends and higher mean income for social security and public assistance. Proportionally, there were more Hawaiian families with incomes below the poverty level.[10]

[10] *Alu Like, 1981.*

3. Changes Expected To Occur Without The Proposed Golf Course

3.1 Policies Of The Hana Community Plan

The current Hana Community Plan, which is part of the Maui County General Plan process, seeks to retain the open space and low-scale development characteristic of Hana. The plan establishes a population projection of 2,300 over 20 years as a framework for planning county policies and services.

While the maintenance of agriculture, ranching and the visitor industry is called for, the plan also encourages diversification of the economic base with horticulture and aquaculture. Development is confined to the areas in and around Hana Town, which is to be retained as the population center for the region. The low-density town character called for by the plan is reflected in a building height limit of 30 feet.

The plan limits growth outside of Hana Town. Urban District expansion would only be allowed within the area between the new Hana School and the old site of the Hasegawa Store. The plan discourages approvals of Special Permits in State Agricultural and Rural Districts unless the proposed actions are necessary to serve the remote areas, support agricultural uses, or are required for the use or distribution of economic resources.

In conjunction with the recent revision to the Maui County General Plan, the Hana Community Plan is being revised. The new plan is being prepared by the County Department of Planning with citizen input. Thirteen Hana residents have been appointed to the Citizen Advisory Committee for the Hana Community Plan. While there may be some revisions to the quantitative guidelines, such as population projections, it is expected that the spirit of the original community plan will continue to be reflected in the policies of the Hana Community Plan.

3.2 Proposed Community Changes Independent Of The Hana Ranch Country Club

The 1991 SIA suggested that three types of changes may occur in Hana without the proposed golf course project. A year later, these changes continue to be the primary potential forces of change for Hana.

3.2.1 Public Improvements

Public improvements are being conducted to improve services to the existing population. In a review of EISs conducted for projects in the Hana District, the only types of projects proposed were public improvements, namely improvements to the various components of Hana's water system. Public officials identified ongoing road repair as another major public effort. With efforts focussed on accommodating the existing population, no major expansions or additions to the infrastructure is being planned.

Changes are being proposed for public services in Hana. The Hana Medical Center is seeking to expand its facilities on an adjacent State-owned 10.7-acre parcel adjacent to the existing facility. The County Fire Department has recently acquired a new fire/rescue truck and may be developing a new fire station on a one-acre parcel.

3.2.2 Commercial Development

Two independent efforts are underway. First, Hina-malailena, a non-profit corporation, proposes the "Hana Village Marketplace," a $1.9 million commercial center on 1.124 acres in Hana Town. Goals of the project include:

- provide an opportunity for self-sufficiency and self-employment;
- retain the local population;
- prevent the displacement of the Native Hawaiian family;
- foster the perpetuation of the Hawaiian culture and historic lifestyle of the residents;
- provide for upgrading of skills and learning experience;
- serve as an example of a community-based commercial facility;
- provide additional income and jobs to the residents;
- increase visitor satisfaction for Maui visitors; and
- provide economic stability in Hana.

The commercial center will provide an opportunity for home-based cottage industries to expand and will house resident-owned small businesses, ranging from clothing, arts and crafts and ice cream shops to a fish market and seafood restaurant. The facility will contain kiosk-type structures and an open market area. The open market will be used for local residents to sell arts and crafts, fresh vegetables, fruits and other produce. This area will also be used for kupuna/youth programs, demonstrations, exhibits and entertainment. Commercial office space will be made available on the second floor to house secretarial services, real estate offices and the management office for the center itself.[11] Hana residents, especially native Hawaiians will have priority for leases. The current priority for Hina-malailena is funding, and the executive director is seeking grants for the implementation of this community-based development.

[11] *Hina-malailena, 1990 and 1991.*

The other commercial project proposed is the Hana Town Center. Keola Hana Maui, Inc. proposes to establish the "Hana Town Center" in the existing commercial area containing the ranch headquarters, the post office, a restaurant, real estate office, a clothing shop, and the ranch store.

The intent of the project is to meet daily service requirements of Hana residents and visitors, to improve the hotel employee working conditions, and to diversify economic and employment opportunities. Project objectives include the following:

- the relocation and expansion of the existing Hana Store,
- the addition of support facilities for the hotel and ranch,
- the introduction of more eating establishments, and
- the provision of opportunities for small-scale entrepreneurs.

The project is currently in the planning stage.

3.2.3 Housing Development

Hana's current housing projects are government-assisted efforts. This is significant in that there have been no prior public sector housing projects in Hana.

As discussed in Section 2.5, Keola Hana Maui, Inc. commissioned a 1991 study of Hana's housing needs. Since the completion of that study, the committee which guided the preparation of the study became the Hana Affordable Housing and Community Development Corporation. The directors comprise the nine persons in the advisory group. The corporation is applying for tax exemption status. Current efforts include:

- Single Family Housing.

  The Corporation is currently working on a 67-unit residential subdivision near the Hana Medical Center. The Corporation is trying to maximize the number of houses constructed under a mutual self-help housing program, and has (1) filed appropriate applications to the Farmers Home Administration in the U.S. Department of Agriculture, (2) requested a grant request for $10,000, and (3) is working with the Rural Community Assistance Corporation which will provide technical assistance. If this project is successful, it will be the largest self-help housing program implemented in Hawai'i. A preliminary subdivision plan has been prepared, and the Corporation recently received $350,000 from the State Legislature. Also, $650,000 of Community Development Block Grant monies are available.

- Elderly Housing.

  The Corporation is also working with the Hana Medical Center Advisory Committee to designate 2.5 acres of the Center's expansion land for an elderly housing project with a maximum of 25 units. The project is in the planning stage.

- Multi-Family Rental Housing.

  The Corporation wants to develop approximately 40 rental units at Niumalu, on 18 acres around the park. This project would be implemented with the Hawai'i Housing Authority and is currently on hold.

In addition to developing housing units, the Corporation is working with Hale Mahaolu, a Kahului-based non-profit organization, to create a program to help prepare prospective buyers in their purchase of homes in the subdivision.

The Hawaii Housing Authority purchased a 6.8 acre parcel in Ka-eleku in December 1991 for the development of low income rental units. The project is currently in litigation.

4. Updated Community Issues

In a social impact assessment, social impacts are those changes which are likely to occur given the nature of the proposed action and the social context in which this action would occur. Social issues are community concerns which arise *in response* to a proposed action. Social issues often shift over time, as people's priorities, environment and lifestyles change.

The purpose of discussing social issues in this report is to include the community's opinions and sentiments in the decision-making process, and to expand the social context for identifying social impacts of the proposed Hana Ranch Country Club.

In the 1991 SIA, there was extensive discussion of Hana residents feelings about their existing community and their reactions to the proposed project. We are including the entire 1991 SIA discussion on community issues in this updated report, as there is no evidence of major changes in the community values and opinions presented in the previous report.

Further, we are incorporating information provided by the Hana Community Association on community concerns. This information proves to be a valuable indicator of community sentiment about the proposed golf course.

Because the previously-identified community issues are likely to continue to be valid, and because of the availability of the Hana Community Association information, we did not conduct additional interviews to discern trends in community issues. Instead, we concentrated our field work efforts on studying potential impacts on Hana's Hawaiian community, which are discussed in Section 5.

4.1 Sources Of Information On Community Issues

4.1.1 Community Interview Process for the 1991 SIA

In the 1991 SIA, we conducted interviews with Hana residents to identify community issues.[12] We solicited input from a cross-section of individuals who:

- are active in community affairs and therefore would have insight on community attitudes,
- collectively included a diversity of cultural and ethnic backgrounds, walks-of-life, religious beliefs, and so on, though not in a statistically accurate proportion,

[12] *The interviews were conducted for Issue Identification purposes only, and not to assess the quantity of community support or opposition, which would require a statistical poll or survey.*

- may be directly and immediately affected by the proposed project.

The selection process was twofold. First, Earthplan approached social work and public service officials, as well as individuals who had previously expressed some reaction on the golf course to the media or Keola Hana Maui, Inc. Second, interviewers asked for referrals, stressing the need for a cross-section of individuals. Further, in a few cases, individuals asked to be interviewed. In all three groups there was a diversity in opinion.

Those interviewed included members of community organizations, church officials, education administrators and teachers, individuals professionally involved in social and health activities, and business people. Most participated in a community, social or religious organization, though they were not asked to "represent" the opinions of their organizations. They were asked to express their own opinion and provide insight into how their peers might react.

The 57 Hana residents interviewed in the 1991 SIA are identified in Appendix A. In terms of their residential relationship to Hana, about 45 percent were *from Hana* in that they were born and raised in the area. Almost 40 percent lived in Hana for more than ten years.

Interviews were held in early December 1990. The average length of the informal interviews was one hour, and almost all were conducted in person. There were three general areas of questions, as follows:

1. **Feelings About Hana.** Interviewees were first asked to identify aspects about Hana that were most important to them. They were asked to talk about things they liked, and problems or concerns related to Hana. Second, informants were asked to describe their expectations and desires for Hana. They were asked what they would like to see remain the same or changed, and what kinds of solutions they desired.

2. **Golf Course.** Those interviewed were asked to share what they already knew about the proposed project. The interviewer then provided project information based on a fact sheet distributed to public agencies for their comment. Informants were then asked what kinds of good things, if any, they saw about this project. Following that response, the interviewer asked about problems arising from the project. Finally, informants were asked if they had any recommendations or revisions.

3. **Keola Hana Maui, Inc. and Referrals.** The last category of questions was related to (1) the informants feelings about Keola Hana Maui, Inc. and (2) any recommendations for future contacts.

4.1.2 Comments Offered by the Hana Negotiations Committee as a Consulted Party

In March 1992, the Hana Community Negotiations Community submitted comments in response to the EIS Preparation Notice on the proposed project. The document entitled Comments Offered by the Hana Community Negotiations Community as a Consulted Party (Submitted March 8, 1992) contained comments on (1) economic issues and concerns, (2) community concerns, and (3) concerns arising from negotiations. Summarized in Section 4.3, these comments were prepared subsequent to the 1991 SIA and provide indications of how the community feels about the proposed project.

4.1.3 Other Sources

Informational sources for community issues also included newspaper articles, local newsletters and a community survey. Honolulu and Maui newspapers were reviewed, as well as newsletters produced by individuals, the hotel and the Hana Community Association. In addition, we summarize a 1992 State-sponsored study on golf courses identified community issues common to golf course development in Hawai'i.

4.2 Findings of the 1991 SIA Interviews

4.2.1 Non-project Issues Described In Interviews

Hana's Strengths And Values

Those interviewed shared numerous thoughts about what is special or valuable to them about Hana. They were encouraged to go beyond the terms "unique" and "special" and were asked to delve into what makes Hana that way. Their comments generally pertained to the three special facets about Hana -- its lifestyle, social qualities and rural/natural environment.

1. **Lifestyle.**

   Of utmost importance to those interviewed was the "small town" lifestyle prevalent in Hana. Informants talked about how things move slowly in Hana; people were patient, accommodating and unhurried. Life is peaceful and tranquil, with minimal disruptions. People valued the "nothingness," the absence of typical urban conveniences such as fast food places. They felt that such fast-paced facilities go against the grain of peacefulness and they would rather do without than give up this lifestyle.

   Hana's seclusion and remoteness are part of this lifestyle. The community is far from "the other side," and while many depend on the other side, they enjoyed the geographical separation. This isolation is said to have a protective quality over Hana's lifestyle. The children are less exposed to

   crime; there is less dependency on materialism. An important element in Hana is the ability to "get by" with very little; no one goes hungry in Hana and everyone has a place to stay.

   Many valued the strong sense of security in Hana. They felt that, with few urban pressures, life in Hana is fairly predictable.

2. **Social Qualities.**

   Hana is often described as the "last Hawaiian place," and much of this has to do with the prevailing Hawaiian culture in Hana's social environment. Those interviewed repeatedly talked about the caring aspects of Hana's people. They shared stories of aloha, of neighbors helping each other in storms, of police officers and storekeepers taking a strong interest in young people, of families opening up their already crowded homes to those in need. "Newcomers" remembered how they were easily and warmly accepted ten, fifteen, twenty years ago. Ho'okipa is a way of life in Hana and lu'au are common.

   Ohana is a basic support system in Hana. In addition to the prevalence of extended families, there were instances related of how a family would hanai others. It was noted many times that "everyone in Hana is related," and multi-interviews in an extended family were common during this study.

   It was often felt that the Hawaiian and community values are so strong that the community ideals of aloha and tolerance often supersede differences and conflicts between individuals. People felt that, even though there may be stressful differences between individuals or "factions," the community would still come together in cases of need and celebration.

3. **Rural/Natural Environment.**

   It was often felt that these other characteristics of Hana would not be possible if it weren't for the area's natural environment. On a practical level, the ocean and mountains provided opportunities to fish and hunt. On a spiritual and emotional level, the lush vegetation and wide, open spaces provide a sense of peace, protection and elation. Hana's environment is said to have a healing quality for its residents, which is increasingly rare in Hawai'i's urban communities. Many feel relieved and calmed as soon as they see a familiar natural landmark on their way back from the other side.

Hana's Concerns And Problems

Just as they were open about the Hana's positive aspects, those interviewed were very willing to talk about their concerns about Hana. The input provided has been categorized into those dealing with the overall community, the family unit and the individual.

1. Concerns at the Community Level.

Fragile qualities -- Informants who were very active in community organizations felt that the existing harmony with Hana's lifestyle, social qualities and the environment is fragile. They felt that external forces, mainly those stemming from development, could threaten the area so that Hana will lose its special qualities. Both those "from Hana" and in-migrants were protective of Hana's special qualities.

Old-timers seemed more confident that Hana could survive in-migration. They noted that a sheer increase in people would not necessarily change Hana, since the area once supported a population over 2.5 times the current population. Rather, they were afraid that new people and their cultures may not blend in with what is already present in Hana.

Housing -- Housing was cited as a major community problem. People pointed to instances of crowding, whereby two or three families lived in a two-bedroom house. Many attributed this problem to two factors. First, there are simply too few housing units. Second, rents are not affordable and families must double up to pay rent. High rents were blamed on the sudden demand for housing during the expansion construction at Hotel Hana-Maui. Construction workers were willing to pay high rents, and landlords took advantage of this situation; when the workers left, the rents remained at their high level.

Land title disputes -- These were unresolved problems. The historic taking of lands under the stewardship of Hawaiians in oftentimes illegal or deceitful ways was unforgivable to both Hawaiians and non-Hawaiians. Those who raised this issue exhibited various degrees of tolerance of this situation, but they generally agreed that this issue was symbolic of the dominance of western values and mores over the Hawaiian culture.

Educational system -- Informants were concerned about the educational system. They felt that, even though graduates are slightly deviating from the traditional military-and-hotel job option, the school curriculum still did not provide enough exposure to the outside world; Hana children are often unaware of career options. It was also felt that the curriculum did not sufficiently support the Hawaiian culture with language programs and courses in agriculture and fishing.

One-company town -- It was felt that being a "one-company" town was a big problem. Business opportunities were reportedly in the hands of few people and most people depended on Keola Hana Maui, Inc. for economic survival.

People preferred more business competition and a diversification in the economic base, though they also saw the economic and stability values of maintaining the big company.

Cultural tendency of not seeking outside help -- Social and public service related individuals felt that a cultural characteristic of the area was the tendency to solve one's own problems rather than seek outside help. This tendency hampered the delivery of some social and public services, such as police protection, education and medical services.

Waning employee aloha spirit -- Informants observed that the employee aloha spirit at the Hotel Hana-Maui is waning. This was a problem both in terms of community morale and economic stability. Many of those interviewed had some interaction with hotel guests and they cited instances in which guests expressed concern over subtle changes in employee spirits.

2. Concerns at the Family Level.

According to those involved in social and public services, many of the community-level problems are manifested within the family unit. Economic survival often requires both parents working at the hotel and other business. With the pattern of hotel job shifts, many children do not have a full support system and adequate supervision. Economic necessities are not the only factors changing the traditional family unit. There are more single-parent families, more divorced families and more step-families. There are problems stemming from lack of parenting skills, such as child and spouse abuse, and these are exacerbated by living conditions which often includes crowding. Also, because of a cultural tendency to solve problems within one's own house, some families find themselves unable to cope with increasing stress and needs.

It was felt that ambition is lacking in some families. For example, students reportedly receive little encouragement to leave Hana for educational purposes. Also, there was little desire to learn about other ways of doing things, and minimal inter-cultural exposure.

3. Concerns about the Individual.

At the individual's level, community and family problems contribute to an erosion of one's "inner ecology." Some of those interviewed felt that traditional family support is becoming difficult to provide because of family-level problems. Also, there is a growing unease about what is going to happen in Hana, about external stimuli for change. Hence, stress was seen as a personal problem by those involved in social/public service, as well as by those very active in community organizations.

To deal with stress, some of Hana's individuals seek unhealthy "escape hatches," such as substance abuse. Alcoholism is reportedly a problem in Hana; there is also an increased usage of drugs.

It was feared that increased drug use, combined with the lack of leisure activities, was unhealthy for young people. An over-dependency on a single economic base was undesirable even at a personal level because of limited upward mobility and a lack of job choices -- these can lead to feelings of helplessness and low self-esteem.

Desires For Hana's Future

Those interviewed were asked what they wanted to see in Hana's future. They were asked about desired changes and improvements, as well as what they wanted to stay the same.

1. **Slow, Planned Growth.** Most of those interviewed felt that change in Hana is inevitable. Regardless of one's background, there was strong consensus as to the type of desired change. It was felt that those who live in Hana should have as much say over the area's destiny as those who invest in the area's land. Informants stressed the need to retain balance and harmony of Hana's existing qualities. Given this need and the likelihood of change, those interviewed felt that slow, planned growth is the key to successful assimilation and adaptation. Elements of this growth were basically the same as those identified in the 1987 community survey (see Section 4.4). These include:

   - retention of open space,
   - low-rise structures,
   - slow-paced changes,
   - sufficient number of jobs for Hana's residents and high school graduates,
   - minimal in-migration, and
   - a diversification of the economic base to lessen economic dependency on the hotel.

   It was often pointed out that the retention of Hana's qualities is of value to Keola Hana Maui, Inc., since visitors come to Hana for its present qualities, as described earlier in this section.

2. **A "Preservation District."**

   Community leaders often described a vision of Hana's future which capitalized on the prevalent Hawaiian culture. They talked about Hana becoming a "Preservation District," which meant that the district as a whole would be a community resource; thus, preserving the valuable aspects of the district would benefit the larger community.

   This Preservation District would serve as Hawai'i's repository of the native culture. Hawaiian language and culture would be practiced and taught, so that Hana would be the place for others to come and learn. For example, food gathering techniques would be shared, as well as ways to ho'oponopono and ho'okipa. Diversified agriculture and aquaculture would naturally play major roles in this scenario.

   This scenario includes existing activities in Hana and it was felt that this type of Hana would complement and enhance the area's visitor industry. Hana could be the place where visitors could learn about Hawaiian ways. It was suggested that Keola Hana Maui, Inc. market the hotel as part of the total entity of Hana, for instance. Also, the hotel could have specific programs which incorporated the community's skills and resources. One example given was an "interactive immersion" program. A family would stay at the hotel, and activities would be arranged through the hotel. Activities might include spending the day learning to hukilau with a local family, hunting in the hills with another local group, and participating in the gardening of Hawaiian plants and herbs.

3. **Affordable Housing.**

   Informants wanted to see more affordable housing and felt that Keola Hana Maui, Inc. should be a major participant. Many, however, discouraged government participation. They felt that fairness and equity laws would prohibit reserving the housing units for Hana's families; thus, the area would be "opened up" to non-Hana residents. Some were also discouraged by government bureaucracy.

4. **Increase in Services.**

   Those interviewed expressed a need for the full-time presence of more County and State service agencies in Hana. They pointed out that they need to go to the other side for many government services. A full-time fire station was desired, as well as a public cemetery.

   The school should be improved, both in terms of facility and curriculum. People wanted to see the medical center expanded to house more social services. Because of the growing elderly population, some wanted to see a nursing home in Hana. Health and social-oriented officials wanted to see increased health awareness.

   Some wanted a *few* more conveniences. They would appreciate more choices in eating establishments and types of food. They wanted more essential stores, such as a hardware store, a clothing store, and a full-service grocery store.

4.2.2 Issues Related To The Proposed Golf Course as Identified in the Interviews

Informants were asked to provide input on what they thought were (1) good things or benefits of the proposed golf course; (2) problems arising from the project; and (3) revisions or modifications. Because this was not a statistical survey, frequency of statements is provided only in extreme situations.

Good Things Or Positive Aspects

Those interviewed identified positive aspects they could see about the project. The most common were statements about economic viability and community opportunities.

1. **Economic Objectives of the Company.**

   The most positive aspect of the project was its potential to achieve and maintain the economic viability of Hotel Hana-Maui and Keola Hana Maui, Inc. Informants wanted to see Keola Hana Maui, Inc. survive because they felt that the community depended on the company's viability. They also did not want to see another change in ownership. However, they were split on whether the proposed project could realistically achieve the financial objectives.

   - Those who felt positively about Keola Hana Maui, Inc. generally believed that a golf course might relieve further development pressures. They hoped that the golf course would meet the company's financial objectives, and that other alternatives, such as subdividing land or expanding the hotel, would be unnecessary.
   - Although others wanted to believe the same thing, they remained skeptical. They found it difficult to believe in the project's economic viability, and remained cynical about any development because of the previous relationship with the Rosewood Corporation.

2. **Potential for Community Opportunities.**

   Those interviewed felt that, if properly done, the project could result in opportunities not currently available to the community. People suggested discount programs for Hana residents, a junior golf program, and golf lessons for senior citizens. Partnerships between Keola Hana Maui, Inc. and the community were also anticipated. The possibilities of profit-sharing and a community fund were raised.

3. **Alternative Recreation.**

   The recreational aspect of the project was viewed positively by both golfers and non-golfers. Golfers appreciated the opportunity to have this resource close to home. Non-golfers felt that the additional resources would provide alternatives for residents, providing there were affordable rates.

4. **Jobs and Job Preference.**

   People liked having new and different kinds of jobs in the area. They believed that non-hotel jobs provided alternatives, and that outdoor jobs would be preferable to many Hana residents.

5. **Other.**

   Some felt that the project location was non-critical and that the project would not affect access. The project was also considered a good thing because it would retain open space and a park-like atmosphere. A few felt confident that golf course chemicals would be gentle to the land.

Problems And Concerns

Discussions regarding problems were generally lengthier than those involving positive aspects, and almost all interviewed raised some concern about the project. The golf course was a symbol of different apprehensions, such as urban development, foreign investment and in-migration. The golf course was also seen as a physical threat to Hana's environment.

1. **Precedence for Further Development.**

   With few exceptions, almost all of those interviewed were apprehensive, though in varying degrees, about the project's potential for further development. They witnessed many examples, including Lahaina and Kihei, where golf courses went hand-in-hand with uncontrolled resort development and luxury housing. They felt that if that were to happen in Hana, then Hana would lose its special and unique lifestyle, social qualities and environment.

   Informants described different fears and suspicions. Some were afraid that Keola Hana Maui, Inc. is planning to build golf course frontage housing anyway, or that the company only wanted to increase land value and sell the property.

   There was also concern that the golf course may not be financially feasible. There was apprehension that (1) the area did not seem climatically suited for a golf course and (2) the hotel may not be large enough to accommodate the number of golfers needed for a viable operation. In these scenarios, the domino effect was feared. The golf course might require further hotel expansion, or the company may need to add luxury housing to offset economic losses.

Further, it was feared that, even though Keola Hana Maui, Inc. may not want to expand the hotel, entrepreneurs may see opportunities for resort condos and bed-and-breakfast establishments. To some, the sheer presence of an artificially manicured landscape was urbanization.

2. **A New Type of Visitor.**

Hana currently attracts two types of visitors: the "rental car" day tourist and hotel guests. Current hotel guests are considered affluent people interested in Hana's natural environment and aloha spirit. Informants felt that a person who comes to Hana to golf would be more action-oriented, and would not be as appreciative of area's existing qualities. They were apprehensive about how this might affect not just the hotel, but also the daily visitor-resident interactions throughout Hana.

3. **Foreign Investment.**

It was felt that foreign interest in land lessened community control over Hana's destiny. Informants felt that foreign investors could afford to be more patient with current land use laws, and may end up urbanizing Hana in the long-range time frame. The project was part of this apprehension in two ways. First, the company is partly foreign-owned. Second, some were wary that the golf course might be sold to a totally foreign entity once approvals are secured.

4. **Chemicals.**

Those interviewed expressed strong concerns about chemicals needed for golf course start-up and maintenance.

Of major concern was the pollution of the nearby ocean. Informants reported that the ocean at Koki and Hamoa is breeding ground for akule; the area is part of Hana's cultural and food-gathering base. It was pointed out that the area experiences large amounts of rain; runoff into the ocean from the golf course means the constant deposit of chemicals into the ocean. Informants feared that this would ruin the coral and fish habitat, and ultimately cause a reduction in the fish population. Those interviewed also did not want to see the ocean and groundwater polluted by chemical seepage into the aquifer. A few people felt confident that proper handling of chemicals would minimize ecological impacts.

5. **Land Ownership.**

There was a strong negative reaction to any quiet title action undertaken for lands in the project site, as well as in other parts of Hana. Those interviewed wanted to see an equitable settlement on land ownership disputes before project implementation.

Feelings About Keola Hana Maui, Inc.

The last opinion-soliciting question posed to those interviewed was "How do you feel about Keola Hana Maui, Inc.?" There were three types of responses. First, there were those who felt that the company had not been in Hana long enough to form an opinion. Second, some informants felt that a reported lack of contact leads to distrust and implies arrogance. They suspected that the company's influential Board members and owners could override the community's wishes. These people felt that Keola Hana Maui, Inc. was responsible for introducing the project to the community, and not interviewers in this study. They did also not like perceived media tactics. Third, there were informants who liked representatives of the company; they believed that company Board members were sincere and open.

Suggested Revisions Or Modifications

People made recommendations on two levels. First, there were project-specific recommendations, those dealing directly with the golf course. Second, there were suggestions for regional and systemic changes involving Keola Hana Maui, Inc.

1. **Assurances.**

With further development being a prime concern, those interviewed felt that there needs to be clear guarantees that no housing will be built around the project site. These guarantees need to be part of any land transaction so that future owners cannot develop the perimeter. There was a suggestion that the company give the community surrounding lands within a reasonable distance to preclude development.

2. **Share Studies.**

Active participants in community organizations expected that detailed studies of the project's impacts would be conducted. They wanted to review these, and were particularly interested in the demonstration of need and feasibility of the proposed project.

3. **Improved Communication and Partnership Development.**

Those interviewed wanted better communication between Keola Hana Maui, Inc. and the community. Golf course plans were introduced during the interviews and many felt that the company officials should have shared information with the community.

Those interviewed wanted to see Keola Hana Maui, Inc. work out a partnership. A major focal point would be some form of profit-sharing. This was seen as an equitable arrangement which would give Hana residents a sense of pride and ownership. Another way to support the community would be active support of the Hana Preservation District.

4. **Other.**

   Resolution of land ownership disputes was desired prior to project implementation and preferably through ho'oponopono. A "totally organic golf course" was seen as the solution to chemical impacts. Another suggestion was that project engineers design the golf course for sheet flow drainage, rather than concentrated flow, to minimize erosion.

4.3 Comments Offered by the Hana Negotiations Committee as a Consulted Party

In February 1991, the Hana community agreed to engage in constructive, good faith dialogue with Keola Hana Maui, Inc. representatives. Twenty Hana residents serve on the Negotiations Committee. This section summarizes comments offered by the Negotiations Committee in a March 1992 document.

4.3.1 Economic Issues and Concerns

Economic issues have been the primary focus of the Negotiations Committee. Essentially, the Committee acknowledges the economic role and value of Keola Hana Maui, Inc. in the community. The Committee feels that the economic need for and long-term viability of a golf course have yet to be demonstrated to the satisfaction of Hana residents. Until such justification is established, the Committee believes that it is difficult to analyze and discuss other effects and impacts. Specific economic issues raised by the Committee are as follows:

1. **Credible and complete justification for the project.**

   The Committee wants more evidence of how the golf course will improve the hotel's and company's economic performance.

2. **Alternative remedies.**

   It has requested a full discussion of alternatives to the golf course so that the community can also weigh the options.

3. **Hotel Hana Maui's capability to compete.**

   The Committee wants to know if the golf course will allow the hotel to fully compete with other luxury hotels or if other elements will be needed for viable competition.

4. **Attainability of objective.**

   The Committee requests information on the ability of the golf course to increase and sustain hotel occupancy.

5. **Economic impact discussion in the environmental assessment.**

   The Negotiations Committee feels that the environmental assessment did not provide information which would lead to a full analysis of the economic impacts of this project. The study's assumptions were criticized and it was unclear if the golf course would be a "cure-all" or "part of the cure."

6. **Employment resources.**

   The Negotiations Committee felt that the golf course jobs will attract Hana residents. Many will likely be hotel employees, who may prefer outdoor work with little hospitality requirements and the jobs may be more flexible than hotel employment. Thus, the Committee expects that "in-house transfers" will fill golf course jobs, leaving the more undesirable entry level jobs open. However the golf course jobs are filled, it was felt that Keola Hana will compete with small business employers who may be unable to offer wages and benefits comparable to Keola Hana Maui, Inc.

7. **Escalated land values.**

   The Negotiations Committee expressed concern that the golf course will increase the values of agricultural lands and displace on-site ranching activities.

4.3.2 Community Concerns

The Negotiations Committee also presented general community concerns about the proposed golf course. It was stressed that these comments were offered within the framework of the economic role and viability of the proposed golf course. Specific community concerns are as follows:

1. **Impact on property owners**

   Initially, the Committee expressed concerns about parcels of project site land whose ownership is disputed. Keola Hana Maui, Inc. has redesigned the golf course to exclude such lands, however, and this area of concern has been eliminated. Also of concern is that the golf course may increase property values of non-Keola Hana Maui, Inc. owned lands; it was feared that this may cause displacement of long-time kama'aina families. Further, higher property values mean increased property taxes, which could cause neighboring property owners to develop or sell their lands.

2. **Impact on traditional cultural and social values.**

The Negotiations Committee wants to make sure that "the residents of the Hana District are able to retain the balance and harmony of the community's lifestyle, cultural and social qualities, and rural and environmental qualities." Members felt that if balance and harmony are not retained, then Hana residents would have two choices: (1) to live an altered lifestyle with different social values, or (2) to react with militancy. Neither choices were desirable, and the Committee strongly suggests that "Hana's lifestyle" be defined for further study.

3. **Sustainability of subsistence lifestyles: farming, fishing and hunting.**

Farming, fishing and hunting are common subsistence lifestyle activities in Hana. Development can alter factors which are interrelated with these activities, such as economics, social characteristics and simply more people and resource competition. The Negotiations Committee believes that it is imperative that subsistence activities be sustained and that such development impacts be minimized.

4. **Impacts on burdened infrastructure.**

Committee members cited the potential for impacts on a number of infrastructure systems and public services, including the water supply and resources, solid waste disposal, medical facilities, educational facilities, police and fire services and housing.

5. **Impacts on recreational resources.**

The Negotiations Committee is concerned that, if the golf course is instrumental in increasing hotel occupancy, then there will be more people in Hana, which means more people at the beaches, outdoor recreational areas and sports facilities.

6. **Impacts on historical evidence of culture and perpetuation of existing culture.**

The Committee wants to see additional work in the archaeological inventory of the project site. Further, the local culture is a living culture, and the Committee is concerned that any development-related impacts on natural resources will have adverse impacts on the living local culture.

7. **Impacts on sustainability of natural, environmental and ecological resources.**

Contamination of groundwater, as well as coastal waters, due to the use of chemicals on the golf course is of concern to the Committee. It was also questioned whether the existing resources were adequate to meet the needs of residents, given the possible increase in the residential population. It was further pointed out that, in Hana, impacts on natural resources have reverberating effects on local culture because of subsistence activities.

8. **Impacts on long range planning.**

The Committee pointed out that the golf course is being discussed as a single item, rather than within the context of long range planning. The concern is that discussion of the overall needs, desires and concerns of the Hana community is confined to deliberations related to the golf course; there is little opportunity to discuss regional long-range concerns in a planning forum. Further, the Committee wants to see a socio-economic baseline study which would help determine residents attitudes so that they can plan accordingly.

9. **Impacts on existing Community Plan.**

Timing is of concern to the Committee, in that a Community Plan amendment allowing the golf course may precede the upcoming revision of the long range plan. The Committee did not want to see such an amendment negating or "cause[ing] a refocus" of issues which should be raised in the plan revision process.

4.3.3 Concerns Arising from Negotiations

The negotiations process was undertaken to resolve differences between the Hana community and Keola Hana Maui, Inc. During this process, certain concerns began to take shape, concerns which were either related to the process itself or were the results of the process. These concerns are as follows:

1. **Sales agreement with previous owner.**

The Negotiations Committee acknowledged that this is not a negotiable item, but expressed concern that a golf course was a key factor in the land transaction deal with the Rosewood Corporation.

2. **Prohibitions on further development.**

The Negotiations Committee wants to see Keola Hana Maui, Inc. be financially successful; economic stability for the company mean employment stability for many of Hana's residents. What it does not want to see, however, is development beyond the golf course in subsequent attempts to stabilize the company, if the golf course does not achieve its financial objectives.

3. **Golf course project linkage to Town Center and to Affordable Housing project.**

   The Committee expressed concern that affordable housing projects may not be realized if the golf course cannot be implemented or is not financially viable. Further, if the golf course is not implemented or successful, then hotel occupancy will theoretically not improve and the proposed Town Center may no longer be necessary.

4. **Philosophical compatibility.**

   It is acknowledged that the Hana Community and Keola Hana Maui, Inc. have established a partnership and that they will continue to negotiate their differences.

5. **Defining "Hana lifestyle."**

   The Committee and Keola Hana Maui, Inc. want to define Hana's lifestyle so they there is a mutual basic understanding of the community. They have contacted an independent facilitator to help in this process.

4.4 Hana Community Association Survey

In 1988, the Hana Community Association conducted a survey of 976 residents; the response rate was 44.6 percent. Almost three-fourths of the respondents expressed a strong desire of Hana District residents to monitor and provide input on development. Almost 80 percent wanted to see lifestyles maintained, but the preservation of the environment was an even stronger desire with 86 percent of the respondents feeling that the latter was "very important." Preservation of the coastline open space was "very important" to 77 percent; mauka open space land preservation was "very important" to 62 percent.

About 70 percent felt that an owner/developer should provide some form of affordable housing, and the majority of respondents felt there was a need to provide commercial and retail facilities for businesses owned and operated by Hana District residents. When asked which community facilities and services have been most burdened by development, respondents named road conditions, increased traffic, parking at other services, recreational areas and water supply as the top five items.

The majority of respondents felt that a "committee of residents" should represent the expressed desires of Hana residents in negotiations with an owner/developer and that the results of the negotiations should be brought to the residents for their approval.

The survey included choice questions on the type of development preferred in Hana. The following summarizes responses:

- A slight majority (52 percent) preferred "low profile, more intense development confined in the Hana Town area" to extending spread-out development beyond the Hana Town area.
- Half of the respondents wanted to see very limited development makai of the Hana Highway, and less spread-out development mauka of the highway. The next preference was for spread-out development mauka of the highway (39 percent).
- Over half wanted economic development to include long-term various types of jobs for Hana residents. There was a slight preference for "a lot" of jobs, even though this may mean bringing in non-Hana workers.

4.5 "Generic" Golf Course Issues

A 1992 study on golf course impacts was conducted by the Office of State Planning. Included in this study was a description of typical issues related to golf course development. The following summarizes the major issues identified.

- **Need and Feasibility of Golf Courses**

  In general, many people have a negative attitude towards golf courses. In a 1990 Advertiser-Channel 2 News Hawaii Poll, three-fourths of the respondents felt that either (1) golf courses are good for Hawaii, but "we have enough of them," or that (2) golf courses were bad for Hawaii.[13]

  Poll results are consistent with studies conducted on individual golf courses. In interviews conducted for specific proposed golf courses, it was found that even though community members may have supported or remained neutral on the individual golf course being proposed, there were nevertheless questions regarding the feasibility of developing the overall *number* of proposed golf courses.

- **Effect on Urbanization.**

  Communities often fear that a golf course paves the way for further urbanization of the area. It was found that, regardless of the developer's commitments and plan modifications in response to community concern, some still felt that the project will eventually bring in luxury housing or other resort facilities. Property value increases may increase development efforts. Also there is apprehension that a golf course will initiate a change in the lifestyle of the area.

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13 *Burris, 1990.*

- **Foreign Investment.**

  Foreign investment has been a statewide issue over the past few years, and the focus of attention has been on Japanese-owned hotels and golf courses. The concern over foreign investment stems from apprehension that there is a growing loss of control over local resources.

- **Environmental concerns.**

  Concerns related to the impacts on golf courses on the environment are the most frequently-raised community issues. In a 1990 review of 20 Environmental Impact Statements (EIS) on golf courses, it was found that there were comment letters in all of the EISs referring to golf course impacts on water. Ninety-five percent of the EISs contained community comments on archaeological and historic sites, and 90 percent contained comment letters on endangered species and vegetation. By comparison, socio-economic impacts generated comments in only 35 percent of the EISs.[14]

It was further found that these issues were present in all golf courses in rural areas such as Hana.

4.6 Analysis of Project-Related Issues

This section discusses how community reaction to the golf course has fared over the last year and a half. Based on the 1991 SIA, the submittal by the Negotiations Committee, and other sources of information, the following is an analysis of community issues related to the golf course.

1. **Many of the issues discussed in the 1991 SIA continue to be community concerns.**

   The Negotiations Committee has clearly acknowledged the potential economic benefits of the proposed golf course, as did those interviewed in the 1991 SIA. Also, as with the previous study, there is strong concern about socio-cultural effects of the golf course development, as well as impacts on the environment.

   The comments in the Negotiations Committee submittal indicate that committee members reviewed the 1991 SIA and that there is some agreement with certain findings of that report. Namely, one of the Committee's basic premises is the need to retain the balance and harmony of Hana's lifestyle, social qualities and rural and natural environment. This was also a finding of the 1991 SIA.

[14] *Ordway, 1990.*

2. **Community concerns about the need and economic viability of the golf course have become more focussed.**

   At the time of the 1991 SIA, the economic impact study for the proposed golf course was still being prepared and had not been reviewed by the community. Hence, those interviewed were cautiously optimistic that the proposed golf course might achieve its financial objectives.

   Since then, the Negotiations Committee reviewed the study, and has expressed strong concerns about the study's findings. Essentially, the Committee suggested specific measures in the economic study which would demonstrate that the project will boost hotel occupancy and help the company operate profitably.

3. **The community continues to want to evaluate alternatives to golf course development.**

   In the 1991 SIA, those interviewed expressed their apprehension at not knowing what would happen if the golf course were not developed. They feared that they would lose their jobs, that the hotel would close, that there would be more hotel rooms, and so on. According to the Negotiations Committee report, there is still no clear idea of the company's alternatives to the golf course and the community's apprehensions still exist.

4. **There has been some progress towards mitigating and addressing community concerns.**

   Over the past year, both Keola Hana Maui, Inc. and the community have made progress in resolving some of the community issues raised in the 1991 SIA. The land disputes are no longer an issue due to a re-siting of the project.

   Of more basic importance is that a working partnership has developed between Keola Hana Maui, Inc. and the Negotiations Committee. At the time of the 1991 SIA interviews, there was doubt that such a partnership could ever be established.

5. **Golf course issues in Hana are consistent with the findings of the statewide study on golf courses.**

   In the statewide study, it was found that all of the typical golf course-related issues in Hawai'i are especially articulated when the golf course is proposed for rural communities. This study finds that, without exception, the Hana community has expressed all of these typical issues, in addition to other more community-specific issues.

5. Probable Social Impacts Of The Proposed Project

5.1 Residential Population Impacts

The project does not include housing and is therefore not expected to directly cause an increase in residential population.

In-migration due to employment occurs when the employment location is isolated, and the employees prefer to forego inconvenient or lengthy commuting distances. Further, in-migration due to employment also occurs when the surrounding community cannot supply the labor force because of (1) low unemployment levels and (2) lack of skills needed to fill the jobs.

The project may increase the population in Hana due to in-migration of employees. First, Hana is isolated and it is unlikely that a non-Hana resident would commute daily to the golf course for a job. Second, Hana's unemployment rate for the second quarter of 1992 is 1.7 percent,[15] which indicates almost no available labor force.

The project will require an estimated 36 full-time employees. Hana residents who fill these jobs will likely leave a vacancy elsewhere in Hana. Non-Hana residents may therefore be needed to fill some of the other vacant jobs.

The upper limit of the project's indirect population impact would be the in-migration of up to 36 households, which represents and estimated 112 and 159 persons.[16] Keola Hana Maui, Inc. hopes to minimize the impacts of in-migration by employing former Hana residents who have left the area, but want to return. Company officials indicated that some former Hana residents have contacted them to express interest in working at the Hana Ranch Country Club in the hopes that they can move back to the area.

No short-term population increase is expected from the construction of the project. Keola Hana Maui, Inc. intends to transport construction employees on a daily basis and *Table 7* contains the company's program for transporting construction employees. It is expected that construction employees will arrive each morning and leave on the same day. A maximum of six aircraft a day will be needed, at which point an estimated 146 construction employees will commute to and from Hana on three morning and three afternoon flights. It is estimated that ten percent of the total construction labor force will live in Hana.

15 *Personal communication with Manuel Fragante, Research Statistician, State Department of Labor and Industrial Relations, May 4, 1992.*
16 *Population estimates are based on a range of household sizes from 3.1 (the 1990 Census estimate) to 4.4 (the 1991 housing study estimate) persons.*

Table 7

Construction Employees Transport Program

Construction Period	Duration	Number of Employees	Daily Transportation To and From Hana *(double number for round trip)*
Initial Start-Up	1st 6 to 8 weeks	18	1 DeHavilland Otter twin turbo-prop
Golf Course Rough Grading Operations	4 to 6 months	51	1 Dash-7
Clubhouse Construction and Continue Golf Course	5 to 6 months	124	3 Dash-7
Final Sitework and Clubhouse Completion	4 to 5 months	146	3 Dash-7
Completion and "Grow-In" Period	5 to 6 months	69	1 Dash-7

Provided by Keola Hana, Inc.

Possible Mitigation

The proposed project could indirectly increase the Hana District's population, as estimated by the 1990 census, by between six to eight percent. In terms of sheer numbers, this increase is not expected to cause significant impact; it is within the population projection of 2,300 established by the Hana Community Plan as a 20-years framework for planning purposes. Thus, no mitigation is necessary.

It is noted that a sheer increase in population is not expected to impact Hana. As discussed earlier, at one time Hana's population was 2.5 times its current estimate. Rather, social impact may stem from a number of variables, and these are discussed in Section 5.3 and 5.4.

5.2 Housing

The indirect increase in population which may be generated by the proposed project may generate a correlating need for up to 36 additional housing units. Rentals, in particular, would be needed to accommodate in-migrants who would come to Hana for employment either at the proposed golf course or to fill a job vacated by a Hana resident working at the golf course. The project may therefore add to the already-existing housing problem.

Any job-generating effort in Hana would add to the housing shortage. For example, the development of the proposed Hana Village Marketplace and the Town Center will provide economic opportunities for Hana residents. Those who choose to work at these new enterprises may vacate current employment positions, thus leaving those jobs open for non-residents who would then need housing.

The demand for up to 36 additional units will exacerbate the current housing shortage.

Possible Mitigation

Any new employment-generating use in Hana will add to the need for affordable housing and developers of these introduced uses should be responsible for ensuring that future employees can rent or buy reasonably-priced units.

As discussed in Section 3.2.3, the Hana Affordable Housing and Community Development Corporation, which receives assistance from Keola Hana Maui, Inc., is currently attempting to develop three housing projects: single family units, multi-family rentals and elderly housing. The ability of these efforts to accommodate in-migration of golf course employees is unknown at this time because the projects are in early stages of planning and development.

Further, as discussed in the previous section, non-Hana construction workers will be transported in and out of the region. This will minimize any kind of artificial stimulus for rent increase similar to that which occurred in previous years.

5.3 Implications for Overall Hana Qualities

Hana's uniqueness has been extolled by residents and visitors alike. Section 4.3 presents Hana's special qualities, as viewed by Hana residents interviewed in the 1991 SIA. Informants felt that Hana was an exceptional place to live, work and raise children. They described a lifestyle typical of a small town, social qualities based in the Hawaiian culture and an environment which surrounds and nurtures the community.

While these three characteristics can be found in other parts of Hawai'i, Hana's strength lies in the *harmonious existence of all three*. Thus far, even though Hana has undergone many changes including major population fluctuations, residents feel that a desirable balance still exists.

Many fear, however, that Hana's "specialness" is fragile; they believe that a significant alteration of any one component would alter the total spirit or essence of Hana. There is strong consensus, as shown both in the community's survey and in interviews conducted for this study, that changes occurring in Hana should be in the context of slow growth which is well-planned with input by the community.

The ability of the Hana community to accept and/or adjust to the proposed project will depend to a large extent on prevailing attitudes and reactions to the golf course. Thus, the co-existence between the golf course and Hana will require mutual benefit, respect and understanding.

This section discusses implications of the golf course on Hana's overall qualities. The qualities selected for discussion are the three which were raised in the 1991 SIA and which were recently reiterated by the community-based Hana Negotiations Committee. These qualities are as follows:

- **Lifestyle**

  The small-town lifestyle in Hana has been characterized as peaceful and unhurried, with people being patient and accommodating, and protected by sheer geographical isolation.[17] Section 5.3.1 explores potential effects on Hana's lifestyle due to the continued presence of Keola Hana Maui, Inc., possible urbanization potential, a change in pace of activities, and the increase in recreational choices.

- **Social Qualities**

  Section 5.3.2 looks at how the proposed golf course may affect Hana's social qualities. Specific factors of change include the change in the type of overnight visitor and the potential for social exclusivity.

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17 *Keola Hana Maui, Inc. and the Negotiations Committee have approached an independent mediator to assist in defining more specific qualities of Hana's lifestyle.*

- **Rural and Natural Environment**

  Hana's physical environment is valued as a source of food, as well as a cultural, emotional and spiritual resource. Section 5.3.3 discusses the social implications of introducing a golf course to this environment.

5.3.1 Lifestyle Implications

- Implications Of Continued Presence And Operations Of Keola Hana Maui, Inc.

The proposed golf course is considered a key ingredient in increasing the economic viability of Hotel Hana-Maui, and thus Keola Hana Maui, Inc. If the proposed golf course can achieve the objectives of increasing hotel occupancy, then presumably the hotel and Keola Hana Maui, Inc. will be more financially viable. It is assumed that other more extreme alternatives, such as the subdivision of company lands, will be unnecessary and that company operations including the hotel and the ranch can continue.

If these economic goals are realized, then the implications of continued presence of Keola Hana Maui, Inc. and its current operations are as follows:

- Most of Hana's economic base, which is tied either directly or indirectly to Keola Hana Maui, Inc., will remain relatively stable.
- With the hotel employing about a fourth of Hana's available labor force, employment security will continue for many Hana residents.
- The project will help keep community planning at a manageable level. The community will be able to continue to work with one single major landowner, rather than many different landowners. This will facilitate a manageable and focussed working relationship between the community and developers.

The aforementioned implications are generally positive. The Hana Negotiations Committee has indicated that Hana wants Keola Hana Maui, Inc. to be economically viable, mostly because it means stable employment for many Hana residents.

The other side of continuing the company and its operations in their current state is that one entity will retain a major role in determining Hana's economy. Changes to the economy by other entities will be limited and difficult because of differences in scale. In the 1991 SIA, economic dominance was viewed both positively and negatively. People want Keola Hana Maui, Inc. to be successful because this means economic stability for Hana. On the other hand, they also want economic diversification so that Hana residents had more job and business alternatives.

Given the slow, planned growth desired by those interviewed, it is believed that the continuation of Keola Hana Maui, Inc., the hotel and the ranch would be compatible with the desires of the Hana community. If it meets the company's financial objectives, the golf course contributes to this compatibility.

The golf course and resulting continuation of the company and hotel is not necessarily compatible with desires for economic diversification.

- Potential For Further Urbanization

The project's potential for urbanization was the most frequently and strongly expressed concern in the 1991 SIA, and is a major issue identified by the Hana Negotiations Committee.

Previous studies on golf courses have found that golf course impacts on property values are geographically localized around the perimeter of the golf course. The potential for further urbanization created by golf course development also has regional implications. Golf courses can be considered *indicators of development interest.*

Statewide and in Hana, there is frequent concern that a golf course is the first step to urbanizing a rural area, and that eventually there will be luxury homes, visitor condominiums and hotels around the golf course. People also fear that property values will increase, and affected property owners will want to develop or sell the nearby land to offset the increased taxes.

Community expectations regarding the eventual urbanization of rural and urban fringe areas due to golf courses are due to several factors. Golf courses have real estate amenity value. Homes around many existing golf courses are prestigious high-priced units at least in part because of golf course frontage; also, golf course frontage in planned communities is a major amenity for "executive homes." Resort golf courses are considered an economic advantage to resort development, which is often an intense urban use. Further, when a planned community or resort development begins construction, a golf course is typically the first increment of development, which suggests to the casual observer that the golf course "causes" hotel rooms or development.

For rural areas such as Hana, a golf course is often a "red flag" indicating that there may be subsequent real estate interest in the area. Community anxiety is heightened because increasing real estate interest may lead to more land being owned and controlled by outsiders, and eventually to a greater loss of control over local resources. Recent studies and news articles regarding the other proposed golf course in Waihe'e and Moloka'i indicate that the community fears future urbanization may accompany the proposed golf courses.

To many interviewed in the 1991 SIA, the proposed golf course development was synonymous with undesired urban development, specifically hotel expansion and expensive housing for outsiders. Lahaina was frequently raised as an example of what Hana did not want to become.

The proposed project does not include these other more intense forms of development, though the golf course is part of the company's master plan for its Hana holdings. Other plan components include housing and the Hana Town Center commercial and office complex. Except for the golf course, the company's master plan confines development to the areas appropriately designated. The overall effects of the total master plan would likely lead to creating a more urbanized environment within allowable areas.

The proposed project in itself is therefore not a precedence for further urbanization *within lands owned by the company*. Other landowners may view the golf course as an opportunity for developing their own properties, in which case the golf course would have stimulated interest in further development. Development opportunities for other landowners exist without the golf course, however, as proven in other proposed community changes, such as a village marketplace.

- Pace of Activities

The small-town lifestyle present in Hana is typified by a slow, unhurried, and tranquil way of life. The district's remoteness and seclusion contribute to this ambience which excludes fast food drive-ins and 24-hour convenience stores. Residents point to a sense of predictability and security, because changes, including physical and social changes, currently seem manageable and under control. Thus far, the thousands of "rental car tourists" who visit Hana and nearby areas appear to have little effect on Hana's lifestyle.

If the golf course achieves its economic objectives and the company does not need to seek other economic alternatives, the proposed golf course will likely not change these tranquil and secure aspects of Hana's lifestyle. The current pace of life is expected to continue for the following reasons:

- The golf course and its support facilities will be contained on one site and no off-site facilities will be needed to supplement proposed facilities. Thus, Hana's town landscape will remain the same and no new urban-type facility will be introduced outside of the project site.
- No new hotel rooms will be added. Rather, the golf course should improve what is already existing by increasing occupancy levels. Hence, the multiplier effect typical of new hotel rooms, in terms of new jobs and housing, is not expected to occur.
- The golf course will not bring in a significant number of people. The economic study for this project estimates 23,600 annual rounds at the golf course, which translates into 65 rounds or golfers per day.

  The market study for this project indicates that the hotel enjoyed occupancy levels of 80 percent and above in the 1970s, and the fluctuations in hotel occupancy levels have apparently had little effect on the pace of life in Hana. It is therefore anticipated that the addition of 64 golfers and their families may have some effect on social interaction (see Section 5.3.2), but will not likely change the overall pace of life in Hana.

- Increase In Recreational Choices

Hana residents currently enjoy active sports, as well as ocean recreation activities including food-gathering, surfing, swimming and so on.

The proposed project will increase choices in recreational activities by adding golf as a leisure time activity. During the interviews held for the 1991 SIA, it was found that informants of Hawaiian, Caucasian and other ethnic groups appreciated this new activity either because they were already golfers or were interested in learning the sport. Further, in meetings held for this study, Hana Hawaiian adults felt the golf course would be an additional recreational opportunity for Hana.

An important consideration in successfully integrating the golf course into Hana's recreation base is resident accessibility. For Hana residents to accept this facility as part of its recreational resources, they need to feel that they have physical, financial and psychological access.

5.3.2 Implications Regarding Social Interactions

- Change In The Type Of Overnight Visitor

The three types of golf patrons expected to use the proposed golf course are hotel guests, off-resort visitors and Hawai'i residents.

Guests of Hotel Hana Maui are estimated to play 90 percent of the total rounds of golf. Most of the hotel guests will likely be free and independent travelers (FIT) attracted by the planned marketing campaign which will include a hotel room and golf package. A small portion of hotel guests will be corporate members of the Kato Group, an affiliate of Keola Hana Maui, Inc. The Kato Group intends to sell 1,000 corporate memberships to members of the four existing Kato Group golf courses in Japan.[18]

Five percent of the golf rounds are estimated to be played by off-resort visitors, and five percent will likely be other Hawai'i residents.

The resort has traditionally been oriented to the luxury market, with emphasis on those seeking rest and relaxation. Consequently, by luxury resort standards, guest activities and retail facilities are considered minimal. The resort offers tennis courts, a fitness center, two swimming pools, and horseback riding; television sets are absent.

The economic study indicates that competitive pressures in the luxury market have increased substantially with the addition of new luxury properties. Many luxury properties are seeking to offer a more differentiated and innovative visitor experience, and these are expected to fair better than those properties offering less amenities and guest activities.

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18 *Composition of golfers is provided by Pannell Kerr Forster, 1992; membership information is provided by Keola Hana Maui, Inc.*

There is a current shift in the luxury market to a more activity-oriented market that expects more guest activities and amenities. Hence, possible changes to the hotel guest profile include:

- A greater number of younger, first-time, action-oriented guests; and
- In light of the international corporate memberships, an increase in predominantly Japanese visitors.

During the 1991 SIA informants claimed that they personally knew of repeat guests who have developed close relationships with Hana residents. They described repeat guests who were older, affluent, non-demanding and friendly. They felt that the repeat guests return for Hana's unique qualities and not for facilities or guest activities. It was reported that, at one time, residents and guests often socialized, but that this was discouraged by previous hotel owners.

The increase in action- or recreation-oriented guests may affect the social interaction between residents and visitors. If the action- or recreation-oriented guests are seeking a pace of activities which is more intense that the current level of Hana activities, Hana's slow pace of life may not be a major attraction. These guests may have different expectations about the level of service than the rest-and-relaxation guest. They may expect and demand more amenities and a quicker response time than what might be offered in a rural resort. While the hotel employees will need to accommodate these newer types of guests, the action- or recreation-oriented guests will also need to adjust their expectations.

An increase in foreign visitors provide opportunities for cultural exchanges as well as barriers. It is likely that the social impact of having more foreign visitors will be similar as that of interacting with people of different social and economic backgrounds, regardless of the origin of the visitors. Though other ethnic values have been assimilated over time, the prevailing culture in Hana is based on Hawaiian values and practices. The present culture of Hana is already one which represents assimilation. Throughout Hana's modern history, different cultures have constantly blended into the prevailing culture, which is based on Hawaiian values and practices. People of Chinese, Filipino and Japanese ancestry have worked with Hana residents on the plantations, and many have made Hana their home. The 1990 census indicates that the proportion of Caucasians has increased significantly during the 1980s, and the culture has been even further impacted. Thus, in spite of the introduction of different cultures, Hana is still predominantly Hawaiian in its culture, its attitude and in daily practices.

- Potential For Exclusivity

Hotel-Hana Maui guests have traditionally been affluent, and with the marketing strategy described in the economic impact study, it is expected that the market will continue to focus on the lucrative independent luxury traveler.

The potential for social conflicts stemming from economic disparity exists if there is obvious exclusivity at the golf course. The golf course, driving range and clubhouse will be open to the public and Hana residents need to feel that they have full physical and psychological access to these facilities. If such access is not apparent, then there is

potential for resentment directed to the Keola Hana Maui, Inc., the golf course operator and hotel guests. This resentment will be more acute if, within the community, there are basically two classes of citizens: the very rich and the very poor.

Economic disparity problems are not necessarily inevitable, however. People of upper income levels live in Hana on a full- or part-time basis and others are guests at the hotel, so there is already interaction between people of different income levels. These more affluent residents participate in community organizations and in social functions. Conflicts based on economic disparity were not reported during the 1991 SIA interview process; such conflicts are either infrequent or may be intertwined with other factors such as ethnicity and culture.

5.3.3 Introduction Of A Golf Course To The Rural Environment

The physical and ecological impacts of a golf course on this rural environment are addressed in other studies conducted for this environmental assessment. This social impact assessment looked at how the proposed golf course might affect the rural character of the immediate environs.

The project site is part of the Aleamai ahupua'a. A cattle pasture, the site is distinguished by the gently-sloping Pu'u Kolo. North and south of the site is more rolling pasture land. Rainforests are located mauka and the Hana Highway is located makai. Further makai is Ka-Iwi-o-Pele, a cinder hill where legend says Pele's bones were left after her battle with her older sister. East of Ka-Iwi-o-Pele is A-lau Island, and south of the hill is Koki Beach Park, Hamoa Village, and Hamoa Beach. The nearest structures are those along the U-shaped road at Hamoa.

The proposed project would alter this rural environment by introducing a frequently-maintained and well-manicured green open space. In addition, at least a portion of clubhouse will be visible; it is assumed that the clubhouse will located to take advantage of scenic views and, if so, it will be seen by passersby.

This change to the rural environment can be approached or viewed in two ways, and those interviewed for the 1991 SIA expressed both viewpoints. In one perspective, the large open space is an attractive, alternative use of open space. It will serve as a foreground for the mountains and complement the vast ocean. The clubhouse may also be considered environmentally complementary if sensitively designed.

On the other hand, the open space quality of a golf course differs from the existing rural spaces such as farmland, pasture or undisturbed natural environment. The placement of trees, waterways and support facilities would be deliberate. The golf course would "urbanize" what is now natural and agricultural. For those who strongly prefer the country atmosphere, the golf course will be an unwelcome introduction of urbanization.

The latter perspective is related to the concern of further urbanization due to golf course development. For Hana residents to not see the golf course as a symbol of urbanization, there will need to be clear measures prohibiting undesirable urban development, such as luxury housing units.

5.4 Impacts on Hana's Hawaiian Community

A recurring theme expressed in the interviews for the 1991 SIA is the strong presence of "Hawaiian" in Hana. The majority of Hana residents are ethnic Hawaiians and the community identity is Hawaiian. It was felt that Hana is the "last Hawaiian place" and the "Hawaiian-ness" of the area should be preserved and perpetuated.

This section explores the project's impact on Hana Hawaiians in two ways:

- **Previous works on Hawaiian culture.**

  One of the responses to the 1991 SIA was that the reviewers wanted to see how the project would impact the Hawaiian culture in Hana. Earthplan therefore researched a scientific study of Hawaiian culture, based on an agreed upon definition of Hawaiian culture. Section 5.4.1 discusses previous works about Hawaiian culture. It is not an exhaustive literature review, but a sample of existing works.

- **Project effects on Hawaiians in Hana.**

  Earthplan conducted fieldwork to understand the lifestyles of Hana Hawaiians and to identify project-related issues specific to Hana Hawaiians. The approach and findings of this fieldwork are presented in Section 5.4.2.

5.4.1 Previous Works on Hawaiian Culture

- Background

A society is a system of interrelated parts or components functioning as a whole unit. Culture is one such component. Culture is a total way of life of a people, a group. A culture consists of the "totality of meanings, norms, and values possessed by interacting persons and carried by material vehicles, such as ritual objects (the cross) or works of art (the outrigger), which objectify and convey these meanings."[19] A society cannot exist without culture.

Another fundamental component of a society is the economic base. Of relevance to this discussion is the change in economic base due to the different forms of capitalism. When capitalism is introduced through the colonization of indigenous agricultural societies, the economic foundation of the indigenous culture gets transplanted by a more technological and complex financial level of capitalism. When this happens, the indigenous culture transforms out of its agricultural/subsistence value structure into a hybrid of the colonizers and the colonized people.

19 *Sorokin, 1947.*

Typically, colonization transforms the subsistence economy of a society from agriculture to industrial to a tertiary base. In Hawai'i, subsistence/agriculture as a way of living was replaced with the plantation, which is industrial in the sense of mechanized agriculture. The plantation was then replaced by a tertiary economic base which is a service/information-based economy.

This economic change has created cultural change throughout the islands. It has entailed acculturation, or a blending of ethnic groups. Centuries of various ethnic groups coming to Hawaii has created a cultural pluralism. Today there is "local" culture -- a combination of the various ethnic groups' distinct cultural habits. Various behaviors, language, foods, music, and so on, have become common to the local culture.

The process of colonization, by its nature, has a diminishing effect on the indigenous culture and Hawai'i is no exception. The most important aspect of culture and cultural transmission is the language and religion. Today, though relatively few families speak Hawaiian in the home or practice the spirituality of their ancestors, there are strong efforts within the community to revive and reconstruct these aspects of Hawaiian culture.

- Studies on Hawaiian Culture

Many studies deal with certain aspects of Hawaiian culture, and the following is a sample of the types of works which address different aspects or indicators of Hawaiian culture:

- **Hawaiian values and lifestyles.**

  There are numerous works which list Hawaiian values. Essentially these works "affirm" Hawaiian values and "advocate" the Hawaiian lifestyle. Two examples of works on Hawaiian values are as follows.

  In Voices of Wai'anae, it is noted that the "single most important aspect of Hawaiian lifestyle is his/her tie with the land." It is further found that Hawaiian self esteem stems from fulfilling one's obligations to others, and affiliative values include honoring commitments to friends, providing aid in need, cooperative fellowship, and shared use of land and resources.[20]

  Aloha is central to all Hawaiian values and strategy, according to **Hawaiian Values for Today.**[21] Hawaiian values were identified and discussed for (1) ho'omana (spirituality), (2) cosmology, time, and sense of place, (3) economics, and (4) leadership.

20 *Alu Like, 1983.*
21 *Kanahele and Snakenberg, 1988.*

- Quality of Life.

  In 1981, Moloka'i residents, many of whom were Hawaiian, identified and rated 14 values in a study of community values in relation to energy development.[22] The number one value was "family together", followed by "education," "rural," and "everybody knows everybody." The ninth most important value was "Hawaiian culture." While Hawaiian culture in itself was an important value, there was no indication of what comprised this culture.

- Mental Health Studies.

  There are works by agencies and groups such as Alu Like and E Ola Mau that approach Hawaiian culture from the health perspective. Basically, this approach states that the loss of cultural identity, separateness, individuality leads to *anomie*, which is a condition of confusion in both the individual and society when social norms are conflicting, absent or weak.[23]

  Anomie creates individual dissonance and illness, and social problems. Health and social work professionals feel the separation of Hawaiians from the land in relation to the loss of their culture, has contributed to the high incidence of health and social problems in the Hawaiian community.

- Studies Specific to Hana

Two anthropologists have conducted studies on Hawaiian culture in Hana. In a 1959 study, Forster presented an ethnographic account of contemporary Hawaiians to determine the degree of loss of *traditional* Hawaiian culture.[24] Ke'anae and Pu'uiki were surveyed; both were rural communities and isolated with a degree of economic and social autonomy. Ke'anae is a farming community of taro and rice farmers. Pu'uiki was dominated by the sugar plantation at the turn of the century.

Forster identified traditional Hawaiian customs such as speaking the language, the use of kahuna and using traditional medicines. He concluded that the interchange between the various cultures over the years made it difficult to isolate purely Hawaiian practices. For example, the growing of taro in Ke'anae did not use a Hawaiian technique but Chinese. The weaving of hats and mats from pandanas involved Filipino practices as well as Hawaiian. A woman spoke of taking a "Hawaiian" medicinal remedy, when in fact it was a combination of Japanese, Chinese and Hawaiian folk medicine.

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22 *University of Hawaii Practicum, 1981; and Canan and Hennessy, 1982.*
23 *Coser, 1977.*
24 *Acculturation of Hawaiians on the Island of Maui, Hawaii. University of Hawaii Archive Thesis No. 2095.*

Using such standards of traditional Hawaiian culture, he concluded that, in both communities, acculturation had progressed to the point where it was difficult to isolate distinct cultural characteristics.

Jocelyn Linnekin wrote a number of articles and books after completing field work in the Hana communities of Ke'anae and Pu'uiki. In Children of the Land: Exchange and Status in a Hawaiian Community (1985), she found that the Ke'anae Hawaiians can distinguish themselves from non-Hawaiians because they are living a model of the past. She expects that, because of current efforts to assert Hawaiian culture and values throughout Hawai'i, Ke'anae will survive and remain distinctively Hawaiian.

She asserts that modern Hawaiian society illustrates both persistence and change. She found that the most salient examples of Hawaiian cultural persistence are the luau, exchange-in-kind (versus selling and buying), and the centrality of women. These were not just important in the prior value system, but meaningful in the modern social and political context. She also noted that Hawaiians are perhaps the most acculturated people in Polynesia.[25] Hawaiian culture itself placed a high value on innovations from outside, thus having the potential for transformation.

- Status of Definition of Hawaiian Culture

With an agreed upon definition of contemporary Hawaiian culture and its characteristics, one that was derived through scientific research and intersubjectivity, we could show how a golf course might impact these characteristics.[26] This definition would have then been the foundation upon which we approached Hana Hawaiians for input on this project.

Our overall finding, however, is that contemporary Hawaiian culture is moving into the twenty first century with no agreed upon definition. The previously cited works "affirm" values, and "advocate" behaviors, but do not identify or explain what makes these values and behaviors a culture. Without such a definition to delineate components of Hawaiian culture, we cannot objectively measure the impact of the proposed project or any other policy and/or development project on Hawaiian culture in Hana.

How to define Hawaiian culture is a topic of debate between many native Hawaiians both within and outside academia. Native Hawaiians contend that the scientific community, particularly the "experts" hired by developers, are doing a disservice to the indigenous culture. They assert that no one can interpret their history but another Hawaiian and that only native Hawaiians qualify to define themselves, their history, traditions, values, norms and beliefs.

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25 *Jocelyn Linnekin, "On History, the Present and the Future," Children of the Land: Exchange and Status in a Hawaiian Community, 1985, pp. 239 - 248.*
26 *For the purposes of this report, a distinction is made between ethnic Hawaiians, those who are not ethnic Hawaiians, but act and consider themselves Hawaiian (self-identification Hawaiian) and people who live in the state of Hawai'i and consider themselves Hawaiian (geographic Hawaiians).*

In Hawaiian Values For Today: *Proceedings of the Waiaha Ku Kanaka Conference*, the authors suggests that a cultural impact study be part of the environmental impact statement, and states that

> *"Hawaiians need to define their cultural values or practices. No one else can or should do that. And not only must they define them, but they must agree on them."*

Defining Hawaiian culture is certainly not within the scope of this study. Ultimately, there needs to be a comprehensive effort which would bring the subject of Hawaiian culture from the micro level of separate analysis as a unique component, to the macro level of universality. In addition to defining Hawaiian culture, that effort should deal with the following types of issues:

- What are the universal tendencies among the Hawaiian communities that give them a distinct culture?
- How different are the Hawaiians from the other sub-groups within a community?
- Does the Hawaiian lifestyle differ significantly from the "local" lifestyle?
- Do Hawaiians in Hana have different cultural behaviors than Hawaiians in Wai'anae or other predominantly Hawaiian communities?
- Do Hawaiians share similar characteristics of say other Polynesians or other indigenous people that had a subsistence lifestyle, such as upland Indians in the interior of Mexico, who have their equivalent amaukua?

5.4.2 Potential Project Impacts on Hana's Hawaiian Community

- Approach

In that there was no agreed upon definition of Hawaiian culture, we changed the direction of effort of the study to explore (1) how the golf course might affect the Hana Hawaiian lifestyle through an understanding of daily activity patterns and social interactions; and (2) reactions to the golf course of Hawaiians in Hana. This information was to be identified by the local Hawaiian population; hence, the standard for analytical interpretation was the reference group.

In March 1992, we collected data from three groups; kupuna, youth and working-age adults. [27] The groups were "self-selected." We asked Hana people who were involved with

[27] *There are a number of demographic variables which we could have used for stratification, including age, sex, ethnicity and education (Babbi, 1973). The groups were stratified by age 1) to see if age made a difference in opinion and 2) to see if jobs, which is often heralded as a positive benefit for the youth, were actually desired by the youth.*

these groups to invite whomever they wished. The groups were to comprise mostly Hawaiian individuals who met the aforementioned age and residence criteria. Further, so that each person had opportunities to participate, we targeted an attendance of about twelve people per group. The following summarizes the meetings with the different groups.

- The first meeting was with the kupuna and was held at the Hana Community Center cafeteria. The eleven who attended were members of the Hanalani Senior Citizens Club. The meeting occurred during a routine weekly gathering of this group, and potential participants were apprised the week before that this meeting would occur. The participants had lived in the Hana District all their lives; the oldest participant was 90 years old. Two people were not ethnic Hawaiians. Most were retired.
- The second meeting was with the youth. The Hana Youth Center operates an after school program at its facility located at the old Hana School. The youth group was informed of the meeting purpose the week beforehand, and they were invited to attend. Eleven people attended this meeting which was held after volleyball practice. The young people ranged from twelve to 14 years of age; two youth counselors also attended. All of the participants in this group were full or part Hawaiian, and all had lived in the area all their lives.
- The meeting with adults was held in the evening at the Hana Community Center cafeteria. Seventeen people attended and they were affiliated with several community organizations, such as the Hana Hawaiian Club, the Hana Cultural Center, and the Hana Rodeo Club. Almost all had lived in the Hana area all their lives; two lived in this area for 30 and 34 years, and one moved from Ka'u to Hana two years ago. All were full or part Hawaiian.

The meetings were structured similarly to ensure the systematic collection of information. Each meeting was divided into two parts and the following sections summarize the findings of the meetings.

- Project Effects on Daily Activities

Lifestyle can be defined as the things people do on an average day, or a daily basis. From the activities, one can discern what is important to the community; their underlying values and norms of the Hawaiians.[28] Specific questions were asked to understand:

- daily routines
- networks
- leadership
- geographic boundaries of "their place"

[28] *The social resource unit (SRU) was used to ascertain the daily activities and social patterns of these people. Using this approach, we identified interaction and activity patterns. Source: Kent and Greiwe.*

- recreational activities
- site use
- characteristics of Hawaiian and/or local lifestyle
- how the proposed project might affect these items.

Information was written on butcher block paper under these headings in front of the group. From this information one can determine Hana lifestyle seeing what people do on a daily basis. After this information was recorded, participants were asked to review the pieces to make sure that the lists accurately represented their input.

Participants were then asked to identify specific ways the proposed golf course would impact the information provided on their daily activities and so on.

Appendix C contains information on lifestyles provided by the three groups and is summarized as follows:

- **Daily Routines.**

  As may be expected, daily activities vary due to the age difference. The adults work, the seniors holoholo and the youth go to school. Work was also mentioned in both the seniors and the youth groups. The youth's work is referred to as chores or babysitting. The work in the other groups could be volunteer, part-time, or working two jobs.

- **Social and Support Networks.**

  Family dominated social and support networks. The answers usually came in specific form such as grandchildren, parents, cousins, and so on. The activities for most social networks were picnics and church, and it was noted that Hawaiians were mostly members of Hana's Catholic Church. The support network question also elicited institutional answers; for example the seniors mentioned the Hana Medical Center and the adults cited banks and stores.

- **Leadership.**

  We specifically solicited information about who participants look up to, whom they considered leaders. Initially, their answers had to do with relatives -- uncles, parents, and so on. When asked to look outside their family, they all named members within their own community.

- **Sense of Place Boundaries.**

  We were trying to get at their "sense of place", or where they see their socio-community boundaries. All three groups said Hana Bay. Two groups said the community center, and "friend's house".

- **Recreational Activities.**

  In all age groups, the major recreational activity is organized sports, including baseball, basketball and volleyball. All ages participate and/or watch these sports.

  The other common recreational activity that all groups engage in is fishing. Areas at which participants liked to fish included Ulanio, Hana Bay, Kaupo, Kipahulu, Makaalai and Waikaloa.

  The adults and seniors listed drinking as a form of recreation. When asked what they will do in the summer for recreation, the youth group responded that they typically leave Hana in the summer. They visit other islands for jobs, shopping and family reasons.

- **Site Use.**

  We asked the youth and adults who currently uses the site and for what purpose.[29] The youth and adults both use the site for the same purpose -- access for hunting and gathering in the area. They hunt animals such as pig and peasant. They gather items, such as bamboo shoots, to make Hawaiian instruments. The youth also said that they use the trail on site for jogging, walking, biking and horseback riding.

Project Impacts on their lifestyle.

After providing information on the various aspects of their lifestyles, participants were then asked how the golf course would affect what they told us about their lifestyle. The youth feared that the golf course might kill the pigs, trees and fauna from which they make Hawaiian instruments.

The adults pointed out that the golf course would limit their access to the area for hunting and gathering. They said it would reduce the pastureland for ranching; and they saw pollution from the run-off killing the fish and seaweed, ultimately, their use of the ocean.

The seniors felt that the golf course would not affect them their daily activities, although as noted earlier, they did not provide site use information.

Hawaiian vs. Local Characteristics

The adults and the youth were asked to discuss what it means to be "Hawaiian," and how does Hawaiian relate to "local." Initially, the youth did not see a difference and asserted that "Local is Hawaiian", "Local is being born and raised in Hawaii." At one point, one youngster felt that "to be local in Hana means you would have had to practice Hawaiiana".

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29 *We ran out of time with the kupuna, and did not ask them for site use information. We did, however, as questions pertaining to project impacts.*

This statement then stimulated further discussion of what they believe are mostly Hawaiian characteristics, including fishing, aquaculture, planting taro, hula, singing, ukulele and language.

Whereas the youth tended to see Hawaiian and local as synonymous, the adults felt that Hawaiian is the very foundation of Hana's lifestyle. To be Hawaiian is to live and work the land, although one person pointed out that it is becoming increasingly difficult to live with the land in the traditional Hawaiian way.

One person noted that, when he was growing up, there was no such thing as "local." You were either Hawaiian, Japanese, and so on. "Local," he felt, is a relatively recent term. They said "local" takes a little from each culture, but stressed that, in Hana, the basic foundation of local culture is Hawaiian.

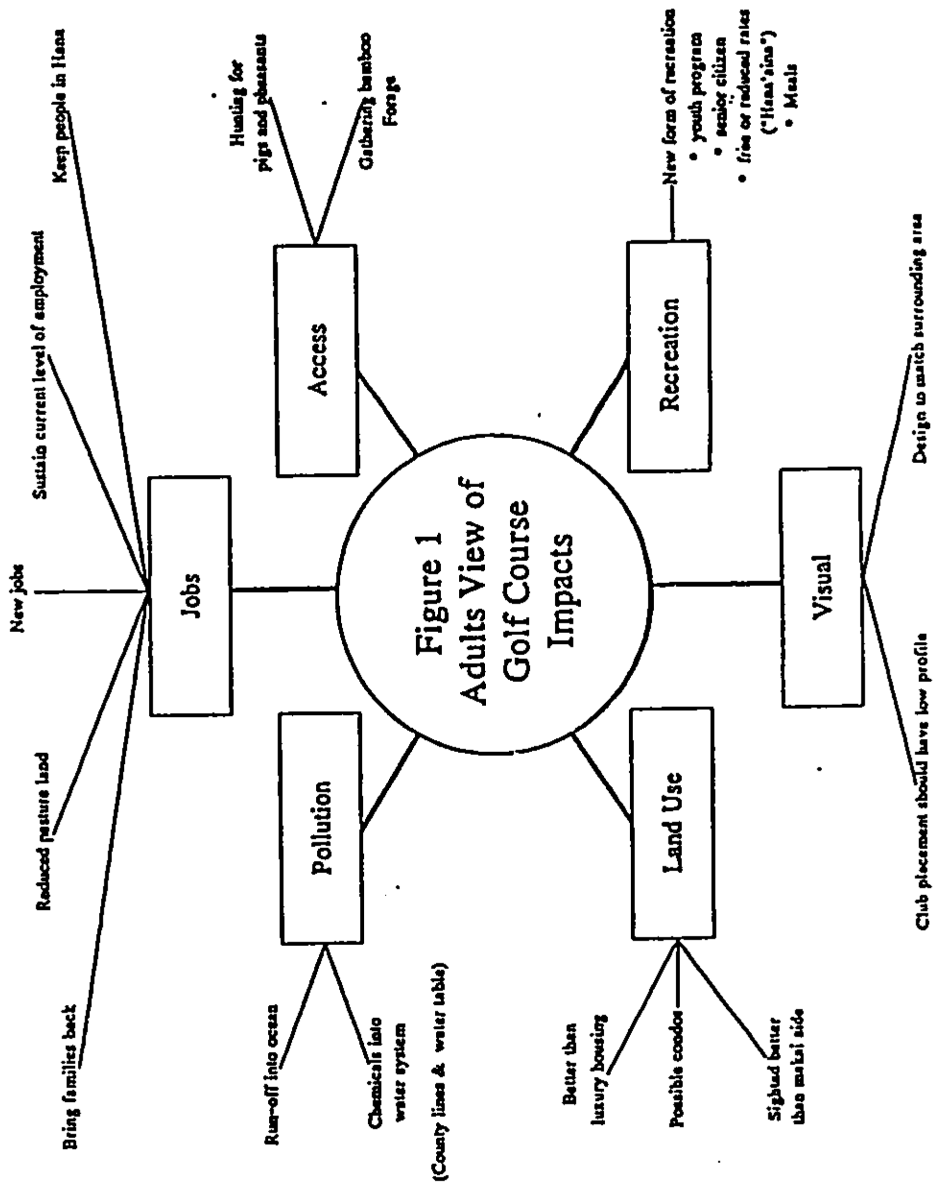
- Project-Related Concerns Identified in Focus Groups

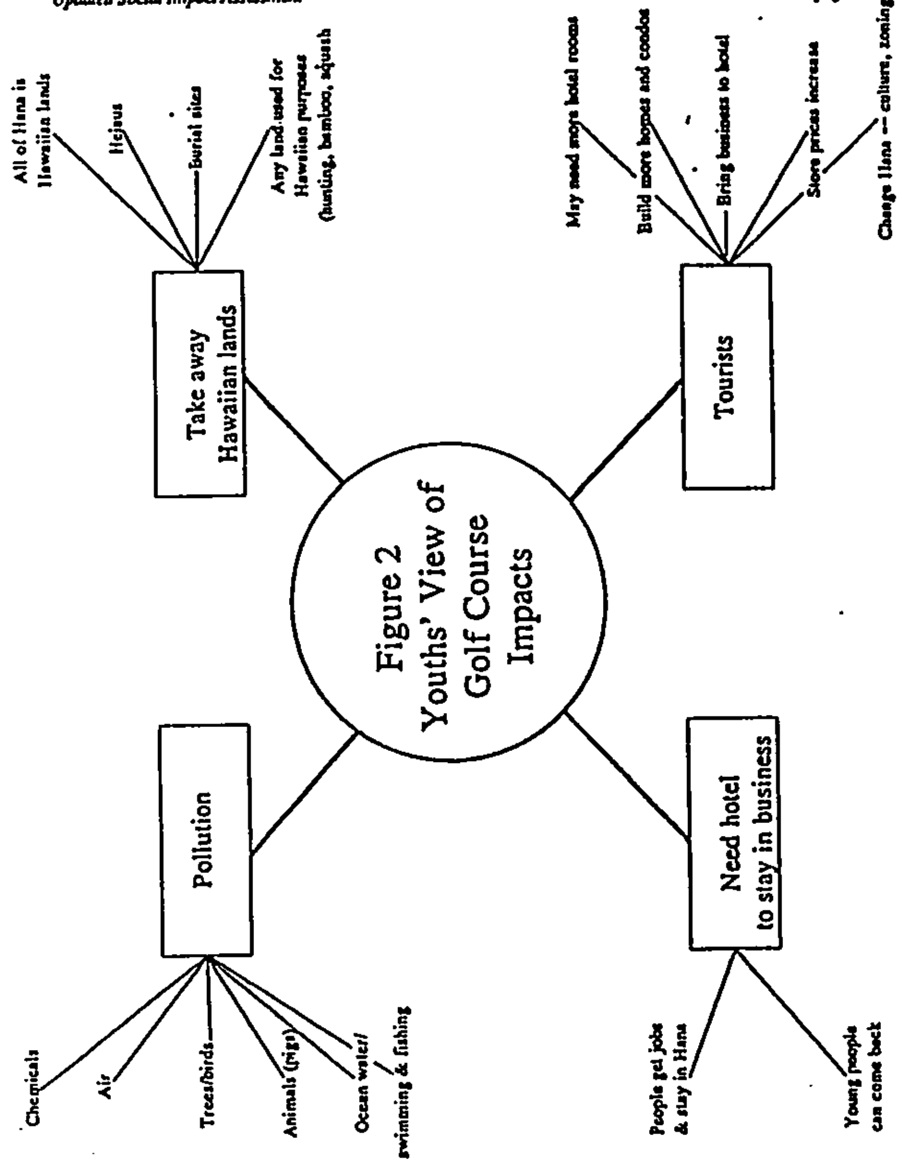
In the second part of the meetings, participants were asked to share their thoughts and concerns regarding the proposed golf course.[30] Each person was asked to write down any impacts they felt about the project on index cards which we provided. All present then shared the first three items on their card, and each item was group-recorded on large paper in front of the group. We went around the room until everyone had exhausted their list. A short break followed, during which facilitators "mapped out" the issues showing trends and relationships. After the break, we discussed the "maps." To ensure that the final products accurately reflected what was discussed, those present were asked to refine, add or delete items as they wished.[31]

Figures 1 and *2* contain the maps illustrating, respectively, the adults' and youths' view of golf course impacts.

30 *We ran out of time with the kupuna, and were unable to conduct the second part of the meeting to the same extent as the other groups. We did, however, ask the kupuna about their feelings about the golf course, and this section presents their comments.*

31 *This technique is "mind mapping." The basic approach was based on discussions in Wilson and Morren, 1990. This technique was used so that participants had time to think about their feelings on the golf course. Everyone was guaranteed the opportunity to provide input, and, for some, reading from an index card proved easier than a group discussion.*





Golf course impacts cited by the adult group included the following:

- **Jobs.**

  For the adults, jobs was the most frequently-mentioned impact generated by the proposed golf course. They pointed out that the hotel is a major employer in Hana and that financial survival of many families is tied to the economic viability of the hotel.

  The bottom line for the adults is that they wanted to stay in Hana. To remain in Hana, they have to make a living, which means employment. If the golf course meant that they can keep their jobs -- and thus live in Hana --, then they wanted to see the project implemented.

  Many of those present expressed fear and stress because, at the time of these meetings, the hotel's occupancy rate was low and employees were either having their hours reduced or were being laid off. They said that, in their own families, people are moving out of Hana to find work.

- **Land use and visual impacts.**

  The adults discussed land use alternatives and design issues. Although they felt the golf course would be more tolerable than luxury housing, they are fearful that condominiums will still be built at a future time. Much discussion took place about the siting of the golf course; they felt that the current siting was better than having a golf course on the makai side of the road.

  They wanted to see the golf course blend in the countryside, and suggested that the course somehow be camouflaged behind the pu'u.

- **Access.**

  As noted earlier, people use the golf course site as part of and access to hunting areas. They also pick bamboo and squash on-site. They were concerned that the golf course would discontinue these activities.

- **Pollution.**

  The adults were concerned that the chemicals from the golf course would pollute the ocean, thereby harming fishing grounds in the area. Chemicals were also seen as a source of pollution to the water system. They noted that the County water lines run near the project site and were afraid that chemicals would enter the pipes. Further they were concerned about the leaching of chemicals into the groundwater.

- **Recreation.**

  The adults saw the golf course as a new form of recreation for Hana. They suggested that Hana residents be given every opportunity to use the golf course and recommended programs to the youth and for senior citizens. They also suggested "Hana'aina" rates for Hana residents.

For the youth, the major impacts of the golf course are as follows:

- **Take away Hawaiian lands.**

  The young people felt a strong sense of cultural impact. They were afraid that the project would destroy heiaus, and felt that eventually they would lose the Hawaiian culture.

  They felt that the golf course would take away Hawaiian lands. We asked them to explain which lands were Hawaiian, and if lands owned by Keola Hana Maui, Inc. were Hawaiian. They expressed the traditional Hawaiian land value of shared use by responding that they see all of Hana as Hawaiian land; they felt that they have access to land in Hana. They further said that, when development takes away land that was previously used for Hawaiian things, such as hunting and gathering, that is taking away Hawaiian lands.

- **Tourists.**

  For the most part, the young people did not like tourists, even though they acknowledged that tourists bring business to the hotel. The youth saw an increase in the number of tourists coming to Hana as a result of the proposed golf course. They thought that perhaps some of those visitors (like others before them) would like Hana and want to stay. This would mean more homes and more people in the area.

  They also talked about the changes that might occur in Hana with the increase of tourists. These changes included more condos and an increase in store prices. With more people coming to Hana, the land use zoning might change to allow for different and more development. All of these potential happenings would alter their culture.

- **Pollution.**

  The youth expressed strong concern about golf course chemicals and possible pollution. They were afraid that chemicals would harm the ocean, as well as the animals in the area. They felt that air pollution would be a problem, and that the chemicals would impact trees and birds.

- **Need hotel to stay in business.**

  Some of the young people said that their parents' jobs were being affected by low hotel occupancy. They acknowledged that the golf course might help people keep their jobs and stay in Hana, and that other young people may be able to return to Hana if there were more jobs. This was clearly not a priority item, however.

Although we did not have enough time to conduct the mapping exercise with the kupuna, we did discuss their feelings about the golf course. Their reactions are as follows

- **No effect on their daily lifestyle.**

  They believed that the golf course would not affect their daily activities, or the social patterns they discussed. They felt that these can continue to occur.

- **Jobs was major benefit.**

  For the most part, the kupuna encouraged the proposed project because they believed that the golf course would bring jobs and help the hotel stay in business. One person did not like the golf course because she "heard a lot of bad things about it" and "lots of people don't want it."

5.4.3 Analysis

- Social Resources

1. **Family.**

   The social resource data was used to characterize the lifestyles of Hawaiians in Hana. The most important social resource of Hana is the *family*. The family, the ohana, rated first on all of the people-oriented social resource unit data. Family provides the support networks, family is the social circle and family is looked to for leadership and advice.

   Because of the fundamental importance of ohana in Hana, it is crucial to Hana Hawaiians that their families stay together. Hence, the economic problems of the hotel whereby employees are laid off or have their hours reduced, ultimately were viewed in our discussions as a threat to Hana's core resource unit. When members of the family have to leave Hana to find jobs, this is a major source of stress and frustration currently affecting individuals and the community.

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- "Bottom Line"

When asked about possible impacts of the golf course, the kupuna, adults and youth groups exhibited different tolerance levels of change. They had very different "bottom lines" when regarding change resulting from the golf course, as follows:

1. **For adults and kupuna = Staying in Hana**

Both the adults and kupuna expressed a strong desire to stay in Hana, and to have the young people be able to live in Hana. Living in Hana meant keeping the ohana together, thereby preserving the most basic social resource in Hana.

For the most part, living in Hana also means having to work or find some means of economic survival. One of the concerns often expressed by the adults and kupuna was that some of Hana's Hawaiians have to leave the area because they could not find work. Thus, no job was often translated into being forced to leave Hana and families breaking up.

The adults and kupuna believed that the golf course meant business for the hotel; it meant more jobs at the hotel and the golf course. The golf course then would help them maintain their bottom line -- it would help them and their children stay in Hana.

2. **For the youth = Hawaiian land and Hawaiian culture**

Although the youth did not initially discuss any participation in Hawaiian culture, they eventually proved to be strong advocates of Hawaiian rights. For them, anything that threatened Hawaiian lands and culture was negative. Tourists were seen as being intrusive, and the taking of Hawaiian land was the worst thing the golf course would do.

It is noted that, in development-related debates, "jobs" is typically considered a benefit, particularly for young people. In such debates, development supporters point out that the development will bring jobs into the community and help the young people stay in the community.

The youth we met with, however, did not cite jobs as a positive benefit, nor did they express a strong desire to stay in Hana. In fact, they often looked forward to typical summer trips outside of Hana. This does not imply that they do not value living in Hana, but simply indicates that these jobs and a future in Hana are not priorities at this point in their lives.

- **Project Impacts Specific to Hana Hawaiians**

Based on our meetings with Hana Hawaiians, it is likely that the proposed golf course will have two direct social impacts on Hana Hawaiians as follows:

1. **Access and Hunting and Gathering Activities.**

Hana Hawaiians use the project site as part of their hunting and food gathering activities. They pass through the site on their way to the mountains, and forage the pu'u for food. Both activities are considered Hawaiian. Hence, if the golf course will discontinue access to hunting and food gathering areas, then the project would negatively impact the Hana Hawaiians. The recreational analysis conducted for the EIS indicates that the project would eliminate one trail and hence affect access to one of five designated hunting grounds in this vicinity. Four hunting grounds will remain unaffected.

Further, a negative social impact would arise if there are impacts on the ocean waters due to golf course chemicals; these impacts would affect fishing along this part of the coast, and fishing is considered Hawaiian. Studies conducted for the EIS have concluded that the golf course will not impact underground or ocean water quality. The project should therefore not impact fishing or other ocean activities conducted by Hana Hawaiian and other residents.

2. **Contribute to Helping Hana Hawaiians Stay in Hana.**

   If the project meets its economic objectives, then the proposed golf course will help Hana Hawaiians to remain in Hana. If the project will help the hotel, where many Hana Hawaiians work, and if the project will create jobs, which can be filled with Hana Hawaiians, then the golf course will contribute to a fundamental need for many Hana Hawaiians to continue to live in Hana. This was the most important aspect for the adult and kupuna groups.

The aforementioned impacts relate to the lifestyle and activities of Hana Hawaiians. The social impacts specific to the Hana Ranch Country Club on the *overall* Hawaiian culture -- whether the impacts are symbolic or site-specific -- will depend on the cultural parameters defined by statewide and Hana Hawaiians themselves. It is noted that only the youth group focussed on "culture," and they felt that there will be negative impacts to their culture. They named the taking of Hawaiian lands as a golf course impact. When asked to explain this impact further, however, they spoke in symbolic terms, rather than project- or site-specific terms. Further, they did not name specific other cultural elements which they felt would be threatened, altered or destroyed.

5.5 Recommendations

Social compatibility between the proposed golf course and the Hana community is imperative to retain the balance and harmony of the community's lifestyle, social qualities and rural and natural environment. Changes to any one of these aspects could affect the other two characteristics and, ultimately, "what makes Hana Hana."

At the core of achieving project compatibility is the Hana community's ability and willingness to accept and/or adjust to the proposed golf course. For some people, the price of acceptance/adjustment is too high, regardless of the potential economic benefit of the project. Others may feel that, if they want to continue to work and live in Hana, they must accept/adjust to the project. For this latter group, it is very important that the conditions of acceptance are community-based, that they have a say in the types of changes the project will bring and how the project can work for them. As the Hana Negotiations Committee stated:

> *"let Hana's people, with Hana's sensitivities, solve Hana's problems with Hana-type solutions."*

The core of our recommendation is that Keola Hana Maui, Inc. work with the Hana community to develop community-based programs and actions. In addition, there are actions which Keola Hana Maui, Inc. can initiate within its organization to assist the Hana community. Two areas of programs and actions should be considered and are as follows:

- **Hana - Keola Partnership**

  The Hana Negotiations Committee indicates that it feels that a partnership has developed between Hana and the company. This partnership will continue to evolve, and it is suggested that specific projects are identified and planned. A good example of how this partnership is evolving is relationship

  between Keola Hana Maui, Inc. and the newly-formed housing corporation. Because the company is interested in housing for its employees and other Hana residents, Keola Hana Maui, Inc. was instrumental in getting this effort off the ground; it also continues to support these efforts. It is the community, however, who worked with consultants in developing a housing needs study, and who continues to lobby, meet and work on housing issues.

  Another possibility for a working partnership is *long-range planning* for the Hana community. The company and the community needs to work together on a comprehensive master plan for Hana lands. The individual components of the Keola Hana Maui, Inc. master plan, such as housing, the golf course and the town center, should be put in the context of a long range plan for Hana. This master plan will then need to be incorporated in the revised Hana Community Plan. It is noted that the advisory committee for the Hana Community Plan includes a company official.

  Defining the *Hana lifestyle* should also be a partnership effort, and we understand that representatives of Keola Hana Maui, Inc. and the Negotiations Committee have approached an independent facilitator to assist in this effort. We suggest that this lifestyle definition effort also include:

  - the development of a socio-economic baseline study of Hana residents which can then be used in obtaining funding and social programs, and

  - a study of Hawaiian culture in Hana, which would have wide implications in Hana and throughout the State.

  Another form of a partnership relationship is the development of Hana as a *repository for Hawaiian culture*. This would be a very long-range effort and further dialogue with community leaders is needed to determine an appropriate scope and role for Keola Hana Maui, Inc. in this effort.

  Types of community access and use of the proposed golf course should be determined as a partnership. Any type of community-oriented program or use should be determined with the community. Both parties also need to work together to see if the on-site hunting access and gathering activities can continue in some form.

- **Internal Initiatives.**

  Keola Hana Maui, Inc. has made an internal management decision to assist the Hana community in certain efforts. Assistance in developing a new fire station, for example, is not a partnership-type decision, but an internal commitment on the part of Keola Hana Maui, Inc..

Section 4.2.1 presents community concerns independent of the proposed project. Some of these concerns such as family problems and substance abuse may seem exclusive of Keola Hana Maui, Inc. However, these problems can and do manifest themselves in the operation of the hotel.

Keola Hana Maui, Inc. has an opportunity to help address these problems on an internal level. Within the hotel, a study of employee needs could be conducted and appropriate programs could be implemented. Because of extended families and close interrelationships in Hana, hotel programs will undoubtedly have a far-reaching effect in the community.

In light of the anticipated increased proportion of action-oriented hotel guests, there should be a marketing program which helps visitors form realistic expectations about Hana. There should be strong emphasis on the tranquil lifestyle, the Hawaiian culture and the rural environment, so as to minimize expectations of some typical urban facilities and services. The hotel welcoming process should include an orientation which reinforces sensitivity to the Hawaiian culture.

Likewise, residents should have an idea of what to expect in golf course patrons. There should be programs for hotel employees which orient them to different and anticipated cultures.

More basic is the need to study and address the employee satisfaction/morale situation at the hotel. If there are morale and service-related concerns, then providing service with aloha will be even more difficult in culturally-sensitive situations.

It is stressed that these recommendations are made in an social environment which continues to change and evolve. Some of these recommendations are similar to those suggestions in the 1991 SIA; others reflect the discussions which have occurred since the first study was completed.

References

Alu Like, Research and Statistics Office. Compendium of Profiles of Hawaiians in the 1980 Census. 1981.

Alu Like Research, Planning and Evaluation Unit. Hawaiian Population by District and Census Tract in the 1990 Dicennial Census. September 1991.

Alu Like. Voices of Wai'anae. 1983.

Babbi, Earl R. The Practice of Social Research. Wadsworth Publishing Company, Inc. 1973.

Bews, Chris Ann. *Changing Times Hana's Struggle to Balance Growth and Tradition.* Maui, Inc. September/October 1991.

Branch, Kristi, Douglas Hooper, James Thompson and James Creighton. Guide to Social Assessment: A Guide for Assessing Social Change. Westview Press. 1984.

Canan, Penelope and Michael Hennessy. *Community Values as the Context for Interpreting Social Impacts.* Environmental Impact Assessment Review; Vol. 3 No. 4. 1982.

Community Resources, Inc. Socio-Economic Impact Assessment for the Proposed Wai-he'e Golf Club (Phase 1), Maui County, Hawaii. Prepared for Sokan Hawaii, Inc. October 1989.

Coser, Lewis A. Master of Sociological Thought: Ideas in Historical and Social Context. Harcourt Brace Jovanovich, Inc. 1977.

Creamer, Beverly. *Hana.* The Honolulu Advertiser. October 26, 1987.

Earthplan. Social Impact Assessment for Hana Ranch Country Club. Prepared for Keola Hana Maui, Inc. January 1991.

Forster, John. Acculturation of Hawaiians on the Island of Maui, Hawaii. University Archives Thesis No. 2095. April 1959.

Fujimoto, Lila. *Hana citizens want development study.* Honolulu Star-Bulletin. July 3, 1990.

Gilder, Nancy. *Creating an Appropriate Social Impact Assessment Procedure for a Controversial Project: the Spaceport*; An Area of Concentration Paper Submitted to the University of Hawai'i Department of Urban and Regional Planning. 1991.

Hana Community Association Board of Directors. *On the Hana beat* (Commentary). The Maui News. April 8, 1990.

Hawai'i Office of State Planning. Golf Course Development in Hawaii: Impacts and Policy Recommendations. January 1992.

Hawai'i State Department of Business and Economic Development. County and District Trends in Hawaii, 1989. *Statistical Report 214.* April 1990.

Hina-malailena. *Construction Funding Package: Loans and Grants.* As distributed to several agencies. 1990.

Hina-malailena. *Hana Village Marketplace: Business Plan.* Hana, Maui, Hawaii. Revised September 1991.

Sam O. Hirota, Inc. Environmental Impact Statement for the Kaupo Water System Improvements, Kaupo, Maui, Hawaii. Prepared for the County of Maui Department of Water Supply. June 1984.

Sam O. Hirota, Inc. Environmental Impact Statement for the Wailua-Hana Water System Improvements, Hana, Maui, Hawaii. Prepared for the County of Maui Department of Water Supply. June 1984.

Sam O. Hirota, Inc. Environmental Impact Statement for the Keanae Water System Improvements, Keanae, Maui, Hawaii. Prepared for the County of Maui Department of Water Supply. August 1984.

Imada, Lee. *Jesse tries to calm Hana fears.* The Maui News. February 15, 1990.

Jetley, Tony de (ed). *Days Gone By.* Mana O'Hana (newsletter produced by Hotel Hana Maui). Spring/summer 1980 edition.

Jetley, Alberta De. *Housing land for Hana people only.* The Maui News. August 1, 1990.

Jokiel, Lucy. *Snow Job in a Hot Place.* Hawaii Business. May 1990.

Kanahele, George S. and Robert Lokomaika'iokalani Snakenberg. Hawaiian Values For Today: *Proceedings of the Waiaha Ku Kanaka Conference.* The Waiaha Foundation. 1988.

Kent, James A. and Richard J. Greiwe. *The Social Resource Unit: How Everyone Can Benefit from Physical Resource Development.*" Pre-Crisis Management: How to Manage Issues Before They Manage You. SRM International, Denver.

Linnekin, Jocelyn. *The Structure of Sentiment in Hawaiian Social Organization.* Paper Presented at the 82nd Annual Meeting of the American Anthropological Association. 1983.

Linnekin, Jocelyn. Children of the Land: Exchange and Status in a Hawaiian Community. Rutgers Univerisity Press. 1985.

Linnekin, Jocelyn. *Inside, Outside: A Hawaiian Community in the World-System.* Clio in Oceania Toward a Historical Anthropology. ed. Aletta Biersack. Smithsonian Institution Press. 1991.

Matsuoka, Jon and Wes J. Shera. Lana'i: A Community on the Threshold of Change. Prepared for Castle and Cooke. April 1990.

Ordway, J.D., Ph.D., Nicholas, *etal.* Analyzing the Market and Environmental Impacts of the Golf Industry in Hawaii. Prepared for the Hawaii Resort Developers Conference. 1990.

Pannell Kerr Forster. Economic Impact Study of the Proposed Hotel Hana Maui Golf Course. Prepared for Keola Hana Maui, Inc. July 1990.

Sorokin, Pitirim A. Society, Culture and Personality. Harper Publishing. New York. 1947.

Tanji, Edwin. *Hana building request to get further study.* Sunday Star-Bulletin and Advertiser. December 17, 1989.

Tanji, Edwin. *Hana Ranch owner plans to build golf course.* The Sunday Star-Bulletin and Advertiser. June 24, 1990a.

Trask, Haunani-Kay. Critique of Children of the Land: Exchange and Status in a Hawaiian Community (Linnekin, 1985) in Hawaiian Journal of History. Volumes 19 and 20. 1985-86

University of Hawaii Planning Practicum. Moloka'i Data Book: Community Values and Energy Development. 1981.

U.S. Department of Commerce, Bureau of the Census. *Census of Population and Housing, 1980: Summary Tape File 1-A, Hawai'i.* Available on microfiche, State of Hawai'i Department of Business and Economic Development library, Honolulu, Hawai'i. Washington, D.C., 1981a.

U.S. Department of Commerce, Bureau of the Census. *Census of Population and Housing, 1980: Summary Tape File 3-A, Hawai'i.* Available on microfiche, State of Hawai'i Department of Business and Economic Development library, Honolulu, Hawai'i. Washington, D.C., 1981b.

U.S. Department of Commerce, Bureau of the Census. *1990 Decennial Census: Preliminary Housing and Special Places Counts, Post Census Local Review Tape.* Available at the State Department of Business and Economic Development, Research and Statistics Branch. Tape dated October 17, 1990.

U.S. Department of Commerce, Bureau of the Census. *Census of Population and Housing, 1990 Summary Tape File 1-A, Hawaii.* Washingtoon D.C. 1991.

Wilson, Kathleen, and George E.B. Morren Jr. Systems Approaches for Improvemets in Agriculture and Resource Management. Macmillan Publishing. 1990.

Youngblood, Ron, with contributions by Beverly Creamer, Carl Lindquist, and Ka'upena Wong. On the Hana Coast. Second edition 1987.

Appendix A

List of People Interviewed in the 1991 SIA

Appendix A

List of People Interviewed in the 1991 SIA

(Affiliations are provided solely to indicate the perspectives of those interviewed. People were asked to speak as individuals, and were not asked to represent the official viewpoints or positions of their organizations.)

Name	Affiliation
Stanley Akoi	Chair of the Local AFL-CIO President of the Hana Youth Center Member of the Development Committee of the Hana Community Association
Father Matthew Alencastre	Pastor of Hana Parish (four churches) of the Catholic Church
John Blummer-Buell	Member of the Board of Directors of the Hana Community Association
Bill Chang	Chief Executive Officer of Hina-malailena President of the Hana Community Arts Council
Genevieve Chang	Community Aide for Hana, Maui Economic Opportunity
Haunani Collins	Member of the Board of Directors of the Hana Community Association Treasurer of Hina-malailena Member of the Board of Directors of the Hana Day Care Center Member of Hana Fisherman's Group (informal)
Billy Conner	Office Manager of Sinenci Contracting
Howard Cooper	Chair of Hana Soil and Water Conservation District Owner of Helani Gardens
Suzette Cossey	Co-owner of Readimix Concrete Company
Brian Dunn	Owner of heavy equipment company

Name	Affiliation
Patricia Eason	Principal of Keanae School and Hana High and Elementary School Board member of the Hana Maui Trust
Morey English	Member of Ka Pilina o'Hana Member of Kawiki Council of the Hana District Pohaku
Violet English	Member of Ka Pilina o'Hana
Greg Friel	Assistant of Land and Agricultural Division of Keola Hana
Bill Fuhrmann	Vice Chair of the Board of Directors of the Hana Community Association and Board Liaison to Keola Hana and the HCA Development Committee
John Hanchett, Jr.	Ranch Manager of Hana Ranch
Harry T. Hasegawa	Member of Hana Community Advisory Committee to the Maui Planning Commission Board member of the Hana Maui Trust Owner of Hasegawa General Store
Neil Hasegawa	Member of the Development Committee of the Hana Community Association Manager of the Hasegawa General Store
Clifford Hashimoto	Director and Member of the Hana Cultural Center
Rosemary Howell	Head Nurse of Hana Medical Center
John Kahalehoe	Hana resident
Henry Kahula	Pastor of Congregational Church in Kipahulu Owner of Town's Gas Station
Jackie Clyde Kahula	Recreation Technician at the Hana Youth Center
Mary Ann Kahula	Employee of Hana Tropicals

Name	Affiliation
Zelda "Mice" Kahula	Employee of Hana Tropicals
Lester Kaiwi, Sr.	Ranch Hand at Hana Ranch
Paul Kaiwi, St.	Coach at Hana High and Elementary School
Kekai Kalaola	Member of Hanalani Senior Citizens Group
William Kalaniopio, Sr.	Retired Ranch Hand
Parley Kanakaole	Teacher at Hana High and Elementary School Member of the Board of Directors of the Hana Community Association
Richard Keohulu	Minister Chief Konohiki of Kawiki Council
Keola Kino	Ranch Hand at Hana Ranch Tour Guide at Hana Ranch Stable
Terry Lind	Park Ranger of the Kipahulu District of the Haleakala National Park
Carl Lindquist	Member of the Board of Directors of the Hana Cultural Center Member of Hina-malailena Member of the Hana Community Association
Rae Lindquist	Member of the Hana Cultural Center Member of Hina-malailena Member of the Hana Community Association
Steve Lyceu	Audio Video Technician of the Maui Public Library
Stacy Lynch	President of Kaeleku Property Owners Association
Tiny Malaikini	Retired Hana Business Person

Name	Affiliation
Michael Minn	Outreach Coordinator for Hana of the Maui Community College Co-Chair of the Development Committee of the Hana Community Center Kawiki Council of the Hana District Pohaku
Kathleen Morton	Public Heath Nurse, State Department of Health
Beth Oliveira	Employee of Hana Tropicals
Tom Parry	Chair of the Board of Trustees of Wananalua Church Member of the Hana Community Association
Ed Pechin	Member of Hana Community Association Trustee of Hana Maui Trust
Jeanne Pechin	Member of Hana Community Association
Jimmy Perry	District Superintendent of Hana District, County of Maui
Tony Pu	Owner of Hana Tropicals
Annie Rahl	Treasurer of the Hana Community Association
Jack Rhineshart	Member of Hana Community Association Self-employed Farmer
Rachel Rollins	Head Librarian of the Hana Public and School Library
Victor Sinenci	Owner of Sinenci Contracting
Roberta Smith	Employee at Hana Tropicals
Leonard Stegman	Head Lifeguard at Hamoa Beach Club
Lieutenant Ivan Takitani	Hana District Commander of Maui Police Department
Laureen Tanaka-Sanders	Co-Secretary of the Hana Community Association Director and Teacher at the Hana Day Care Center

Name	Affiliation
David Travis	Handles artwork and design at Hana Treasures Member of Hina-malailena
Robert Vogele	Chair of the Board of Directors of the Hana Community Association Coordinates Family Support Center in Hana
Elsa Wittbold	Dentist

Appendix B

List of Participants in Hana Meetings on this Project

Appendix B

List of Participants in Hana Meetings on This Project

Kupuna Group	Adult Group	Youth Group
Don Atoy	Roxane Friel	Lea Carvalho
Bill Chang	Benjamin Helekahi	Leo Kalalau
Anna Kahaleuahi	Katherine Helekahi	Lilia Kalaola
Isabelle K. Kalaola	Sonia Helekahi	Kaipo Lono
Mary Anne Koko	Alvin Kalwi	Charlyn Mizner
Rosaline Logue	Harolen Kalwi	Domingo Sinenci
Connie Manjin	Lester Kalwi, Sr.	Poha Tolentino
Ellen Okada	Selma Kalwi	Jonathan Tolentino
Evelyn Oliveira	Cecilia Kalalau	Ruth Tolentino
Thelma Smith	Milton Kawaiaea	Dani Waring
Rose Tipon	Roback J. Kawaiaea	Jessica Wilhelm
	Connie Manjin	
	Sabae Manjin	
	Billy Roback	
	Jonathan Tolentino	
	Ruth Tolentino	

Appendix C

Individual Responses in Lifestyle Questions at Hana Meetings

Appendix C

Individual Responses in Lifestyle Questions at Hana Meetings

Daily Routines
What do you usually do during the day?

Kupuna	Youth	Adults
• Holoholo - Hana Bay - beach • Pick limu and mango • Shoreline fishing • Gardening/yardwork • Work (both full- and part-time) • Go walking on different routes	• School • Talk on the phone (in many place • Babysit • Chores • After school sports • During the weekend: - swim - church - aquaculture - go to Wailuku - cruising	• Work - hotel - county - 2 jobs - community work - self-employed - part time • Yardwork • Drink beer • Take care grandchildren • Cruise

Social Networks and Activities
Whom do you spend time with the most and what do you do to socialize?

Kupuna	Youth	Adults
• Family • Planned outings • Picnics • Church (mostly Catholic church) • Luau	• Friends • Cousins • Just talking with friends • Watch VCR movies together	• Family - visits - meals • Grandchildren • Church choir practice • Partying • Friends • Fishing/hunting • Drinking

Support Networks
Whom do you go to when you need help?

Kupuna	Youth	Adults
• Hana Trust • Family • Hana Medical Center	• Friends • Family • Ho'oponopono • Principal • Kupuna	• Parents/family • Uncle Milton • Welfare • Friends • Banks/stores

Geographic Sense of Place
What places do you consider "your place?"

Kupuna	Youth	Adults
• Ocean and coast • Hana Bay • Wainapanapa • Mountains	• Youth center • Phone booth • Friends' house • Hana Bay	• Hana Bay • Hana Ranch • Ballpark • Community Center • Farm • All of Hana • Shoreline and beach • Waikaloa • Friends' house

Leadership
Whom do you look up to? Whose opinion/advice do you respect?

Kupuna	Youth	Adult
• Family • Neice's husband • Billy Robak • Liebert Langraff • Bill Fuhrman • Pastor • Sister Relief Society	• Friends • Family • Governor • Auntie Terry Poaipuni • Auntie Paka • Joe Fournier • Dick Waring • Harry Hasegawa	• Parents • Relatives • Close friends • Kupuna • Senator Solomon • Police • Dr. Taube • Billy Robeck • Retired Hana people

Recreation
What do you do for recreation?

Kupuna	Youth	Adult
• Drink beer - ballpark - home - Hana Bay - Hamoa • Softball/mountainball tournaments • Read • Sew • Watch t.v. • Fishing - Ulaino - Hana Bay - Kaupo - Kipahulu - Makaalei - Waikaloa	• Volleyball • Fishing • Visit phone booths • In the summer, go to Honolulu, Waikiki and Hilo, for family, jobs and shopping	• Play or watch: - baseball - volleyball - basketball • Play cards • Aerobics • Tennis • Fishing • Hunting • Rodeo • Drinking

Use of Site
Do you use the project site? If so, for what?

Kupuna	Youth	Adult
We did not have time to ask the kupuna this question.	• Jogging trail • Run, walk, bike on site • Horseback riding • Hunting • Gather plants such as bamboo shoots	• Hunt pigs, pheasants • Gather plants such as bamboo shoots

APPENDIX M

TRAFFIC IMPACT ASSESSMENT REPORT FOR HANA RANCH COUNTRY CLUB

Prepared by Pacific Planning and Engineering, Inc., July 1992

TRAFFIC IMPACT ASSESSMENT REPORT

FOR

HANA RANCH COUNTRY CLUB

July 7, 1992

Hana, Maui, Hawaii

TMK: 1-4-07: 4 & 6; 1-4-02: 4, 8 & 9; and 1-4-03: 9

Prepared for:

Keola Hana Maui, Inc.

Prepared By:

Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

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EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to identify and assess future traffic impacts caused by the proposed Hana Ranch Country Club on the island of Maui. This report identifies and evaluates the traffic impacts generated by the proposed project in the year 1995 when the project is expected to be completed.

Project Description

Keola Hana Maui, Inc. is planning to develop the Hana Ranch Country Club in the Hana district on the island of Maui. The proposed project area will consist of approximately 201 acres of ranch land located mauka (west) of Hana Highway.

The proposed development consists of an 18-hole championship golf course, a driving range, clubhouse, and maintenance facility. The clubhouse will include a pro-shop, locker facilities, snack shop, office, and restaurant capable of supporting banquet functions. A total of 150 parking stalls will be provided near the clubhouse. Access to the project site will be from a privately-owned project access road leading from the intersection of Hana Highway with Haneoo Road to the clubhouse and parking lot. The completion date for the project is early 1995.

About 36 people will be employed by the project for grounds maintenance, snack-shop and restaurant operations, pro shop activities and administration. The hours of operation for the golf course and driving range will be from 7:00 am - 6:00 pm during the summer, and from 8:00 am - 6:00 pm during the winter. The clubhouse restaurant's hours of operation will be from 11:00 am - 9:00 pm. Employee work hours will be staggered based upon 8-hour shifts.

The Hana Ranch Country Club project will be a privately owned golf course that is open to the public. Users of the golf course are expected to be primarily guests of the Hotel Hana-Maui Resort (90%). The remaining users would consist of non-resort visitors to Maui (5%) and residents (5%). Golfers from the Hotel Hana-Maui are anticipated to be shuttled to/from the golf course project while the remaining users will travel using private cars.

Conclusion and Recommendations

The proposed Hana Ranch Country Club project will have minimal impact on traffic flow at the intersection of Hana Highway with Haneoo Road/Project Access Road when the project is completed by 1995.

Without the project in 1995, drivers attempting turning movements at the study intersection will experience little or no traffic delays (LOS A) during the afternoon peak hour.

With the project in 1995, drivers attempting turning movements at the study intersection will continue to experience little or no traffic delays (LOS A). The predominant users of the golf course project will be guests from the

Hotel Hana Maui. The use of hotel shuttle vans transporting users between the golf course and hotel should help decrease the number of trips generated by the project and further minimize the impact on traffic flow at the study intersection.

It is recommended that the intersection of Hana Highway with Haneoo Road/Project Access Road be improved to Maui County standards. This improvement will provide for safer operating conditions and smoother traffic flow. Minimum improvements recommended at the intersection of Hana Highway and Haneoo Road/Project Access Road are:

1. Provide adequate turning radius to accommodate school buses and vans.
2. Widen Haneoo Road to provide for a minimum two-lane, two-way roadway at the vicinity of the intersection.
3. Provide adequate sight distances in both directions along Hana Highway at the study intersection.

PROJECT DESCRIPTION

Keola Hana Maui, Inc. (Keola) is planning to develop the Hana Ranch Country Club in the Hana district on the island of Maui. The proposed project area will consist of approximately 201 acres of ranch land located mauka (West) of Hana Highway, and identified by Tax Map Keys: 1-4-07: 4, and 6; 1-4-02: 4, 8, and 9; and 1-4-03: 9. Figure 1 shows the general project location and the roadway network in the project's vicinity.

The proposed development consists of an 18-hole championship golf course, a driving range, clubhouse, and maintenance facility. The clubhouse will include a pro-shop, locker facilities, snack shop, office, and restaurant capable of supporting banquet functions. A total of 150 parking stalls will be provided near the clubhouse. Access to the project site will be from a privately-owned project access road leading to the clubhouse and parking lot from the intersection of Hana Highway with Haneoo Road. Figure 2 shows the site plan for the proposed golf course. The project will be completed and operational by 1995.

About 36 people will be employed by the project for grounds maintenance, snack-shop and restaurant operations, pro shop activities and administration. The hours of operation for the golf course and driving range will be from 7:00 am - 6:00 pm during the summer, and from 8:00 am - 6:00 pm during the winter. The clubhouse restaurant's hours of operation will be from 11:00 am - 9:00 pm. Employee work hours will be staggered based upon 8-hour shifts.

The Hana Ranch Country Club project will be a privately owned golf course which is open to the public. Users of the golf course are expected to be primarily guests from the Hotel Hana-Maui Resort (90%). The remaining users would be composed of non-resort visitors to Maui (5%) and residents (5%). The majority of golfers from the Hotel Hana-Maui Resort are anticipated to be shuttled to/from the golf course project while the remaining users will travel using private cars.

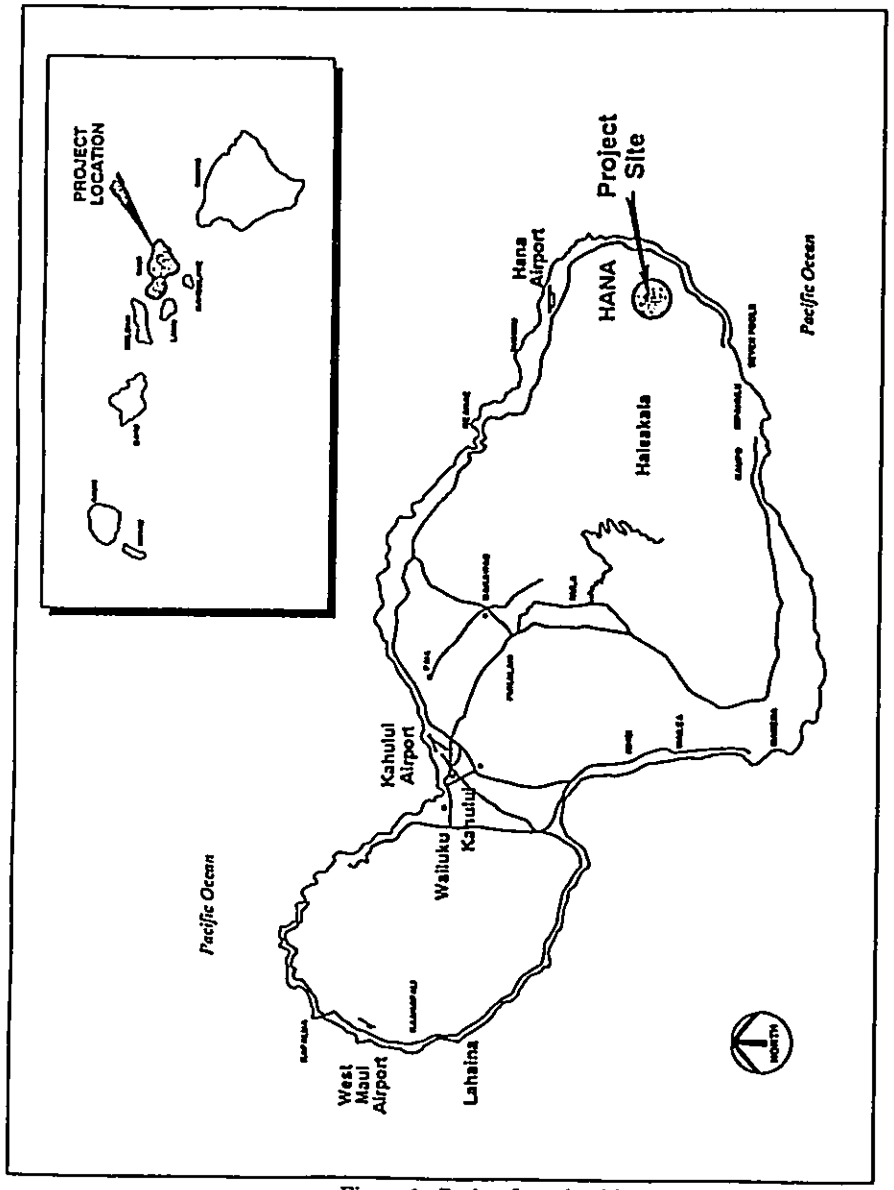

Figure 1. Project Location Map

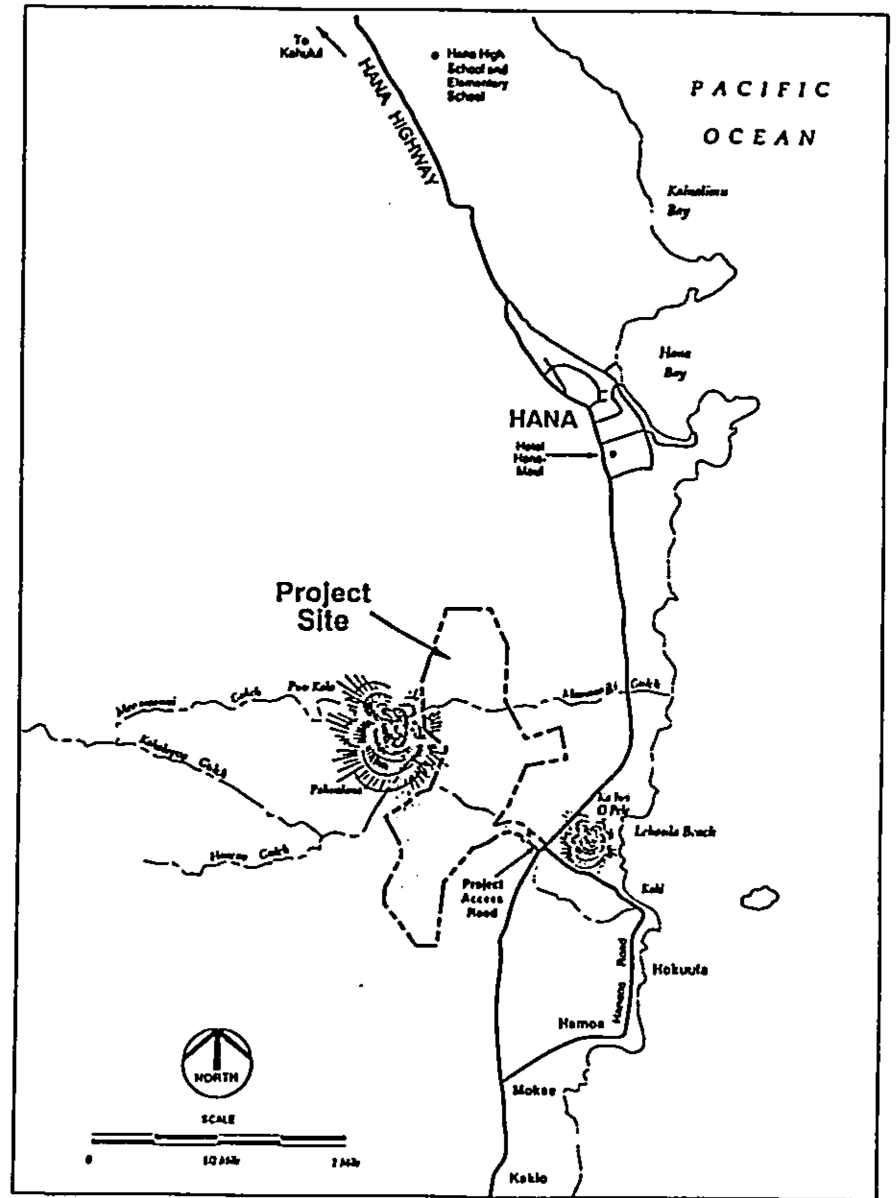

Figure 2. Project Site Map

EXISTING CONDITIONS

A survey of existing conditions was conducted to ascertain the current traffic conditions in the area, and to provide a basis for forecasting the probable traffic impact from the proposed project. This survey included the review of land uses in the area, roadway facilities, and existing traffic conditions.

Land Uses

The project site is located mauka (west) of Hana Highway and the privately owned Leho'ula Beach near the small rural community of Hoku'ula. The proposed Hana Ranch Country Club is planned to be developed on existing Keola ranch land currently undeveloped and designated for agricultural use by the Hana Community Plan.

Land uses in the general vicinity of the project site are consistent with the rural nature and characteristics associated with Hana. The land area located around the project site is undeveloped ranch land comprised predominantly of trees, grassland, and brush. Developed land uses in the area are a few homes located along Haneoo Road near the shoreline.

Roadway Facilities

Hana Highway, which is a State maintained highway, is the only roadway providing vehicular access to the district of Hana and project site. From Hana Harbor, Hana Highway is maintained by Maui County, and generally runs along the scenic coastline ending in the rural community of Kipahulu located further south of Hana.

In the Hana district, Hana Highway is a winding road that includes many bridges, some of which are wide enough for only one vehicle to proceed at a time. Hana Highway between Hana High and Elementary School and the Hana Ranch Town Center, has recently been resurfaced.

At its intersection with Haneoo Road near the project site, Hana Highway has 10-foot wide lanes in each direction along with grassed shoulders ranging from 4 to 10 feet wide on both sides. The posted speed limit along Hana Highway varies between 15 and 35 mph in the Hana district. At its intersection with Haneoo Road near the project site, the posted speed limit is 35 mph.

Haneoo Road is a County maintained roadway that forms a stop-controlled unsignalized T-intersection with Hana Highway near the proposed project site. As shown in the Project Site Plan, Haneoo Road travels in a U-shaped pattern from Hana Highway makai (east) to the coastline and back, forming two unsignalized intersections. This road is primarily used by residents living in the district and along the coastline. The road has a total pavement width of 12 feet with 6 foot grassed shoulders on both sides.

Traffic Conditions

Twenty-four hour traffic counts taken in the Hana district in 1989 were obtained from the State Department of Transportation (DOT) Highways Division. Based on the data, the peak traffic period generally occurs between 1:00 to 3:00 pm in the afternoon. The data collected also indicated that the afternoon traffic volumes were significantly higher than the morning volumes, therefore, manual traffic counts were taken during the afternoon peak period because highway traffic and project traffic would be the highest during this weekday time period.

Manual counts were taken at the intersection of Hana Highway with Haneoo Road near the proposed project site on Wednesday, August 1, 1990, between 12:30 pm to 3:15 pm. Counts were taken of passenger cars, trucks and buses by turning movements and approaches. Based upon the traffic counts collected, it was determined that the afternoon peak hour occurred from 2:00 pm to 3:00 pm. Figure 3 shows the afternoon peak hour traffic volumes obtained at the study intersection. During the field counts, the weather was partly cloudy, and the roadway pavement was dry. The traffic count data collected during the field survey are summarized in Appendix B.

Observed Traffic Conditions

The following observations were noted at the intersection of Hana Highway with Haneoo Road during the field survey:

1. A few tour vans were observed travelling along Haneoo Road.
2. Motorists travelling along Hana Highway by the study intersection were observed slowing down to decide if they should turn onto Haneoo Road.
3. The average travelling speed of vehicles observed along Hana Highway at the study intersection was estimated between 25 to 30 mph.

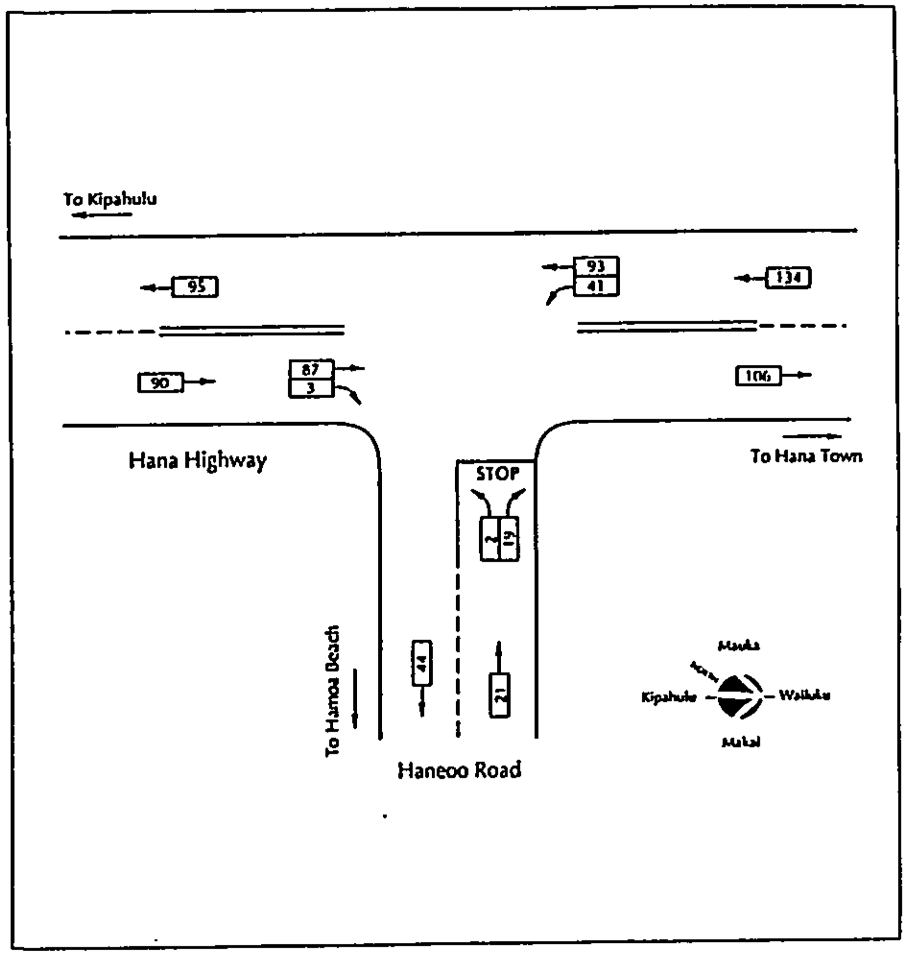

Figure 3. 1990 Existing Afternoon Traffic

FUTURE CONDITIONS

Research of approved planned developments and improvements to transportation facilities was conducted to estimate future traffic conditions at the study intersection.

Future Land Uses

Traffic generated by the following proposed developments in Hana are expected to generate traffic at the study intersection of Hana Highway with Haneoo Road by the year 1995:

- Hana Village Marketplace
- Hana Ranch Town Center
- Hana Public Housing Project

Hana Village Marketplace

Hina-malailena, a non-profit Hana community development corporation, is proposing to build the Hana Village Marketplace on 1.12 acres of land located adjacent to the Wananalua Congregational Church in Hana Town[1]. This development is planned to be a 10,900 square foot commercial complex consisting of kiosk-type structures having sizes of 144 square feet, 256 square feet, or 400 square feet. These kiosks will be either separate or combined structures accommodating restaurants, clothing and craft shops. Native Hawaiians and residents of Hana would have priority for the commercial space.

[1] Hana Village Marketplace Business Plan, prepared by Hina-malailena, revised September 1991.

Hana Ranch Town Center

Keola Hana Maui, Inc. is currently preparing a master plan to renovate and expand the existing Hana Ranch Town Center. This development will consist of expanding existing commercial facilities, such as the Hana Store, and constructing additional commercial and retail space to serve residents and visitors to Hana. In addition support facilities for Hotel Hana-Maui operations will also be constructed. Using available information, the following facilities and increased retail space should be completed and operational by 1995:

• Hana Restaurant expansion	2,700	square feet
• Hana Store expansion	6,200	square feet
• Hotel Hana-Maui Laundry Building	5,000	square feet

Hana Public Housing Project

The Hawaii Housing Authority is proposing to develop the Hana Public Housing project on approximately 13.5 acres of land located adjacent to Hana Highway near Hana Airport. This project proposes to provide low income public housing by constructing 50 units comprised of a mix of one, two and three bedroom units in a multi-family configuration.

Future Roadway Improvements

Based upon discussion with County public works staff, there are plans to resurface Hana Highway and Uakea Road from the recently completed section near the Hana Town Center to the Seven Pools area. This work has commenced and will be constructed in phases with completion anticipated later this year.

PROJECTED TRAFFIC CONDITIONS

Future traffic was forecasted to determine traffic conditions without and with the Hana Ranch Golf Course project. Traffic forecasts were estimated for the year 1995 when the project is expected to be completed.

Future Traffic Without Project

Future traffic without the project was forecasted by increasing the existing through-traffic volumes along Hana Highway by the projected growth rate, and by adding additional traffic generated by future developments previously described. Figure 4 shows the forecasted traffic without the project in year 1995.

<u>Growth in Through-Traffic Along Hana Highway</u>

Through-traffic is the term to describe vehicular traffic without an origin or destination point near the project site, such as visitors travelling through Hana Town to get to Kipahulu.

Because Hana Highway is the only roadway providing vehicular access to/from the Hana district and between communities, the growth in through-traffic was forecasted based upon the historical growth trend of vehicular traffic along Hana Highway. Due to the location and characteristics associated with Hana, the growth in through traffic will primarily reflect increases in tourist related vehicles. The growth in through traffic was estimated using a linear regression analysis based upon historical data obtained from DOT count station 33-D (Hana Highway

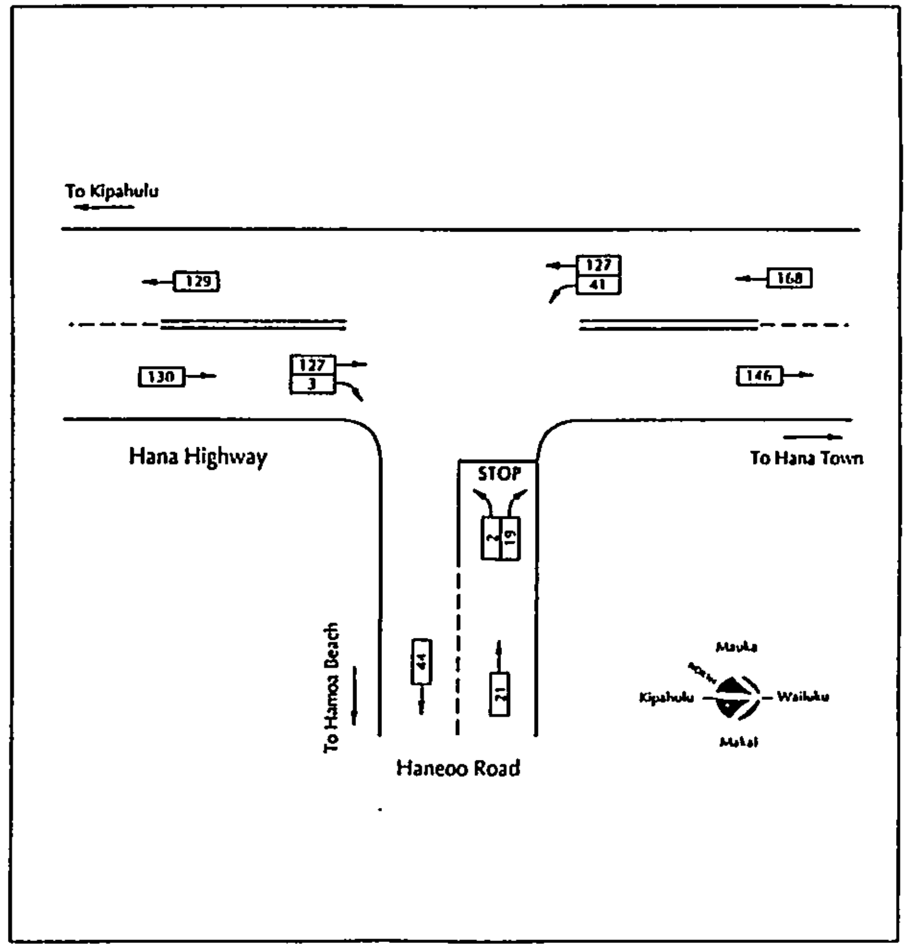

Figure 4. 1995 Afternoon Traffic Without Project

The results of the growth trend analysis based upon DOT data collected over the past 13 years indicates an annual growth rate of approximately 3.5% a year along Hana Highway, and is graphically shown on Figure 5. Based upon the results of the growth trend analysis, the existing afternoon peak hour through traffic volumes on Hana Highway were increased by 18% (3.5% for 5 years).

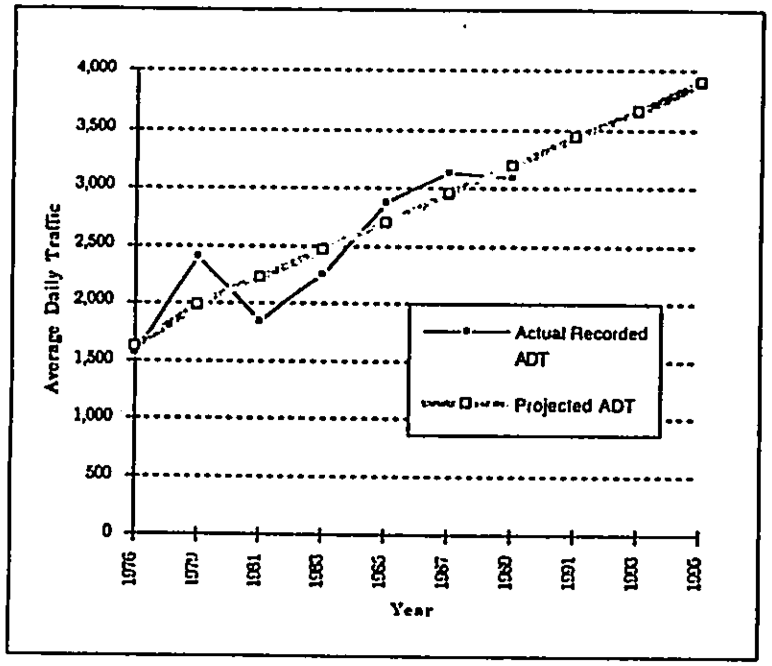

Figure 5. Growth Trend on Hana Highway

Traffic Generated by Other Developments

A three-step procedure of trip generation, trip distribution, and traffic assignment was used to forecast future weekday afternoon peak hour traffic generated by the previously described developments. The trip generation step estimates the number of vehicle trips that would be generated based upon the development's land use using data from the Institute of Transportation Engineers (ITE) Trip Generation Report (5th Edition, 1991). Table 1 shows the resulting trip generation for the future developments.

Table 1. Trip Generation for Future Developments

Land Use	Amount	Units	Afternoon Peak Hour Enter	Afternoon Peak Hour Exit
Hana Village Marketplace	10,900	sq. ft. GLA	28	21
Hana Town Center				
Hana Restaurant expansion	2,700	sq. ft. GLA	29	25
Hana Market expansion	6,200	sq. ft. GLA	44	39
Hotel Laundry Building	5,000	sq. ft.	5	5
Hana Public Housing	50	units	38	21

A large percentage of vehicular trips generated by the Hana Village Marketplace, Hana Restaurant, and Hana Market commercial developments will consist of passby trips. Passby trips are vehicle trips to land use destination which are a secondary part of one's primary destination. An example of this is residents stopping by a shopping center on their way home from work, or tourists stopping at a fast food restaurant on their way to other attractions.

It was estimated that approximately 70% of the trips generated by the Hana Village Marketplace will consist of passby trips based upon the ITE Trip Generation Report and project's Business Plan. These vehicular trips do not increase Hana Highway traffic because they reflect vehicle trips already on the highway which are predominantly tourist related traffic. However, turning volumes would be increased due to vehicles entering and exiting the Hana Village Marketplace. The remaining 30% are considered primary trips and were added to the roadway because they would consist of new vehicle trips primarily generated by residents to/from the development.

Similarly, this methodology of distinguishing between passby and primary trips was also applied to the estimated trips generated by the expansion of the Hana Restaurant and Hana Store. It was estimated that 50% of the trips generated by these developments will consist of passby trips with the remaining 50% considered primary trips representative of increased trips by residents.

The trip distribution step assigns vehicle trips from their predicted origins to destinations. The distribution of primary trips generated by future developments were determined by estimating existing resident populations in Hana because they should represent vehicle trips generated by Hana residents. Available information presented in tax maps were used to identify residential areas. The intent of the Hotel Laundry Building is intended to service the operations of the Hotel Hana-Maui. As a result, trips generated by it were determined to occur within the Hotel and Hana Ranch Town Center area and were distributed accordingly. Table 2 shows the directional distribution percentages for future developments.

Table 2. Trip Distribution for Future Developments

Land Use Trips	Entering From Wailuku	Entering From Kipahulu	Exiting To Wailuku	Exiting To Kipahulu
Hana Village Marketplace	70%	30%	70%	30%
Hana Town Center				
Hana Restaurant expansion	70%	30%	70%	30%
Hana Market expansion	70%	30%	70%	30%
Hotel Laundry Building	100%	0%	100%	0%
Hana Public Housing	70%	30%	70%	30%

The traffic assignment step assigns vehicle trips to specific routes on the roadway network that will take the driver from origins to destinations. Traffic was assigned based upon the shortest route or travel time between origins and destinations. Because proposed future developments will generally be located along Hana Highway, all vehicle trips generated were assigned to Hana Highway.

Future Traffic With Project

Future traffic with the project was forecasted by adding traffic generated by the Hana Ranch Country Club project to the forecasted traffic without the project. The resulting afternoon peak hour forecast traffic volumes with the project in 1995 are shown by turning movements in Figure 6.

The three-step methodology of trip generation, trip distribution, and traffic assignment was again used to forecast future afternoon peak hour traffic generated by the proposed project.

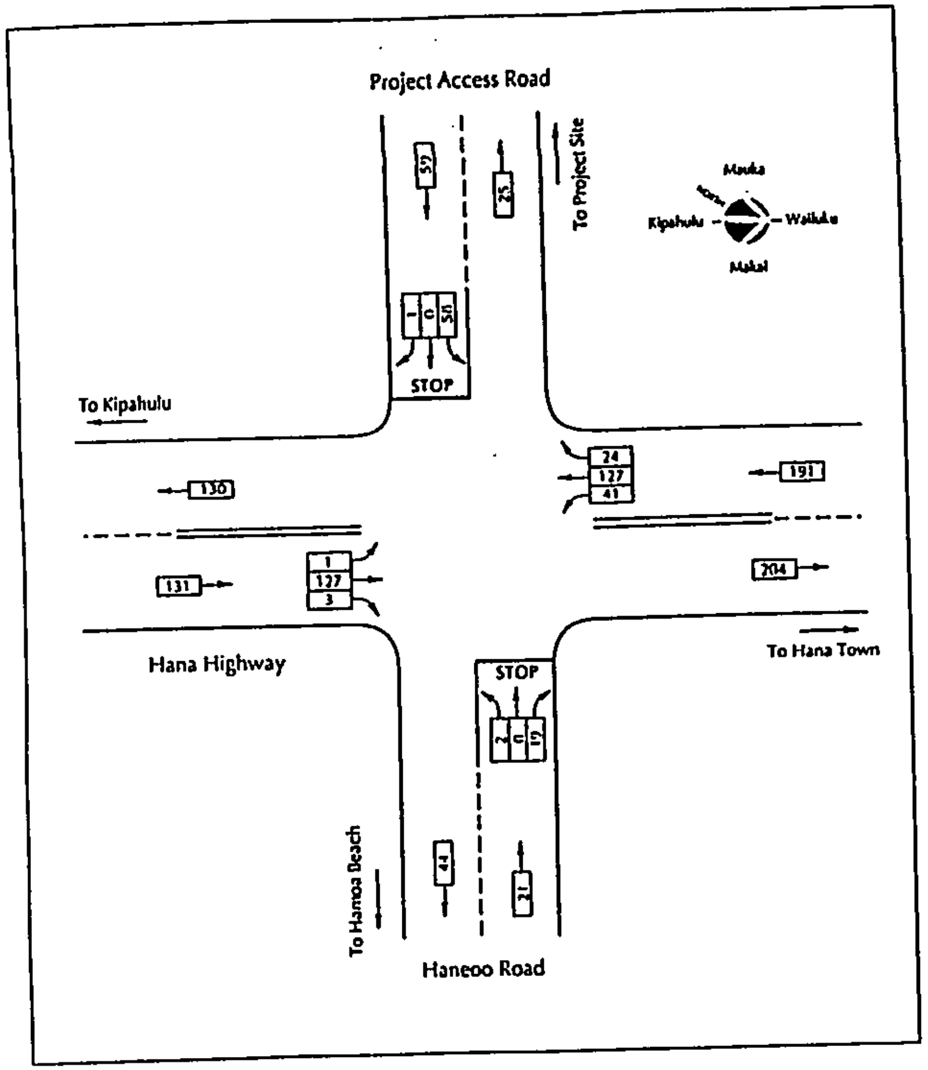

Figure 6. 1995 Afternoon Traffic With Project

The number of vehicle trips generated by the 18-hole championship golf course project was estimated using data from the ITE Trip Generation Report. Table 3 shows the resulting trip generation for the Hotel Hana Maui Golf Course project.

Table 3. Trip Generation for Hana Ranch Country Club Project

Land Use	Amount	Units	Afternoon Peak Hour Enter	Afternoon Peak Hour Exit
Hana Ranch Country Club	36	employees	25	59

It is anticipated that the trips generated by the project should be less than that estimated using the Trip Generation Report. This is due to the expected use of hotel shuttle vans transporting hotel guests between the hotel and golf course. An Economic Impact Study for the Hana Ranch Country Club by Pannell Kerr Forester estimates that 90% of the golf course users will be guests from the Hotel Hana-Maui. The remaining users will consist of residents (5%) and off-resort non-residents (5%). Based upon discussions with Keola Hana Maui, Inc., approximately 50% of their hotel guests fly into Hana. Therefore, assuming that each shuttle trip to/from the golf course may result in a reduction of two vehicular trips, the adjusted number of trips generated by the project could be reduced by a total of about 15 to 20 trips.

The trip distribution for the project traffic was based upon predicted origins and destinations considering estimates of population and existing travel patterns using the manual traffic count data. Using the results from the Economic Impact Study, trips generated by the project were categorized as hotel guest, non-hotel non-resident, and resident trips. These trips were then distributed to their expected destinations for each category. The resulting distribution patterns for the project generated traffic is shown below in Table 4.

Table 4. Trip Distribution for Project Traffic

	Afternoon Peak Hour			
	Entering		Exiting	
Project Traffic Type	From Wailuku	From Kipahulu	To Wailuku	To Kipahulu
Hotel Hana-Maui Guest	100%	0%	100%	0%
Non-Hotel Non-Resident	100%	0%	100%	0%
Residents	70%	30%	70%	30%

Trips generated by the project were generally assigned to Hana Highway based upon the shortest route or travel time between origins and destinations.

TRAFFIC IMPACTS

The intersection of Hana Highway with Haneoo Road was analyzed to determine the relative impact of the Hana Ranch Country Club project on the roadway system. The analysis was performed for existing conditions, and 1995 forecasted conditions without and with the project.

Analysis Methods

Impacts on traffic resulting from the proposed Hana Ranch Country Club were measured by the change in Level-of-Service (LOS) using the methodology for analyzing unsignalized intersections from the Highway Capacity Manual (Special Report 209, 1986). The LOS for unsignalized intersections are classified into six categories ranging from little or no delay (LOS A) to extremely long traffic delays (LOS F). Appendix A provides a descriptive summary for each LOS category.

This analysis method is based on the estimated number of vehicle turning movements which could proceed through a conflicting traffic stream. The LOS is determined by the amount of vehicle reserve capacity available for a particular turning movement. A lower amount of reserve capacity indicates a poorer level of service.

Analysis Results

The analysis was performed using the existing and forecasted weekday afternoon peak hour volumes. The results of the unsignalized intersection analysis are shown below in Table 5.

Table 5. Unsignalized Intersection Analysis Results
Afternoon Peak Hour

Turning Movement		1990 Existing	1995 Without Project	1995 With Project
Hana Highway				
Northbound (to Wailuku)	LT	n/a	n/a	A
Southbound (to Kipahulu)	LT	A	A	A
Haneoo Road				
Westbound (mauka)	LT	A	A	A
	TH	n/a	n/a	A
	RT	A	A	A
Project Access Road				
Eastbound (makai)	LT	n/a	n/a	A
	TH	n/a	n/a	A
	RT	n/a	n/a	A

n/a - Not Applicable

Presently, drivers attempting left-turns from Hana Highway into Haneoo Road experience little or no traffic delays (LOS A) during the afternoon peak hour. Drivers attempting turning movements from Haneoo Road onto Hana Highway also experience little or no traffic delays (LOS A).

Without the project in 1995, drivers attempting left-turns from Hana Highway into Haneoo Road will continue to experience little or no traffic delays (LOS A) during the afternoon peak hour. Drivers attempting turning movements from Haneoo Road onto Hana Highway will also experience little or no traffic delays (LOS A).

With the project in 1995, drivers attempting left-turns from Hana Highway into Haneoo Road or the new Project Access Road will continue to experience little or no traffic delays (LOS A) during the afternoon peak hour. Drivers attempting turning movements from both Haneoo Road and the Project Access Road onto Hana Highway will experience little or no traffic delays (LOS A).

CONCLUSION AND RECOMMENDATIONS

The proposed Hana Ranch Country Club project will have minimal impact on traffic flow at the intersection of Hana Highway with Haneoo Road/Project Access Road when the project is completed by 1995.

Without the project in 1995, drivers attempting turning movements at the study intersection will experience little or no traffic delays (LOS A) during the afternoon peak hour.

With the project in 1995, drivers attempting turning movements at the study intersection will continue to experience little or no traffic delays (LOS A). The predominant users of the golf course project will be guests from the Hotel Hana Maui. The use of hotel shuttle vans transporting users between the golf course and hotel should help decrease the number of trips generated by the project and further minimize the impact on traffic flow at the study intersection.

It is recommended that the intersection of Hana Highway with Haneoo Road/Project Access Road be improved to Maui County standards. This improvement will provide for safer operating conditions and smoother traffic flow. Minimum improvements recommended at the intersection of Hana Highway and Haneoo Road/Project Access Road are:

1. Provide adequate turning radius to accommodate school buses and vans.
2. Widen Haneoo Road to provide for a minimum two-lane, two-way roadway at the vicinity of the intersection.
3. Provide adequate sight distances in both directions along Hana Highway at the study intersection.

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE FOR UNSIGNALIZED INTERSECTIONS

DEFINITION OF LEVEL-OF-SERVICE FOR UNSIGNALIZED INTERSECTIONS

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Location: Hana Highway with Haneoo Road

Date: Wednesday, August 1, 1990

	Hana Highway Northbound To Wailuku		Hana Highway Southbound To Kipahulu		Haneoo Road Westbound Mauka		
Time Period	TH	RT	LT	TH	LT	RT	Total
12:30 - 12:45	8	2	4	22	5	1	42
12:45 - 1:00	9	4	1	24	4	2	44
1:00 - 1:15	8	1	1	28	3	0	41
1:15 - 1:30	8	2	2	12	3	3	30
1:30 - 1:45	6	2	0	26	4	1	39
1:45 - 2:00	10	4	1	19	11	4	49
2:00 - 2;15	16	3	1	15	4	1	48
2:15 - 2:30	9	1	0	28	7	3	48
2:30 - 2:45	16	1	0	29	3	5	54
2:45 - 3:00	28	2	0	23	2	3	58
3;00 - 3:15	17	0	0	15	4	1	37
PM Peak Hour 2:00 - 3:00							
Total	69	7	1	95	16	12	200

APPENDIX N

GEOTECHNICAL CONSULTATION SERVICES
PROPOSED HANA RANCH COUNTRY CLUB

Prepared by Pacific Geotechnical Engineers, Inc.

GEOTECHNICAL CONSULTATION SERVICES
PROPOSED HANA RANCH COUNTRY CLUB
WANANALUA, HANA, MAUI, HAWAII

FOR THE KEOLA HANA MAUI, INC.

PGE, INC. JOB NO. 9195-001

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GEOTECHNICAL CONSULTATION SERVICES
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WANANALUA, HANA, MAUI, HAWAII

FOR THE KEOLA HANA MAUI, INC.

1.0 INTRODUCTION

This report presents the results of the geotechnical consultation services that we performed for the proposed Hana Ranch Country Club to be located at Wananalua, Hana, Maui, Hawaii. The approximate location of the site is shown on the Vicinity Map, Plate 1 and the Map of Area, Plate 2.

2.0 PROJECT CONSIDERATIONS

The site is located on the west side of Hana Highway, approximately between Elevations 200 to 600 feet. All elevations in this report are referenced to Mean Sea level datum. An 18-hole golf course with parking and clubhouse facilities will be developed over an area of approximately 201 acres. The golf course will include greens, tees, fairways, roughs, and ponds. The ponds will provide storage for on-site runoff and irrigation water supply as necessary.

We understand that your subconsultant, Environmental and Turf Services, Inc. (ETS), will be performing a contaminant transport modelling study of the site. We understand that input data on subsurface soil conditions and hydraulic conductivity properties are needed for their model.

The proposed project features are shown on the Plot Plan, Plate 3, in the insert to this report.

3.0 PURPOSE AND SCOPE OF WORK

The purpose of this study was to obtain data regarding the approximate thickness of the overburden soils and hydraulic conductivity of the subsurface soils and rocks to allow ETS to select appropriate input parameters for their computer model.

To accomplish this purpose, we performed the following scope of services:

1. Review of Available Data - We reviewed information in our files from past nearby projects, available data from reports performed by others, and other available information on general geology and subsurface conditions in the area.

2. Field Exploration - Subsurface conditions were explored by drilling three soil test borings to depths ranging from 9.5 to 50 feet below the existing ground surface. During the drilling, disturbed and relatively undisturbed soil samples and rock cores were recovered. Logs of the borings, along with a more detailed description of the subsurface exploration are presented in Appendix A.

We performed field permeability tests in each boring, consisting of falling head tests in the surface soils and packer tests at 2 to 9-foot intervals in the underlying lava formation to obtain data on the hydraulic conductivity of the subsurface soil and rock formation. The test results are presented in section 6.0 of this report. A detailed description of the test procedures are presented in Appendix A.

At the completion of the drilling, we installed a perforated PVC casing in each of the borings to check for possible perched ground water. Where appropriate, the screens were installed directly above potentially less permeable zones, such as hard, intact basalt rock layers. We periodically checked for the possible presence of ground water in the installed PVC casings during our field work.

3. Geophysical Survey - We also performed a near surface geophysical exploration program consisting of a seismic refraction survey to provide data on general depths to bedrock and the approximate thicknesses of the overburden soils. The test results are presented in section 5.0 of this report. A detailed description of the test procedures and the test results are presented in Appendix B.

4. Laboratory Testing - At the completion of the subsurface exploration, the soil samples and rock cores were returned to our laboratory in Honolulu for testing. We performed only limited laboratory testing consisting of moisture content and dry density determinations on selected soil samples. The laboratory test results and a more detailed discussion of the laboratory test program are presented in Appendix A.

5. Engineering Analysis and Report - Based on the results of our data review and the field exploration and geophysical survey, we performed engineering analysis and developed recommendations and conclusions regarding:

   a. A description of the general subsurface conditions within the study area;
   b. Preliminary estimates of overburden soil thicknesses, including estimates of the depth to bedrock based on the geophysical survey; and
   c. Estimates of the hydraulic conductivities of the near surface soils and the lava formations based on the field permeability test results.

The results of our geotechnical consultation have been summarized in this report, complete with field and laboratory test data.

4.0 SITE CONDITIONS

4.1 GEOLOGY OF THE AREA

The project area lies along the East Rift Zone of the Haleakala volcano. Rift zones generally extend outward from a volcano summit. They are structurally weak zones comprised of roughly parallel fissures from which magma discharges. In the shield building stage of a volcano, rift zones are marked by open cracks, collapse craters, and spatter cones. In the later stages, rift zones are dominated by cinder cones and spatter.

The geology of the project area is characterized by lava flows and associated cinder cones and ash deposits of the Hana Volcanic Series. The Hana Series is a product of Hawaiian Island volcanism in its later stages of activity and represents one of the last major occurrences of volcanism on Maui.

Three large cinder cones, Ka Iwi O Pele on the east, and Puu Kolo and Pahuolona on the west, border the project area. Volcanic ash and cinder, which have weathered into a dark brown silty soil, blankets the lava flow bedrock. The lava bedrock is primarily the a'a type characterized by a very rough, rubbly surface overlying a relatively massive basaltic core. The lava flows are well-exposed in parts of the gulches that cut across the project area.

4.2 SURFACE CONDITIONS

The project site is located on the eastern slope of Haleakala volcano. Ground surface elevation ranges from approximately +170 feet in the east to +550 feet in the southwest.

The site is situated between three relatively large cinder cones and has an undulating topography characteristic of areas dominated by a'a lava flows. The slope is 3 to 15 percent towards the east. Moomoonui and Kaholopoo Gulches and associated gullies generally cross the site from the west to east. During our field work, we did not observe any flowing water in the gulches. We did, however, observe some standing water in the gulches during our field work.

The site is presently used for pasture. Electric fences separate pasture areas. Access through the site is provided by jeep trails. Vegetation generally consists of various types of grass, Christmas berry, guava, kaimi clover, koa, and hedges. Areas with relatively thicker tree cover, such as parts of the southern half of the site, are generally rocky with very little soil cover. Many boulders were observed on the surface throughout the site.

4.3 SUBSURFACE CONDITIONS

The surface soil cover, consisting of a fine sandy clayey silt, ranged from 4 to 5 feet in thickness in the three soil test borings drilled for this study. The United States Department of Agriculture Soil Conservation Service has mapped this soil as the Hana Series silty clay loam having slow to moderate runoff and slight to moderate erosion hazard.

In some areas, such as in the southern half of the site, we observed that the soil contains abundant basaltic gravel, cobbles, and boulders on the surface. We believe that in these areas, the volcanic ash deposits were thinly deposited over the rubbly surface of the underlying a'a lava flows.

A thin layer of silty sand was encountered in Boring 2 below the surface clayey silts at a depth of 4 to 6 feet. Similarly in Boring 3, a thin layer of silty basaltic gravel was found below the silts at a depth of 5 to 6 feet.

Basaltic bedrock was encountered below the silty sand and gravel layers in Borings 2 and 3 at a depth of approximately 6 feet, and in Boring 1, about 4 feet beneath the clayey silt mantle. The basaltic rock formation was encountered to the maximum depth explored in Boring 2, at 50 feet. The basalt ranged from moderately to highly weathered and from slightly to highly fractured. Zones of clinker gravel up to three feet in thickness were found within the basalt formation.

At the completion of each boring, a slotted 1-inch diameter PVC pipe was installed near the bottom of each boring to check for the possible presence of perched groundwater. No groundwater was observed in all three borings during our field work.

Based on water levels observed in water supply well drilled between Kaeleku and Waiohonu, two miles south of the project, basal water levels are anticipated to occur at several feet above sea level (Water Resources Associates' Report, March 1992). These levels would correspond to depths of about 165 to 545 feet below the existing ground surface at the project site.

5.0 GEOPHYSICAL EXPLORATION RESULTS

Surface geophysics, consisting of a seismic refraction survey, was performed at the site to provide data on general depths to bedrock and approximate thickness of the overburden soils. A mechanical energy source consisting of sledge hammer impacts on an aluminum plate placed on the ground surface was used to produce seismic shock waves. Geophones were placed along a line on the ground surface extending from the energy source to record the shock waves.

Sixteen (16) transect lines, each approximately 110 feet in length, were performed at the site. Two additional transect lines, T-10B and T-12B, were performed to supplement and better interpret the initial sets of data in this area. A summary of the seismic refraction survey along with the depth ranges and calculated seismic velocities at each station are presented on Table 1. A more detailed description of the test procedure, results, and arrival time versus distance plots for each transect are presented in Appendix B.

In general, the seismic refraction survey results are consistent with the subsurface conditions encountered in the three exploratory borings. The seismic refraction survey data indicate that the studied locations are generally covered by a thin mantle of residual soil approximately 1.5 to 8.5 feet in thickness. Based on the characteristics of the arrival time versus distance plots, the exploratory borings, and the general geology of the area, the underlying higher velocity refractors appear to include clinker layers and variously weathered basaltic lava flows. The extent of these geologic deposits appeared to vary in both vertical and horizontal directions, and generally within short distances.

Based on the boring information and geophysical results, we believe that measured seismic wave velocities of less than approximately 1,300 feet per second (fps) are indicative of soil type material. As shown on Table 1, the estimated thicknesses of surface soils generally range from 1.5 to 8.5 feet, except at T-6, where seismic velocities ranged from 460 to 1,370 fps. At T-6, the soil cover appears to be on the order of 25 to 35 feet in thickness. This transect line was located on the lower flanks of an existing cinder cone.

Measured seismic velocities ranging from approximately 1,300 to 3,100 fps appear to indicate moderately to highly weathered basaltic rock and clinker gravel. Velocities in this range were measured at depths of on the order of 8 to 28 feet at transect lines T-1, T-2, T-5, T-7, T-8, T-9, T-11, T-12A, T-12B, T-15, and T-16.

We believe that velocities greater than 3,100 fps at this site probably indicate relatively less weathered and less fractured rock layers. Velocities greater than 3,100 fps were measured at most transect locations at depths of about 2.5 to 35 feet.

6.0 PERMEABILITY TEST RESULTS

Three (3) falling head tests and ten (10) packer permeability tests were performed to obtain data on the permeability characteristic of the surface soils and underlying lava formation. A summary of the tests is presented on Table 2. A more detailed description of the test procedure is presented in Appendix A.

Calculated permeabilities from the falling head tests performed in the borings on the surface clayey silt soils ranged from 3×10^{3} to 7×10^{3} centimeters per second (cm/sec). These values were estimated using conventional falling head equations for saturated soil conditions. Calculated permeabilities from the packer tests performed in Boring 2 in the lava formation ranged from 8×10^{-4} cm/sec at a depth of 48 to 50 feet to as high as 4×10^{3} cm/sec at a depth of 8.7 to 14.7 feet. We observed that measured permeabilities in the highly fractured basalt and clinker gravel layers were on the order of the same magnitude.

7.0 DISCUSSION

The soil test borings and seismic refraction survey indicate that the surface soils over the majority of the project area appear to be on the order of 2 to 9 feet in thickness, except in the area of

T-6, where the surface soil thickness appears to be on the order of 25 to 35 feet thick. The variations in the soil cover thickness across the site is probably due to the rubbly surface of the former a'a lava flow, variations in thickness of ash and cinder deposited over the area, and the close proximity of the project site to existing cinder cones.

Falling head tests performed in the surface soils indicate permeabilities of on the order of 10^{-5} cm/sec. Additionally, the permeabilities of the surface soils were estimated based on the results of the falling head tests performed over short for periods of generally less than ½ hour. We expect that the calculated permeabilities may generally be less if the tests were run for longer periods of time and the soils were allowed to become saturated.

Measured permeabilities from the packer tests performed in the lava formation indicate permeabilities of on the order of 10^{3} cm/sec for highly fractured basalt and clinker gravel to 10^{-4} cm/sec for less fractured and relatively intact rock. No cavities, voids, or lava tubes were encountered in the borings drilled for this study. We anticipate, however, that some cavities, voids, and lava tubes may potentially exist within the lava formation beneath the project area. These secondary structural features of the lava formation normally have much higher permeabilities than the basaltic rock and clinker gravel material.

No perched ground water was observed in the standpipe piezometers installed for our field work. According to available water well information, the basal groundwater level is anticipated to be found at several feet above sea level. This corresponds to depths of on the order of 165 to 545 feet below the existing ground surface at the project site.

8.0 LIMITATIONS

We have prepared this geotechnical consultation report for the use of Keola Hana Maui, Inc. and their architect and civil engineer in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report does not reflect variations which may occur in the subsurface conditions between borings and geophysical transect lines.

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The following plates and appendices are attached and complete this report.

Plate 1	-	Vicinity Map
Plate 2	-	Map of Area
Plate 3	-	Plot Plan
Table 1	-	Summary of Seismic Refraction Survey
Table 2	-	Summary of Field Permeability Tests
References		
Appendix A	-	Subsurface Exploration, Permeability Tests, and Laboratory Testing
Appendix B	-	Seismic Refraction Survey

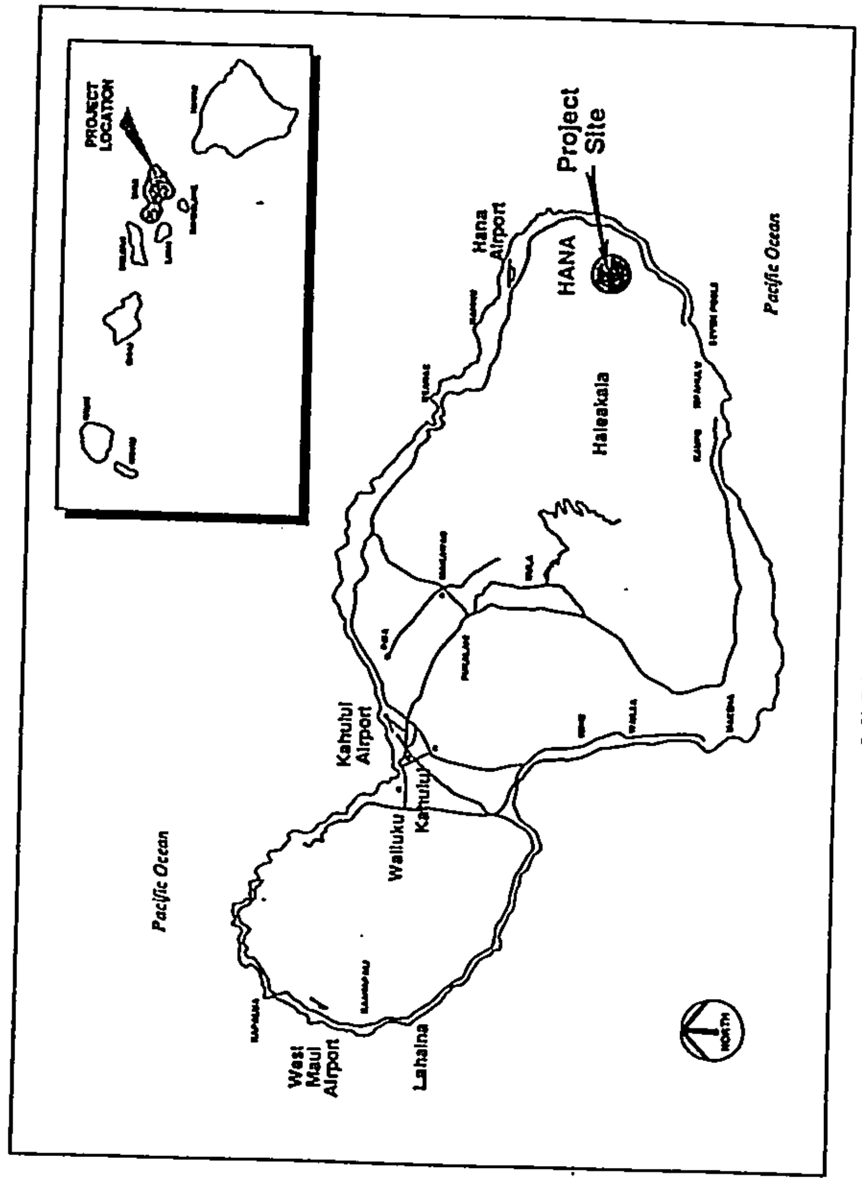
Yours very truly,

PACIFIC GEOTECHNICAL ENGINEERS, INC.

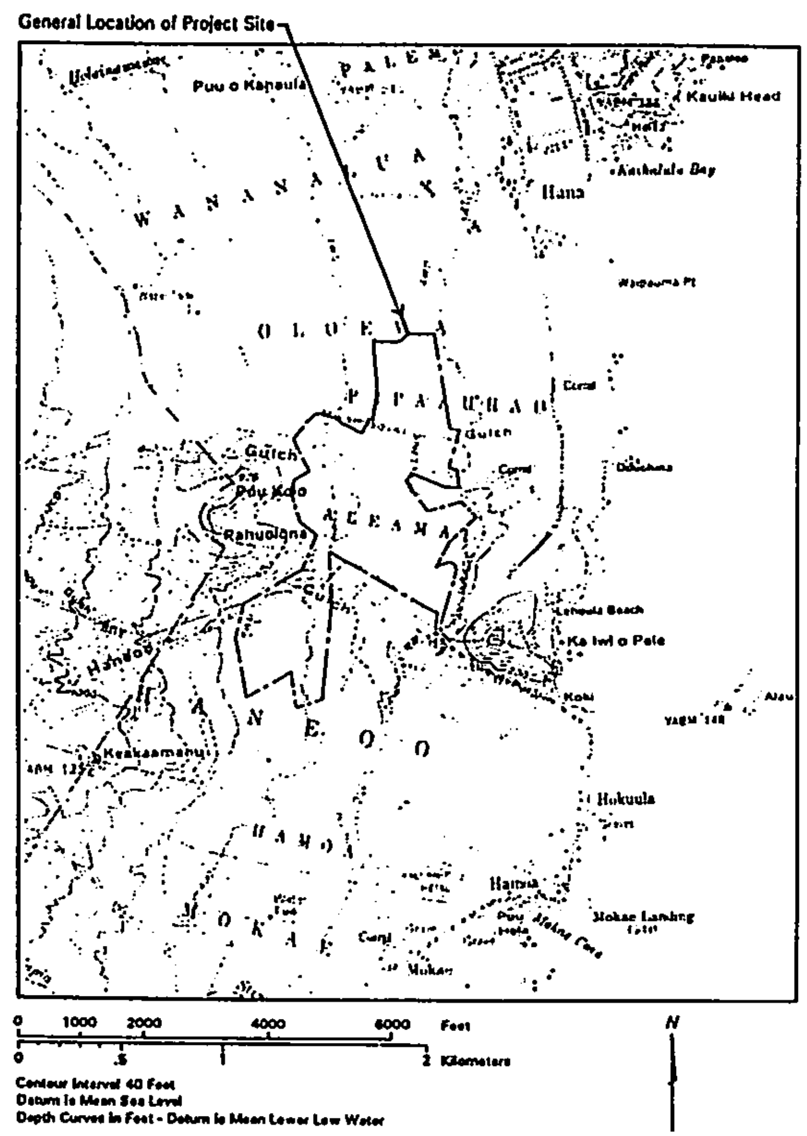
Glen Y.F. Lau

Glen Y.F. Lau, P.E.
President

GYL/LKO(014A.RPT:9195-001)
(Six copies submitted)



VICINITY MAP



MAP OF AREA

Reference:
U.S.G.S. Topographic Map
Hana, Maui, Hawaii (1983)

Pacific Geotechnical Engineers, Inc.

PLATE 2

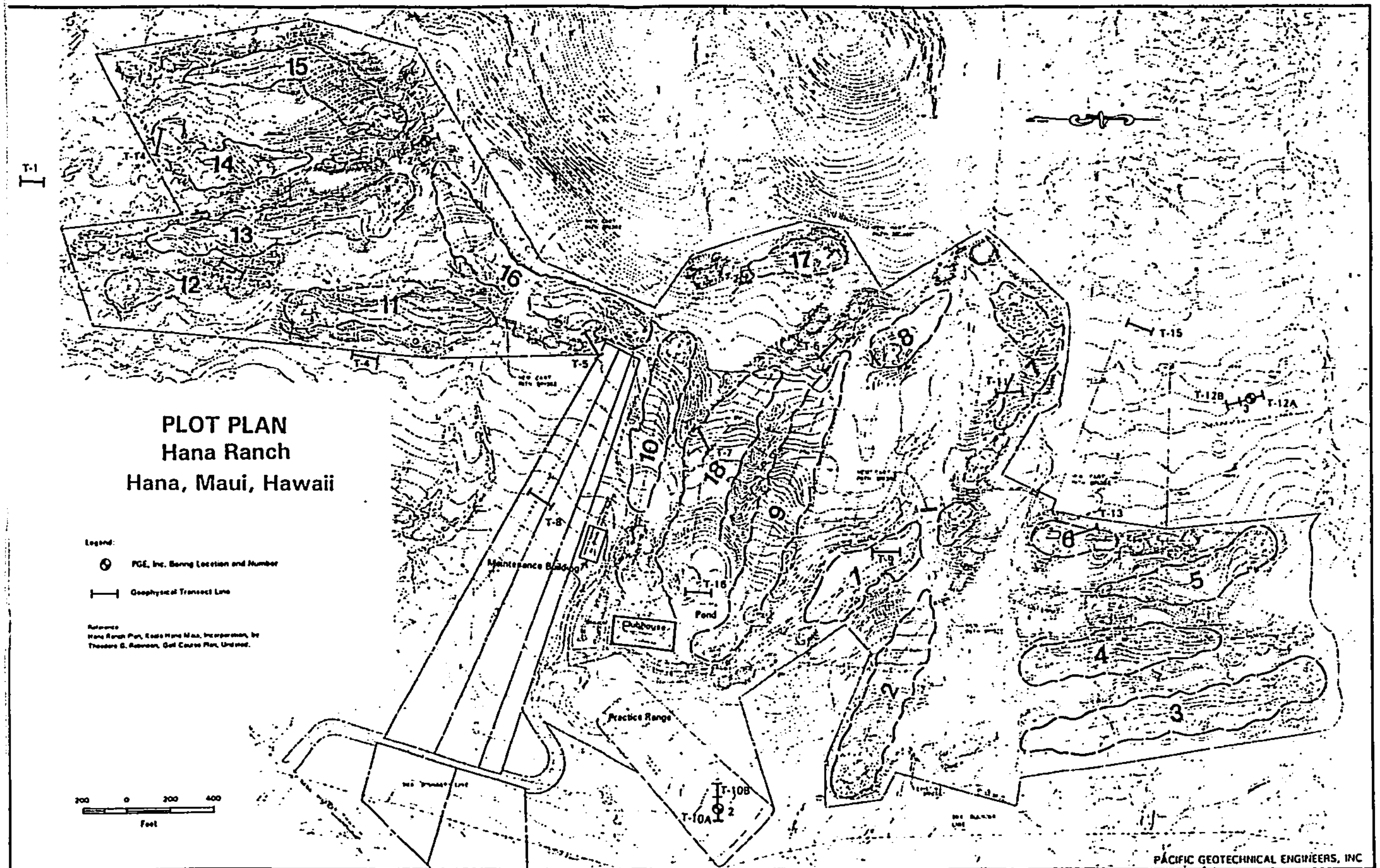

PLOT PLAN
Hana Ranch
Hana, Maui, Hawaii
Legend:
PGE, Inc. Boring Location and Number
Geophysical Transect Line
200 0 200 400
Feet
15
14
13
12
11
16
17
10
18
9
8
7
1
2
3
4
5
6
T-1
T-4
T-5
T-6
T-7
T-8
T-9
T-10A
T-10B
T-11
T-12A
T-12B
T-13
T-15
T-16
Maintenance Building
Clubhouse
Pond
Practice Range
PACIFIC GEOTECHNICAL ENGINEERS, INC

PLATE 3

TABLE 1

SUMMARY OF SEISMIC REFRACTION SURVEY

TRANSECT LINE NO.	STATION	DEPTH RANGE (feet)	CALCULATED SEISMIC WAVE VELOCITIES (feet per second)
T-1	0+00	0 - 2	800
		2 - 13	3,160
		13	6,665
	1+10	0 - 2.5	855
		2.5	4,640
T-2 (Near Boring 1)	0+00	0 - 2	1,000
		2 - 10.5	1,600
		10.5	3,125
	1+10	0 - 1.5	930
		1.5 - 9	1,285
		9	3,600
T-3	0+00	0 - 7	1,260
		7	7,090
	1+10	0 - 6	1,110
		6	6,430
T-4A	0+00	0 - 5.5	1,335
		5.5	3,715
	1+10	0 - 6	1,000
		6	9,140
T-5	0+00	0 - 2	455
		2 - 15.5	2,260
		15.5	6,085
	1+10	0 - 2.5	500
		2.5 - 10.5	2,775
		10.5	4,315

TABLE 1 (Continued)

TRANSECT LINE NO.	STATION	DEPTH RANGE (feet)	CALCULATED SEISMIC WAVE VELOCITIES (feet per second)
T-6	0+00	0 - 35	1,290
		35	7,000
	1+10	0 - 25	1,145
		25	6,000
T-7	0+00	0 - 7	1,365
		7 - 35	2,090
		35	5,165
	1+10	0 - 8	1,050
		8	5,665
T-8	0+00	0 - 4.5	1,110
		4.5 - 20	2,500
		20	8,750
	1+10	0 - 3.5	1,110
		3.5 - 19	1,820
		19	9,335
T-9	0+00	0 - 3.5	915
		3.5 - 14.5	2,445
		14.5	5,455
	1+10	0 - 1.5	910
		1.5 - 16	1,830
		16	8,835

TABLE 1 (continued)

TRANSECT LINE NO.	STATION	DEPTH RANGE (feet)	CALCULATED SEISMIC WAVE VELOCITIES (feet per second)
T-10A (Near Boring 2)	0+00	0 - 7	750
		7	3,719
	1+10	0 - 5	750
		5	6,188
T-10B (Near Boring 2)	0+00	0 - 3	695
		3	3,430
	1+10	0 - 3.5	750
		3.5	2,945
T-11	0+00	0 - 1.5	835
		1.5 - 16.5	1,945
		16.5	7,400
	1+10	0 - 3	700
		3	4,855
T-12A (Boring 3)	0+00	0 - 2.5	855
		2.5 - 16.5	1,755
		16.5	7,555
	1+10	0 - 5	690
		5 - 16.5	2,000
		16.5	7,430
T-12B (Boring 3)	0+00	0 - 2	590
		2 - 15	1,935
		15	8,335
	1+10	0 - 5	600
		5	4,000

TABLE 1 (continued)

TRANSECT LINE NO.	STATION	DEPTH RANGE (feet)	CALCULATED SEISMIC WAVE VELOCITIES (feet per second)
T-13	0+00	0 - 6	1,250
		6	6,000
	1+10	0 - 6	1,250
		6	5,000
T-14	0+00	0 - 6	1,765
		6	8,570
	1+10	0 - 5.5	1,305
		5.5	4,285
T-15	0+00	0 - 1.5	910
		1.5 - 23.5	1,970
		23.5	5,050
	1+10	0 - 5	1,035
		5	3,400
T-16	0+00	0 - 5.5	790
		5.5 - 18	2,610
		18	4,515
	1+10	0 - 8.5	980
		8.5	3,875

TABLE 2

SUMMARY OF FIELD PERMEABILITY TESTS

BORING NO.	GROUND SURFACE ELEVATION (feet)	DEPTH INTERVAL TESTED (feet)	MATERIAL TYPE	TYPE OF TEST (1)	TEST PRESSURE (psi) (2)	CALCULATED PERMEABILITY (cm/sec)
1	450.	0.0 to 1.4	Clayey silt	Falling Head		3×10^{-5}
		4.5 to 9.5	Highly fractured basalt	Packer	22	2.4×10^{-3}
2	257.5	0.0 to 4.5	Clayey silt	Falling Head		5×10^{-5}
		8.7 to 14.7	Highly fractured basalt	Packer	5	4×10^{-5}
		8.7 to 14.7	Highly fractured basalt	Packer	15	2.6×10^{-3}
		24.0 to 30.0	Moderately fractured basalt	Packer	7.5	2.5×10^{-3}
		24.0 to 30.0	Moderately fractured basalt	Packer	20	2×10^{-5}
		33.5 to 39.5	Clinker gravel and Slightly fractured basalt	Packer	25	1.5×10^{-3}

TABLE 2 (continued)

BORING NO.	GROUND SURFACE ELEVATION (feet)	DEPTH INTERVAL TESTED (feet)	MATERIAL TYPE	TYPE OF TEST (1)	TEST PRESSURE (psi) (2)	CALCULATED PERMEABILITY (cm/sec)
2	257.5	48.0 to 50.0	Moderately fractured basalt	Packer	27	8.0×10^{-4}
3	361.3	0.0 to 0.9	Clayey silt	Falling Head		7×10^{-5}
		5.0 to 11.0	Moderately fractured basalt	Packer	19	2.4×10^{-3}
		14.5 to 20.5	Clinker gravel	Packer	27	1.7×10^{-3}
		21.0 to 30.0	Slightly fractured basalt	Packer	25	1.3×10^{-3}

NOTES:

(1) Single Packer used for Packer Test Inflatable.
(2) Test Pressure indicated for Packer Test only.

REFERENCES

1. MacDonald, G.A., Agatin, T.A., Peterson, F.L., 1983. Volcanoes in the Sea, The Geology of Hawaii, Second Edition, University of Hawaii Press, Honolulu, 517 p.

2. Pacific Planning & Engineering, Inc., 1991. "Hana Ranch Environmental Assessment, Hana, Maui, Hawaii", dated January 1991.

3. United States Department of Agriculture Soil Conservation Service, 1972. "Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii", 1972, 232 pp.

4. Warren S. Unemori Engineering, Inc., "Engineering Report for Hana Ranch Wananalua Well (State No. 4559-01) at Hana, Maui, Hawaii", dated 1988.

5. Water Resources Associates, 1992. "Water Resources and Supply for Proposed Hana Golf Course, Hana, Maui", dated March 1992.

APPENDIX A

SUBSURFACE EXPLORATION, FIELD PERMEABILITY TESTS, AND LABORATORY TESTING

A.1 SUBSURFACE EXPLORATION

The subsurface exploration was performed during the period from February 4 through February 7, 1992. Three test borings, ranging in depth from 9.5 to 50 feet below existing ground surface, were drilled by our subcontracted drilling crew using a truck mounted drill rig. The drilling was performed using the auger and rotary wash drill methods. A 4-inch diameter steel casing was used to maintain an open borehole during the drilling and testing. A water truck and existing water troughs provided by Keola Hana Maui, Inc. were used to supply water for the exploratory drilling.

The drilling was performed under the technical supervision of our engineer, who prepared a log of the soil and rock materials encountered, and obtained relatively undisturbed and disturbed soil samples and rock cores. The soil samples and rock cores were returned to our laboratory for further inspection and laboratory testing.

The locations of the borings are shown on the Plot Plan, Plate 3 in the text. Graphical representations of the soils and rocks encountered are presented on the Log of Borings, Plates A-1.1 through A-1.3. Soil materials were classified in accordance with the Unified Soil Classification System, Plate A-2.

Soil samples were obtained using a Sprague and Henwood sampler driven with a 140-pound hammer falling 30 inches. The sampler was driven for a total distance of 18 inches, and the blow counts for each 6 inches of penetration was recorded. The blow counts for the last 12 inches of penetration are noted on the Log of Borings.

Rock materials were continuously cored with a double tube NX-size core barrel, which recovers cores approximately 2 inches in diameter. The rock quality designation (RQD) and percentage of core recovery are indicated on the Log of Borings. RQD is defined as the total length of intact core pieces, 4 inches or longer, expressed as a percentage of the overall core run.

At the completion of each boring, a slotted PVC pipe was installed near the bottom of the boring to check for possible groundwater

A.2 FIELD PERMEABILITY TESTS

Permeability tests consisting of falling head and packer tests were performed to obtain data on the permeability characteristic of the near surface soils and underlying lava formation. The results of the permeability tests are summarized on Table 2 in the main text.

The tests consisted of auguring a borehole to the depth of the test zone, filling the borehole to the ground surface with water, then measuring the drop in water level in the borehole after shutting off the water supply. The tests were performed to depths ranging of 1.4 feet in Boring 1, 4.5 feet in Boring 2, and 0.9 feet in Boring 3.

Packer tests were performed at various depth intervals in the basaltic bedrock. The nature of the basaltic material tested included slightly to highly fractured basalt and clinker gravel. The tests were performed by isolating increments of the borehole by means of an inflatable rubber packer. Water was then pumped into the section of the borehole below the packer seal. The water pressure was maintained at a constant value and flow rate was measured. This data was then used to compute an average value of permeability for the tested section. Test water pressures ranged from 5 to 27 pounds per square inch. The basic equipment set up for single packer assembly is shown on Plate A-3.

A.3 LABORATORY TESTING

We performed laboratory testing consisting on moisture content and dry density determinations on relatively undisturbed soil samples. Moisture content is expressed as a percentage of dry weight of each sample. The results of the moisture content and dry density tests are presented on the Log of Borings, Plates A-1.1 through A-1.3 at the appropriate sample depth.

The following plates are attached and complete this appendix.

Plates A-1.1 through A-1.3	-	Log of Borings, Borings 1 through 3
Plate A-2	-	Unified Soil Classification System
Plate A-3	-	Single Packer Assembly

PROJECT Hana Golf Course JOB No. 9195-001

LOCATION Hana, Maui, Hawaii DRAWN BY ln

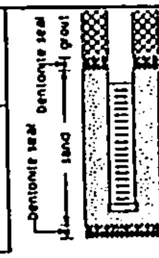
BORING 1 (Page 1 of 1)

SURFACE ELEVATION 449 ± Feet

DATUM MSL

LAB DATA: MOISTURE CONTENT %	LAB DATA: DRY DENSITY %	CORE INFO: CORE TYPE	CORE INFO: RECOVERY %	CORE INFO: RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
28	74				25				ML	Dark yellowish brown fine sandy clayey silt, medium stiff, with basaltic gravel and grass roots, moist
										grades with basaltic cobbles
		NX	54	0	-	5				Gray to dark gray basalt, medium hard, closely fractured, moderately to highly weathered
										grades highly vesicular from 5.5 to 6.5 feet

WELL



Boring completed at 9.5 feet on 2-7-92
Groundwater not encountered

NOTES:
■ - Undisturbed sample
⊠ - Disturbed sample
□ - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY 140-lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A1.1

BORING 2 (Page 1 of 2)

PROJECT Hana Golf Course JOB No. 9195-001
LOCATION* Hana, Maui, Hawaii DRAWN BY Jn

SURFACE ELEVATION 257 ± Feet
DATUM MSL

Depth (feet)	Moisture Content %	Dry Density %	Core Type	Recovery %	RQD % or (RQI) %	Blows/Ft.	Soil Class	Description	Well
0–1							ML GM	Dark yellowish brown fine sandy clayey silt, medium stiff, with highly weathered basaltic gravel, cobbles, and grass roots, moist	gravel
1.5	40	70				16			
3						-			
3.5							SM	Dark brown silty sand, very dense, moist	
5	18					85/4"			
5.5								Gray basalt, hard, moderately to highly fractured, moderately weathered, slightly vesicular	cutting
7			NX	100	58				
10			NX	100	0				
13								grades highly fractured, highly vesicular	
14							GP	Gray basaltic clinker gravel	
15			NX	36	14				
17								Gray basalt, hard, highly fractured, moderately weathered, moderately vesicular	
18							GP	Gray basaltic clinker gravel	
23			NX	58	0				
24								Gray basalt, hard, moderately fractured, moderately weathered, moderately vesicular	
24			NX	100	0				
25			NX	67	17				
28								grades reddish gray, highly vesicular	
30			NX	75	0				cement
32								grades slightly fractured	
34							GP	Reddish gray clinker gravel and cobbles	
35			NX	75	0				
38								Reddish gray basalt, hard, highly fractured, moderately weathered, highly vesicular	bentonite seal
39			NX	67	36				

NOTES:
■ - Undisturbed sample
☒ - Disturbed sample
☐ - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING
Pacific Geotechnical Engineers, Inc.
PLATE A1.2

BORING 2 (Page 2 of 2)

PROJECT Hana Golf Course JOB No. 9195-001

Depth (feet)	Moisture Content %	Dry Density %	Core Type	Recovery %	RQD % or (RQI) %	Blows/Ft.	Soil Class	Description	Well
42			NX	50	8				
43						-	GP	Reddish gray clinker gravel and cobbles	sand
46			NX	71	0				
47								Gray basalt, hard, slightly to moderately fractured, moderately weathered, moderately to highly vesicular	
49								grades slightly weathered, slightly vesicular	bentonite seal

Boring completed at 50.0 feet on 2-5-92
Groundwater not encountered

NOTES:
■ - Undisturbed sample
☒ - Disturbed sample
☐ - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING
Pacific Geotechnical Engineers, Inc.
PLATE A1.2

PROJECT Hana Golf Course — JOB No. 9195-001
LOCATION Hana, Maui, Hawaii — DRAWN BY In

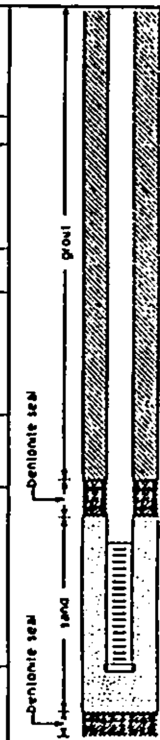
BORING 3 (Page 1 of 1)

SURFACE ELEVATION 361 ± Feet
DATUM MSL

LAB DATA: MOISTURE CONTENT %	LAB DATA: DRY DENSITY %	CORE INFO: CORE TYPE	CORE INFO: RECOVERY %	CORE INFO: RQD % or (NQI) %	BLOWS/FT.	DEPTH (feet)	SOIL CLASS	DESCRIPTION
35	127				9		ML	Dark yellowish brown fine sandy clayey silt, medium stiff to stiff, with some basaltic cobbles, gravel, and grass roots, moist
44	69	NX NX	47 83	0 47	60/4.5"	5	GM	Dark yellowish brown silty basaltic gravel, highly weathered, very dense, moist
								Gray basalt, hard, moderately fractured, moderately weathered, slightly to moderately vesicular
						10	GP	Gray clinker gravel
		NX	80	33				Gray basalt, hard, moderately fractured, moderately weathered, moderately vesicular
		NX	60	8		15	GP	Gray clinker gravel
		NX	100	70		20		Gray basalt, hard, slightly fractured, slightly to moderately weathered, slightly vesicular
		NX	33	8		25	GP	Dark reddish gray clinker gravel
						30		Gray basalt, hard, slightly fractured, slightly to moderately weathered, slightly vesicular

Boring completed at 31.0 feet on 2-7-92
Groundwater not encountered

WELL



NOTES:
■ - Undisturbed sample
⊠ - Disturbed sample
□ - Sample lost during excavation
☑ - Standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A1.3

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	[illegible]
				GP	[illegible]
	[illegible]	GRAVELS WITH FINES [illegible]		GM	[illegible]
				GC	[illegible]
[illegible]	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	[illegible]
				SP	[illegible]
	[illegible]	SANDS WITH FINES [illegible]		SM	[illegible]
				SC	[illegible]
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	[illegible]
				CL	[illegible]
				OL	[illegible]
[illegible]	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	[illegible]
				CH	[illegible]
				OH	[illegible]
HIGHLY ORGANIC SOILS				PT	[illegible]

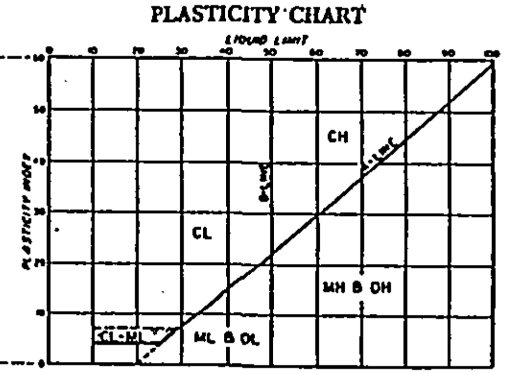
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE †	MILLIMETERS	SIEVE SIZE †
SAND FINE	.074	#200 †	0.42	#40 †
MEDIUM	0.42	#40 †	2.00	#10 †
COARSE	2.00	#10 †	4.76	#4 †
GRAVEL FINE	4.76	#4 †	19.1	3/4" ‡
COARSE	19.1	3/4" ‡	76.2	3" ‡
COBBLES	76.2	3" ‡	304.8	12 ‡
BOULDERS	304.8	12 ‡	914.4	36"

† U.S. STANDARD ‡ CLEAR SQUARE OPENINGS

PLASTICITY CHART



SAMPLES

■ · INDICATES UNDISTURBED SAMPLE
□ · INDICATES DISTURBED SAMPLE
□ · INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
I · INDICATES LENGTH OF CORE RUN

NOTE: DEFINITIONS OF ANY ADDITIONAL DATA REGARDING SAMPLES ARE ENTERED ON THE FIRST LOG ON WHICH THE DATA APPEARS.

NOTES:

1. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS.
2. WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

COHESIVE SOILS	APPROXIMATE SHEARING STRENGTH IN KSF	COHESIONLESS SOILS	
VERY SOFT	LESS THAN .25	VERY LOOSE	THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.
SOFT	0.25 TO 0.5	LOOSE	
MEDIUM STIFF	0.5 TO 1.0	MEDIUM DENSE	
STIFF	1.0 TO 2.0	DENSE	
VERY STIFF	2.0 TO 4.0	VERY DENSE	
HARD	GREATER THAN 4.0		

UNIFIED SOIL CLASSIFICATION SYSTEM

PACIFIC GEOTECHNICAL ENGINEERS, INC.

PLATE A-2

APPENDIX B

SEISMIC REFRACTION SURVEY

B.1 SEISMIC REFRACTION SURVEY

Measurements of the time required for seismic waves to travel through the ground can be used to develop an interpretation of subsurface conditions. Although a number of different paths may occur for waves traveling outward from a source point, the refraction method relies on two types - direct waves and refracted waves. Direct waves travel from one point to another solely through a given layer. In cases where multiple layers occur, some waves travel downward, following along layer interfaces and then travel back to the ground surface. Refracted waves are those that utilize these deeper paths. For refraction wave travel, however, the velocity of sequentially deeper layers must increase. When this condition is met, waves which travel along the deeper paths eventually overtake and pass the shallow direct traveling waves.

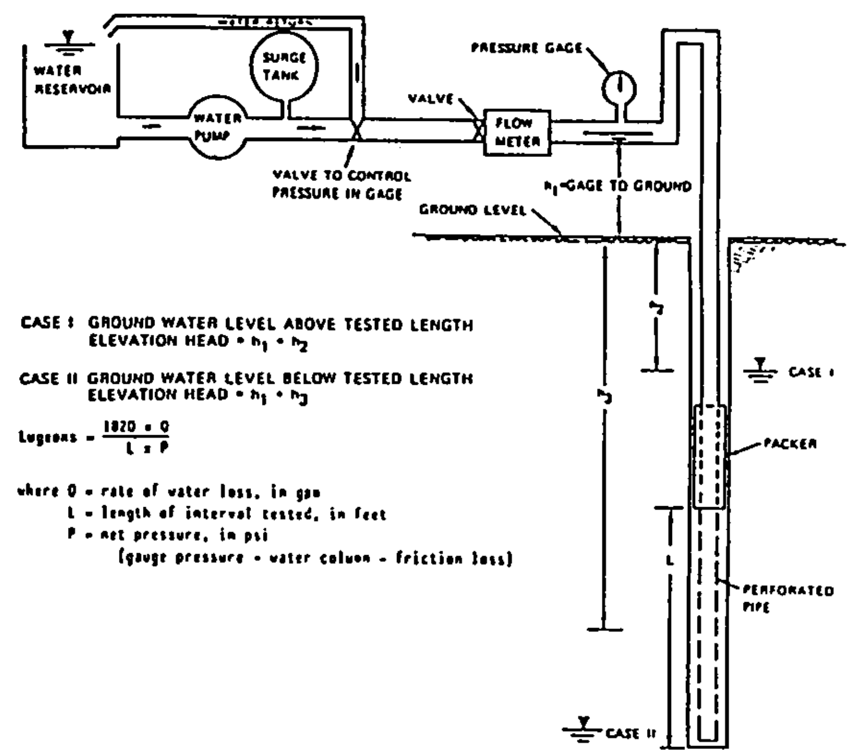
Seismic refraction testing was performed at sixteen locations, as shown on the Plot Plan, Plate 3 in the text. One refraction profile was made at fourteen of the sixteen locations. At the two remaining locations where test borings had been performed, two refraction profiles were made oriented in-line with each other (T-10B and T-12B).

Seismic wave arrivals were detected by geophones placed in a line along the ground surface at increasing distances away from the source point. The geophones were connected to a seismograph, which was used to make a record of geophone responses. Timing for wave travel was based on the instant that the seismic shock wave was produced. The energy source consisted of a sledgehammer impacting an aluminum plate. A signal enhancement seismograph was used to record the geophone responses. The signal enhancement system adds individual impact records. In this operation, random background noise tends to cancel and true seismic signal tends to be enhanced in amplitude.

The depth of the investigation by the refraction method is generally controlled by the spacings between geophones and the resulting length of the geophone array and by the amount of energy put into the ground. For shallow investigations, geophone spacings of 10 to 25 feet are frequently used.

For this seismic refraction survey, we used a Geometrics ES-1225 signal enhancement seismograph with a 16-pound sledgehammer energy source. A twelve-geophone array was used with geophone spacings at 10 feet. Recordings of each geophone array were made for energy points (shot points) located at the end of each array.

Field seismograms of geophone response were evaluated for the time of onset motion of the earliest arriving seismic wave at each geophone. These arrival times were plotted at the respective location of each geophone in the array to produce time-distance plots. Straight line segments were



CASE I GROUND WATER LEVEL ABOVE TESTED LENGTH
ELEVATION HEAD = $h_1 + h_2$

CASE II GROUND WATER LEVEL BELOW TESTED LENGTH
ELEVATION HEAD = $h_1 + h_3$

Lugeons = $\frac{1820 \times Q}{L \times P}$

where Q = rate of water loss, in gpm
L = length of interval tested, in feet
P = net pressure, in psi
(gauge pressure + water column - friction loss)

BASIC EQUIPMENT SETUP FOR SINGLE PACKER ASSEMBLY drawn through the arrival time data and the inverse slope of each segment yielded an apparent seismic wave velocity. Depths to various velocity layer interfaces were calculated from the apparent velocities and their zero distance intercepts.

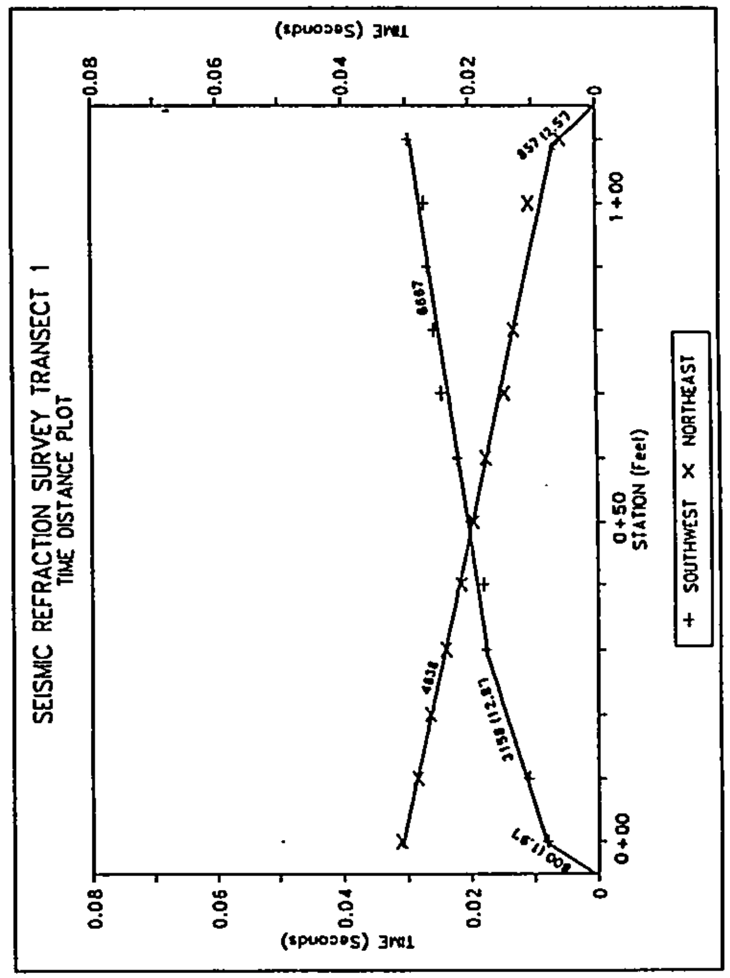
Refraction profiles were recorded for reverse directions in order to determine if the subsurface layer interfaces are dipping. If interfaces are parallel with the ground surface, the apparent velocities from opposing directions will be equivalent. If the apparent velocities differ, then dip is indicated. The rate of dip and the true layer velocities can be calculated from the reverse profile data.

The time-distance plots constructed from the seismic refraction data are reproduced and are presented on Plates B-1.1 through B-1.16. Apparent seismic wave velocities corresponding to each line segment are given in feet per second (fps). In very general terms, low seismic velocities are representative of loose, unconsolidated materials. Higher seismic wave velocities correspond with more competent and denser materials.

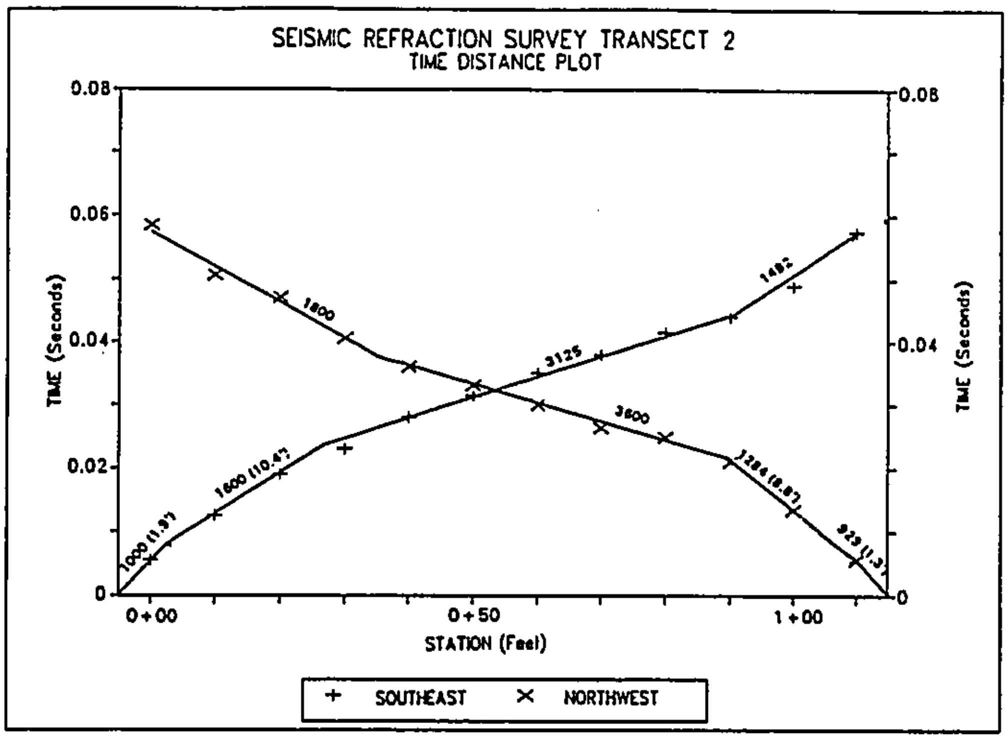
Depths calculated for layer interfaces are annotated along the time axis of each plot. A summary of the depth ranges and calculated seismic wave velocities is presented in Table 1, in the main text.

The following plates and table are attached and complete this Appendix:

Plates B-1 through B-16 - Seismic Refraction Survey Time Distance Plots, T-1 through T-16



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).



NOTES:

1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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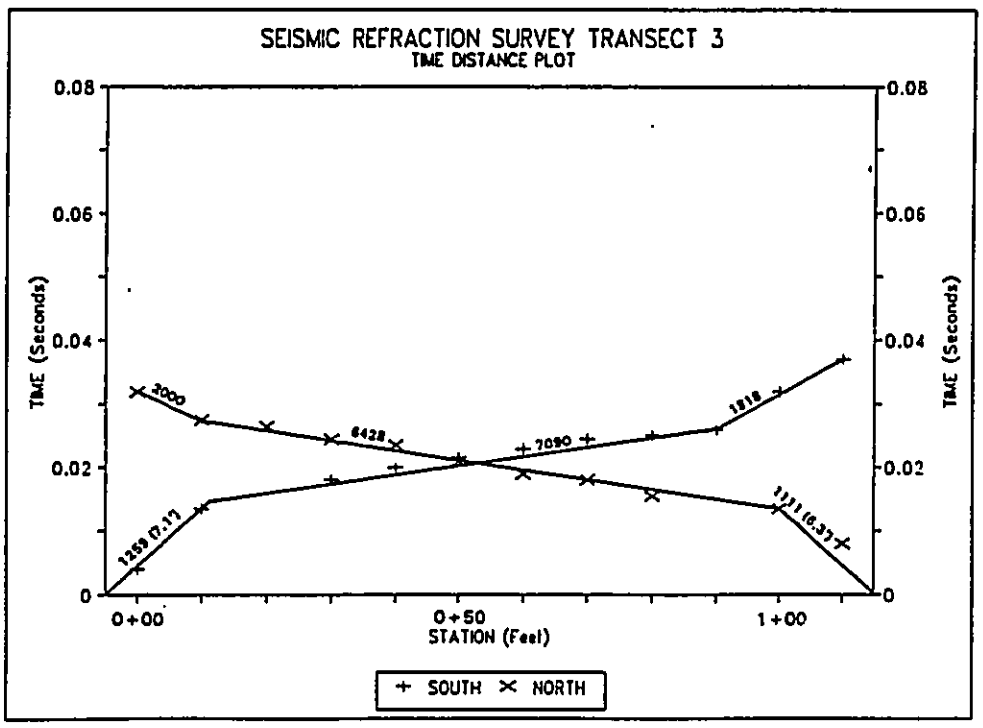
PLATE B-2



NOTES:

1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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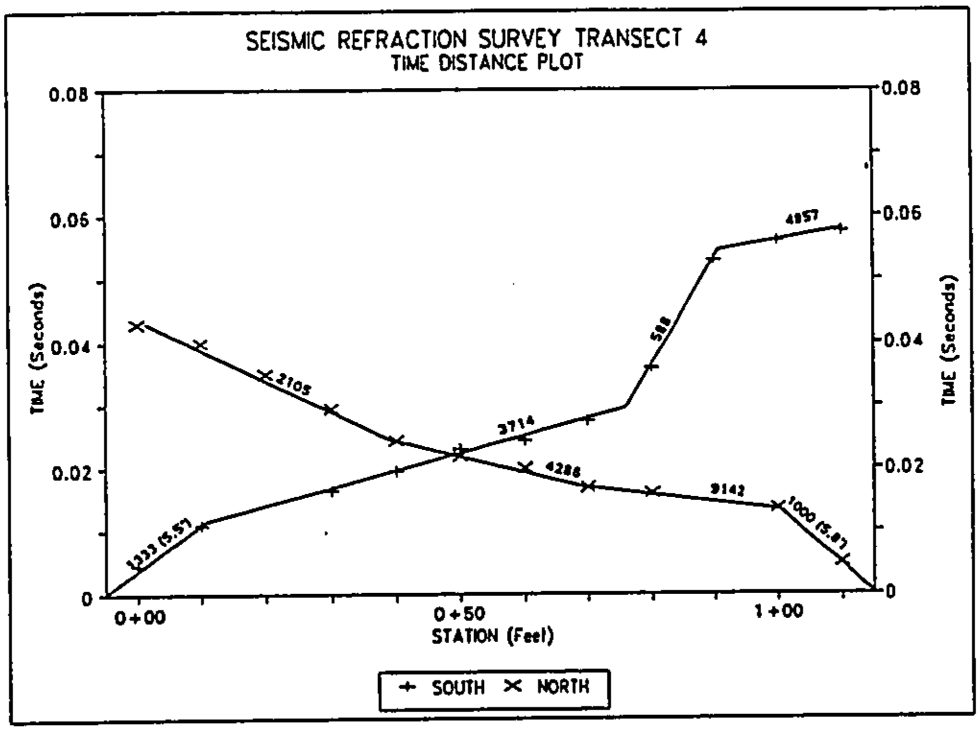
PLATE B-3



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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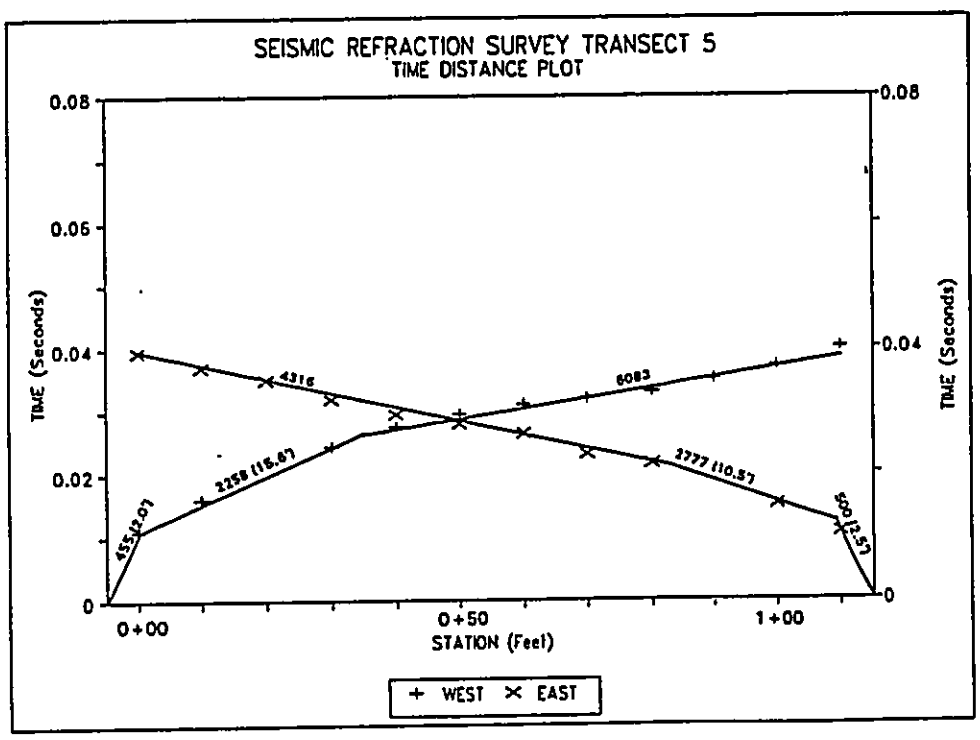
PLATE B-4



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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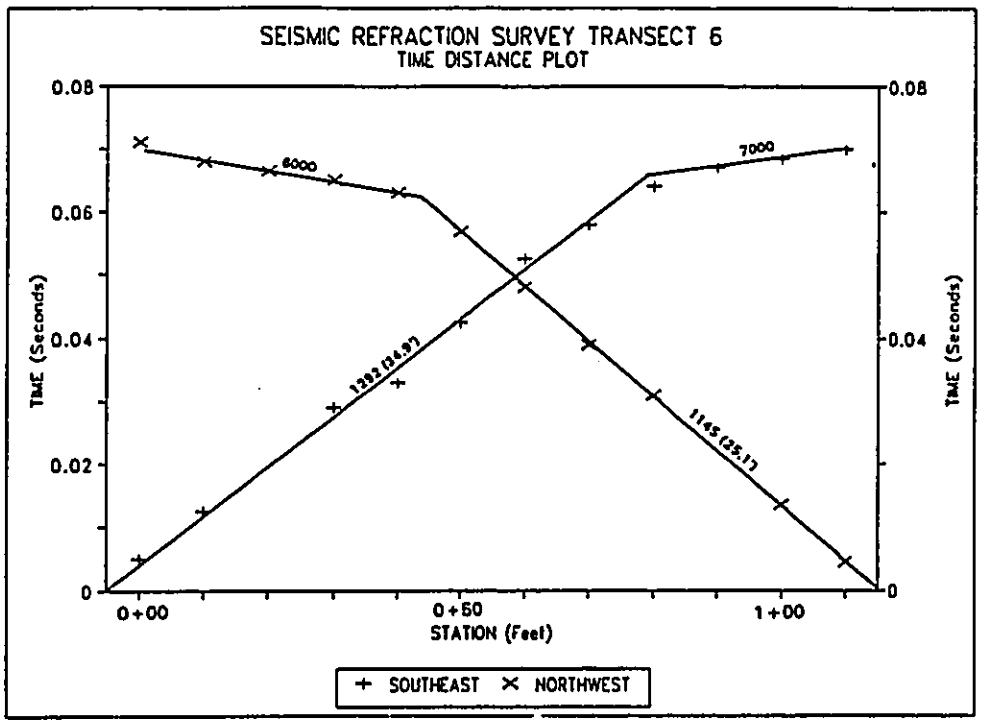
PLATE B-5



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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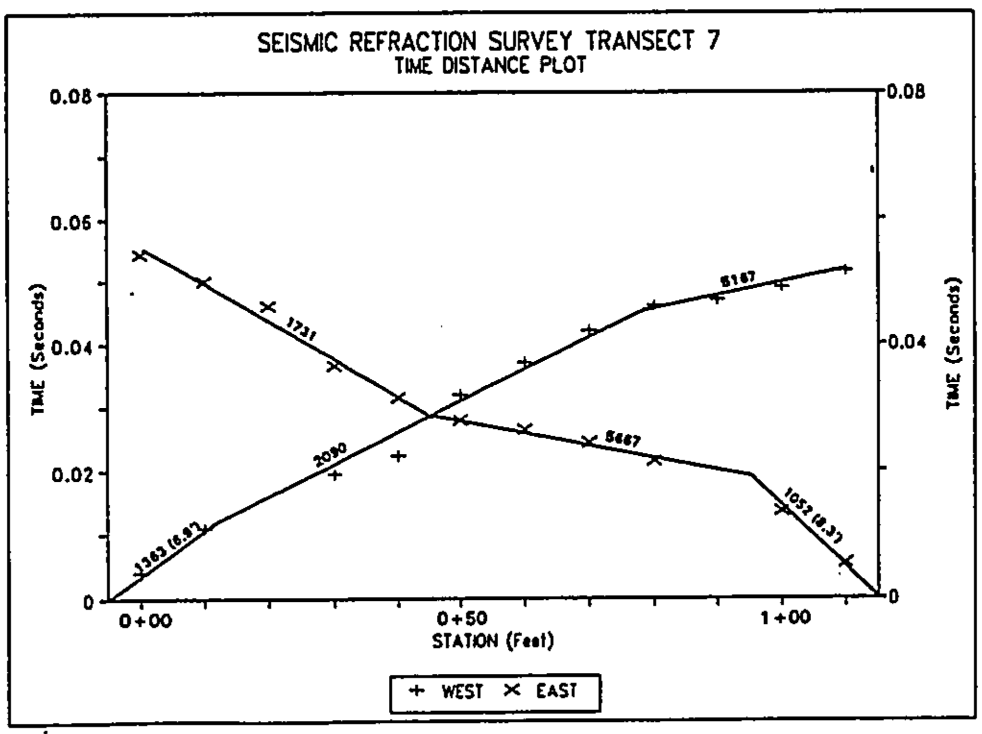
PLATE B-6



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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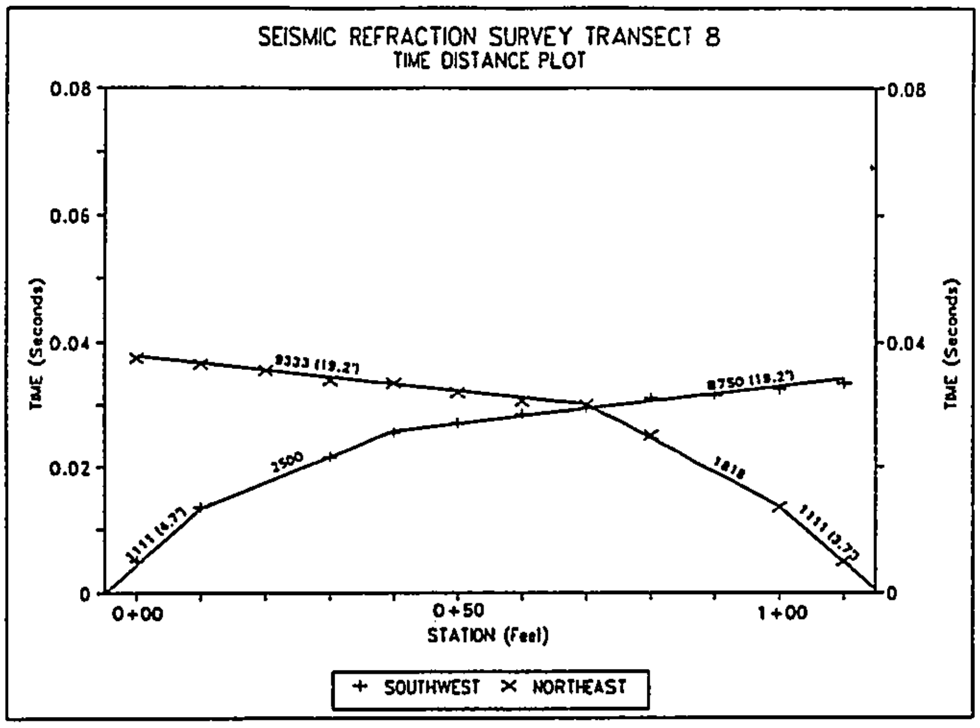
PLATE B-7



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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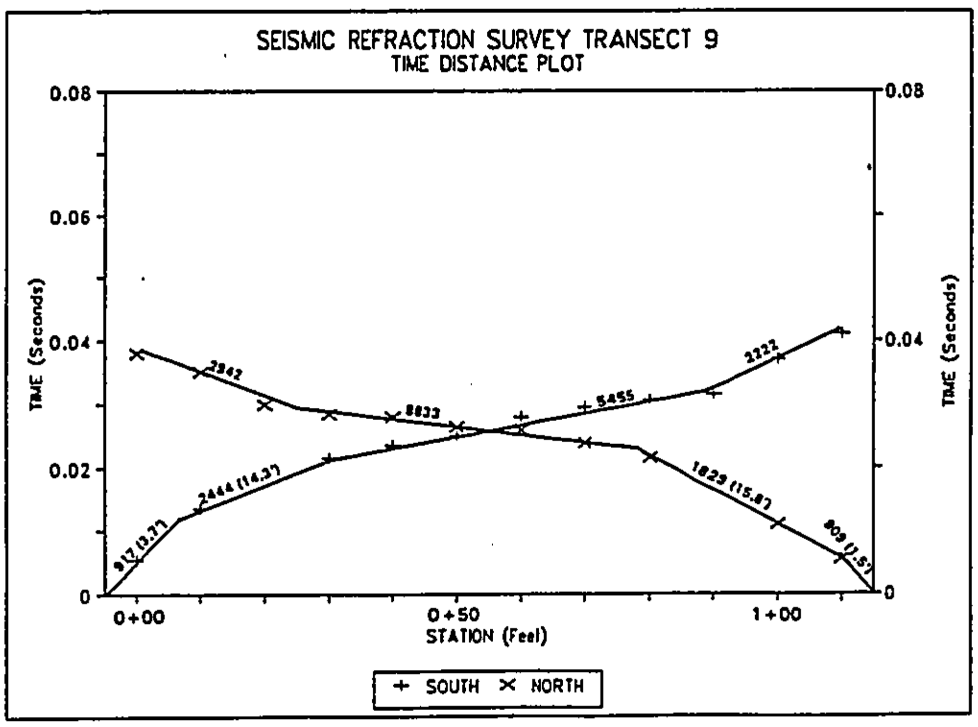
PLATE B-8



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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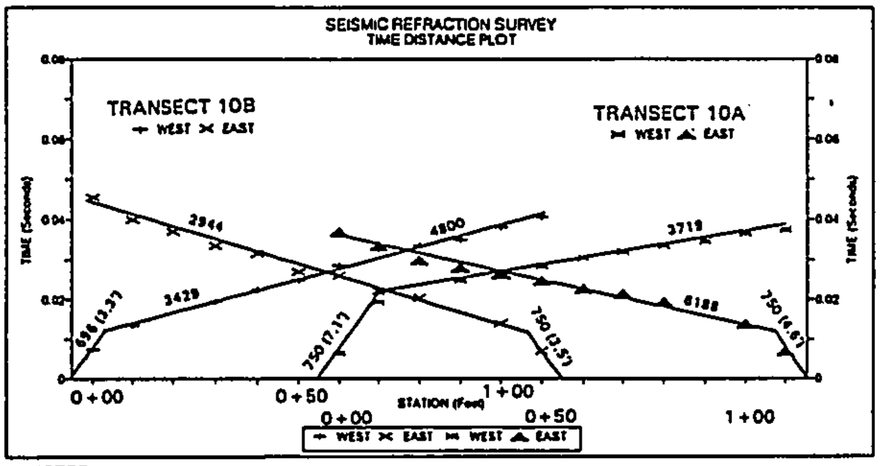
PLATE B-9



NOTES:

1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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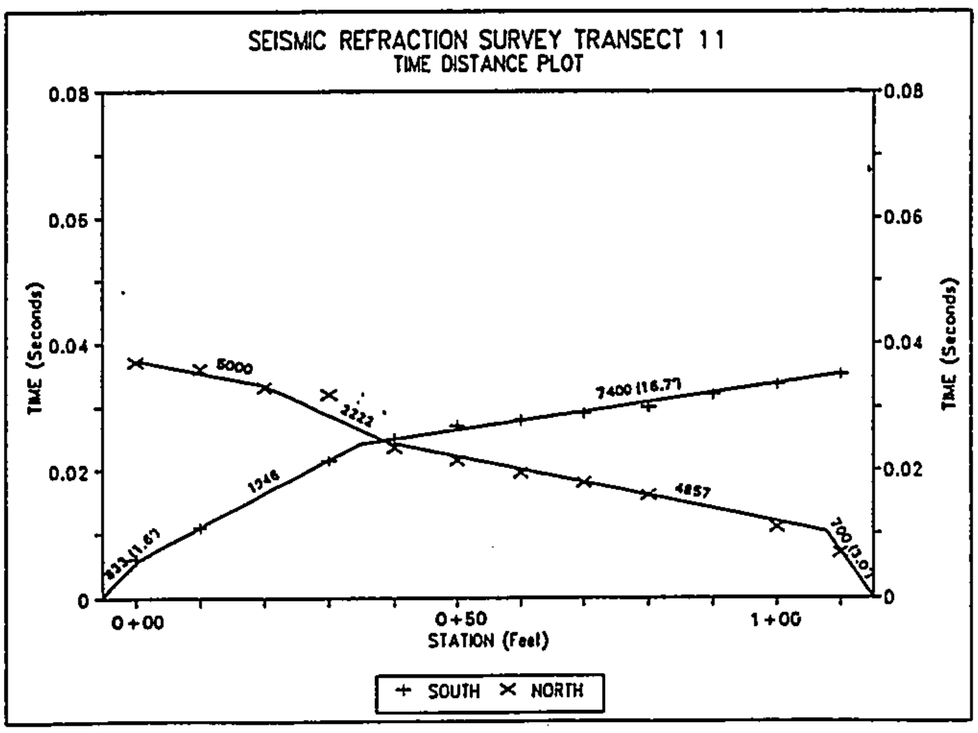
PLATE B-10



NOTES:

1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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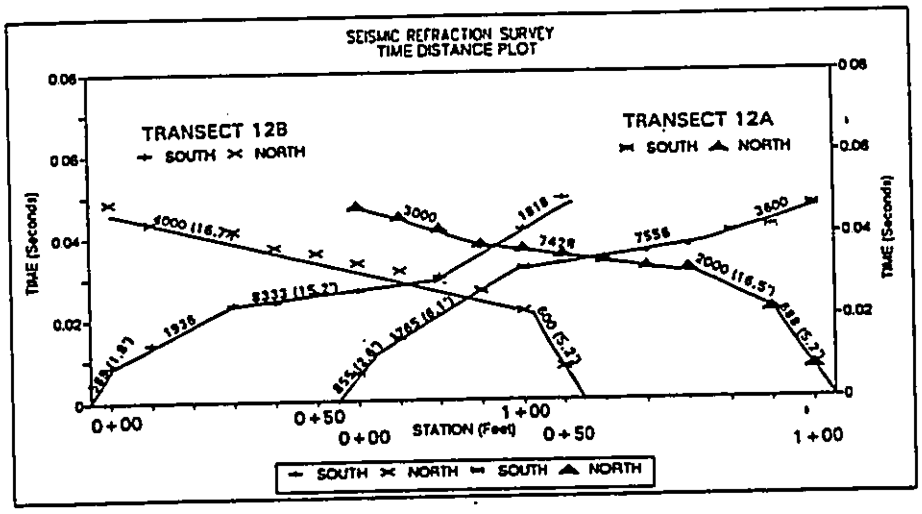
PLATE B-11



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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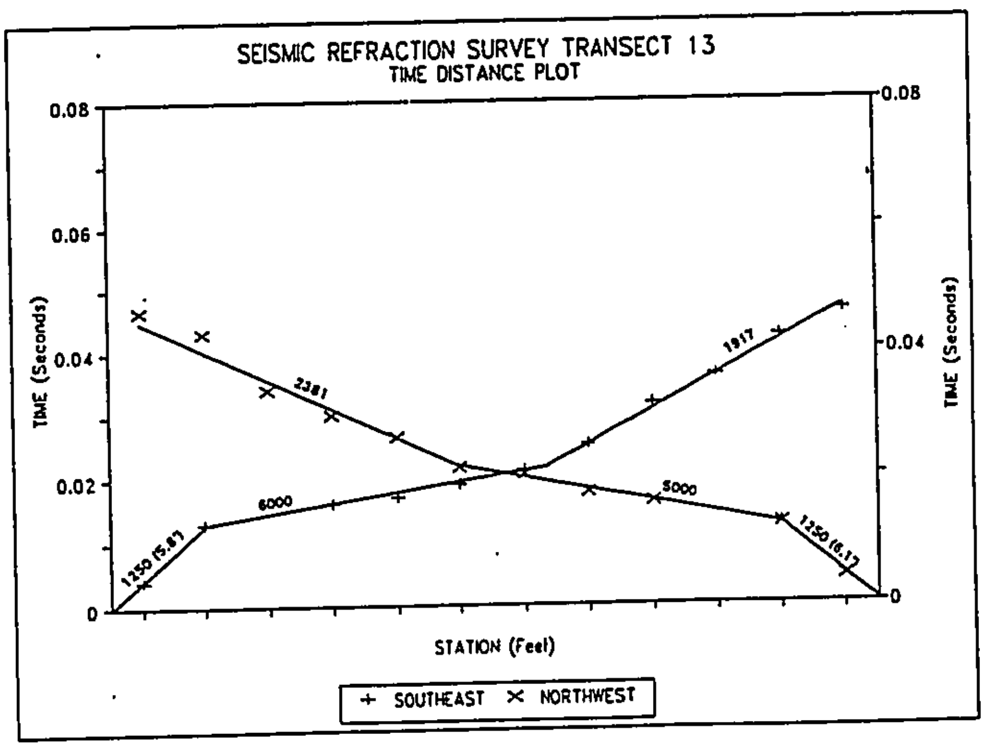
PLATE B-12



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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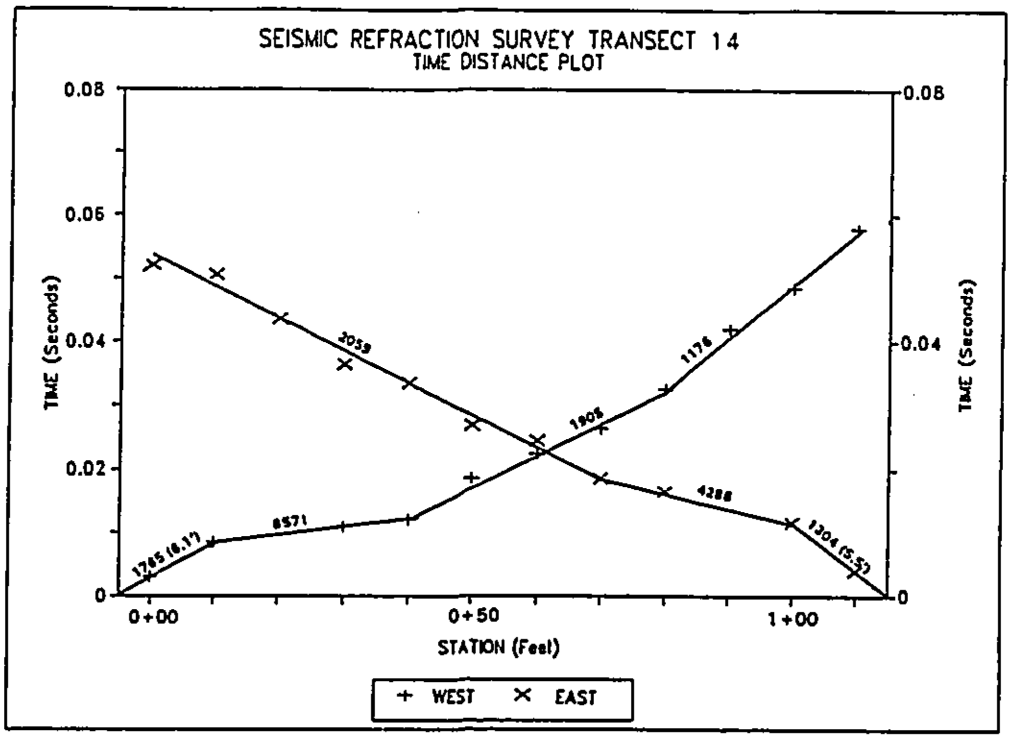
PLATE B-13



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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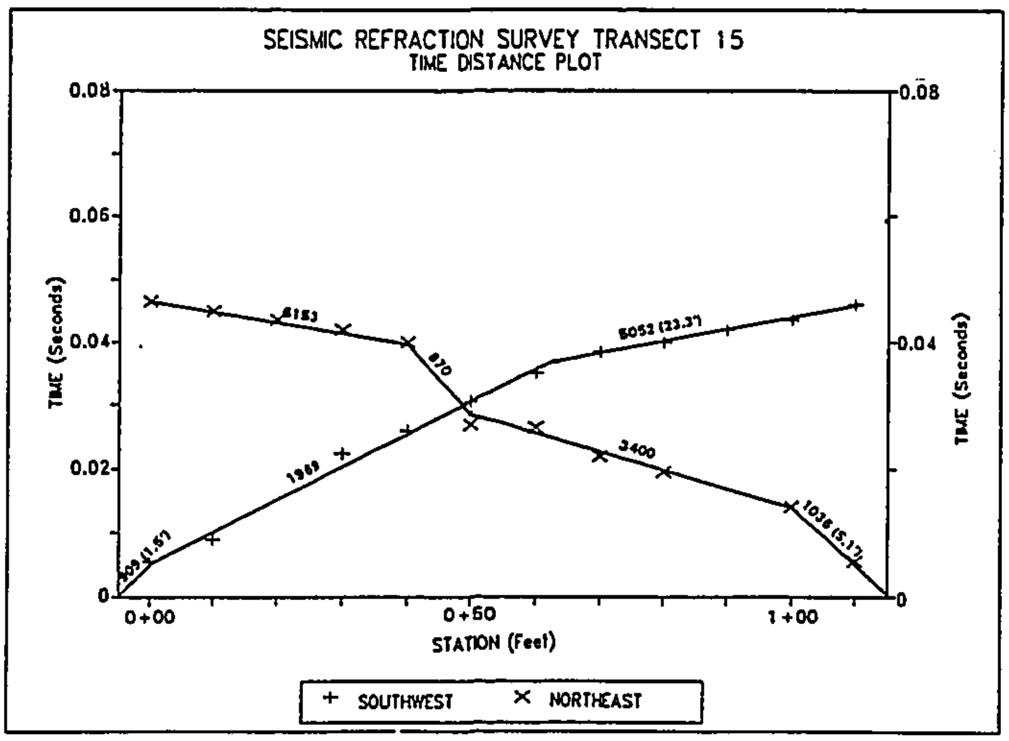
PLATE B-14



NOTES:
1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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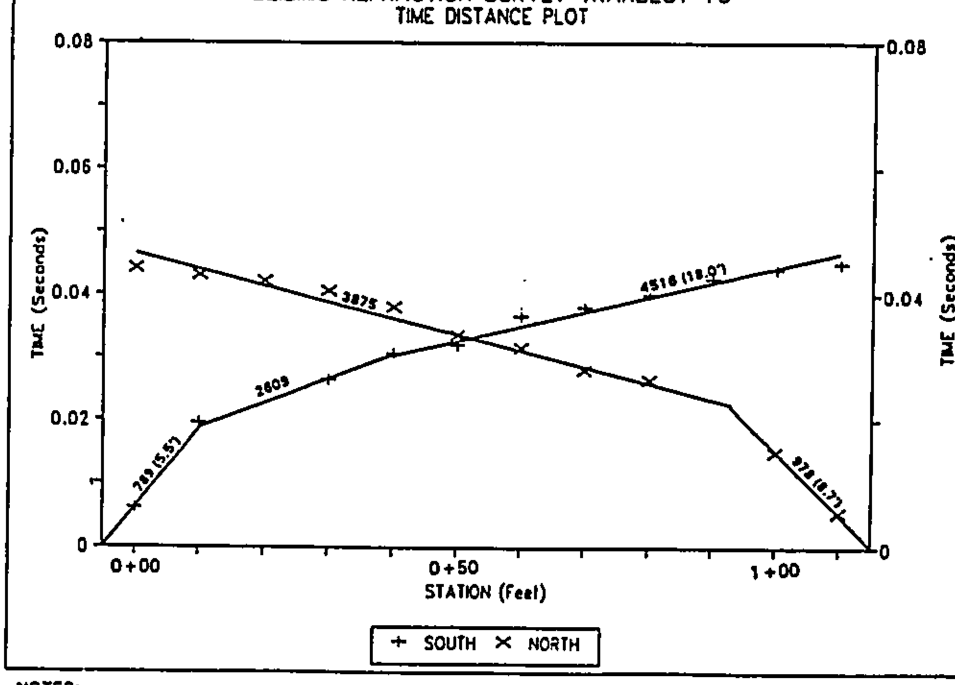
PLATE B-15

SEISMIC REFRACTION SURVEY TRANSECT 16
TIME DISTANCE PLOT



NOTES:

1. Calculated Velocities in feet per second are shown adjacent to each curve.
2. Numbers in ( ) are calculated depths in feet (see text also).

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PLATE B-16