FILE

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DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
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OFC. OF ENVIRONMENTAL QUALITY

June 23, 1992

Mr. Brian Choy, Director
Office of Environmental
Quality Control
Central Pacific Plaza
220 South King Street, 4th Floor
Honolulu, HI 96813

Dear Mr. Choy:

Subject: LUC Docket No. A92-677 - NORTH KONA DEVELOPMENT GROUP (Hawaii)

At its meeting of May 28, 1992, the Land Use Commission accepted the Environmental Impact Statement (EIS) on the subject docket as filed by Petitioner for the reclassification of 388.057 acres of land currently in the Conservation District into the Urban District at Manini'owali/Kuki'o 2, North Kona, Hawaii. The EIS had previously been accepted by the County of Hawaii, Department of Planning on March 10, 1992. In accordance with the Environmental Impact Statement Rules, we are filing a copy of the Commission's Findings of Fact, Conclusions of Law, and Decision and Order Accepting An Environmental Impact Statement For A State Land Use District Boundary Amendment.

If you have any questions, please call me or Bert Saruwatari of my staff at 587-3822.

Sincerely,

Esther Ueda

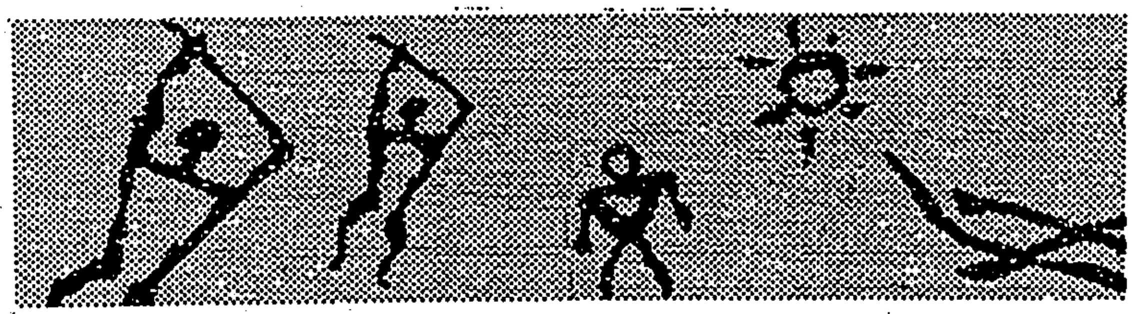
ESTHER UEDA
Executive Officer

EU:dyk

Enclosure

MANINI'OWALI RESIDENTIAL COMMUNITY

North Kona District, Island of Hawai'i



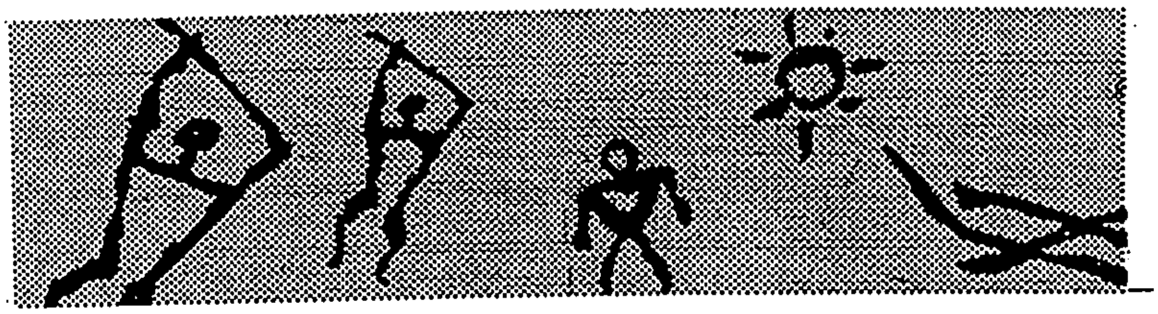
FINAL

ENVIRONMENTAL IMPACT STATEMENT

FEBRUARY 1992

NORTH KONA DEVELOPMENT GROUP
2877 KALAKAUA AVENUE, #G.F.1
HONOLULU, HAWAII 96815

MANINI'OWALI RESIDENTIAL COMMUNITY



FINAL ENVIRONMENTAL IMPACT STATEMENT

PREPARED FOR:
NORTH KONA DEVELOPMENT GROUP

PREPARED BY:
GROUP 70 INTERNATIONAL, INC.

FOR SUBMISSION TO:
HAWAI'I COUNTY PLANNING DEPARTMENT

SUBMITTED BY:

FRANCIS S. ODA, AIA, AICP
ITS: CHAIRMAN
GROUP 70 INTERNATIONAL, INC.
HONOLULU, HAWAI'I

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C. Environmental Aspects of Storm Water Runoff: Manini'owali Residential Community, North Kona Hawaii, Gordon L. Dugan, Ph.D., June 1991.

D. Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Manini'owali Golf Course, Charles L. Murdoch, Ph.D. and Richard E. Green, Ph.D., March, 1991.

E. Water Resources and Supply for the Manini'owali Residential Community, North Kona District, Island of Hawaii, Waimea Water Services, October, 1991.

F. Groundwater Impact Assessment for Maniniowali, Hawaii, Oceanit Laboratories, Inc., October, 1991.

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H. Botanical Survey: Manini'owali Project Site, North Kona, Island of Hawaii, Char & Associates, May 1991.

I. Survey of the Avifauna and Feral Mammals at Awake'e/Manini'owali, North Kona, Hawaii, Phillip L. Bruner, October, 1990.

J. Archaeological Inventory Survey of the Land Exchange Parcel in Manini'owali/Kuki'o 2 Ahupua'a, North Kona District, Hawaii Island, Bishop Museum, Applied Research Group, Public Archaeology Section, July, 1991.

K. Traffic Impact Analysis Report for the Proposed Manini'owali Residential Community, The Traffic Management Consultant, October, 1991.

L. Environmental Noise Impact Assessment, Manini'owali Residential Community, Hawaii County, Hawaii, Darby & Associates, July, 1991.

M. Air Quality Study For the Proposed Manini'owali Residential Community Project, Barry D. Neal and Associates, October, 1991.

N. Manini'owali Residential Community, Social Impact Assessment, Earthplan, October, 1991.

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ESSENTIAL INFORMATION

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This Draft Environmental Impact Statement (Draft EIS) has been prepared to address the potential environmental impacts of the proposed Manini'owali Residential Community. It has been compiled to fulfill application requirements of the County of Hawai'i Planning Department for a General Plan Amendment and for a petition to be filed with the State Land Use Commission for a change in land use designation from Conservation District to Urban District.

This Executive Summary includes brief descriptions of the proposed project, beneficial and adverse impacts, proposed mitigative measures and alternatives. The project's relationship to existing government policies and plans for the area is also discussed, along with required permits and approvals.

Description of the Proposed Project

The proposed Manini'owali Residential Community is located about five miles north of the Ke-ahole Airport on approximately 388 acres in the North Kona District of the Big Island. The North Kona Development Group (NKDG), the applicant, is seeking the necessary government approvals to develop a residential community of 900 to 1,100 single-family and condominium homes planned around an 18-hole golf course. Also included in this development is a golf clubhouse, golf driving range, tennis center, preservation areas and community park. The homes are intended to be sold for between $500,000 to over $1 million to buyers in Hawai'i and other U.S. states as primary or retirement homes, and to U.S. and foreign residents seeking a second home in West Hawai'i.

The project site is located approximately 1,000 feet from the ocean shoreline, located between the proposed Kaupulehu and Kuki'o (Hu'ehu'e Ranch) resort development properties to the north and the State land at Awake'e to the south and to the west, along the shore. Queen Ka'ahumanu Highway borders the property's eastern boundary. The project site was acquired from the State in a 1991 land exchange for a parcel on the coast at Awake'e.

The site has generally gently to moderately sloping terrain formed by relatively recent lava flows from 1801 and earlier. Pu'u Kuili at Awake'e is the dominant land form of this portion of the coast. Another small cinder cone pu'u is located at the northern end of the subject property. The land is not suitable for agricultural cultivation. Vegetation is sparse, the majority of which is grassland composed of fountain grass with scattered *kiawe* trees. The mauka portion of the site is largely barren *'a'a* and *pahoehoe* flows.

Construction of the project's roads, utilities, golf course, and building sites will require site disturbances such as clearing, grubbing, grading, and excavation. Building construction will involve the wastewater treatment facility, golf clubhouse, tennis center, maintenance building, and 900 to 1,100 residential units. Infrastructure requirements that will be constructed include: roadways; wastewater collection, treatment, and disposal facilities; potable water and non-potable irrigation water supply and distribution systems; and other utilities installations.

The proposed project will create both beneficial and adverse effects on the natural and human environment. A detailed description of the existing environmental conditions was prepared for each environmental factor, and this was used as a background to assess potential benefits and adverse effects.

<u>Beneficial Impacts</u>

There are a number of features associated with this project that will be beneficial to residents of the Big Island, especially those in the West Hawai'i region. Anticipated beneficial impacts of the proposed project are listed below.

1. A new semi-private golf course will be developed on the site which will include periods for public use. The golf clubhouse complex will include a golf driving range, practice putting green, landscaped gardens, swimming pool, locker rooms, tennis courts, a convenience store, and parking facilities.

2. As a condition of the land exchange, upon development of the project, NKDG is required to provide an improved access road to the State's shoreline wilderness park, and develop park facilities. As a result, more County residents will be able to use the excellent Manini'owali Beach at Kua Bay for recreation.

3. Approximately 10 percent of the project site will remain unaffected as natural areas to be contained within preservation areas. Preservation areas will be protected from project development activities. Approximately, 65 percent of the property will be natural and landscaped open space and outdoor recreational uses.

4. Archaeological resources have been inventoried on the property, and significant sites will be data recovered or preserved in accordance with DLNR-HPD and the County. All burials on the site will remain preserved in place.

5. Approximately 280 direct construction jobs will be created over the short-term period between 1994 and 2006, and approximately another 390 indirect jobs will be created over the same period.

6. Approximately 108 direct operational jobs will be created by time of anticipated project completion in 2006.

7. Net annual fiscal benefits to the State government as a result of the project are expected to be $3.4 million (1991 dollars) annually by 2006. Net annual fiscal benefits to the County of Hawai'i are projected to be $5.5 million (1991 dollars) annually by 2006.

8. Job training will be provided for interested local residents for positions available at the Manini'owali community's golf course, clubhouse, tennis center, and maintenance operations.

9. Affordable housing units will be provided off-site. The number and location of the units will be determined in discussions with the State and County.

<u>Anticipated Short-term Adverse Impacts and Mitigative Measures</u>

Project development activities will involve the construction of the residences, golf course, roadways, utilities, and support facilities. Short-term construction-related impacts on the environment will be generated by the project, and mitigative measures will be implemented to minimize these impacts.

Anticipated short-term adverse impacts and mitigative measures are listed below.

1. Soils will be disturbed for grading and excavation, and additional soil will be imported for golf course turf and landscaping ground cover. Some soil erosion will occur during construction but will be controlled on-site. An Erosion Control and Sedimentation Plan for the construction will be prepared for the project, which must be approved by the County of Hawai'i Department of Public Works. Proposed mitigation will include soils management measures and drainage controls that will minimize soil erosion and control it on-site.

2. Introduced wildlife species occurring in areas of the project site that will be cleared for construction will be displaced temporarily to undisturbed areas. Landscape plantings are expected to provide a permanent replacement habitat for some wildlife types. Some native plant species which require less water will be among the species of new landscape plantings. Over 250 acres of the site will be either undisturbed land, landscaped areas and golf course, all of which provide habitat areas for wildlife.

3. Trucks and worker vehicles will create a short-term effect on traffic conditions on local roadways, mainly Queen Ka'ahumanu Highway and its nearby intersections. Mitigative measures that will be implemented to minimize short-term traffic effects will include off-peak truck use of highways, and possibly staggered worker start and finish times.

4. Noise will be generated by construction activities on the project site. Compliance with existing State and County regulations will mitigate construction noise generated by the project to acceptable levels. Rock removal by blasting may be required, which will be accomplished with use of a blast mat to direct the explosive energy into the rock, muffling the airborne pressure pulse and controlling flying debris. The blast will be perceived as a muffled "thump" sound and should cause negligible vibration through ground structures located in the vicinity.

5. Air quality will be affected by the generation of fugitive dust, and construction equipment and worker vehicle emissions. Dust conditions will be controlled by frequent watering of roadways, and equipment will be maintained in proper working order to minimize emissions.

6. Construction activities will be most visible at the entrance on the mauka section of the project site, along the access roadway through the middle of the site. The construction operations will be visible at several points, including the tennis center, entrance features, some residences, portions of the golf course, and the wastewater treatment facility. A 150-foot setback from the Queen Ka'ahumanu Highway right-of-way is proposed, which will help buffer construction activities from the highway. Views of the construction operations on the site will be minimized by proper equipment and materials storage, minimized vegetation clearing, expedient re-vegetation, and non-intrusive security lighting.

7. If the proposed project precedes construction of planned State improvements to Queen Ka'ahumanu Highway, modifications to the highway will be made to construct a temporary channelized intersection with the new project access road, including traffic signals if required. Highway construction will be limited to off-peak hours, and maintenance and protection of traffic will be undertaken according to Hawai'i Department of Transportation requirements. If the State's highway improvements precede the proposed project's construction activities, an unsignalized intersection to a frontage road is planned, and similar measures as those described above would be undertaken to maintain and protect traffic.

8. Emergency medical facilities in Kealakekua, Kailua-Kona, or Waimea may occasionally be utilized by sick or injured construction workers during the period 1994 to 2006.

<u>Anticipated Long-term Adverse Impacts and Mitigative Measures</u>

Once the Manini'owali Residential Community is completely developed and full operations are underway, some long-term adverse effects will have occurred or will continue to occur. Mitigative measures have also been proposed to minimize the long-term adverse effects of the project.

Anticipated long-term adverse impacts and proposed mitigative measures are listed below.

1. Grading of the most of the project site (315 to 325 acres) will affect most of the site's topography. Grading changes will only be undertaken where necessary and will be coordinated with drainage control improvements. A County of Hawai'i Grading Permit must be obtained prior to construction, and proposed grading changes will be fully reviewed and approved. NKDG will preserve the small cinder cone on the northern portion of the project site, some natural buffer areas, a historic trail segment and burial sites.

2. Minor contributions of fertilizer constituents and pesticides will enter storm water runoff generated on the project site. Detention basins, drywells, landscaped areas, and golf course turf will collect this runoff during peak precipitation periods. Fertilizers and pesticides (approved types) will be carefully controlled in amounts applied following an Integrated Pest Management (IPM) program. No applications will be made preceding or during high precipitation periods. A Certified Golf Course Manager will supervise irrigation and maintenance activities. No impact on ocean water quality or marine life is expected.

3. Minor concentrations of nitrates from treated wastewater effluent and fertilizer and pesticides could enter groundwater through percolation of precipitation and irrigation water. Application of irrigation water, fertilizers, and pesticides will be carefully controlled by a Certified Golf Course Manager to avoid over-application. The installation of groundwater monitoring wells will be required to establish baseline pre-project conditions and periodically assess groundwater quality to detect potential degradation of the aquifer.

4. Pending permission from the State, approximately 1.09 mgd of non-potable water (average daily demand) will be withdrawn from the brackish water aquifer and utilized for both domestic purposes (after deslinization) and for irrigation purposes. The Kiholo Aquifer has adequate excess capacity to supply this project well within its maximum *sustainable* yield.

5. Approximately 315 to 325 acres of existing land will be cleared of vegetation in the course of constructing the proposed development. Extensive landscaping will be performed to re-establish vegetation across much of the area, including use of native plant species.

6. Existing habitat for birds and other wildlife species will be affected over the 315 to 325 acres of cleared areas. Some wildlife species will leave these areas, and relocate in adjacent open space areas within the project site, or neighboring sites, such as in the State parkland to the south and west (*makai*). Landscape plantings will re-establish some habitat areas in the golf course perimeter and other planted areas around roadways and buildings.

7. Slight amounts of irrigation water and fertilizer nutrients and pesticides will be introduced to the ocean through groundwater seepage underground. Restrictive fertilizer and pesticides application rates, as well as special design features for on-site containment, will minimize the effect of these chemicals on marine water quality and marine ecology. A preliminary baseline survey of ocean water quality has been made; additional water quality data will be collected along with ocean current measurements. Periodic ongoing ocean water quality monitoring surveys will be conducted at the anchialine pond near Manini'owali Beach and offshore to assess actual water quality effects of the project.

8. There are 25 significant archaeological sites in the project area. Significant sites will undergo archaeological data recovery or site preservation, in accordance with

DLNR-Historic Preservation Division and County recommendations Included among the preserved sites is a portion of a trail which will connect with the shoreline trail on State park property to the west, and will be open for public use.

9. If the proposed Manini'owali project precedes Queen Ka'ahumanu Highway improvements, the project will create a temporary, new intersection to the highway at the project access road. With or without the project, the highway at this intersection is projected to operate under capacity (at Level-of-Service E) during the AM and PM peak traffic hours. Turning/stacking lanes into, and from, the project access road would be installed to minimize delays associated with highway through-traffic. Eventually this project will be served by the expanded Queen Ka'ahumanu Highway, which will terminate the use of the at-grade intersection.

10. Noise will be generated by vehicles traveling to and from the project on local roadways, and by the operation of the maintenance equipment.

11. Parts of the project will be visible from Queen Ka'ahumanu Highway and from some areas along the shoreline. However, due to distance and the slope of the land, the development will generally not be visible from Manini'owali Beach at Kua Bay. Visible elements of the project will include: the project entrance, the project access road, some residential structures and the peak of the clubhouse roofline. Sensitive building design and landscaping will minimize the visibility of structures, roadway features, and lighting from the areas *mauka* of the project.

12. The population increase associated with Manini'owali is approximately 2,200 persons (full-time and part-time residents), which will represent approximately three percent of the region's population in 2006.

13. The project will create a maximum of seven tons per day of refuse for removal and disposal by a private carting firm at an appropriate County landfill, or other solid waste disposal facility. Property tax revenues generated by the project are expected to alleviate any shortage in the waste disposal facilities capacity due to the added demand caused by the project.

14. The area's existing elementary, intermediate, and high schools are already at capacity in student enrollment. According to State eduction officials, 135 school children would be added to local schools by the project, creating an impact on the capacity of area already over crowded schools.

15. Public services such as police and fire protection, emergency medical facilities, and recreational facilities will be required by the project, but only a minor effect is expected on these services. Property tax revenues generated by the project are expected to cover any increase in operational costs caused by the project.

Alternatives to the Proposed Project

Three alternatives to the proposed project have been considered involving different land use and development concepts. These alternatives include: the no-action alternative; a 2,000-unit residential development; and a recreational alternative including two 18-hole golf courses. Included below are brief discussions of each alternative, selected associated impacts, and a comparison with the proposed project.

No Action Alternative: The no-action alternative would keep the project site in its present undeveloped condition. No beneficial or adverse effects would be generated by this alternative. The owner of the land would continue to pay property taxes for this land without gaining any return on the initial investment or tax payments. Archaeological sites on the property would probably continue to be vandalized. In terms of environmental consequences, this alternative would create the least adverse and beneficial effects of all alternatives considered. There would continue to be limited public access to the site and the Kua Bay area.

Residential Subdivision Alternative: A residential subdivision could be developed utilizing most of the site at the same density as the proposed development. This project would result in twice as many homes (2,000) being built, as compared to the proposed project, with corresponding increases for roads and utilities. Overall water demand would be about the same as with the proposed project, but a larger portion would be for potable water. There would be requirements for approximately twice the wastewater collection, treatment, and disposal facilities to support the entire development, with disposal by injection or other non-golf course method. Traffic generated by this development would create an over-capacity condition during the afternoon peak traffic hour at the project access road intersection to Queen Ka'ahumanu Highway. Air quality would be slightly worse, but still within National and State EPA limits. Far fewer employment opportunities would be generated. As with the proposed project, the affordable housing requirement for this project would be satisfied on-site, with approximately 1,200 units, or 60 percent of the total residential development. In comparison to the proposed project, this alternative would create similar, or greater, environmental impacts, but without the benefits of recreational facilities development.

36-Hole Golf Course Alternative: The recreational alternative would involve development of two 18-hole golf courses, clubhouse, driving range, and a golf course maintenance facility. Approximately 350 acres would be developed, and impacts to topography and vegetation would be approximately the same as the proposed project. More than twice as much irrigation water would be required to irrigate the additional golf course area, with minimal potable water requirements. Overall water consumption would be greater with this alternative. Vehicle traffic generated by the project would be much less with this alternative. Use of fertilizers and pesticides would be greater overall with two golf courses than with the proposed project. Noise levels of traffic would be slightly less along Queen Ka'ahumanu Highway, and less air pollutants would be generated. No housing would be created by the recreational alternative, and property tax revenues would be about one-fifth of those generated by the proposed project. The requirement for government services would also be appreciably less. In comparison to the proposed project, the environmental impacts of this alternative would be similar and in some cases greater.

Relationship to Existing Policies and Plans

This Draft EIS includes a detailed discussion of how the proposed project is generally consistent with most existing State and County policies and plans for the area. Specific measures are being taken to minimize project plans which contradict any of these policies and plans. Plans and policies considered in this evaluation were:

1. Hawai'i State Plan
   Objectives and Policies, Priority Guidelines, and Functional Plans
2. County of Hawai'i General Plan
3. State of Hawai'i Coastal Zone Management Plan Program
4. Special Management Area Rules and Regulations of the County of Hawai'i
5. West Hawai'i Regional Plan (1989) and earlier regional plans

An extensive discussion of the project as compared to these policies and plans is contained in Section 6.

Required Permits and Approvals

Several "discretionary" permits and approvals will be required to implement the proposed project. These are as listed below with their related agencies.

1. State Land Use District Boundary Amendment
   From Conservation to Urban
   Agency: State Land Use Commission

2. Conservation District Use Application (CDUA)
   For subdivision of lands within a Conservation District
   Agency: Board of Land and Natural Resources

3. County of Hawai'i General Plan/LUPAG Map Amendment
   General Plan Land Use section: To include Manini'owali as an urban center
   Land Use Pattern Allocation Guide (LUPAG) Map: From Conservation to Urban Expansion
   Agency: County Planning Department/County Council

4. Zoning District Change
   From Open to a Zoning Designation to be determined which allows medium density residential and golf course development
   Agency: County Planning Department/County Council

5. Special Management Area (SMA) Use Permit
   Agency: County Planning Commission

6. New Water Source Development
Agency: State Department of Land and Natural Resources/Water Commission

7. Numerous other permits and approvals will be required from the State and the County. These actions are generally ministerial in nature; however, each is important in the overall success of the project.

Some of the permits at the State level include:

• Department of Health	Wastewater treatment facility
• Department of Transportation	Entrance from Queen Ka'ahumanu Highway

County of Hawai'i approvals include:

• Planning Department	Subdivision and plan approvals
• Department of Water Supply	Water source and distribution system
• Department of Public Works	Building and grading permits

SECTION 1 – Introduction

1.0 INTRODUCTION

Section 1 provides an introduction and background of the proposed development, including location, ownership, and land use of surrounding properties. Detailed descriptions of the project are further described in the following sections.

1.1 DEVELOPMENT SUMMARY

Applicant/Land Owner:	North Kona Development Group
Property Location:	North Kona Judicial District, County of Hawai'i, Manini'owali/Kuki'o 2 *Ahupua'a.*
Tax Map Key (TMK):	Division 3, Zone 7, Section 2, Plat 04, Parcel por. 17
Land Area:	388.057 acres
Existing Land Use	State Land Use District: Conservation-General Subzone (97%) and Resource Subzone (3%) County General Plan/LUPAG: Conservation/Open Area County Zoning: Open Special Management Area: Entire Site Shoreline Setback: Property boundary is located approximately 1,000 feet *mauka* of the shoreline.
Existing Land Use:	Vacant, with no physical improvements except portion of a dirt road accessed from Queen Ka'ahumanu Highway. Road leads to Kua Bay and is accessible to four-wheel drive vehicles.
Proposed Land Uses:	Low- and medium-density residential subdivision of between 900 to 1,100 dwelling units in a mix of approximately 700 single-family and 300 multi-family residences, 18-hole golf course and clubhouse, tennis facility, and supporting infrastructure.
Proposed Changes to the Hawai'i County General Plan:	Requested changes to the General Plan: 1) Amend the General Plan Land Use section (p. 81) to include Manini'owali/Kuki'o 2 as an urban center, and 2) Amend the LUPAG Map from the existing designation of Conservation to Urban Expansion.
Proposed Change to the State Land Use District:	Reclassification of 388.057 acres from the Conservation District to the Urban District.
EIS Accepting Agency:	County of Hawai'i Planning Department

1.2 LOCATION

The subject property of Manini'owali/Kuki'o 2*, owned by the Applicant, the North Kona Development Group (NKDG), is situated in the North Kona Judicial District on the island of Hawai'i (Figure 1). The North Kona District lies on the western coast of the island, within the larger region known as West Hawai'i (Figure 2). The district's northern boundary is at Anaeho'omalu Bay and its southern boundary is at Kealakekua Bay. The inland boundaries of the district are defined by the land masses of Mauna Loa and Hualalai. The North Kona Judicial District includes Census Tracts 215 (Kailua-Kona) and 216 (the remainder of the district). Kailua-Kona, the second largest town in Hawai'i County, is the primary commercial center of the region. Secondary urban centers are found in the communities of Holualoa, Honalo, Kainaliu, Keauhou and Kalaoa.

The NKDG property of Manini'owali (TMK: 7-2-04: por. 17) is bounded by the Queen Ka'ahumanu Highway to the east, State lands to the south and west, and the urban areas of Kuki'o 1 and Kaupulehu to the north (Figure 3). The site is approximately four miles north of Ke-ahole Airport, and located *makai* of the Queen Ka'ahumanu Highway.

The property is located approximately 1,000 feet *mauka* of the shoreline which includes the sandy Manini'owali Beach at Kua Bay. To the south of the property is Pu'u Kuili, a natural landmark which rises above the general coastal landscape and is visible from the north and south approaches of the Highway.

1.3 BACKGROUND

NKDG acquired the 388-acre Manini'owali parcel in April 1991 through exchange with the State of Hawai'i pursuant to Section 171-50, Hawai'i Revised Statutes. An Environmental Assessment was filed with the State Department of Land and Natural Resources (DLNR) in October 1990 addressing the details of the exchange (NKDG, October 1990). The subject Manini'owali parcel of 388 acres, formerly owned by the State of Hawai'i, was exchanged for the adjacent land to the south at Awake'e totaling 333.817 acres, formerly owned by NKDG (Figure 4). The State's acquisition of Awake'e, while retaining the shoreline at Manini'owali, consolidates their ownership of coastal lands in this area, and furthers their goal of developing a regional shoreline wilderness park along the North Kona coast from Keahole to Kua Bay. In turn, NKDG has acquired property adjacent to the Urban District lands of Kuki'o 1 and Kaupulehu where there is existing resort development and approved resort projects in various stages of implementation.

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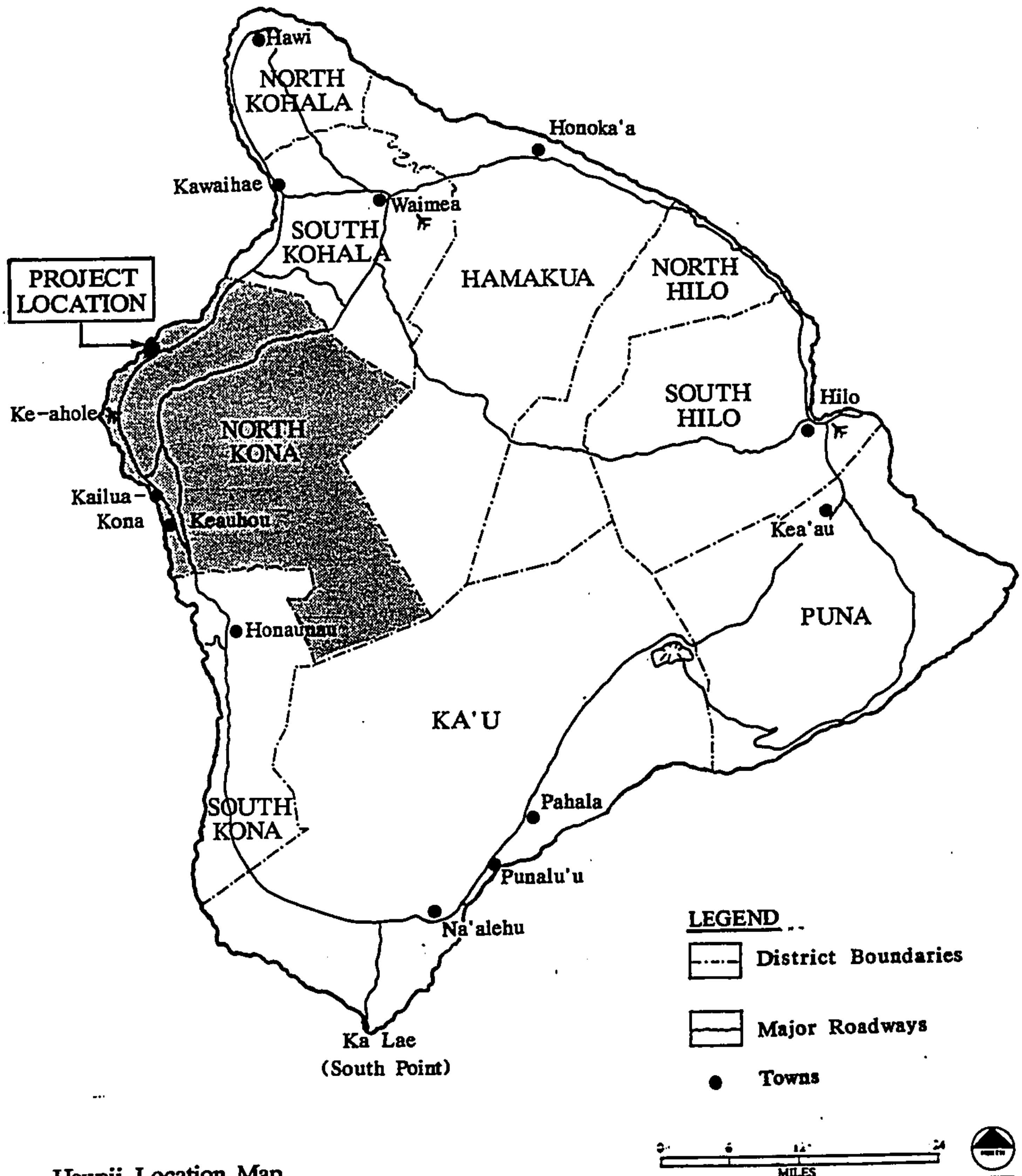
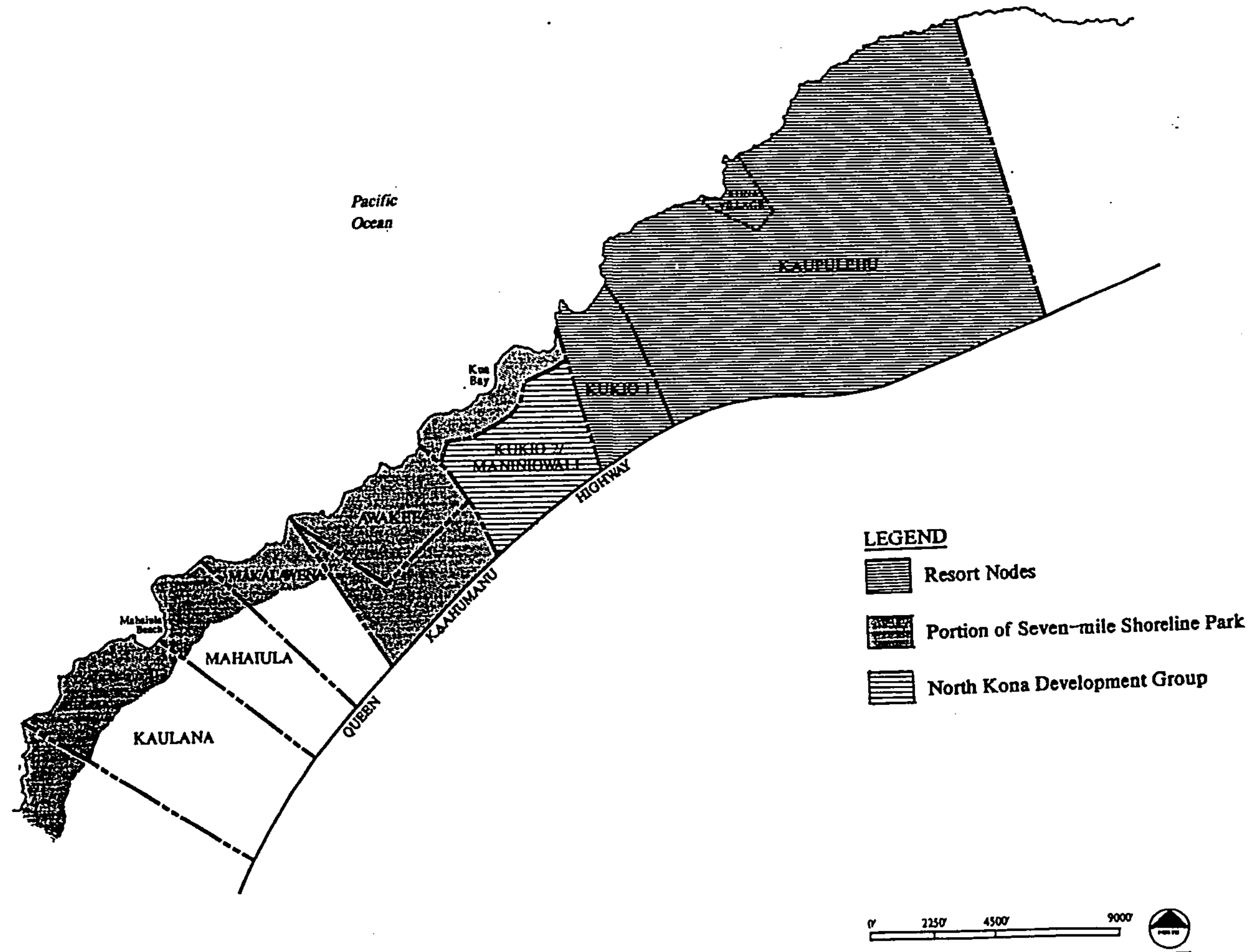
* The *ahupua'a* known as Manini'owali/Kuki'o 2, extends over many miles from the coast to the crest of Hualalai. Most of the land, except for the subject 388.057 acres owned by the North Kona Development Group, is owned by the State of Hawai'i. In this document, reference to Manini'owali generally identifies NKDG lands. The State's portions are identified as such, or as wilderness park land. Additionally,the Manini'owali parcel includes a portion of land known as Kuki'o 2. For the purposes of this document, the subject parcel is generally referred to as Manini'owali.



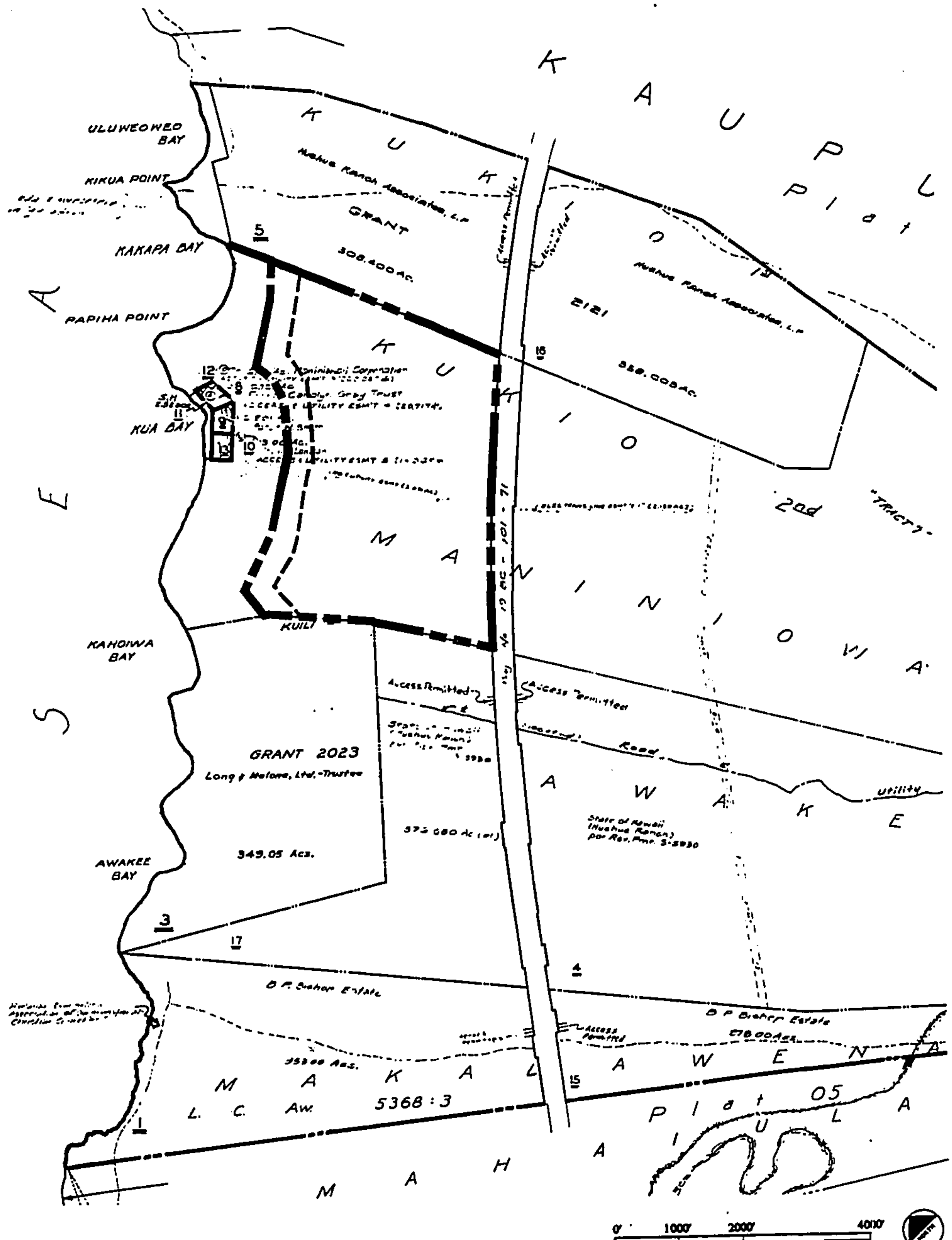
Hawaii Location Map

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 1

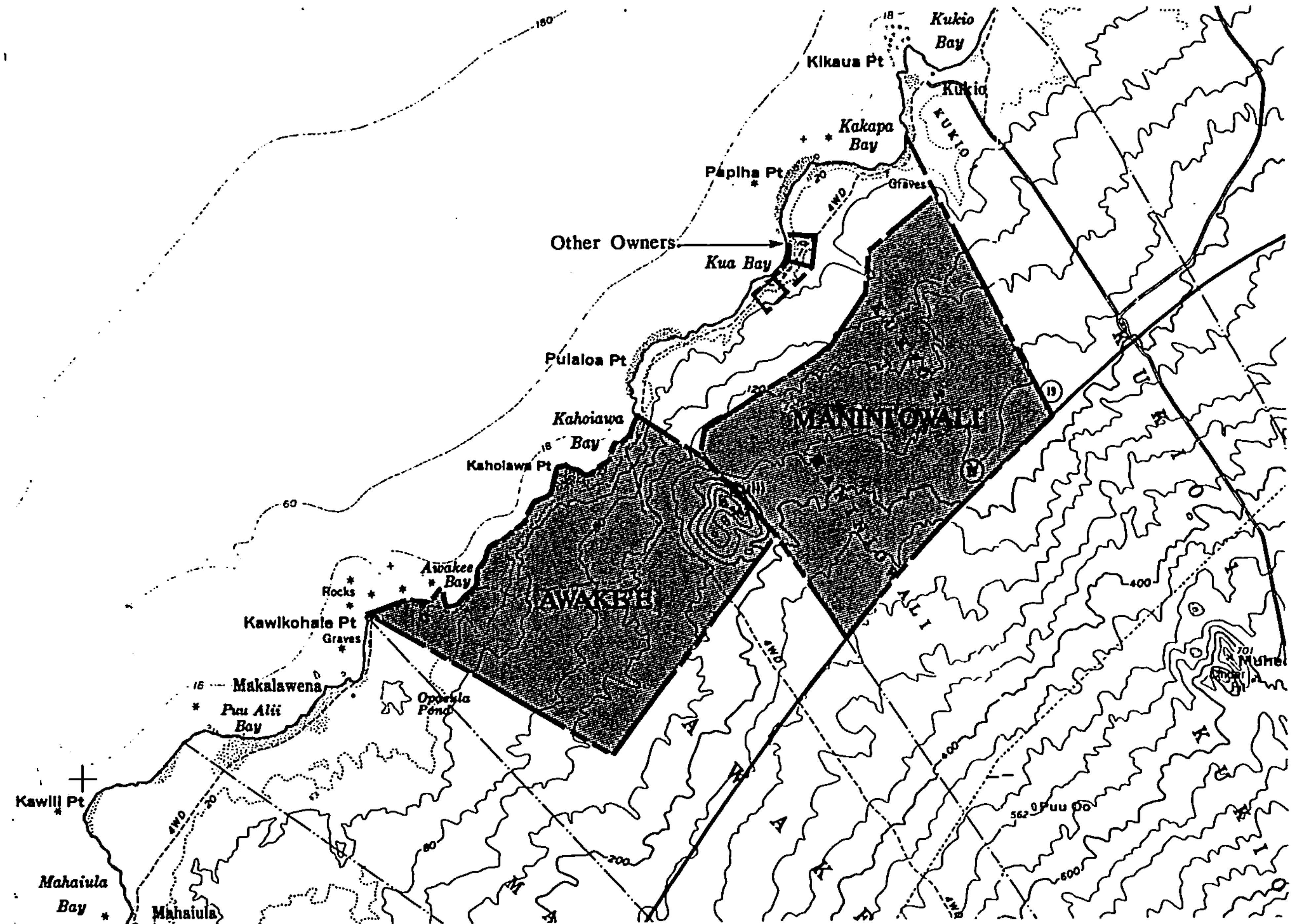


Regional Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY
FIGURE 2



Property Boundary Map
MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 3



Manini'owali/Awake'e Exchange Parcels Boundary

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 4

The Board of Land and Natural Resources (BLNR) approved the NKDG's land exchange proposal subject to numerous conditions. Many of the conditions have been incorporated into the conveyance deed as perpetual easements and covenants. As part of the land exchange process, the makai boundary of the land was set at 1,000 feet from the shoreline. These are briefly summarized as follows:

1. Within the privately owned Manini'owali parcel, in a 400 feet wide zone mauka of and along the seaward boundary line of Kuki'o 2/Manini'owali containing approximately 53.037 acres, the construction and placement of any buildings or structures is prohibited. The 400 feet wide zone may be used for golf course purposes.

2. The entire privately owned parcel of Kuki'o 2/Manini'owali shall be restricted to residential, residential-commercial, condominium and apartment, golf course, golf course clubhouse, tennis center, and/or other similar ancillary uses, upon obtaining all the applicable State and County approvals and permits. The development of a hotel or apartment offering time-sharing shall be prohibited.

3. Any portion of the designated landmark of Pu'u Kuili that is found to be within the exchange parcel, and the smaller unnamed *pu'u* located at the Kuki'o end of the land shall be preserved.

4. Continuous public access to Kua Bay shall be retained by the State until a superior access is provided, at which time the existing vehicular and utility access may be relocated and/or extinguished upon the mutual agreement of the NKDG and the State. The State shall retain a sixty (60) foot wide easement from Queen Ka'ahumanu Highway to Kua Bay for vehicular access and utilities across the Kuki'o 2/Manini'owali parcel. The location of the easement shall be determined by park planning, final archaeology work, and land use planning. If an access acceptable to the Chairperson is provided off-site, this easement shall be extinguished with the approval of the BLNR.

5. In the event the proposed project is developed, the landowner shall construct a public roadway from Queen Ka'ahumanu Highway to the Kua Bay area and public park facilities. This is subject to the landowner obtaining all applicable State and County approvals and permits [for the permitted uses]. The roadway and improvements may be considered in satisfying all or part of any such requirements which may be imposed by the State Land Use Commission and/or the County of Hawai'i.

   In the event that the State constructs the public access roadway and the park facilities, and the improvements satisfy any of the public access requirements which may be imposed by the State Land Use Commission and/or the County of Hawai'i, the landowner shall reimburse the State for the full cost of the roadway and park facilities in an amount not to exceed the maximum sum of $2,500,000.

6. In the event that NKDG develops a water system at the private Kuki'o 2/ Manini'owali parcel, the State shall have the right to connect to the water system.

1.4 OWNERSHIP AND DESCRIPTION OF THE PROPERTY

The project site is owned by the North Kona Development Group (NKDG), a Hawai'i Corporation. NKDG is affiliated with Davidson Communities, an award-winning San Diego, California residential developer. NKDG acquired the property in May 1991 through a land exchange with the State of Hawai'i (described in the previous section). NKDG proposes to develop a low and medium-density residential community and recreational amenities, including a golf course, club house, tennis center and supporting infrastructure.

The project site is currently vacant except for a portion of an unimproved dirt road extending *mauka-makai* from Queen Ka'ahumanu Highway leading to the Kua Bay area. This road is normally passable only by four-wheel drive vehicles.

The project area consists of 388 acres of open land situated approximately five miles north of Ke-ahole Airport. The site is roughly rectangular in shape and located approximately 1,000 feet from the shoreline. The entire site is covered with lava and slopes gently from approximately 60 feet above mean sea level (msl) to 250 feet msl at the border of Queen Ka'ahumanu Highway, about 3,600 feet inland. Natural features on the property include a small unnamed *pu'u* (elevation 160 feet above msl) at the northern end of the site and vegetation consisting of *kiawe* thickets and fountain grass on approximately half of the property. The subject property is presently described as TMK: 7-2-04: por. 17.

1.5 SURROUNDING LAND USES

The site is surrounded on all sides by land. Listed below are the surrounding land uses and owners starting from the east.

- Across Queen Ka'ahumanu Highway to the east (*mauka* of the NKDG property), is the *mauka* portion of the Manini'owali/Kuki'o 2 *ahupua'a*. This land rises near to the summit of Hualalai. It is owned by the State of Hawai'i (TMK: 7-2-04: por. 17) This land is currently vacant, and designated State Conservation near the highway.

- The parcel to the south of the NKDG property is a portion of the Awake'e *ahupua'a* (TMK: 7-2-04: 3 and por. 17) owned by the State of Hawai'i and a portion of the newly acquired Awake'e land previously owned by NKDG (TMK: 7-2-04: 3). It is presently vacant but the State's plan is to integrate these two Awake'e parcels into a regional shoreline wilderness park. These lands are designated State Conservation.

- To the west of the NKDG property (*makai*) is a 1,000 feet strip of coastal lands of the Manini'owali/Kuki'o 2 *ahupua'a*. The State currently owns 123 of the 132 acres.

Nine acres located at Kua Bay are owned by private landowners. The State has initiated condemnation proceedings to acquire these small parcels. When the acquisition is complete this coastal strip will become a key area within the shoreline regional park. All of these lands are designated State Conservation.

- To the north of the NKDG property is the Urban-designated resort areas of Kuki'o 1, Kona Village and Kaupulehu. The adjacent property, Kuki'o 1 (TMK: 7-2-04: 05), owned by Hu'ehu'e Ranch has received approval for a resort development which will include hotel, resort residential condominium, and golf course uses. The resort development will also extend to the Hu'ehu'e property located *mauka* of Queen Ka'ahumanu Highway. The *mauka* and *makai* Hu'ehu'e lands at Kuki'o, the Kona Village resort and a portion of the Kaupulehu lands are classified within the State Urban District.

1.6 PURPOSE AND CONTENTS OF THE ENVIRONMENTAL IMPACT STATEMENT

This Final Environmental Impact Statement (FinalEIS) has been prepared to identify and evaluate the existing conditions and potential impacts of the development of the Manini'owali Residential Community on the natural and human environment. The Final EIS is required as part of an application to the County of Hawai'i, General Plan Amendment. This document is being filed with the County of Hawai'i Planning Department and with the State Office of Environmental Quality Control (OEQC).

This report is presented in nine sections. Section 1 contains this introduction. Section 2 describes the NKDG development proposal. Section 3 lists the land use and zoning controls applicable to the property. The environmental, social, and economic characteristics of the proposed development are presented in Section 4, including existing conditions, potential impacts, and mitigative measures. Alternatives to the residential/golf course community are described in Section 5. A review of the appropriate existing State and County policies and plans is contained in Section 6. Section 7 summarizes issues not resolved to date in the planning and review of the proposed project. Section 8 lists the individuals, organizations, and governmental agencies which have been contacted in the preliminary planning process, lists individuals who have been involved in the preparation of this report, and provides copies of comment letters. Section 9 includes copies of the consultant reports referenced in the text (Appendices A-O) which have been used in the writing of this document.

In addition to the General Plan Amendment Petition, the EIS process is being completed to partially satisfy the requirements for several additional approvals, including: a State Land Use District Boundary Amendment, a County of Hawai'i Special Management Area Use Permit, and a County of Hawai'i Change of Zone Application.

SECTION 2 – Project Description

2.0 PROJECT DESCRIPTION

This section presents a discussion of the proposed Manini'owali Residential Community project, including elements of the Master Plan. Also discussed in this section are construction activities, infrastructure, a preliminary development timetable, preservation of archaeological and natural features, and public access to the shoreline.

2.1 MASTER PLAN DEVELOPMENT GOALS

The overall goal of this project is to develop a residential community with recreational amenities of a golf course and tennis facility on the 388-acres site. The various land use elements of the Master Plan, as shown in Figure 5, include 900 to 1,100 single and multi-family residential units, 18-hole golf course, clubhouse, driving range, tennis facility, hiking trails, and open space preserve/buffer areas. Table 1 includes the approximate areas of each land use element included in this conceptual land use plan.

Infrastructure facilities to support the development include the internal circulation roadway network, a wastewater treatment and disposal system, a potable water supply and fire protection system, a non-potable water irrigation system and other utilities systems.

The Master Plan also delineates the preservation commitments of natural and archaeological resources on the site including a small cinder cone (*pu'u*), historic trail, and burials. Under direction from DLNR and the Hawai'i Island Burial Council, the location of these burials will not be shown on maps included in the EIS. A 150-foot wide buffer zone will be established along the *mauka* boundary of the site at Queen Ka'ahumanu Highway.

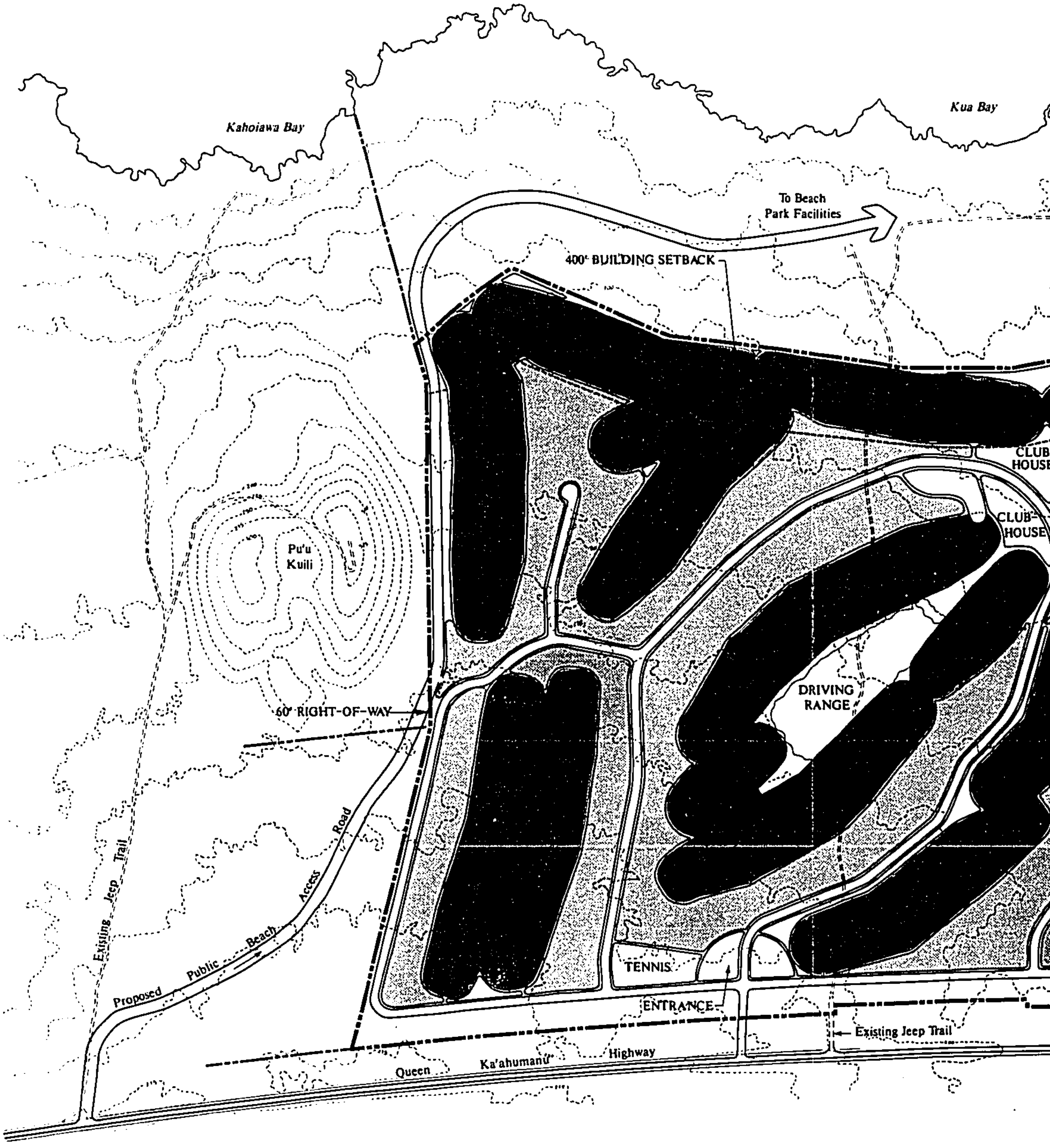
Additionally, as required by the terms of the land exchange with the State of Hawai'i, Should the project proceed as planned, NKDG will provide continued and improved access to Kua Bay and provide park improvements at the State-owned coastal portion of the Manini'owali *ahupua'a*. A brief description of each element of the Master Plan is presented below.

2.1.1 Residential Component

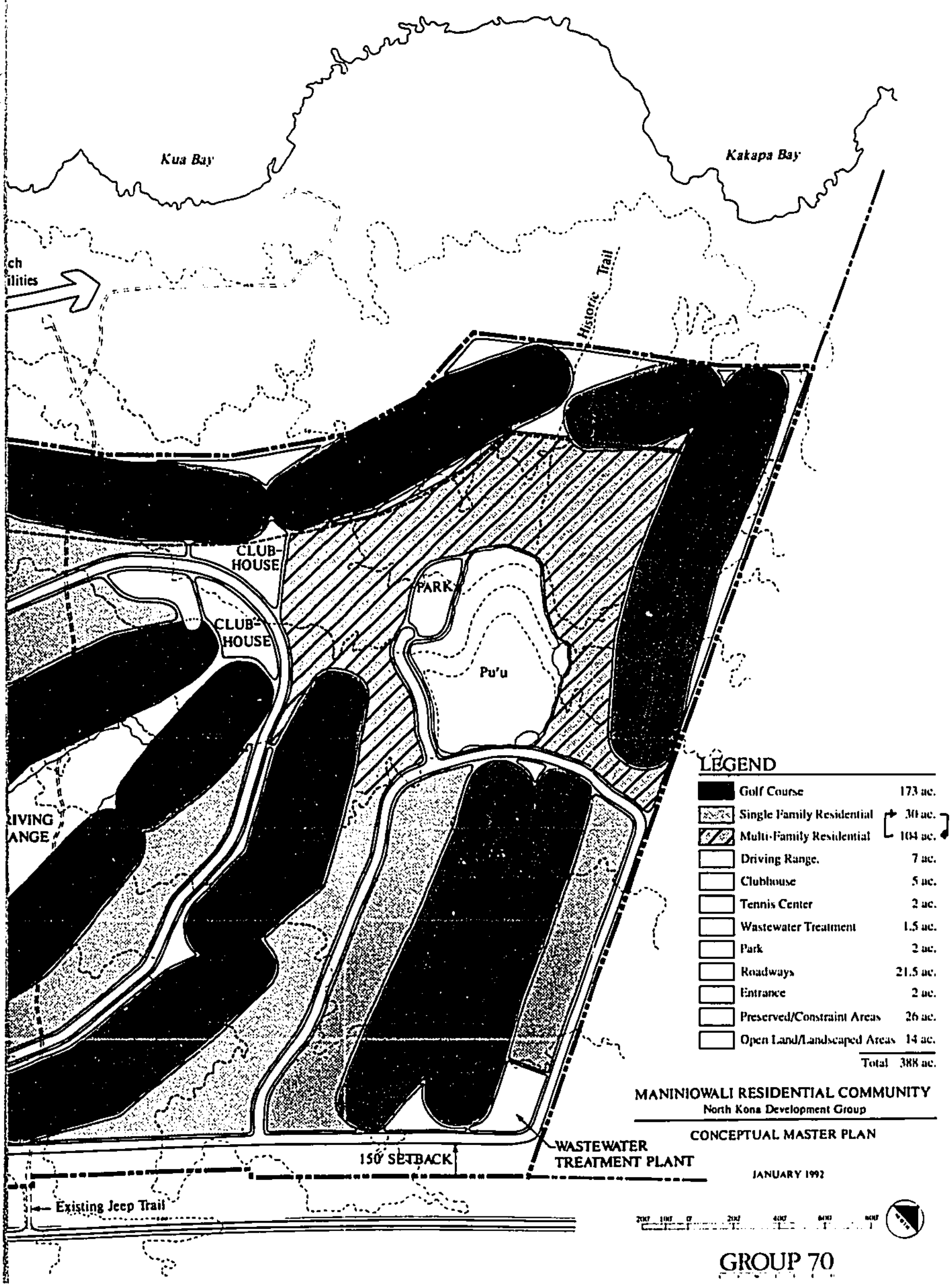
This project proposes a low- to medium-density development of 900 to 1,100 residential units in a housing mix which will include single and multi-family units covering approximately 134 acres (including landscaped areas). Three types of units are planned: single-family residences, single-family attached, and condominium units.

2.1.2 Golf Course

Approximately 170 acres of the site will be used to create an 18-hole golf course and surrounding landscaped areas. The golf course will be a recreational amenity to the



Kahoiawa Bay
Kua Bay
To Beach
Park Facilities
400' BUILDING SETBACK
CLUB
HOUSE
CLUB-
HOUSE
Pu'u
Kuili
DRIVING
RANGE
60' RIGHT-OF-WAY
Existing Jeep Trail
Proposed Public Beach Access Road
TENNIS
ENTRANCE
Existing Jeep Trail
Queen Ka'ahumanu Highway



Kua Bay
Kakapa Bay
Historic Trail
ch
ilities
CLUB-HOUSE
CLUB-HOUSE
PARK
Pu'u
RIVING
ANGE
150' SETBACK
WASTEWATER TREATMENT PLANT
Existing Jeep Trail
LEGEND
Golf Course 173 ac.
Single Family Residential 30 ac.
Multi-Family Residential 104 ac.
Driving Range. 7 ac.
Clubhouse 5 ac.
Tennis Center 2 ac.
Wastewater Treatment 1.5 ac.
Park 2 ac.
Roadways 21.5 ac.
Entrance 2 ac.
Preserved/Constraint Areas 26 ac.
Open Land/Landscaped Areas 14 ac.
Total 388 ac.
MANINIOWALI RESIDENTIAL COMMUNITY
North Kona Development Group
CONCEPTUAL MASTER PLAN
JANUARY 1992
GROUP 70

Figure 5

TABLE 1

CONCEPTUAL MASTER PLAN
LAND USES AND APPROXIMATE AREA

FACILITIES	APPROXIMATE AREAS (ACRES)	
Golf Course	**170**	**(1)**
Residential	**134**	
Facilities		
Golf Course Maintenance Facility	3	
Driving Range	7	
Clubhouse	5	
Tennis Center	2	
Wastewater Treatment	1.5	
Park	2	
Subtotal	20.5	
Entrance	**2**	
Roads		
40' Internal Road (Right-of-way)	19	
60' Park Access Road (Right-of-way)	.5	
Subtotal	19.5	
Preserve/Constraint Areas		
Cinder cone (small pu'u) preserve	10	
Highway setback	14.5	
Open Land/Landscaped Buffer Zones	14	
Historic preserve	1.5	
Subtotal	40.0	
Total Land Area	**388**	

(1) Includes approximately 86 acres of turfed play areas and 84 acres of surrounding landscaped and natural land area.

members of this new community, and will also provide an open space area adjacent to most homes. The golf course will weave through the site with residential frontage along its entire length. Parts of five golf holes are located within the 400 feet-wide "no structures zone", as described in Section 1.3.

The Master Plan (Figure 5) shows the preliminary layout for the golf course. Portions of the golf course will be constructed following a target golf design to minimize disturbance of natural areas. The golf course will have views of the ocean and mountains, as well as the natural terrain of the lava fields. Ponds will be constructed as water features on several holes, and will serve aesthetic and storm water runoff control purposes, and may also provide for some of the irrigation water storage.

2.1.3 Clubhouse

Associated with the golf course will be a five-acre clubhouse area. The clubhouse will include a restaurant, snack bar, office, locker rooms, a kitchen, and a pro-shop. Other small commercial uses may be proposed at the clubhouse, such as a small convenience store to serve the local residents. A practice putting green, swimming pool, tennis courts, landscaped gardens, and parking area will also be provided.

2.1.4 Driving Range

A golf driving range will be constructed within the golf course, covering approximately seven acres. The driving range will contain 15 to 25 tee positions and a small manager's office.

2.1.5 Golf Course Maintenance Area

The golf course maintenance area will contain a building to house maintenance equipment and offices for the maintenance staff. The maintenance area will utilize approximately three acres of the site, located adjacent to the golf course. The site for this facility has not been defined in the current conceptual plan. The maintenance building will also contain the raw materials for course maintenance, including sand and chemicals. This building will be designed according to standards required for proper chemical storage and usage.

2.1.6 Tennis Facility

The tennis facility will include tennis courts, a tennis clubhouse including locker rooms, pool, exercise room and other support facilities. This facility will cover approximately two acres, including landscaping and parking. The tennis area is planned to be located near the project entrace at Queen Ka'ahumanu Highway.

2.1.7 Entrance and Circulation Roadway Network

Access to the Manini'owali Residential Community will be via a new roadway extending *makai* from Queen Ka'ahumanu Highway. Figure 5 shows the proposed entrance location and circulation roadway network. The circulation roadway system is planned to provide access for residents and visitors using the recreational amenities at the site. The roadways will be privately owned and maintained by a property owners association. Internal roadways will likely include a bicycle lane.

2.1.8 Wastewater Treatment Facility

Wastewater will be generated at the project by the residences, the clubhouse, and the tennis facility. An on-site wastewater treatment facility is planned to be located near the northwestern corner of the property on an, approximately, 1.5 acre site. This facility will be constructed by NKDG at their own cost. A wastewater collection system will be installed primarily along the proposed circulation roadway system, and will be connected to all buildings where wastewater will be generated. Gravity sewers and force mains will be used, as topography requires, to convey wastewater to a wastewater treatment facility. Activated sludge treatment process is proposed for this facility.

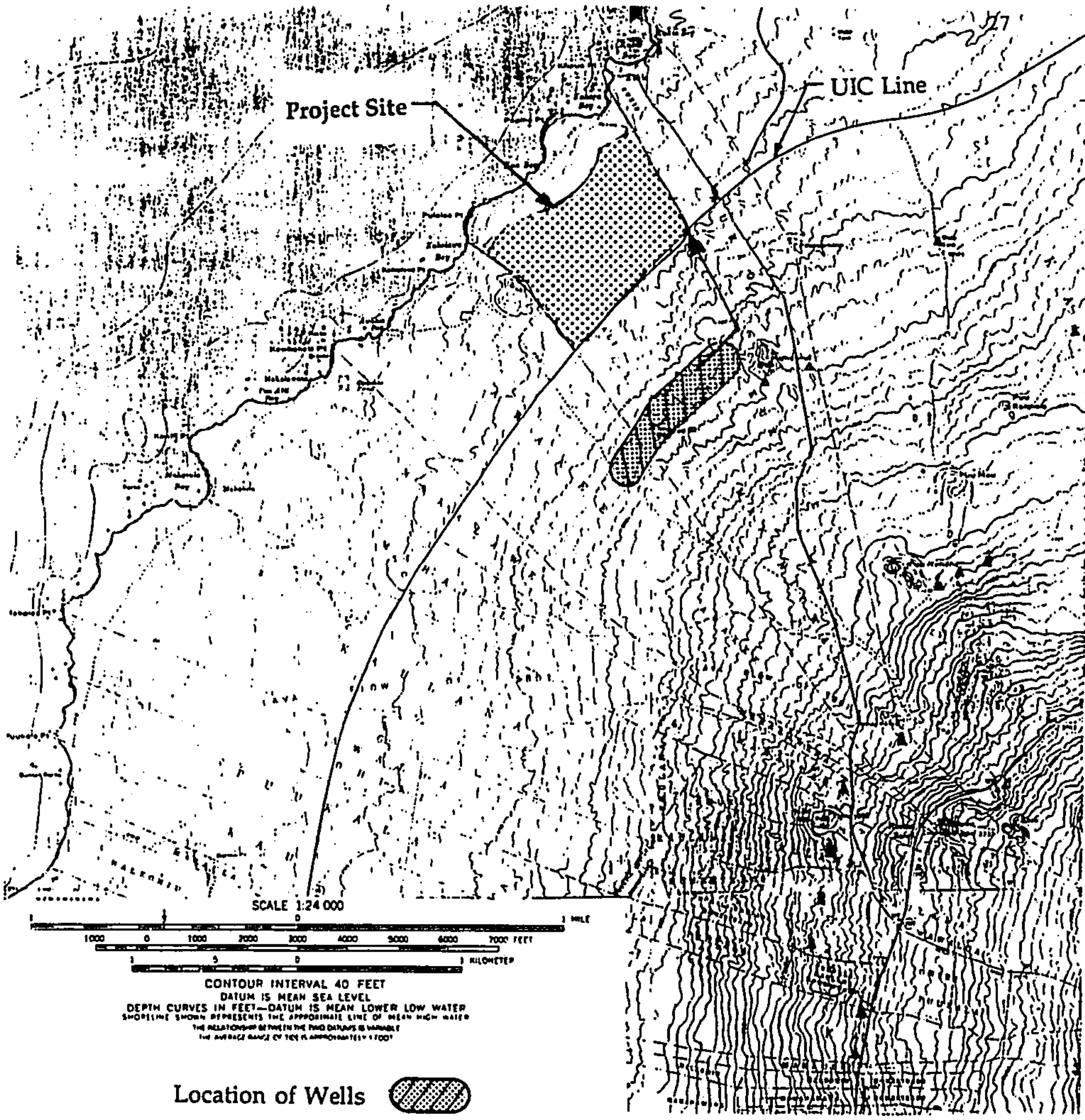
2.1.9 Potable Water System

NKDG is supplying its residential community with a dual system of potable and non-potable brackish water for residential use and irrigation, respectively. The proposed development plan calls for brackish water to be pumped from beneath State lands at approximately 600 feet above mean sea level (Figure 6). NKDG will be requesting permission for use of State lands in the *mauka* section of Manini'owali for water source development. With the use of a desalinization system, the water pumped will be able to satisfy the total water demand of the Manini'owali Residential Community (Table 2).

Figure 7 illustrates the components and operation of the water system. The water will be stored at the source in a primary water tank. Pipes will transmit the water over State land to the project site. Brackish water will be desalinated through a reverse osmosis (RO) system located on the project site. The potable water will be used by households in the community, ultimately becoming wastewater. The RO process will also produce an equal quantity of by-product water, which will be used for irrigation. Once approvals are received, it is anticipated that NKDG will also supply potable water to the State's future park at Kua Bay.

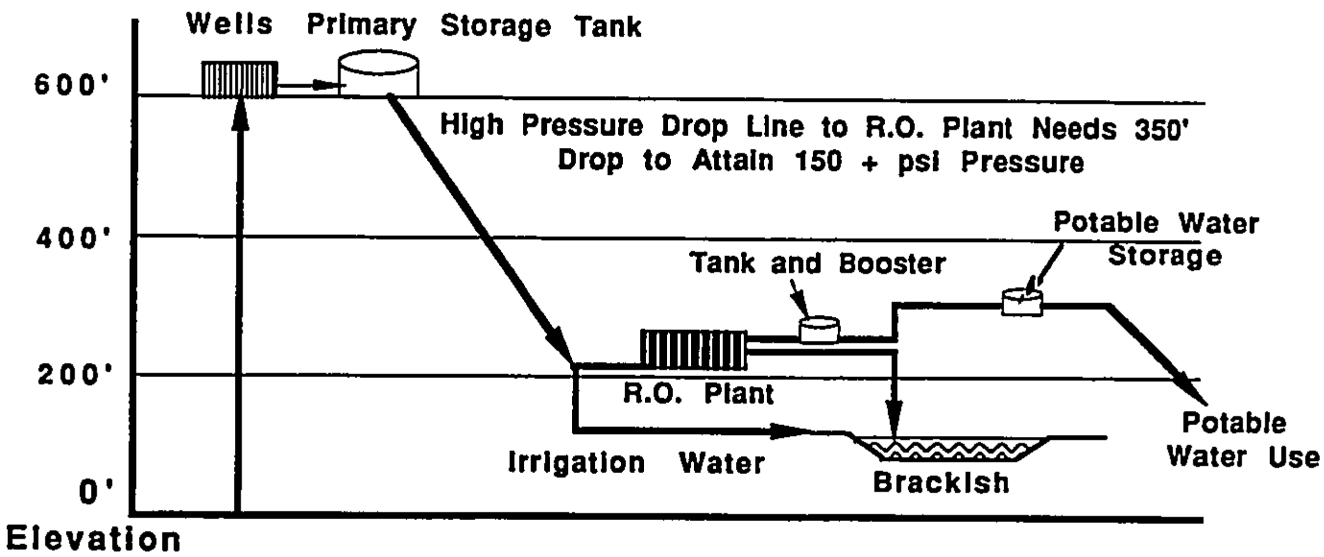
2.1.10 Non-Potable (Irrigation) Water System

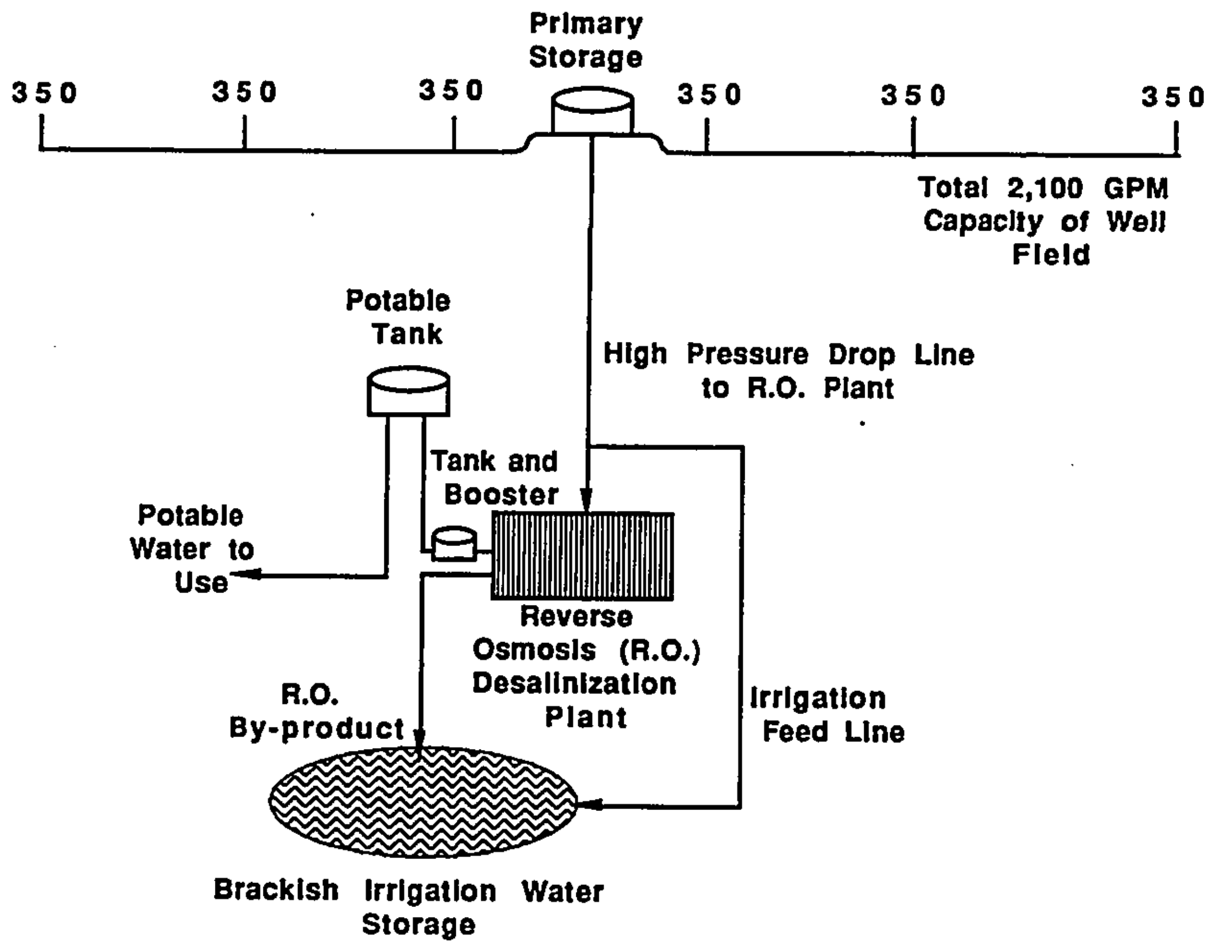
Irrigation water will be required to maintain the golf course turf and landscaped areas. Non-potable water for irrigation includes brackish water, by-product water from the RO desalinization process, and treated wastewater effluent. By-product water will be combined with non-desalinated brackish water in suitable proportions to maintain water quality integrity, and use this for irrigation. To minimize the project's demand for water, the wastewater will also be treated and then recycled for use in golf course irrigation. However, the treated wastewater effluent will be mixed with brackish and by-product water and used only for irrigation of the golf course and community landscaped areas, and not on residential lawns and landscaping vegetation.



Proposed Location for Brackish Water Wells

MANINI'OWALI RESIDENTIAL COMMUNITY **FIGURE 6**





Schematic Layout of Proposed Water System

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 7

TABLE 2

PROJECTED POTABLE AND NON-POTABLE WATER DEMAND

POTABLE WATER USE	AVERAGE DAILY DEMAND GAL/UNIT	(GPD)(1)	MAXIMUM DAILY DEMAND GAL/UNIT	(GPD)
1,000 Housing Units	400(2)	400,000	600	600,000
1 Golf Club House and Tennis Center		20,000		30,000
1 Golf Maintenance Center		10,000		15,000
1 Sewage Treatment Plant		600		900
TOTAL POTABLE WATER DEMAND		**430,600**		**645,900**

NON-POTABLE WATER USE	AVERAGE DAILY DEMAND GAL/UNIT	(GPD)	MAXIMUM DAILY DEMAND GAL/UNIT	(GPD)
1,000 Housing Units	300	300,000	450	450,000
Golf Course (86 acres turf) and Driving Range (7 acres),	4,800	446,000	7,200	670,000
Landscaping (40 acres)	4,800	192,000	7,200	288,000
3 Water Features	1,200	3,600	1,800	5,400
1 Sewage Treatment Plant	5,400	5,400	8,100	8,100
TOTAL NON-POTABLE WATER DEMAND		**947,000**		**1,421,500**
TREATED EFFLUENT (RECYCLED POTABLE WATER)		**-291,200**		
R.O. BY-PRODUCT WATER		**-430,600**		
ADJUSTED TOTAL NON-POTABLE WATER DEMAND		**225,600**		
TOTAL AVERAGE DAILY DEMAND			**1,086,800(3)**	

(1) gpd = gallons per day
(2) County of Hawaii DWS standard
(3) Average daily water demand from brackish well field

SOURCE: Waimea Water Services (October 1991)

2.1.11 Drainage Facilities

Grading of the golf course will include creation of retention and detention areas through which storm water runoff will be routed. Some of these areas will serve as temporary detention and sedimentation basins during construction, while others will be designed as permanent water features within the golf course layout. Some of the ponds will serve both as aesthetic features as well as retention areas for storm water runoff. Drainage of runoff will be accommodated on-site through a system of drywells installed throughout the development.

2.1.12 Solid Waste Disposal

Debris generated during construction, will either be utilized on-site or trucked off-site. Solid waste generated by the project (during and after construction) will be collected by a private collection company and disposed of at the nearest County of Hawai'i sanitary landfill. It is estimated that up to seven tons per day (tpd) of refuse may be generated by the various components of this project upon completion and full occupancy.

2.1.13 Other Utilities

Utility lines will be installed underground throughout the project. Electricity, communication, and cable television conduits will be installed along the proposed access and circulation roadways.

2.2 CONSTRUCTION ACTIVITIES

Construction activities at the project will involve vegetation clearing, grading (cut and fill), excavation, rock drilling and blasting, construction of buildings and roadways, and planting and landscaping. A brief description of each element is provided below.

2.2.1 Vegetation Clearing and Grubbing

The project site is typical of other undeveloped West Hawai'i coastal areas. The open landscape is generally barren lava fields with pockets of *kiawe* thickets. Fountain grass, an introduced species, has become estabished in many areas of the site. No other tree species or mature trees occur at the project site.

Clearing of grasses and some *kiawe* trees will be required over most of the site to create buildable areas for the construction of all the project elements described in Section 2.1. Within the 388-acre project site, some sections will be completely cleared, while other sections will be selectively cleared or retained as buffers and natural area transition zones. There will be approximately 12 acres remaining essentially uncleared within the preservation areas at the cinder cone and a burial site preserve area (includes some landscaping). Efforts will also be made to preserve some of the *kiawe* thickets, especially in open space areas.

Complete clearing and grubbing will occur over approximately 315 to 325 acres to accommodate construction of the project features. Extensive vegetation clearing will be required for the roadways, wastewater treatment facility, golf clubhouse, golf course maintenance facility, golf driving range, and the tennis center. Selective clearing is possible for some portions of the golf course and residential areas. Impacts to existing vegetation and topography are discussed in Section 4.

2.2.2 Grading (Cut and Fill)

Site grading will be required in most areas to accommodate the construction of the project design elements, described in Section 2.1. Earthwork on-site will grade the land to allow for structures and roadways to be constructed. Extensive grading will be required to complete the golf course. Fill will be placed in some areas, and lava rock will be removed (cut) in other areas to allow construction to progress. Most, if not all, excavated materials will be retained on-site to minimize the quantity of earthwork materials that will be transported off-site.

Topsoil will be imported to the site by truck to add soil cover over approximately 86 acres for golf course turf. Additional topsoil will be placed in landscaped areas surrounding the common areas and homes.

2.2.3 Excavations

Excavations for roadways, building foundations, irrigation water storage reservoirs, piping, and utility trenches will be required to complete the project. Utility installations will mainly occur along the circulation roadway system. Additional excavation work will be necessary along and across Queen Ka'ahumanu Highway to connect proposed utilities to the existing distribution systems. Materials excavated for the trenches and foundations is expected to be reused on-site.

2.2.4 Rock Removal

The project site is *'a'a* and *pahoehoe* lava. To enable the construction of the access road from the highway into the *makai* parcel and the roadway system, some drilling and blasting is expected to be required for rock removal. Other development features, including the golf course, residential development and support facilities will also require some rock removal. Rock debris will be utilized on-site and not transported off-site for disposal.

2.2.5 Construction of Buildings and Roadways

Roadway development will require clearing, grading, road bed construction, drainage facilities installation, paving, lighting and other safety provisions. Building lots and multi-family housing sites will require grading and excavation for development of building pads, drainage facilities, landscaping and utilities installation.

2.2.6 Planting and Landscaping

Extensive landscape plantings will be incorporated in most sections of the project. Landscaping will make up a large percentage of the residential areas and golf course, as well as around the common facilities. The golf course and clubhouse will be landscaped extensively with ornamental and native plants suitable for the North Kona environment and designed to frame the course features and enhance the aesthetic beauty of the completed course. The access roadway and all common areas will receive special attention by the landscape architect. The entrance area will be tastefully designed with native and ornamental plantings to complement the Queen Ka'ahumanu Highway corridor. The landscaping design will also utilize xeriscape water conservation principles.

2.3 MARKET DEMAND

The market demand for new market-priced residential homes and a semi-private golf course at this project has been documented through a Market Assessment prepared for this project by John Zapotocky (October 1991, Appendix A). Information from the Market Assessment for each of the major proposed development elements is given below.

2.3.1 Residential Component

Development of 900 to 1,100 single and multi-family units is proposed by NKDG. The homes will all be constructed by the landowner, North Kona Development Group, in association with Davidson Communities of San Diego, California. In addition to housing units which will be built on-site, NKDG will satisfy State and County affordable housing requirements. The number and location of affordable residential units have yet to be determined.

Although the Big Island as a whole generally has an adequate housing supply according to the Comprehensive Housing Market Analysis (San Francisco Housing and Urban Development Office, 1987), the West Hawai'i area and employment centers of North Kona and South Kohala districts specifically have a housing shortage. Future demand for housing is expected to be affected by existing shortages, population growth, future household sizes, desired vacancy factors, and housing affordability. The demand for housing units in West Hawai'i is estimated at approximately 1,475 units per year. There is a demand for approximately 500 resort units per year and permanent residential use of approximately 975 units per year. The demand for affordable units is approximately 680 units per year, or 49 percent of total housing unit demand, and 72 percent of permanent resident unit demand.

NKDG estimates an annual absorption of at least 100 units per year at this development, commencing in 1996. This demand presently exists and could expand depending on the progress of the Kaupulehu and Kuki'o Resorts. A much faster overall absorption is possible, and even, likely due to the broad array of housing choices to be offered by NKDG and neighboring resorts, and the existing pent-up demand.

The proposed project intends to tap the residential, second home, and retirement markets which eventually cluster around maturing resort communities. It also anticipates targeting a broader spectrum of the market for residential, second home, and retirement markets than resort developments planned in the Kaupulehu/Kona Village/Kuki'o Resort Node. The developer will differentiate itself from other Kona and Kohala developments by emphasizing its larger unit size, while also offering *makai* orientation, truly residential accommodations, and the highest priority golf access.

Based on market mixes achieved at other comparable developments, and on the characteristics of the site and the proposed development, the market for the homes is expected to be composed principally of older families. The projected buyer markets include: 1) Hawai'i and other western U.S. residents seeking a primary home in West Hawai'i; 2) Hawai'i and other U.S. residents seeking a retirement home; and 3) other U.S. or foreign residents seeking a second home. The primary residents are expected comprise about 75 percent of the households; secondary ("second home") residents will comprise approximately 25 percent. A substantial segment of the buyers will be attracted by the project's golf course and other recreational amenities. The homes are anticipated to be priced between $500,000 and $1,000,000.

Of the *900 to 1,100* residential units planned, approximately 70 percent will be single-family homes and 30 percent will be multi-family homes. The single-family residences will be built at low-to-medium densities in two different ranges. Approximately 15 percent of the units will be built in the lowest density range of three to five residential units per acre. These units will vary from about 2,500 to 4,500 square feet, and average about 3,000 square feet in gross floor area. About 55 percent of the units will be built at a density of six to eight units per acre. These units range from two to four bedrooms in size (three bedroom units predominating) and will average about 2,300 square feet in floor area. The multi-family homes are expected to be about 1,750 square feet in size.

As an indicator of the acceptability of a residential development like this community, low density condominium developments fronting golf courses offered at Mauna Lani, Waikoloa, and Keauhou have been well received. While other new communities will offer golf course-oriented resort or residential units, none has the the unique combination of location and amenities as will the Manini'owali Residential Community.

The Manini'owali Residential Community expects to capture between 10 to 20 percent of the resort home market, assuming competition is limited to the projects forecast for the resort nodes in the West Hawai'i Regional Plan "2005 development scenario." The project also has the potential to capture 10 to 20 percent of the $500,000 plus residential home market. Combined, the Manini'owali Residential Community has the potential to deliver 55 to 110 units per year.

2.3.2 Golf Course

An 18-hole daily fee, championship golf course is being proposed at this project to be integrated with, and enhancing, the residential areas at this project. The golf course would be ready for play by sometime in 1996.

NKDG estimates that the Manini'owali Residential Community is likely to supply 38,000 rounds annually at build-out, based upon the community's likely demographic makeup. Other resident play is estimated at approximately 7,000 rounds annually, comprised primarily of reduced-fee *kama'aina* play. Demand from other resorts in the West Hawai'i area, including the overflow demand from the Kaupulehu/Kona Village/Kuki'o Resort community, is estimated at approximately another 7,000 rounds.

Based upon alternative projected growth scenarios of from zero to five percent population and visitor growth rates, it is estimated that the County of Hawai'i has a demand for 14 to 50 additional golf courses. The County's unmet golf demand is also indicated by observations that existing courses are operating at maximum or overcapacity and that green fees are escalating.

The Big Island currently has 11 golf courses with another nine under construction, and an additional 26 courses in various stages of planning. Zapotocky (October 1991) estimates that only approximately half of those in the planning stage will actually be built due to problems with financing, physical constraints of site development, and obtaining government permit approvals.

The South Kohala, North Kona, and South Kona regions are expected to account for the bulk of the residential development and visitor facility expansion through the year 2010. Growth in golf demand is expected to continue not only because of increased population growth, but also due to the increasing popularity of the sport.

The demand for golf at the Manini'owali Residential Community is assured due to three factors: 1) its location within the high growth Kona region; 2) proximity to the target market of this residential community, whose home owners are likely to be high frequency golfers; and 3) its location adjacent to the Kaupulehu/Kona Village/Kuki'o Resort Node.

2.4 PRESERVATION OF NATURAL AND ARCHAEOLOGICAL FEATURES

The most significant archaeological resources on the site will be preserved, including a historic trail segment, burials, and a small small cinder cone (*pu'u*) located on the northern portion of the property. Details of the archaeological findings and potential impacts are presented in Section 4.10. As landowner, NKDG intends to provide stewardship, protection, and preservation measures to assure respect in the treatment of the on-site burials. A landscaped buffer area and a wider construction buffer will be established surrounding the burial site. Details of the permanent buffer and construction buffer will be defined by the DLNR with recommendations from the Hawai'i Island Burial Council, and the County.

A cultural resources management plan is being formulated by Aki Sinoto Consulting (formerly with the Sishop Museum) to address data recovery, mitigation and preservation plans for the historic sites uncovered in the reconnaissance survey. Some of the sites not being preserved will be examined more closely and documented per the Department of Land and Natural Resources (DLNR) administrative regulations. These sites will be selected on the basis of research potential and frequency of occurrence. NKDG is workig with the proper authorities to establish mitigation plans.

2.5 PUBLIC ACCESS TO THE SHORELINE

Public access from Queen Ka'ahumanu Highway to the shoreline at Manini'owali will continue to be provided along the existing jeep trail until a superior access is provided. This roadway traverses the NKDG property and leads to an area close to Kua Bay, and is normally accessible only by 4-wheel drive vehicles. BLNR conditions to the land exchange require NKDG to construct a public roadway from Queen Ka'ahumanu Highway to the Kua Bay area and new proposed public park facilities upon development of the subject parcel.. This is contingent on NKDG obtaining all applicable State and County approvals for the proposed development. The NKDG proposed route for the shoreline access, as shown in Figure 5, follows part of an existing jeep road on State land at Awake'e, passing north of Pu'u Kuili, and extending along the southern boundary of the NKDG property; then turning north towards Kua Bay. The route proposed by NKDG will need to be approved by the appropriate State and County agencies.

2.6 DEVELOPMENT TIMETABLE

The current schedule anticipates that all approvals for development will be in place to allow construction to begin in 1993 to 1994. Construction of the golf course, the first increment of homes, clubhouse, tennis facility, and supporting infrastructure could be completed by 1995 to 1996. All homes are anticipated to be completed over the following 10-year period, ending approximately in 2005 to 2006, when full occupancy is expected.

2.7 APPROXIMATE INFRASTRUCTURE COSTS

Order of magnitude estimates of costs for infrastructure development at the proposed project are shown in Table 3. Total infrastructure costs are anticipated at $47 million (1991 dollars), including contingency costs. Estimates include both off-site and on-site infrastructure development and grading. The water system costs include trench excavation and piping to bring brackish water from the proposed well field and reservoir on State land at the 600 feet elevation *makai* to the project site, crossing Queen Ka'ahumanu Highway. Also reflected is the cost to import fill material and topsoil for golf course and residential landscaping, as well as for landscaping at the project entrance, and at appropriate facilities (i.e, clubhouse, driving range, park, and the perimeters of the tennis center, maintenance facility, and wastewater treatment plant).

TABLE 3

ORDER OF MAGNITUDE INFRASTRUCTURE COSTS (1991 DOLLARS)

1.	POTABLE WATER SYSTEM Control Building , Reservoir, Site Improvements and Salt Water Reverse Osmosis Desalinization plant (650,000 gpd), and Water Main	$5,330,000
2.	NON-POTABLE WATER SYSTEM Development of 6 wells @ 420,000 each, Control Building , Site Improvements, Reservoir, and Water Mains	$3,200,000
3.	WASTEWATER Sewage Treatment Plant Appurtenances	$3,955,000
4.	STORMWATER DRAINAGE Pipes , Dry Wells, and and Appurtenances	$1,653,000
5.	GRADING/CLEARING/EXCVATION/EARTHWORK Clearing ,Grubbing, Trench Excavation, and Topsoil Borrow Material	$9,189,000
6.	ROADWAYS Major Roads and Park Access Road	$7,104,000
7.	OFF-SITE ELECTRICAL Electrical Substation, 12 KV Distribution, and Telephone Feeder	$950,000
8.	ELECTRICAL ON-SITE (MAJOR ROADWAYS/INFRASTRUCTURE) Electrical Service and distribution controls for Major Roadway, Sewer Pump Station, and Wastewater Treatment Plant	$5,436,000
SUBTOTAL		$39,337,000
20% CONTINGENCY		$7,868,000
TOTAL COSTS		$47,205,000

SOURCE: Park Engineering (October 1991)

SECTION 3 – Land Use and Zoning Controls

3.0 LAND USE AND ZONING CONTROLS

This section includes a description of the existing State and County land use and zoning designations for the project area. Changes in land use classification and zoning required to implement the proposed project are described, as well as other required approvals.

3.1 STATE OF HAWAI'I

3.1.1 Conservation District Use Permit

A Conservation District Use Application (CDUA) for the subdivision of the newly acquired exchange land will be filed with the Board of Land and Natural Resources (BLNR). Pursuant to Chapter 343, subdivisions of lands in the Conservation District require approval of a CDUA. The TMK parcel number of this property may be changed when the request is granted.

3.1.2 State Land Use Boundary Amendment

Most of the 388.057 acres project site is located within the State Conservation District, General Subzone. A small portion of the coastal area is located within the Resource Subzone. NKDG will be requesting the State Land Use Commission for reclassification of the entire project site from the Conservation District to the Urban District. A State Land Use District map which includes the NKDG property and the surrounding properties is shown in Figure 8.

3.2 COUNTY OF HAWAI'I

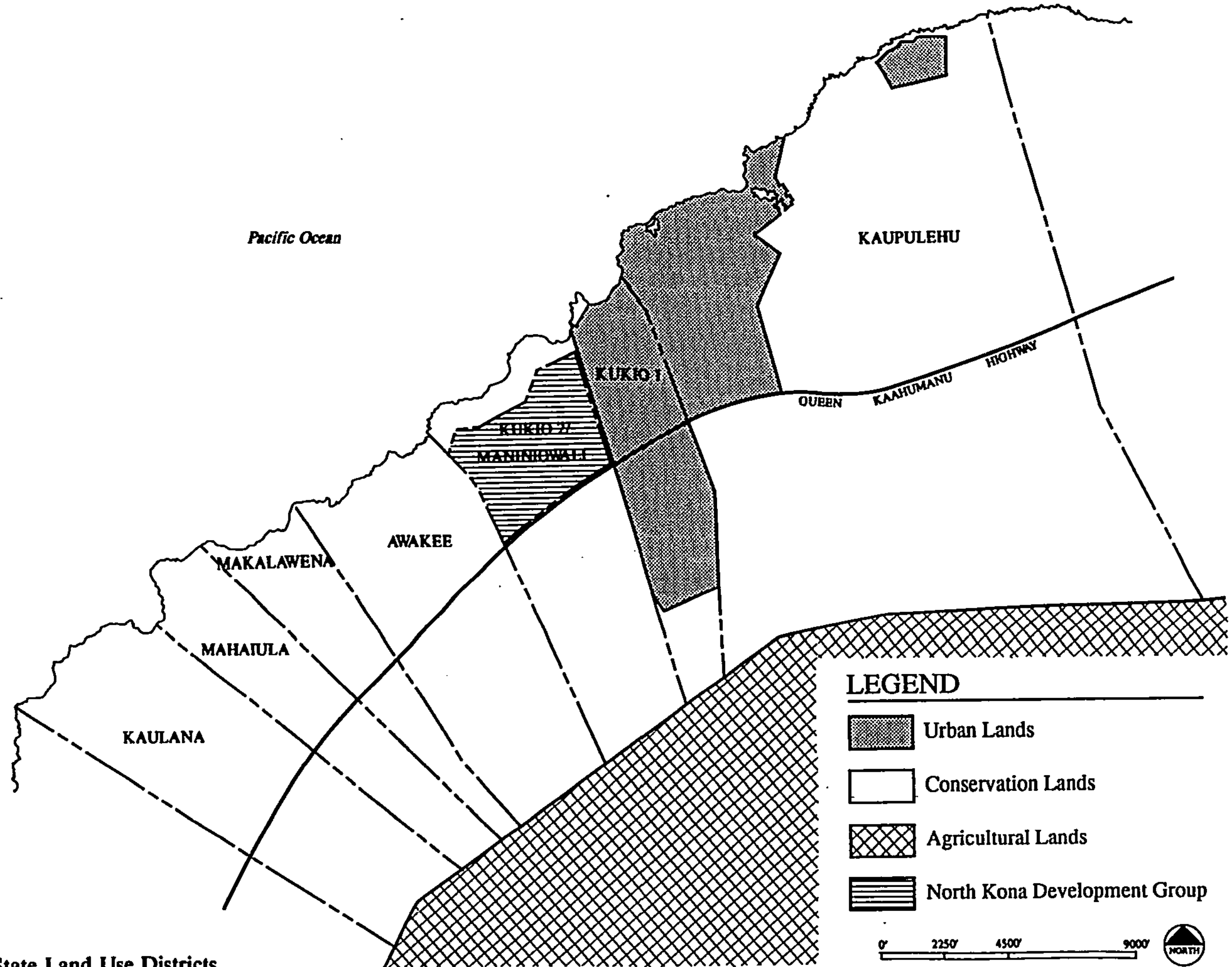
3.2.1 General Plan/LUPAG Map Amendment

NKDG is requesting the following changes to the County of Hawai'i General Plan and Land Use Pattern Allocation Guide (LUPAG) Map: 1) Amend the General Plan Land Use section (p. 81) to include Manini'owali/Kuki'o 2 as an urban center, and 2) amend the LUPAG Map from the existing designation of Conservation to Urban Expansion.

Specifically, the application will request the appropriate changes to the General Plan document to include the residential units and golf course/clubhouse and other recreational amenities at the 388-acre site and the LUPAG Map (Figure 9) from the existing designation of Conservation to Urban Expansion designation.

3.2.2 Zoning

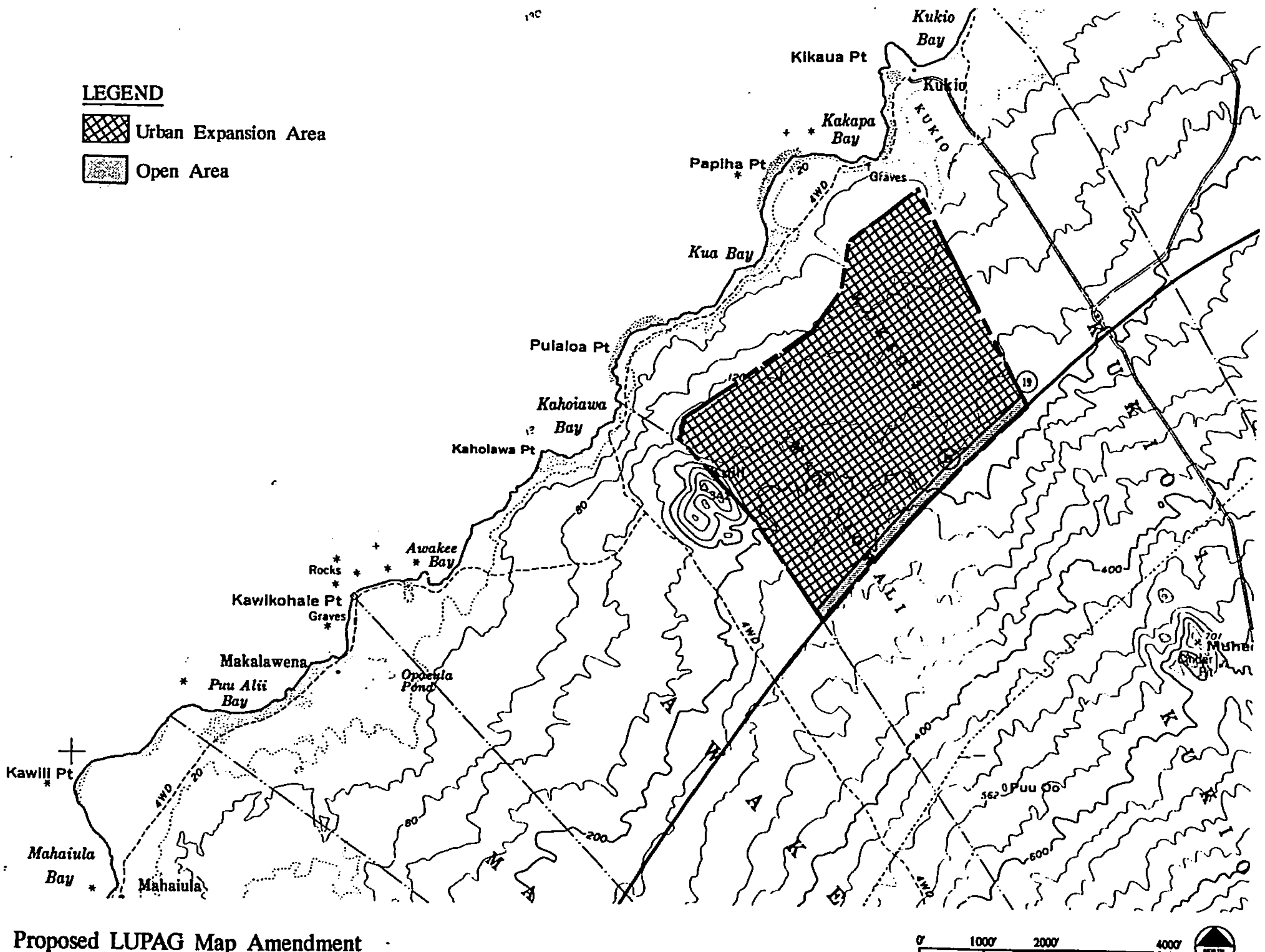
A Change of Zone request will be made subject to obtaining approval of the General Plan and Land Use Boundary Amendments. The subject parcel lies within the zoning district designated as Open. The Applicant will pursue a zoning change to accommodate



State Land Use Districts

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 8



Proposed LUPAG Map Amendment

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 9

the low- and medium-density residential development and the recreational amenities of the golf course, clubhouse, and tennis facility. The specific zoning district designations to be requested will be determined later in the planning process.

3.2.3 Special Management Area Use Permit

The border of the Special Management Area extends along Queen Ka'ahumanu Highway in the area of the project. The entire project site is within the Special Management Area and will require County of Hawai'i approval of a Special Management Area Use Permit.

3.2.4 New Water Source Development

Development of a new water source to serve the proposed project will require approval from the State Department of Land and Natural Resources and the Water Commission. NKDG prposes to establish a brackish water well system on State land, as described in Section 2.1.9.

3.3 OTHER REQUIRED APPROVALS

Numerous other permits and approvals will be required from the State and the County. These actions are generally ministerial in nature; however, each is important in the overall success of the project.

State of Hawai'i approvals include:

- Department of Health — Approval of a wastewater treatment facility and irrigation with treated effluent
- Department of Transportation — Approval for highway entrance from Queen Ka'ahumanu Highway

County of Hawai'i approvals include:

- Planning Department — Subdivision and plan approvals
- Department of Water Supply — Water source and distribution system approvals
- Department of Public Works — Building and grading permits

SECTION 4 – Description of Environmental Setting Anticipated Impacts and Mitigative Measures

4.0 DESCRIPTION OF THE ENVIRONMENTAL SETTING, ANTICIPATED IMPACTS AND MITIGATIVE MEASURES

This section presents background information on the existing human and natural environment. Utilizing this background, the proposed project is evaluated for its potential to generate significant environmental impacts. Impact discussions, where appropriate, are divided into short-term construction-related impacts, and long-term operations-related impacts. Mitigative measures, which are planned to be implemented to minimize the potential short-term and long-term impacts, are also discussed in this section.

Technical consultant studies have been prepared to analyze the existing environmental conditions and the potential impacts on the environment caused by the proposed project. Findings from these reports are summarized in this section; the full texts of these consultant studies are presented in a companion Volume II.

4.1 CLIMATE

A. Existing Conditions

The project site is located inland from the coastal area of the North Kona coast. The climate is semi-tropical and semi-arid. Average annual precipitation in this area is 17 inches. Average annual temperature is 78 degrees F, with an average high temperature of 83 degrees F and an average low of 67 degrees F. Rainfall increases with elevation from the coastal area, with a high rainfall belt located between the 1,200 and 3,000 feet elevations on the leeward slopes of Hualalai and Mauna Loa.

The large land masses of Mauna Loa, Mauna Kea, and Hualalai generally shelter the North Kona coast from the predominant northeasterly trade wind system affecting the Hawaiian Islands. Winds follow a typical pattern of on-shore winds (westerly and southwesterly) in the morning and early afternoon. Cloud banks often form along the higher elevation slopes during the day, and off-shore breezes occur in the late afternoon and evening. Typical wind velocities range from 3 to 14 knots. Relative humidity generally ranges between 71 to 77 percent the year round.

B. Anticipated Impacts and Mitigative Measures

Design of the proposed project will be typical for a semi-arid, tropical climate. The proposed project will have no affect on climatic conditions and no mitigative measures are required.

4.2 TOPOGRAPHY

A. Existing Conditions

The parcel is located on the western slope of Hualalai, a dormant shield-type volcano (summit elevation 8,271 feet). The Keahole Point area was formed by progressive layering of prehistoric lava flows from Hualalai. The lavas are primarily *pahoehoe* with thicknesses varying from six inches to 100 feet. Lava layers are very porous and contain numerous lava tubes, cracks and fissures. Anchialine ponds, common to West Hawai'i, are found near the southern coastal border of the adjacent Awake'e and Makalawena *ahupuaa's*, and one pond is located adjacent to Kua Bay at Manini'owali. There are no anchialine ponds on the project site.

The topography of the project site is gently to moderately sloping. The significant topographic feature includes a small *pu'u* or cinder cone, at the northern end of the property. This *pu'u* will be preserved in its natural condition as required by the BLNR conditions of the land exchange. Average slopes at the development site are five to seven percent, with elevations ranging from 60 to 250 feet above mean sea level (msl). The southern property line is near the foot of Pu'u Kuili, a large cinder cone located on Awake'e, which reaches an elevation of 342 feet above msl. The average slope from Queen Ka'ahumanu Highway to the *makai* boundary of the Manini'owali parcel is five to six percent.

B. Anticipated Impacts

Construction activities of the project will require mass grading which will have a long-term unavoidable impact on the topography. As much as possible, the project will be designed to minimize major changes to topography. As discussed in Section 2.2.1 and 2.2.2, clearing and grading will occur on approximately 315 to 325 acres to prepare the lands for construction of the project features. Development of the golf course, roadways, and building sites will require fine grading to establish level building surfaces. Rock removal will also be required in some locations. Cut material from grading will be retained on the project site. The amounts of cut and fill will be balanced in the grading plan to minimize the need to import fill. Soils will be imported to the site to allow establishment of the golf course and project landscaping.

C. Mitigative Measures

Several mitigative measures, as listed below, will be implemented to minimize impacts on topography.

Project Design: The location of land uses in the master plan and siting of facilities will avoid changes in topography as much as possible. The site's natural slopes and features will be respected to minimize grading requirements.

Grading Ordinance Compliance: All grading operations will be conducted in a manner which will ensure full compliance with dust, erosion and sedimentation control standards and guidelines of the Hawai'i County Code. A grading permit must be obtained from the County to modify the topography of the site. The grading plans for the site are reviewed and approved in this process.

4.3 SOIL TYPES AND AGRICULTURAL CAPABILITY

A. Existing Conditions

The soil types for the area have been mapped as part of the U.S. Department of Agriculture, Soil Conservation Service (1972) soil survey for the State of Hawai'i. Four soil types occur on Manini'owali. These include *pahoehoe* lava flows (rLW), cinder land (rCL), rock land (rRO), and *'a'a* lava flows (rLV). The predominant soil types of the land are *'a'a* lava flows and rock land (Figure 10). There are generally few sections of the site which have soil depths exceeding a few inches. These soil areas are able to support a few species of dry land grasses and trees.

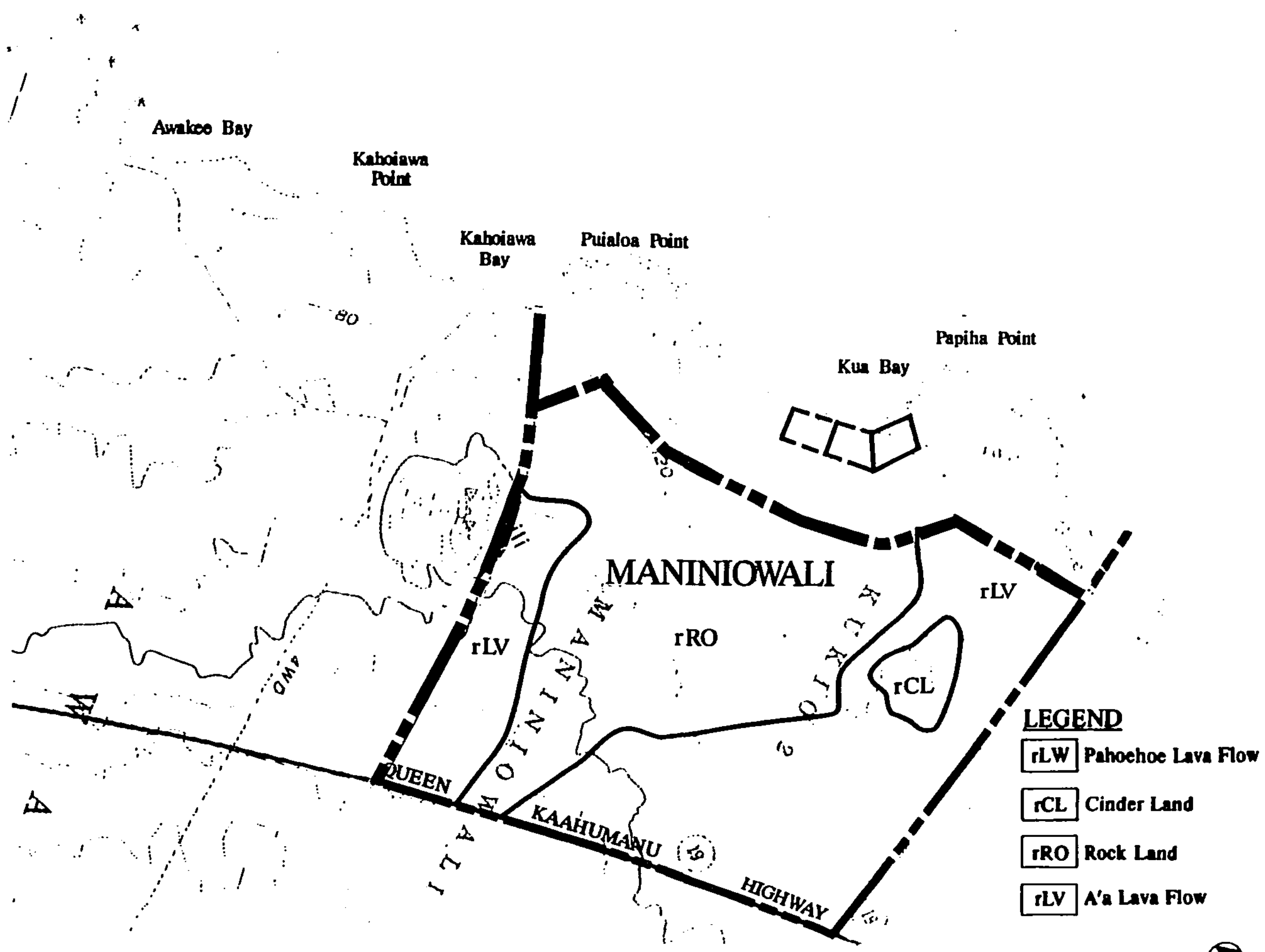
According to the U.S. Department of Agriculture (1972), soils at Manini'owali have been determined as not suitable for agricultural use. *Pahoehoe* lava flows, cinder land and *'a'a* lava flows have an agricultural capability class rating of VIII, which is defined as soils and land forms whose limitations preclude the cultivation of commercial plants. Rock land is given a capability class rating of VII, which includes soils which have very severe limitations that make them unsuitable to cultivation, and restrict their use largely to pasture or range, woodland, or wildlife habitat. The subject parcel is lava rock and generally unsuitable for agricultural uses.

Two other land classification systems are used to rate the agricultural potential of soils in Hawai'i on a scale ranging from A (best) to E (poorest). The University of Hawai'i Land Survey Bureau (1972) classifies the soils of the property as category E soils, which indicates they are not suited for agricultural uses. The State of Hawai'i Department of Agriculture has also mapped Agricultural Lands of Importance to the State of Hawai'i (ALISH). The site does not contain soils rated as "prime", "unique", or "other important" agricultural lands, as defined for ALISH.

B. Anticipated Impacts

The development of this project will have no impact on commercial agriculture since none presently exists, nor is likely to ever exist given the semi-arid climatic conditions and sparse pockets of soil.

In the developed areas, at least 12 inches of soil will be added to the graded ground surface as required for golf course development (high maintenance turf areas). About 6 to 8 inches of soil is required for residential and golf course landscaping. Of the total 388 acres proposed for development, approximately 350 acres will be associated with project features. Of this development area, approximately 10 percent of the site will remain as natural buffer at edges of the golf course and between some residential areas and golf course. The cinder cone *pu'u*, the highway setback area, and specified archaeological sites are preserved within this area.



Soil Series Map

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 10

Clearing and grubbing activities on approximately 315 to 325 acres during construction will temporarily disturb the soil retention values of the existing vegetation and expose the soils to erosional forces. Some wind erosion of soils could occur without a proper watering program. Precipitation events will also cause some erosion of soils over disturbed areas of the land.

C. Mitigative Measures

The impact of construction activities and long-term operations on soils will be mitigated by several measures, as listed below:

Construction Erosion Control: Construction activities will follow strict erosion control measures as specified in the following:

a. Hawaii County Code, Chapter 10, Erosion and Sedimentation Control;

b. State Department of Health, Section 401 Water Quality Standards and Guidelines

c. U.S. Soil Conservation Survey Erosion and Sediment Control Guide for Hawai'i, (1968).

Prior to any grading a permit application will be submitted to the County of Hawai'i, Department of Public Works; erosion and sedimentation control measures as specified in the regulations cited above will be addressed. Erosion control measures may include, but are not limited to, the use of temporary sedimentation ponds, cut-off ditches and temporary ground cover.

Watering and Landscaping: In particular, a construction area watering program will be implemented to minimize soil loss through fugitive dust particulate emission levels from construction sites and roadways. Other control measures include good housekeeping on the job-site, and pavement or landscaping of bare soil areas as quickly as possible.

Landscaping and Long-Term Erosion Control: Landscaping will be established throughout it's grounds, and establish control over existing erosion areas on steeper slopes. This continuous, long-term management of the property will reduce erosion from existing conditions.

4.4 DRAINAGE AND RUNOFF WATER QUALITY

This section presents a discussion of the existing drainage conditions and storm runoff water quality. Potential impacts of the proposed project on drainage and runoff water quality are discussed in three technical consultant reports. These reports were prepared to address storm runoff water quality, as well as runoff water quality relating to landscaping and the use of fertilizers and pesticide application to golf course turf and residential landscaping. Mitigative measures are proposed to be implemented which will minimize both drainage and runoff water quality impacts.

4.4.1 DRAINAGE CONDITIONS

Drainage conditions within the project site, and potential project impacts on drainage, were evaluated by Park Engineering (October 1991). The full engineering report is included in Appendix A; the drainage findings are summarized below.

A. Existing Conditions

Rainfall in the area is light - approximately 17 inches annually - and groundwater recharge is restricted to seasonal storms or through higher elevation precipitation on the upper slopes of Hualalai.

Due to the high permeability of the site's volcanic soil and geologic subsurface, there is very rapid storm water drainage into the lava layers, and runoff is essentially non-existent. The existing soil type would be classified as Class A by the U.S. Soil Conservation Service, meaning that it has the highest water intake rate. The incident precipitation travels briefly over land as sheet flow before it percolates into the soil to become groundwater. There is no surface runoff to the ocean from the project site. Estimated runoff volumes for existing conditions are listed in Table 4. Groundwater eventually finds its way downslope to the only major surface water body in proximity to the site, the Pacific Ocean, located approximately 1,000 feet from the *makai* property boundary.

The only drainage improvements near the site are those located along Queen Ka'ahumanu Highway. Three drainage culverts connect the mauka portion of Manini'owali with the NKDG lands makai of the Highway are shown in Figure 5.

B. Anticipated Impacts

Pending final site planning and engineering design, the proposed project will involve clearing, grubbing and grading of about 315 to 325 acres of the property.

In the areas to be developed, soil and foundation materials will be added to the graded ground surface as required for development of the residential and golf course, roadways and landscaping. New drainage patterns will direct stormwater runoff through grass swales and detention basins, and eventually to the many drywells located throughout the project site. There are no stream channels that could be modified and none will be created. The natural slopes and vegetation of the preservation areas which include the small *pu'u* at the northern portion of the site will not be affected by construction.

Although the overall developed soil conditions will have a lower water intake than the present Class A condition, there will be no effect on off-site drainage conditions as a result of the project. Incremental storm water runoff over and above natural runoff conditions is planned to be collected and discharged to drywells located throughout the

TABLE 4

STORM WATER RUNOFF VOLUMES

STORM CHARACTERISTICS			HYDRAULIC (acre ft./event)		
Duration (hr.)	RI (yr.)(1)	Amount (in)	1991	2006(2)	Increase(3)
1	1	1.00	0.0	1.5	1.5
1	5	1.50	0.0	3.2	3.2
1	10	1.75	0.0	4.4	4.4
1	25	2.00	0.0	5.8	5.8
1	50	2.25	0.0	7.4	7.4
1	100	2.50	0.0	9.1	9.1
24	1	2.75	0.0	11.0	11.0
24	5	4.00	0.1	22.4	22.3
24	10	5.00	1.9	33.8	31.9
24	25	6.00	5.7	46.9	41.2
24	50	6.75	9.7	57.5	47.8
24	100	7.40	13.8	67.2	53.4

(1) RI = Recurrence Interval
(2) Year of Full Development
(3) Increased hydraulic volumes are controlled on-site as discussed in Section 4.4.1.B

SOURCE: Gordon L. Dugan (June 1991)

project site. Overland storm water drainage from the site onto adjacent land will be similar to or less than existing conditions. No runoff from the site will reach the ocean.

The proposed development will increase the quantity of peak runoff generated to various degrees, depending on storm conditions. Changes in land surface types will be made by the construction of impervious surfaces such as roads and buildings. Dugan (1991) estimated existing and post development runoff volumes, for use in evaluating runoff water quality. As shown in Table 4, the total volume of storm water runoff generated under full development conditions for the one-year, one-hour duration storm is predicted to be 1.5 acre-feet, whereas, there is presently none. Near the extreme in severity of runoff conditions, a 100-year storm of 24 hour duration will cause the on-site runoff to increase five times - from 13.2 to 67.2 acre-ft. The incremental difference, however, is 53.4 acre-ft. This increase in runoff volume will be accommodated by on-site drainage facilities, thus, eliminating surface runoff impacts on adjoining lands or the ocean.

The runoff values presented (acre-ft./event) represent a volume of water and should not be confused with peak discharge rates, which represent the maximum volume of storm water runoff discharge per unit of time (e.g. cubic feet per second or million gallons per day). Peak discharge rates are required for engineering design of proposed drainage facilities and ascertaining the capacity of existing facilities, while total runoff provides a more realistic estimate of potential impact on water quality. Peak discharge rates will be calculated for the engineering design of grading and drainage plans for the golf course, residential development, and other areas to be altered for construction of the project's facilities. These rates will be calculated using County of Hawai'i drainage standards, and cannot exceed current peak discharge rates for this land.

C. Mitigative Measures

Several measures will be implemented to insure the public safety and environmental integrity at on-site and off-site areas with respect to runoff volume and off-site flow. These measures are discussed as follows.

Drywells: Most of the projected increase in runoff will result from the development of homes, roadways, parking areas and other impervious surfaces. For many of the residential lots, and for major roadway sections, storm runoff can be routed through the golf course and landscaped areas to dampen the runoff rate.

The principles followed in developing the storm water runoff plan for this project are comparable to other West Hawai'i development projects. Storm water runoff will be primarily directed to specially constructed, on-site drywells, or drain-pits, at numerous locations throughout the development area. Dry wells which will vary in sizes from four to eight feet in diameter and two to four feet in height will be installed at low spots on the project site within grassed and paved surface areas. Collected runoff water will recharge the groundwater table beneath the site through openings pitched at a 45° angles. This design allows the runoff to be discharged through more ground surface area for infiltration. These drywells will be designed for a storage capacity equal to the runoff volume generated by a 10-year storm as required by the County. This will ensure that the maximum flow rates of surface runoff departing the site will be similar to, or less than, the existing rates.

Erosion Controls: Increases in constituent suspended sediment loads in runoff could result from construction activities, especially if a significant storm occurs during the interim period between exposed and stabilized soil conditions. To limit these potential increases, strict soil erosion control measures will be adhered to. With the existing high infiltrative soil/rock conditions of the project site, this is of lesser concern than with most similar project developments in Hawai'i that have higher rainfall and soil conditions permitting less infiltration. Erosion and sedimentation control standards and guidelines will be in conformance with the Hawaii County Code, Chapter 10, Erosion and Sedimentation Control.

4.4.2 STORM RUNOFF WATER QUALITY

A. Existing Conditions

As explained in Section 4.4.1 above, there are presently no surface water bodies and no intermittent streams on the project site. The only major surface water body in proximity to the site is the Pacific Ocean, located approximately 1,000 feet from the *makai* property boundary. A small anchialine pond exists on a privately-owned parcel surrounded by the adjacent State land just *mauka* of the beach at Kua Bay. Neither the pond nor the ocean presently receives surface water runoff from the project site. Marine resources and ocean water quality are discussed in Section 4.6, which relates indirectly to the surface runoff water quality on the site.

B. Anticipated Impacts

Potential impacts to surface water quality on-site and off, include both short-term, construction-related effects and long-term, operations-related effects. The proposed residential community, including the golf course, will not generate surface runoff that will reach the ocean. Runoff flowing from the NKDG site onto adjoining lands will be at rates comparable to or less than existing conditions.

Short-term construction-related effects on runoff water quality include erosion and suspended sediment due to construction area runoff. The site will be cleared of vegetation over approximately 315 to 325 acres. This clearing operation, and subsequent grading for site development, will create exposed soil areas that could be eroded by storm water runoff without the implementation of soils management measures during construction. Soils on cleared areas will be stabilized (as required) by temporary vegetation or other measures prior to the clearing of new areas.

Long-term operational activities also will not create surface water quality effects. Surface runoff will enter groundwater, which ultimately drains into the ocean. Potential impacts on groundwater quality are discussed in Section 4.5. Potential impacts on ocean water quality are discussed in Section 4.6. Activities which may create the most environmental concerns with regard to surface water quality and quantity include the application of pesticides and fertilizers, and irrigation disposal of treated effluent. These concerns are addressed below.

Fertilizer and Pesticides Application Impacts on Runoff: The development and maintenance of the golf course will require application of fertilizers to supply essential nutrients to turf grasses and ornamental plants. Pesticides will also be required to control the associated weed, disease and insect pests that affect grasses and plants. Pesticide applications will be carefully controlled through implementation of an Integrated Pest Management (IPM) program, which is discussed more fully later in this section. These chemicals will be applied to the greens, tees, and fairways on the golf course, and infrequently on the roughs. Maintenance of landscaping in residential areas will also require infrequent application of small amounts of fertilizers and pesticides.

The potential for surface water quality effects that may result from fertilizer and pesticide application was evaluated in technical studies by Dugan (June 1991) (fertilizer and suspended sediment only) in Appendix C, and Murdoch and Green (July 1991) in Appendix D. Their findings are summarized below.

Fertilizers may be subject to movement from the application point by runoff during high intensity storms, or by movement toward groundwater. The primary fertilizer elements of concern for possible transport in runoff are nitrogen and phosphorus. The constituent changes anticipated for nitrogen, phosphorus and suspended solids in storm water runoff for one-hour and 24-hour durations are presented in Appendix C. This data assumes use of soluble fertilizer which is much more mobile than the slow-release nitrogen fetilizer planned for use on this site.

Under normal conditions of irrigation and precipitation, phosphorus attaches itself very tightly to iron and aluminum hydroxides which are plentiful in the Hawaiian soils. Phosphorus is expected to move little if any from the site of application. Under extreme storm conditions, where phosphorus may not penetrate the soil, the phosphorus concentration in runoff waters from the completed project could be several times higher than the concentration under existing conditions. This potential condition will be substantially mitigated, however, because fertilizer applications would be timed to avoid severe weather conditions, otherwise the effectiveness of the application would be poor. In addition, the use of drywells and diversion through the golf course and landscape buffer will promote phosphorus removal by means of absorption onto settled suspended solids, and an increase in contact with bare soil and/or nutrient uptake by vegetation in the drainage path.

The drywells are designed to slowly release the collected storm water to the groundwater, thus, some of the applied phosphorus is expected to accumulate within silt collected in these basins. Even if small amounts of phosphorus are carried in runoff waters, the surface runoff water will not reach the ocean or the anchialine pond *makai* of the project site.

The fertilizer constituent of primary concern is nitrogen. While ammonium nitrogen (NH_4) moves little in soils, nitrogen applied in the ammonium form can be converted to the oxidized nitrate forms (NO_3 and NO_2) which are not bound to the soil and moves readily with water. The high nitrogen uptake by turf grasses, however, means that nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss of nitrogen by surface runoff, or by leaching below the root zone. This nitrogen movement will be controlled by applying much less mobile slow-release nitrogen fertilizers. Runoff will be routed to detention basins, waste bunkers and grassy swales which contain plants that will utilize much of the nitrogen, prior to collection in dry wells.

Pesticides application, including herbicides, insecticides and fungicides, will be required at the project. Of the three pesticides types, the most frequently used in Hawai'i are herbicides. The potential for contamination of surface runoff water by pesticides will be minimal because of measures being implemented to significantly reduce the frequency and amounts of pesticides applied through an IPM program for the golf course and common areas. Additionally, groundwater wells and lysimeters will enable measurement of pesticide and fertilizer runoff control measures. Detention basins, waste bunkers, and grassy swales will act as sinks for runoff, substantially cutting the concentration of pesticides entering drywells and percolating to groundwater.

Suspended Sediments in Runoff: The construction period will have the greatest potential for generating suspended sediments in runoff. Extensive measures will be implemented to minimize soil erosion from construction sites. The incremental load of suspended sediment is predicted to increase for all storms considered. However, the numerous waste bunkers and drywells distributed throughout the project site will restrict constituent loads to the property. Natural filtering processes of the drywells will remove suspended solids prior to entering groundwater.

C. Mitigative Measures

Planning for this residential and golf course project considers elements which are designed to minimize potential negative impacts to groundwater quality. Mitigative measures will be employed to minimize potential impacts during the short-term construction phase as well as the long-term operational phase.

Erosion Controls: Soil erosion mitigation measures recommended by the State DOH, County of Hawai'i, and SCS are included in Section 4.2. In addition, soil stockpiling will be conducted to contain excavated earth in controllable areas prior to its use elsewhere on the site. Expedient stabilization and revegetation of exposed areas on the site will also minimize erosion of soils.

Integrated Pest Management (IPM): An IPM program will be instituted to minimize the frequency and amounts of pesticides being applied at the golf course. IPM programs involve extensive monitoring of turf conditions which enables early detection of pest conditions before they become widespread. Smaller and less frequent pesticide applications are necessary when IPM programs are implemented. The types of chemicals being utilized for treatments will be the lowest possible, in terms of toxicity and their persistence and mobility. When compared to traditional pesticides application rates, IPM programs typically reduce total pesticide usage at golf courses from 35 to 50 percent. The reduction of the total amounts of pesticides being used will substantially reduce the potential for their release to the environment outside the golf course.

Irrigation Management: Golf course and common area irrigation management is critical to minimizing fertilizer and pesticide impacts on surface waters. If excessive irrigation water is applied, the likelihood of nitrate and pesticide movement in surface waters or movement to groundwater is increased. A U.S. Weather Bureau Class A evaporation pan and a computerized irrigation system will be used to measure evaporation and to properly schedule irrigation applications in the operation of the golf course. Irrigation scheduling will follow programs described in Golf Course and Grounds Irrigation and Drainage (Jarret, 1985).

Fertilizer Application: Slow-release nitrogen fertilizers will be applied for the most part on the golf course and residential landscaping areas. These fertilizers release nitrogen at the same rate which it is used by turf and landscape plants. Since irrigation water will contain some naturally occuring amounts of nitrogen, the fertilizer application of nitrogen will be reduced to compensate.

Detention Bains, Waste Bunkers, Swales and Drywells: In combination with the measures being taken to reduce fertilizer and pesticides usage on the golf course, sinks for runoff will be developed at detention basins, waste bunkers, grassy swales and drywells. Each of these areas will increase the time that fertilizers and pesticides in runoff will be exposed to water, sunlight, soils, vegetation and organic material. The sink areas will allow for detention, dilution, uptake, breakdown of the nutrients and chemicals, and capture of most suspended sediments. Vegetation and organic soil material in waste bunkers and swales will capture much of the nutrients, pesticides and sediment from the storm water runoff.

Certified Golf Course Management: A well-qualified Certified Golf Course Superintendent will be responsible for managing the golf course. Mitigative measures proposed above are also based on sound management practices that will be followed with regard to fertilizer and pesticide application and irrigation. The Golf Course Manager will be thoroughly trained and experienced in the implementation of the IPM program and the management of chemicals on the site.

Urban & Runoff Control - Best Management Practices: Runoff from residential areas will be released through natural vegetation swales to help eliminate potentially adverse concentrations of chemicals through evaporation, sunlight breakdown, dilution, and uptake of organic material. Best management practices promoted by the State Department of Health will be implemented, as applicable and practicable to this project.

4.5 GROUNDWATER RESOURCES

This section includes a discussion of the alternative water sources and the existing groundwater aquifer which underlies the site. In addition, the potential impacts that could result from the proposed project are identified. A hydrogeological study of the area and the proposed project site has been prepared by Waimea Water Services (October 1991) and is included in Appendix E. Oceanit Laboratories, Inc. (OLI), (October 1991) has studied the potential for impacts to groundwater from the proposed residential and golf course uses; the OLI report is included as Appendix F. Information from these studies are summarized in this section.

A. Existing Conditions

On-Site Groundwater Resources: There are no potable groundwater reserves at the project site. Salinity ranging from 1,500 to 3,000 mg/l total chlorides would be expected from any wells on the property. It is unlikely that any groundwater fresher than 1,500 mg/l total chlorides could be drawn from a well located within the NKDG property.

Groundwater inflow under the project site originating upslope is estimated at 0.75 mgd based upon average rainfall and evaporation rates for the area. Groundwater recharge by percolation of rainfall over the project site (and including the adjacent coastal State land) amounts to approximately 0.07 mgd. Groundwater outflow to the sea over this section of the coast is therefore estimated at 0.82 mgd.

Kaupulehu/Kuki'o/Manini'owali Area Potable Water Supply: The County of Hawai'i has water systems extending as far as the Keahole Airport, approximately four miles to the south of the project site. The County's *mauka* water system is planned to be extended to the southern boundary of the Hu'ehu'e Ranch. County water is not available to be transmitted to the project site as current water commitments exceed availability and transmission line capacity.

Based upon water resource studies by Island Resources Ltd., any off-site fresh water wells must be privately developed north of Kailua-Kona and located between *mauka* elevations of 1,500 and 1,800 feet. These wells (provided adequate water resources are found) would need to be properly located to integrate with the County water system and neighboring private water systems for future cross connections. Once developed, these wells could be turned over to the County for maintenance and operation (generally on the condition that 60 percent of well capacity would belong to the County DWS), or operated and maintained as a private system.

The presence of a thin basal lens has been confirmed at elevations between 1,500 to 1,800 msl with brackish water found at the top of the water table in the water development of the Kaupulehu and Kuki'o resorts. The projected water demand of the existing Kona Village Resort, the planned Kaupulehu (currently under construction) and Huehue Ranch developments is estimated to be 2.4 mgd of potable water and 3.0 mgd of non-potable water.

Brackish water which directly underlies the project site has a total chloride content ranging from 1,500 to 3,000 mg/l which exceeds levels which can be used for irrigation water. Further *mauka* on State land in Manini'owali and Awake'e, groundwater chloride levels approach 1,000 mg/l at an elevation of approximately 600 feet above msl. This brackish water has excellent potential for direct use for irrigation and also for potable water for domestic purposes through desalinization.

The sustainable yield or capacity of an aquifer represents the amount of water available in the aquifer. It is the rate of total pumping which could be continually withdrawn from the Kiholo aquifer without affecting the quality or the quantity of the output. The sustainable capacity of this aquifer is estimated to be about 14 mgd (Waimea Water Services, 1991). The existing approved potable and non-potable water demands for developments in the adjacent resort node, which include Kaupulehu, Kona Village and Kuki'o resorts, total approximately 5.41 mgd or about 39 percent of the estimated sustainable capacity.

B. Anticipated Impacts

Potential Impacts on Water Supply

North Kona Development Group proposes to construct a dual water system to provide its required potable and non-potable water. Potable water is required for domestic uses at residential units, golf clubhouse, tennis center, maintenance buildings, and the wastewater treatment plant office. Non-potable water will also be required for irrigation of the project's golf course and landscaped areas.

Based on the Water System Standards of the County of Hawai'i Department of Water Supply's (DWS), the project's estimated average daily requirement for potable water is 430,600 gallons per day (maximum daily demand of 645,900 gpd) for 1,000 housing units and the other project elements. Water demand projections are shown in Table 2, and discussed in Section 2.1.9 and 2.1.10. The project will also require a total of 947,400 gpd of non-potable brackish water to irrigate the golf course and landscaped areas. Of this amount, approximately 291,200 gpd will be recycled treated effluent water from the wastewater treatment plant. The adjusted brackish water demand for irrigation is 656,200 gpd. Total average daily demand on the aquifer due to this project is approximately 1.09 mgd.

NKDG has investigated the potable and non-potable water supply alternatives for development for the proposed project, including desalinization of brackish water, as well as off-site development of potable water with shared resources and infrastructure costs with adjacent landowners. The investigation identified the creation of an independent system using brackish water for non-potable and desalinization for potable water as the favored approach for the project's water supply. NKDG has requested permission to utilize State lands *mauka* of the site on Manini'owali and Awake'e to establish a field of six brackish water wells. According to Waimea Water Services (October 1991) brackish water derived from wells at approximately 600 feet above msl could be used directly or blended with treated effluent for irrigation. The total chloride level is anticipated to be approximately 1,000 mg/l, which will be used directly for irrigation of turf and landscaping. A desalinization plant will also produce the 430,000 gpd of potable water to serve the average daily demand of the proposed project.

The project will require approximately 1.09 mgd (average daily demand) of total brackish water for both potable and non-potable uses. Including this new demand with the other wells tapping this aquifer, the total regional demand on this aquifer will become approximately 6.4 mgd, or about 48 percent of the estimated sustainable capacity of the aquifer.

Potential Impacts on Groundwater Quality

Considerations for groundwater quality relating to this project include the irrigation disposal of treated wastewater effluent, irrigation with brackish water, and the application of fertilizers and pesticides on the golf course and landscaped areas. Potential impacts of fertilizers and pesticides in groundwater entering the coastal marine environment is discussed in Section 4.6.

Treated Wastewater Effluent Disposal: A study of wastewater treatment and disposal for this project has been prepared by Park Engineering (October 1991) (Appendix C). The proposed development is expected to generate approximately 291,200 gpd of wastewater, all of it classified as domestic. The wastewater will be treated by an activated sludge secondary treatment system. Secondary treatment with chlorination will remove 99 percent of the bacteria and up to 99 percent of the viruses in wastewater effluent.

The most environmentally sensitive approach for this project to dispose of the effluent is in golf course or other land irrigation, rather than through an ocean outfall, injection wells, or septic tanks with leaching fields. The State Department of Health strongly supports the concept of utilizing treated wastewater for irrigating community landscaping areas and the golf course (Lewin, August 20, 1991). This is a proven technique of effluent disposal in Hawai'i, and its practicality has been demonstrated by field investigations conducted by the Water Resources Research Center of the University of Hawai'i. Tests showed that percolate from irrigation water consisting of secondary effluent does not carry bacteria or viruses through the soil mantle. Carefully managed irrigation applications at the project will minimize infiltration of nitrates and other nutrients. The project site is located below the UIC line which runs along the Queen Ka'ahumanu Highway.

Treated wastewater will be diluted with brackish water, and disposed of by land irrigation of the golf course in an acceptable manner approved by the State. Treated wastewater effluent will have the following characteristics: BOD - 5 to 15 milligrams per liter (mg/l); suspended solids - 5 to 15 mg/l; nitrogen - 5 to 7 mg/l; phosphorus - less than 6 mg/l; and total coliforms - less than 23 per 100 milliliters (ml). Adequate disinfection will also insure that coliform counts do not exceed 240 per 100 ml in any sample. These levels are acceptable for secondary treated effluent according to proposed Hawai'i Administration Rules, Title 11, Department of Health, Chapter 62, Wastewater Systems. Disposal of diluted secondary-treated effluent by irrigation methods is also regulated by the State Department of Health, State Department of Land and Natural Resources and the County Department of Water Supply.

The volume of treated wastewater effluent (291,200 gpd) will amount to about 30.7 percent of the average golf course irrigation needs (947,400 mgd). Typically, only 5 to 10 percent of properly applied soluble nitrogen eventually infiltrates the groundwater with the other 90 to 95 percent utilized by plant and soil ecology uptake. This utilization rate applies to all soluble nitrogen sources applied to the golf course from both fertilizer and treated effluent. Land application of treated wastewater effluent has the potential to add approximately five percent of effluent nitrogen from percolate to the groundwater. Studies of groundwater quality prepared by Oceanit Laboratories, Inc. (October 1991), show that with proper irrigation management of turf areas, treated effluent nitrogen is expected to be utilized completely by the turf grasses, with minimal leaching to groundwater. Dilution of the minor amount of leached nitrogen within the groundwater lens will further reduce its concentration within the aquifer. Nitrogen input to groundwater through treated effluent irrigation is not expected to reduce the quality of this aquifer.

The presence of bacteria and viruses will be well within allowable limits and none are expected to reach the aquifer. Bacteria and viruses will essentially be removed from treated effluent during the final treatment steps. The remaining bacteria and viruses will generally be removed in contact with organic material and particles in the soil profile. Domestic wastewater effluent also does not normally contain concentrations of heavy metals and other contaminants in excess of EPA limits.

Non-Potable Water Use in Irrigation: Areas irrigated directly with non-potable water (1,000 mg/l chlorides) must be supplied on a regular basis at a rate approximately 20 percent greater than plants require in order for the dissolved salts contained in the treated wastewater to adequately leach out of the root zone. By-product water from the desalinization process will also be used in a diluted form. Most of the golf course will be irrigated with a mixture of 70 percent brackish water and 30 percent treated wastewater effluent. Treated effluent has a low salinity, and therefore will dilute the salinity of the golf course irrigation water, and minimize the need for over-irrigation to remove dissolved salts. The mean groundwater salinity may increase slightly (less than five percent), much less than the natural variation during the year.

The introduction of irrigation water will impact the aquifer by changing the existing recharge pattern and increasing the total mean annual recharge volume. When included with groundwater flow from the primary water budget area, the increase in total groundwater flow through the project site will be only approximately six percent.

The recharge from irrigation water will act as a continuous source of water at the site, which will slightly distort the groundwater flow. Streamlines will tend to diverge at the site due to the source effect of the irrigation water. There will be a slight rise in the mean groundwater table estimated at from 0.8 to 1.0 inch to accommodate the additional water.

Fertilizer Use on Golf Course and Landscaped Areas: For a typical 18-hole golf course in Hawaii, fertilizer use rates differ for the various areas of the course. Greens and tees receive the most frequent application (two and four weeks, respectively) while fairways and roughs are fertilized less frequently (eight weeks and three months, respectively). Complete fertilizers are usually applied, meaning those that include nitrogen, phosphorus and potassium. Nitrogen is applied in larger quantities and is the only fertilizer element likely to enter groundwaters.

The golf course at this project will have approximately 86 acres of total maintained turf area. Fertilizer application rates for this golf course have been calculated in Murdoch and Green (March 1991) and are shown in Appendix E. The golf course will be designed to minimize high application areas, such as greens and tees, to approximately eight acres. Greens and tees are the most highly manicured areas on the golf course, and pose the greatest risk for contributing nitrogen to groundwater since they receive the most frequent fertilizer application and irrigation. Fairways are the largest area of a golf course, and this course is planned to have approximately 42 acres of fairway. Fairways are much less maintained than tees and greens, yet must be fertilized and irrigated regularly. The least maintained area on the golf course is the rough, which is allowed to grow tall, is infrequently fertilized and irrigated. The golf course is planned to have approximately 36 acres of rough. The golf course will utilize approximately 14.6 tons of nitrogen, most of which will supplied by applied fertilizer and approximately 10 percent supplied by nitrogen in treated effluent disposed by land irrigation (discussed in the previous section).

The proposed golf course will be irrigated under strict management to avoid excess irrigation, and will primarily use slow-release nitrogen fertilizers instead of soluble nitrogen fertilizer. Excessive irrigation only serves to pass the nitrogen beyond the turf root zone, where it provides little benefit to turf growth. Carefully managed irrigation will restrict the amount of soluble nitrogen leaching through the soil and ultimately reaching the underlying aquifer. A golf course which does not strictly manage its irrigation will create waste and cost to the operation, and could contribute greater quantities of nitrogen to the groundwater.

When soluble nitrogen fertilizers are carefully applied to turfed areas of a golf course, approximately 90 to 95 percent of the nitrogen is used by the plants. If only soluble nitrogen fertilizers are used, approximately 5 to 10 percent of the soluble fertilizer nitrogen could potentially leach below the root zone of plants on the golf course, and eventually enter groundwater. The golf course, common areas and residential lots will primarily utilize slow-release nitrogen fertilizers instead of soluble nitrogen fertilizers, since they cause significantly less leaching of nitrogen below the soil profile. The use of the slow-release nitrogen fertilizers generally in place of soluble nitrogen fertilizers will reduce the loss of nitrogen through the soil profile to 1.5 percent, which will equate to 0.2 tons of nitrogen per year contributed to groundwater from the golf course area. Soluble nitrogen forms will be used periodically in low growth periods, but only in small quantities that will be utilized almost completely by turf plants and the soil ecology.

The golf course and other land uses involving fertilizer application will be developed on lands which range in elevation from approximately 60 to 200 feet above the basal aquifer. The vertical distance between the point of nitrogen application and the basal aquifer will allow for further dilution of any nitrogen leaching below the root zone. Once contacting the aquifer, nitrogen dilution effects will again be substantial, considering the expansive volume of the underlying aquifer. The quality and quantity of nitrate infiltration from the proposed golf course and other land uses involving fertilizer application is not expected to degrade the basal aquifer.

Oceanit Laboratories (October 1991) has modeled the worst-case potential contribution of nitrogen to groundwater below the project site. Aquifer nitrogen concentration at the site is estimated at 0.85 mg/l. Average nitrogen concentration in the underlying aquifer is increased to a predicted concentration of 2.18 to 2.95 mg/l under this worst case scenario. This value is well within the EPA potable water limit of 10 mg/l. No water source could be affected by tis nitrogen because of the groundwater flow towards the ocean.

Unlike nitrogen, phosphorus generally becomes fixed to soil particles and will not infiltrate to groundwater. Phosphorus combines quickly with iron and aluminum compounds and forms insoluble phosphates. Thus the impact of phosphorus on the aquifer is very small. Potassium not consumed by plants is expected to remain in the soil because of ion exchange processes.

Use of Pesticides on Golf Course and Landscaped Areas: Pesticide is a loosely used term for chemicals applied to control either pest insects or diseases of turf grass and landscaping vegetation. Pesticides consist of herbicides (weed killer), insecticides (insect killer) and fungicides (fungus killer). All of these types of chemicals will be required to maintain turf quality on the proposed golf course, and to maintain turf and landscaped vegetation in common areas and on private residential lots. The chemicals used will only be those approved for golf course application in Hawai'i, regulated by the U. S. Environmental Protection Agency and the State of Hawai'i Department of Agriculture.

The amount and frequency of pesticide use, the types of chemicals used to control pests, and the quality and thickness of the topsoil affect the potential impact to groundwater quality in the aquifer underlying the proposed project. The amount of pesticide leaching to the aquifer can be controlled by importing topsoil with a high organic content and by maintaining adequate topsoil thickness. Based upon a soil thickness of at least 12 inches with an organic content of at least two percent, and traditional rate of application of pesticides (non-IPM approach), estimates of the resulting worst-case pesticide concentrations in the groundwater as a result of this project were calculated by Oceanit Laboratories (September 1991). The results are presented in Appendix G. The implementation of the planned IPM program, described as a mitigative measure below, will eliminate or reduce these predicted levels far below potentially deleterious concentrations. Under the worst-case scenario, none of the pesticides concentrations predicted to reach the groundwater will come close to the Health Advisory Limits established by EPA for drinking water.

The approach to the controlled use of pesticides at the proposed golf course will involve a technique developed and utilized extensively in agriculture called Integrated Pest Management (IPM). IPM programs have been developed in the past by the agriculture industry for specific crops as a means to control waste and costs through unnecessary or excessive pesticide usage. The control of pesticide overuse is a major concern for the natural and human environment, to minimize the potential for pesticides entering surface water, groundwater and the air. The goal of the IPM program will be to use cultural, chemical, and biological control measures to suppress pest populations to levels at or below the aesthetic or economic threshold which is set. The health of the golf course turf is critical in keeping the pest populations down, and minimizing the need to apply pesticides. IPM does not eliminate the use of pesticides on a golf course, rather it creates a high level of turf management and control over the use of pesticides, which results in less overall use of pesticides.

The proposed golf course will occupy approximately 170 acres of land; however, only 86 acres will be turf. Of that amount, tees and greens will constitute approximately eight acres of the golf course, and the majority of pesticides application will occur in these areas. The remainder of the turfed golf course (78 acres of fairways and roughs) will receive none or infrequent pesticide applications, especially with the proposed use of resistant turf types. Approximately 84 acres of landscaped and natural buffer area will surround the golf course, and the landscaped portion will receive very infrequent applications of pesticides. The project will employ the xeriscape method of landscape planting, which uses plants which require less water than traditional landscape plantings.

Irrigation control is another key in golf course management which affects the ability of applied pesticides to pass through the turf root zone and soil profile. The Golf Course Manager also is responsible for the irrigation program, which must consider the areas applied with pesticides. Irrigation soon after application of pesticides will be avoided, to discourage washing pesticides through the soil profile without time to interact with the turf and organic material in the soils. The Golf Course Manager will make every effort to be aware of weather conditions to avoid applications of pesticides prior to rain storms.

C. Mitigative Measures

Mitigative measures are recommended which address the impacts to the area's water supply, as well as to groundwater quality. Discussed below are measures for the conservation of potable water, the conservation of non-potable water, and measures which will minimize impacts to groundwater.

Seasonality of Precipitation: Rainfall varies over the year at Manini'owali, with wetter months being during the winter. Irrigation water demand from the off-site wells will typically be near it's estimated maximum during the summer months. Pumping requirements stated earlier are calculated based on the average day demand for the golf course, common areas and country lots.

Potable Water Supply Conservation

Development Measures with Regional Impact: By developing a dual water distribution system at its proposed project, NKDG will help conserve the regional potable water supply. Moreover, its proposal to develop brackish water wells and create, by desalinization, its own supply of potable water, further conserves the region's potable water resources.

Reduced Potable Water Usage: Potable water usage is not expected to be as great as calculated for the project due to the varied occupancy of the residential properties. Of the approximately 1,000 market residence units that will be developed, 75 percent of homes are expected to be occupied by full-time residents. The other 25 percent will likely be second homes, and will utilize less potable water and generate less wastewater than full-time occupant units.

Potable Water Conservation Practices: Extensive water conservation practices will be employed to reduce the requirement for potable water. Conservation measures include the use of non-potable water for irrigation of the golf course, common areas and residential lots. Residential lots will have dual water systems, with irrigation systems installed for the use of non-potable brackish water. Potable and non-potable systems will be separate to eliminate the possibility of cross connecting. Non-potable spigots will be clearly labeled to prevent inadvertant consumption of non-potable water.

Non-potable Water Supply Conservation Measures

Salt Tolerant Turf Grass, Xeriscape and Native Plantings: A salt-tolerant variety of golf course turf will be selected for much of the 86 acres of the golf course. Conservation of non-potable irrigation water will be accomplished by implementing a xeriscape plan for the landscape planting design and maintenance of common areas and private residential lots. Xeriscape is a method of landscape planting which uses plants which require less water than traditional landscape plantings. The xeriscape plan is expected to reduce irrigation water consumption by as much as 50 percent in these areas, as compared to standard landscaping irrigation water requirements. Native dryland species suitable for arid coastal areas will be considered for the landscaping of the golf course and common areas.

Measures to Mitigate Groundwater Impacts

Utilization of Organic Rich Topsoil: A minimum of 12 inches of topsoil with high organic carbon content will be utilized in high maintenance sections of the golf course, to control leaching of pesticides. This thickness of soil is more than adequate to establish healthy turf. Many of the pesticides proposed for use are highly sorbed to organic matter in the turf and the high organic content soils. Use of organic-rich soils will effectively remove much of the pesticides penetrating the root zone and potentially reaching groundwater.

Irrigation Water Control: Irrigation water use will be strictly controlled to amounts that are necessary to maintain the golf course and the common landscaped areas. A Certified Golf Course Manager will be employed, who will ensure proper irrigation water use. Excess irrigation is never desirable because of the waste and extra costs created by pumping of water. Excess irrigation could also cause undesired "washing out" of fertilizer and pesticide below the intended turf root zone, as well as the potential degradation of groundwater quality by leached chemicals.

Integrated Pest Management (IPM) Program: An IPM program will be instituted to minimize the frequency and amounts of pesticides being applied at the golf course. The types of chemicals being utilized for treatments will be the lowest possible, in terms of toxicity and their persistence and mobility, and total amounts applied. The reduction of the total amounts of pesticides being used will reduce the potential for their release to the groundwater and environment outside the golf course. Fertilizer and pesticides will also be applied under the supervision of the certified Golf Course Manager, who will strictly control the amounts following the IPM program and avoid over-application.

Different types of IPM programs have been instituted successfully at golf course developments throughout the United States and also in Europe and Japan. Implementation of the IPM program is expected to result in a reduction of total pesticide usage up to 50 percent, as compared with the pesticide application amounts at typical golf courses in Hawai'i. The reduced pesticide use, included with other control measures discussed later in this section, will greatly reduce the potential impact of pesticides affecting the quality of the groundwater below the site.

IPM involves extensive knowledge about the management of healthy turf, and its potential pests and diseases. The keys to successful implementation of a golf course IPM program are the experience and thoroughness of the golf course management staff. Knowledge of the types of pests and diseases experienced at golf courses in West Hawaii will be crucial in identifying turf problems early before they become widespread. The frequency and area of pesticide applications are carefully controlled in this manner. The golf course superintendent and staff must maintain the turf in healthy condition and monitor it constantly, identifying turf problems immediately and applying pesticides in a carefully controlled manner.

Pesticide chemicals have varying toxicity to human and wildlife, and these chemicals also vary in their persistence and mobility in the environment. The IPM program will use the least toxic chemicals in the lowest possible concentrations and lowest volumes for application which will be needed to cure a pest or disease problems. At times it may be more environmentally responsible to use a more toxic compound in small doses to eliminate the pest problem, to avoid more frequent and voluminous applications of a less toxic compound. The Golf Course Manager will have the ultimate responsibility over the choice of pesticide used, concentration mix, area for application, volume to be applied, and timing of application. The Golf Course Manager will be certified through strict training programs (and regular update programs) to ensure his/her ability to safely control chemical use. This manager will follow state-of-the-art management techniques in safeguarding the human and natural environment from exposure to toxic chemicals in pesticides. The Golf Course Manager will also be concerned about the costs involved with overuse of pesticides, because they are expensive products. Golf course employees responsible for chemical applications will undergo training and be licensed to apply pesticides.

Management of Chemical Storage and Use: The golf course maintenance area is the point on the site where the greatest quantities of toxic chemicals will reside. The entire maintenance area is planned to be contained within a chemical control area, where impermeable collection surfaces would be installed. Activities in and around buildings and maintenance areas will be prevented from releasing chemicals into the ground by accident. Mixing and storage areas for pesticides, fuel storage and loading areas, equipment maintenance areas, equipment washing areas and areas storing chemicals associated with maintenance would all be included in this chemical control area. Runoff and washing waste from this chemical control area will be collected and treated, and recycled within the maintenance area water system.

Land Application of Treated Wastewater Effluent: As described earlier, treated wastewater effluent will be disposed through dilution with irrigation water and application to the golf course. Nitrogen compound contributions to groundwater will be minimal under this method of wastewater disposal. The total nitrogen applied to the golf course will be the combined contribution of fertilizer and treated wastewater effluent. Irrigation scheduling will be closely managed to avoid over-irrigation, thus minimizing the infiltration of nitrate and other nutrients and allow their uptake by turf grass. The use of advanced secondary-treated wastewater effluent and brackish water mixture for golf course irrigation will be coordinated with the County of Hawaii, Department of Public Works and the State Department of Health. Impacts on water quality are not expected to result because of the high level of treatment and turf utilization of nitrogen.

Slow-Release Nitrogen Fertilizer Use: Slow-release nitrogen fertilizers will be utilized on the golf course, landscaped common areas, and residential lots. These fertilizers release nitrogen at rates comparable to turf plant uptake rates, so very little nitrogen passes below the root zone. The overall effect on groundwater quality underlying the project site due to nitrogen application is expected to be negligible because of slow-release nitrogen fertilizer use and groundwater dilution effects.

Groundwater Monitoring Program: As a precautionary measure to protect against contamination of groundwater, the State of Hawai'i Department of Health (DOH) requires all new golf course developments to install monitoring wells down-gradient of new projects. NKDG will install and maintain monitoring wells as required by the DOH. Existing groundwater quality measurements must be undertaken to determine background levels prior to operation of the golf course. Periodic testing of groundwater samples will be undertaken to assess the potential degradation of the groundwater aquifer. Should adverse parameter levels be detected in groundwater which are a result of the golf course or other project operations, measures will be taken immediately to eliminate the source of the contaminants. Additionally, ground lysimeters will be installed at selected locations for measuring pesticides and nitrogen leaching past the top soil layer.

DOH Twelve Conditions for New Golf Courses: The latest State DOH conditions relating to new golf course development and maintenance will be implemented as applicable.

4.6 MARINE RESOURCES AND OCEAN WATER QUALITY

This section includes a discussion of the existing marine environment along the shoreline near the project, and potential impacts to this environment as a result of development of the Manini'owali Recreational Community. A detailed study of the potential impact on the marine environmental resources of the area was prepared by Oceanit Laboratories, Inc. (OLI) (September 1991). Findings of this study are presented in this section, and the complete report is included in Appendix G.

A. Existing Environment

A baseline assessment of the nearshore marine environment was conducted by OLI during March 1991. The primary objective was to assess nearshore water quality changes brought about by groundwater nutrient and chemical inflow. In addition, qualitative assessments of the nearshore biological communities inhabiting the area were conducted in order to evaluate the potential for changes to biota from alteration of water chemistry.

Water Quality: The marine environment is typical of other areas found along the West Hawai'i coastline. Earlier studies of the area have found that the nearshore waters off the North Kona lands are classified by the State Department of Health as AA, and can be considered pristine. Lack of suspended material results in extreme water clarity, but itmay decrease on occasion because of heavy surf or surface macroplankton blooms. There are no streams entering the sea along Manini'owali, but there is evidence of high volumes of highly nutrified groundwater inflow.

Three water quality samples were taken for comparison with other Kona area studies. These samples were taken at the anchialine pond, the beach, and at Puialoa Point (Figure 10). Water quality in the nearshore ocean off Manini'owali generally conforms to State water quality standards set for AA coastal waters. The ocean samples taken for this project are well within the State's water quality standards for dry, open coastline for all parameters except nitrate + nitrite. However, the relatively high level of nitrate + nitrite is a normal background concentration for areas of natural groundwater influx.

The sample of water taken from Kua Bay off Manini'owali Beach was of slightly lower salinity, higher silicate, and higher nitrogen than the Puialoa sample. Groundwater is commonly very high in both nitrogen and silicate. However, these constituents are normally low in the marine environment and are rapidly removed from the water through biological action. The measurement of high nitrogen and silicate near the beach is consistent with the hypothesis that this is a major site of freshwater inflow. The second water sample taken from the *pahoehoe* headland, Puialoa Point, is more typical of oceanic water (lower nitrogen and silicate), possibly indicating a lower groundwater flow or higher mixing rate in this area.

Coral and Marine Life: Within the shoreline area (from high splash zone to subtidal breaker zone) there is a variety and abundance of marine life determined largely by wave energy, and by the topography and bathymetry of the shoreline that affords shelter to aquatic life. The type of lava flow (*'a'a* or *pahoehoe*) will markedly affect the character of habitat in the surf and intertidal zones. Boulders from an *'a'a* flow provide increased vertical relief and more shelter from the surf. Bays formed from headlands will also vary in the type of biota they support depending upon their age, depth, and type of bottom. The shoreline at Manini'owali is characterized by three main types: *'a'a* flow, *pahoehoe* flow, and sandy beach.

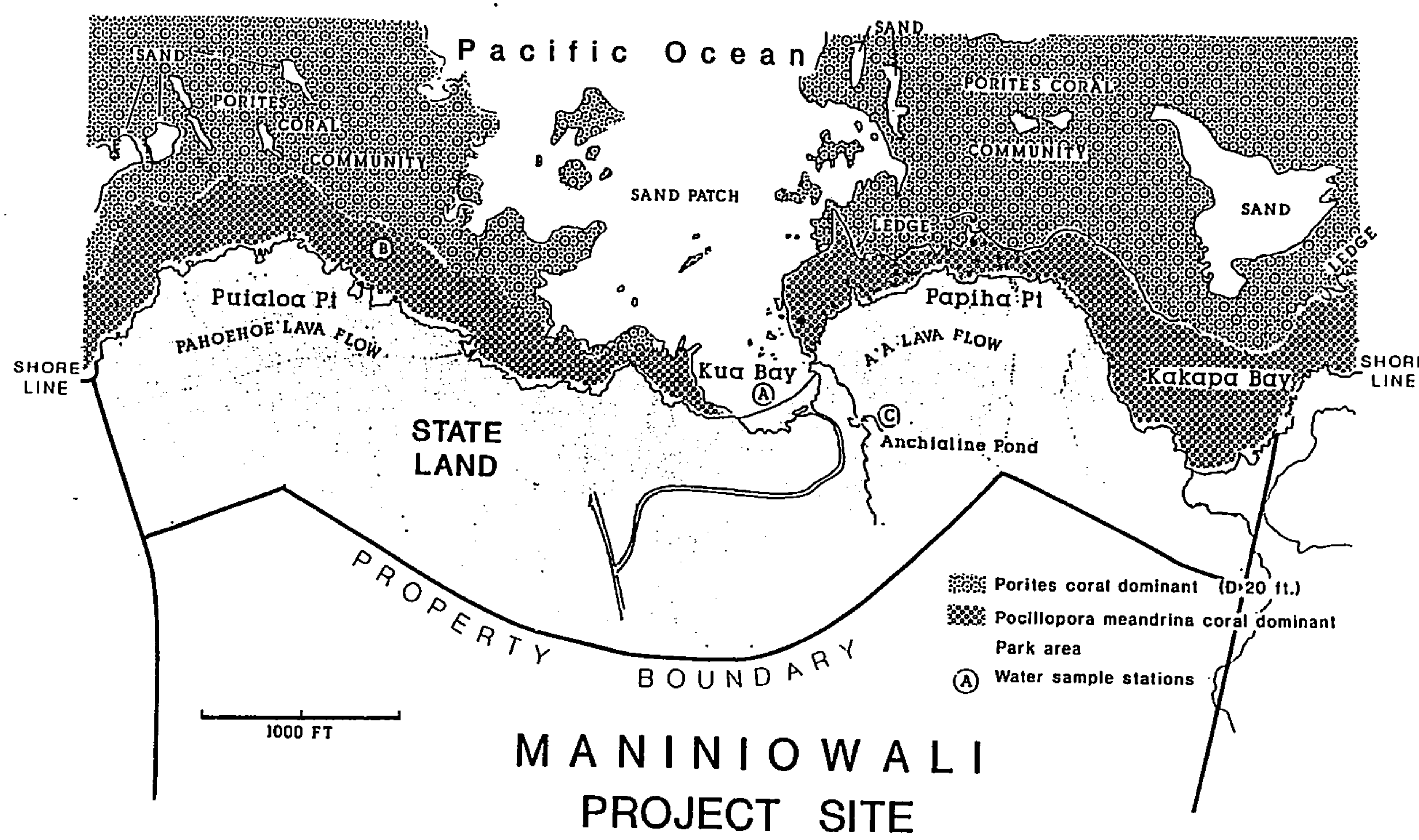
The most recent (1801) *'a'a* lava flow is located along the northern third of the coastline parallel with the project site. The distribution of large boulders and lava outcroppings forms a series of tidal pools which support intertidal seaweeds such as Turbinaria ornata, Anfeltia concinna, Sargassum echinocarpum, and Porphyra sp. Sea urchins, including Echinometra matheai, and Echinostrephus aciculatus, are plentiful in protected cracks between boulders. Several small coral heads, Pocillopora meandrina, were noted in deeper tidal pools.

The white sand of Manini'owali Beach (at Kua Bay) stretches for approximately 450 feet along the coastline, but appears to be seasonally variable in size. A few Ghost Crab (Ocypode ceratophthalma) burrows were visible along the beach. Because of lack of cover, marine life over the sand patch offshore of the beach is largely limited to transient fish species and other fish or invertebrate species that are adapted to hide in, or just above, the sand. One school of *opelu* (Decapturus sp.) was seen, but no cryptic or sand dwelling species were noted during the survey.

The older *pahoehoe* flow characteristic of the shoreline south of Manini'owali Beach forms a ledge at the waterline, dropping immediately into five to ten feet of water along most of this coast. Tidepools here are not so numerous or richly populated as those at the tip of the *'a'a* lava flow. Dominant algae include Turbinaria ornata and Sargassum echinocarpum.

Nearshore subtidal marine communities are generally defined by the physical nature of the bottom substrate. Unconsolidated sand or rubble will support a relatively low population of surface dwelling invertebrates and fish. Hard substrate may either be basalt (lava) or calcareous in nature and in general provides more niches for fish and invertebrate habitation. Often on the Kona coast the solid basaltic flow is covered by a thin veneer of consolidated limestone sand.

Because of the relatively young geologic age of Big Island lava flows and the relatively slow growth of corals in these subtropical waters, most corals are growing on a substrate of basalt and do not form true coral reefs, but rather coral communities. Each zone is



Coastal Features of Manini'owali

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 11

characterized by a depth range, substrate type, and primary coral species. Down to a depth of approximately 25 feet, the high surge Boulder Zone, Pocillopora meandrina thrives. From 20 to 45 feet depth, the Reef Building Zone, is P. lobata. This is a zone of moderate surge. The same coral community, however, is also found at 100 feet and below, a depth experiencing low surge. P. compressa lives in the Slope Zone, from 40 to 100 feet, characterized by moderate surge.

The benthic communities located offshore of Manini'owali are much like other nearby nearshore benthic communities in that coral cover is generally lowest in the nearshore reef zone (15 feet). However, the species diversity is greater in shallow regions compared to the deeper areas. This kind of distribution pattern reflects the relative harshness of physical conditions in the nearshore area, primarily in response to wave stress. Under prevailing conditions, no single coral species is able to monopolize substrata.

Reef Fish Communities: The reef fish were abundant during the baseline survey. The presence of large gamefish including parrotfish (Scarus sp.), *ulua* (Caranx sp.), goatfish (Parupeneus sp. and Mulloidichthys sp.) and squirrel fishes (Holocentrus and Myripristis sp.) indicate that this area has not yet been subjected to heavy fishing pressure. Qualitatively the reef fish community off Manini'owali is typical of other sites along the north Kona coast.

Threatened or Endangered Species: With the exception of the hawksbill turtle (Eretmochelys imbricata, endangered), green sea turtle (Chelonia mydas, protected) and the humpback whale (Megaptera novaegliae, endangered), there are no other protected or endangered species known from the Kona marine environment.

Anchialine Pond Survey: The single anchialine pond near the project site is located on the privately owned land (targeted for State aquisition) approximately 250 feet behind the beach. There are no anchialine ponds on the project site. Anchialine ponds are nearshore ponds with measurable, normally low, but highly variable salinity. The water levels of anchialine ponds rise and fall with the tides, although they have no surface connection to the ocean. The shallow bottom of the pond is covered with sandy mud that supports a rich colony of blue green algae (Schizothrix sp.) growing on other unidentified freshwater algae, possibly widgeon grass (Ruppia maritima). The pond supports a large population of mosquito fish (Poecilia sp.) and at least one species of shrimp, probably Palaemon debilis. No other shrimp species (Macrobrattachium, Halocaridina, or Metabetaeus) were seen.

The pond, approximately 16 square yards in surface area, may be classified as a mature pond. Its salinity is about six parts per thousand (35 ppt = full seawater) which is on the high side of normal for a mature anchialine pond. Both the nitrogen and silicate level were slightly higher than those of an average anchialine pond, but entirely within the normal range for a mature pond.

Ciguatera Fish Poisoning: There have been recent assertions that golf course chemical use is somehow linked to the increase in ciguatera fish poisoning. In fact, there is no known causitive correlation between golf course or other upland development and ciguatera poisoning.

The incidence of ciguatera fish poisoning in the Hawaiian Islands has been on the increase during the past 20 years. Fish are believed to become ciguatoxic by eating and accumulating poisons that are produced by a single celled marine diatom named Gambierdiscus toxicus. This diatom species (and probably others) produce a toxin as they grow attached to the surface of large benthic algae or dead coral. Fish ingest toxin by eating the algae (with attached diatoms). The toxin is passed up the food chain from herbivorous fishes and concentrated in higher level predatory fishes. If there is a population bloom Gambierdiscus can coat benthic algae with up to 500,000 diatom cells per gram of algae. The State Department of Health has indicated that concentrations of Gambierdiscus greater than 20 cells per gram should be considered potentially toxic.

Outbreaks of ciguatera poisoning have been correlated with man-made coastal disturbances such as dredging or the construction of breakwaters. Where there is a disturbance in the nearshore ecosystem, either man-made or natural, this provides an opportunity for many different populations to bloom and take advantage of the disturbance. If Gambierdiscus populations bloom in an area, then the fish in this area have the increased potential to become ciguatoxic. There is no known method to prevent Gambierdiscus from blooming or creating toxins.

B. Anticipated Impacts

Short-term impacts on the marine environment from nearshore construction projects could potentially result from airborne dust and increased silt in runoff waters. Dust and silt introduction to the ocean will not occur due to this project because of the 1,000 feet distance of the property from the shoreline, extensive construction site watering, the low normal rainfall, and the lack of surface runoff from the site.

Long-term impacts on the marine environment could potentially occur from the use of fertilizers and pesticides, irrigation disposal of diluted secondary treated sewage effluent, and the increased public access to the shoreline. These potential long-term effects are discussed below.

Fertilizer Use and Treated Effluent Disposal: As discussed in Sections, 4.4 and 4.5, golf course and residential activities have the potential to add nutrients to the nearshore marine environment. Nutrification of the aquatic environment most often impacts the ecosystem by stimulating growth of phytoplankton or benthic algae, but may also affect coral growth. However, nutrification implies a balanced increase in nutrients (nitrogen, phosphorus, potassium, trace minerals) required to stimulate plant growth. Groundwater in the Kona region is typically high in nitrogen and low in phosphorus and potassium. The introduction of small additional amounts of nitrogen to an environment already high in nitrogen should not stimulate plant growth. Nearshore ocean water productivity is limited by low phosphorous levels, as is typical in the nearshore ecosystem.

Studies indicate that groundwater nutrient concentrations vary in shoreline areas fronting some existing West Hawai'i golf course developments. At Keahou Bay, nitrogen levels in nearshore waters increased by 127 percent. The concentration of nitrogen and phosphate in anchialine ponds at the Waikoloa Resort increased by 98 percent and 55 percent, respectively. However, at other locations, such as the Mauna Lani and Westin Mauna Kea, there has been no observable increase in nearshore nitrogen levels.

Estimates generated by the studies of the groundwater impacts indicate that the existing groundwater level of nitrogen (approximately 0.847 mg/l) may be increased to 2.18 to 2.95 mg/l by anticipated golf course and residential fertilization. Previous studies in the region indicate, however, that this small nutrient increase will not adversely affect anchialine pond biota or nearshore marine life. In comparison with natural groundwater concentrations of nitrogen in different aquifers in West Hawai'i and around the state, the predicted maximum nitrogen concentration with the project is well within the range of natural groundwater conditions.

At the Manini'owali coast, it is not likely that coral communities deeper than three to six feet will receive nitrogen from the inflow of groundwater. Freshwater tends to rise and spread out on the surface limiting its ability to convey nutrients. The benthic communities within the tidal and surge zones may receive a steady flux of nutrified groundwater. The extent of this effect will not likely be noticeable, because nitrogen in the groundwater, which is the primary nutrient likely to be increased by golf course and residential development, is already in excess in the nearshore environment. The proposed residential and golf course development will occur at least 1,000 feet away from the coastline, allowing for extensive dilution in the aquifer, thus reducing the extent of groundwater inflows of nutrients. This separation will serve as a buffer to environmental impacts to the nearshore marine environment. Furthermore, wave and current mixing in the near shore environment will immediately dilute nutrient subsidies. It is possible that some areas of intertidal algal growth may shift toward rapid growth species which are more adept at taking advantage of increased nitrogen levels.

It is speculated that rapid water turnover within anchialine ponds prevents algae blooms from occurring. There has been no indication that the increased nitrogen levels are affecting anchialine ponds adjacent to other golf course developments. There have been no reported adverse impacts on nearshore marine biota from increased nitrification of groundwater caused by golf course fertilization.

Pesticides Use on the Golf Course and Landscaped Areas: No golf course development in Hawai'i has been linked to pesticides input to the nearshore environment, nor has there been any evidence directly implicating golf course pesticide use with impacts on the nearshore ecology. Based on the findings of groundwater studies by Oceanit Laboratories (October 1991), the concentrations of pesticides entering the ocean in groundwater are expected to be extremely minute, and will likely be below the measuring instruments' detection threshold.

Worst-case analysis was followed in the Oceanit Laboratories (October 1991) groundwater study, which examined the case where golf course pesticides use follows a traditional application schedule, as presented in Murdoch and Green (March 1991). With implementation of the proposed Integrated Pest Management (IPM) program at the project, pesticides use will be reduced by as much as 50 percent. With an IPM program in place, there will be no impact on the ocean due to careful pesticides use. In addition, the proposed residential and golf course development will occur at least 1,000 feet away from the coastline, allowing for extensive dilution in the aquifer, further diluting the minute concentration of pesticides.

If a pesticide compound was transmitted by groundwater to the ocean, than the significant mixing processes occurring in the nearshore zone would disperse it rapidly. Toxicologically significant amounts of pesticides compounds will not occur or persist in the nearshore area. Because the on-site control measures planned, chronic contributions of pesticides will not occur, presenting little potential for bioaccumulation of these compounds in nearshore organisms.

Public Access Impacts: As discussed in Section 2.4, upon development of the proposed project, it is planned that the public will have increased access to the ocean shoreline by way of a new public roadway to be constructed from Queen Ka'ahumanu Highway to the Kua Bay area for the State's new public park facilities.

Increased public access poses a concern for public safety. Also, increased public pressure on marine resources could lead to a decrease in abundance of fish and desirable invertebrates such as lobsters and squid. The anchialine pond near Kua Bay will attract the attention and possible contamination, or disruption, by visitors. Since the pond can provide an important biological indicator for measuring impact from groundwater inflows, any disruption could have serious ramifications. Some people are also inclined to litter and leave wastes behind, befouling the shoreline area and marine environment.

C. Mitigative Measures

Mitigative measures discussed in Sections 4.4 and 4.5 are directly related to the potential effects on marine resources and ocean water quality. These include measures of erosion control during construction, as well as long-term operational measures.

Erosion Controls: Runoff during and after construction will be retained on-site, allowing for percolation into the ground. Erosion will also be minimized by compliance with all governmental regulations and standards. After completion, the project's soil erosion should be negligible due to the establishment of turf and landscaping on the site and the lack of any streams to carry suspended sediments to the ocean.

Managed Fertilizer Applications: Nitrate enrichment in runoff entering groundwater from golf course and landscape fertilization will be minimized through sound golf course management practices followed by the Certified Golf Course Manager. The use of slow-release nitrogen fertilizers, will minimize nitrate percolation into groundwater, since these fertilizers release nitrogen at the same rate as the turf grass uptake rate.

Managed Pesticides Usage: Quantities of pesticides expected to be introduced to the ocean from the project will be negligible due to carefully controlled pesticide use on the project. The planned IPM program will minimize pesticides applications and the Golf Course Manager will avoid application during precipitation periods and over-irrigating applied areas.

Groundwater/Marine Water Monitoring Program: Since groundwater enters the nearshore waters, monitoring of groundwater quality (as discussed in Section 4.5) will be employed as a precautionary measure. In addition to this groundwater monitoring, NKDG will also conduct periodic monitoring and testing of the anchialine pond waters and nearshore ocean water.

4.7 NATURAL HAZARDS

A. Existing Conditions

The NKDG parcel is subject to natural hazards, as are similar lands along this stretch of Kona coastline, including the possibility of seismic activity and lava flow inundation.

Tsunami inundation is not expected at this inland location since it is located 1,000 feet from the coastline at elevations of 60 to 250 feet above msl. The property is designated within Zone X, an area determined to be outside of the 500-year flood plain, on the Federal Emergency Management Agency's National Flood Insurance Program flood-hazard areas map. A portion of the State's adjacent shoreline area *makai* of the property boundary is within zone "VE," meaning that it is subject to coastal floods with a velocity hazard of wave action. This area has a flood elevation of eight feet. This hazard zone is strictly limited to a narrow band of approximately 200 feet along the ocean shoreline, approximately 800 feet from the nearest property boundary.

The U.S. Geological Survey (USGS) has classified the regions of the volcanically-active island of Hawai'i into "hazard zones" rated from 1 to 9, with zone 1 being of greatest risk. Hazard zones from lava flows are based chiefly on the location and frequency of both historic and prehistoric eruptions. The Hualalai region including the subject property is classified by U.S.G.S. as Zone 4 lands, based upon its eruptive history. Twenty-five percent of the volcano is covered by flows less than 1,000 years old. According to the USGS report, *Volcanic and Seismic Hazards on the Island of Hawai'i*, Hualalai last erupted in 1800-1801 from several vents on the northwest rift zone. Large flows spilled down both sides of the ridge formed by the rift zone and quickly reached the ocean. One of these flows lies at the location of the Kona Village resort. Another flow underlies the northern end of the Keahole Airport. The lava flows at Manini'owali are believed to be generally about 1,000 years old.

For earthquake considerations the project site is located in Seismic Zone III of the Uniform Building Code (UBC). Although Hualalai has been dormant for 190 years, underground movement of magma toward it's core has produced numerous earthquakes over the years. The closest large earthquake to the site occurred on October 6, 1929, and was centered under Hualalai Volcano with a magnitude of 6.5. Assuming a distance of ten to fifteen miles from the center of the 1929 earthquake, Modified Mercalli intensities of VII to VIII at the site would have resulted. This corresponds to ground motion causing damage ranging from negligible to slight in well-built structures and slight to considerable damage in ordinary substantial buildings.

Although there appears to be no immediately predictible danger from lava flows, some earthquake activity can be expected. Historic data on the frequency of seismic shows that earthquakes of a level of 6.4 Richter Scale magnitude occur on the average of every 62 years (Kona Regional Plan, 1982).

B. Anticipated Impacts and Mitigative Measures

The proposed project will have no affect on natural hazards and no mitigative measures are required. The design of structures on the property will account for the potential occurence of earthquakes at this location.

4.8 VEGETATION

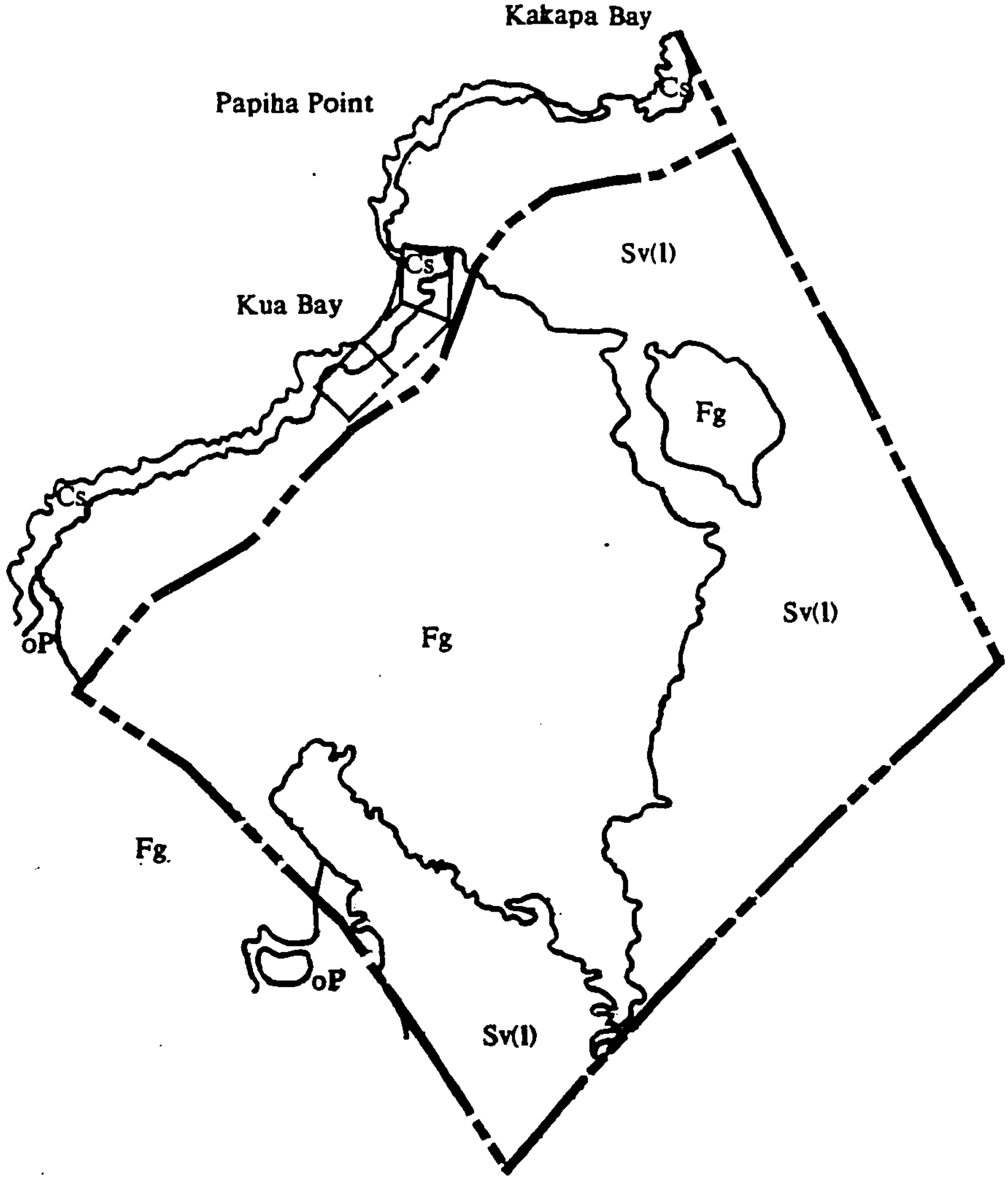
Botanical assessments of Manini'owali have been conducted by Char and Associates in 1986, 1989, 1990 and 1991 to assess general vegetation types (Figure 11). The majority of the area surveyed is covered by a grassland composed of fountain grass with scattered kiawe trees. Strand vegetation exists at the coastal edge, outside of the project boundaries. The *mauka* portion is largely barren *'a'a* and *pahoehoe* lava flows. Two major vegetation types are found on the area surveyed and are summarized below. The complete text of the report is included in Appendix H.

A. Existing Conditions

Existing vegetation cover types on the NKDG site are shown in Figure 12.

Grassland - The grassland occurs on prehistoric, very weathered *pahoehoe* lava flows. Fountain grass (Pennisetum setaceum) cover is very dense, varying from 70 to 90 percent cover. Scattered through the grassland are small stands of *kiawe*, from 6 to 12 feet tall. Shrubs and subshrubs include *'ilima* (Sida fallax), *'uhaloa* (Waltheria indica), and *a'ali'i* (Dodonaa viscosa).

A cinder cone composed of reddish-brown, cinder-ash-pumice material is found near the large *'a'a* lava flow along the Kuki'o boundary. It supports all those species previously mentioned plus *pili* grass (Heteropogon contortus), *'ihi* (Portulaca pilosa), threadstem carpetweed (Molluga cerviana), goosefoot (Chenopodium murale), sixweeks threeawn (Aristida adscensionis), bitter herb (Centaurium erythraca), and buffel grass (Cenchrus ciliaris). Around the base of the cinder cone, the *kiawe* forms a dense ring of trees from 15 to 18 feet tall. *'Ilima*, threadstem carpetweed, and *'ihi* are locally abundant in places.



LEGEND

Cs	Coastal strand	Sv(l)	Scrub Vegetation on lava
Fg	Fountain grass grassland	oP	Open Prosopis

1000' 500' 0' 1000' 2000'

Vegetation Map

MANINI'OWALI RESIDENTIAL COMMUNITY FIGURE 12

Scrub on 'A'a - Vegetation is sparse on the *'a'a* lava flows on the *mauka* half of the area surveyed and on the large flow on the northern boundary. Scattered patches of fountain grass, *kiawe*, pluchea (Pluchea symphytifolia), *'uhaloa*, and *'ilima* can usually be found in depressions or on the *pahoehoe* outcrops among the *'a'a* flow. Two native species found only in this vegetation type during our survey were *nehe* (Lipochaeta lavarum) and *pua-kala* (Argemone glauca).

No officially listed threatened and endangered plants was recorded at the project site. Two candidate endangered species, the *pololei* fern (Ophioglossum concinnum) and tree *'ohai* (Sesbania arborea) have recently been collected from adjacent properties. The *pololei* fern was found to occur within the State parkland portion of Manini'owali near the shoreline.

B. Anticipated Impacts

Construction activities will include vegetation clearing and grubbing. Clearing of the grassland and scrub vegetation will be required over most of the site to create buildable areas for the golf course, housing units and other project elements. Approximately 315 to 325 acres of land will be cleared of vegetation and graded to allow for development of the project.

C. Mitigative Measures

Two mitigative measures will be implemented to minimize adverse effects on vegetation.

Erosion Control: Measures will also be taken to alleviate runoff and soil erosion effects on undisturbed vegetation throughout the project site. Steps will be taken during the construction phase to minimize erosion tendencies, as discussed in Section 4.5. Re-vegetation will be timed so that soil exposure will be minimized.

Landscaping and Use of Native Plants: Extensive landscaping is planned for the site within golf course, residential, and common areas. NKDG plans to implement a xeriscape landscaping program, utilizing plants which will include native species suitable for the arid coastal climate.

4.9 WILDLIFE

Field surveys for the presence of avifauna and feral mammals in the area were conducted in 1986, 1989 and 1990. In September 1989 and September 1990, Phillip Bruner surveyed Manini'owali from the coast *mauka* to Queen Ka'ahumanu Highway. His findings are are summarized below, and the complete report is included in Appendix I.

A. Existing Conditions

Resident Endemic Land and Water Birds: During the 1989 survey, four Black-necked Stilt or *Ae'o* (Himantopus mexicanus knudseni) were seen flying from the adjacent State owned Awake'e parcel along the shore towards Kapoikai (also known as Opaeula Pond) at Makalawena. This endemic and endangered species is not as numerous on Hawai'i as it is on some of the other islands in the State. Suitable habitat such as shallow ponds with small islands free of mammalian predators are scarce on Hawai'i, especially along the Kona coast. Kapoikai at Makalawena represents a vital resource for this species as well as for other native and migratory waterbirds. The lack of the presence of water at the project site precludes the occurrence of any of the endangered waterbird species that are known to inhabit the neighboring Awake'e and Makalawena parcels.

No Short-eared Owl or *Pueo* (Asio flammeus sandwichensis) were observed but this bird could potentially occur occasionally on this property. *Pueo* are relatively common on the island of Hawai'i particularly at higher elevations.

Migratory Indigenous Birds: Of all the shorebirds species which winter in Hawai'i, the Pacific Golden Plover (Pluvialis fulva) are the most abundant. A total of three Pacific Golden Plover were recorded during the 1990 field survey. These birds were observed along the shoreline on the State parcel. Most of the project development area surveyed is too brushy or the grass too tall to provide suitable habitat for plover. The Pacific Golden Plover arrive in Hawai'i in early August and depart to their arctic breeding grounds during the last week of April. These populations likewise remain relatively stable over many years. A total of two Wandering Tattler (Heteroseclus incanus) were also recorded along the rocky shoreline at the State's coastal property. This species is usually solitary. Other possible shorebirds which might occur along the coastal area are Ruddy Turnstone (Arenaria interpres) and Sanderling (Calidris alba).

Resident Indigenous Birds: No seabirds were observed on the State land or the project site. Some seabirds nest and roost on barren lava flows in Hawai'i but at much higher elevations.

Exotic Birds: The property supports the normal array of introduced bird species commonly found in this type of environment in Hawai'i. A total of only 11 species of exotic birds were recorded during the 1989 survey: Gray Francolin (Francolinus pondicerianus), Spotted Dove (Streptopelia chinesis), Zebra Dove (Geopelia striata), Common Myna (Acridotheres tristis), Yellow-billed Cardinal (Paroaria capitata), Northern Cardinal (Cardinalis cardinalis), Japanese White-eye (Zosterops japonicus), Nutmeg Mannikin (Lonchura punctualata), Warbling Silverbill (Lonchura malabarica), House Finch (Carpodacus mexicanus), and Yellow-fronted Canary (Scrinus mozambicus). Other exotic bird species that might also be expected to occur on Manini'owali include: Barn Owl (Tyto alba), Ring-necked Pheasant (Phasianus colchicus), Erckel's Francolin (Francolinus erkelii), Black Francolin (Francolinus francolinus), California Quail (Callipepla californica), Japanese Quail (Coturnix japonica), Northern Mockingbird (Mimus polyglottos), Saffron Finch (Sicalis flaveola) and Lavender Waxbill (Estrilda caerulescens).

Feral Mammals: Small Indian mongoose (Herpestes auropunctatus), feral cats, and goats were all recorded on the survey. Goats are fairly commonly observed at the small cinder cone on-site. Not sighted were feral donkeys or the Hawaiian Hoary Bat (Lasiurus cinerus semotus); however, they have been recorded on nearby properties.

The following are conclusions related to bird and mammal activity on the property reached by Bruner (1990). All representative types of habitat found on the property were censused. The more densely forested *makai* sections of the property support the greatest number of birds. The more open lands were virtually devoid of avifauna, except the Warbling Silverbill (Lonchura malabarica).

The property supports the normal array of exotic species of birds one would expect in this type of environment in Hawai'i. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief, or that they went undetected, or a combination of these and other factors. The low numbers of some species may be attributed to lack of specific food resources, such as flowering *kiawe* trees.

B. Anticipated Impacts

The proposed development will cause the disruption of wildlife use of the site. During construction, most birds and feral mammals will migrate to undisturbed areas along the coast such as Awake'e or Makalawena. Once the project is completed, extensive open areas and landscaping will make the site attractive to many birds. No threatened or endangered wildlife species will be affected by the project, as none occur on the property.

The controlled use of fertilizers and pesticides in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with the golf courses (Murdoch and Green, 1991). Fertilizers are relatively non-toxic unless ingested in large amounts, and all herbicides and fungicides used in golf course maintenance in Hawai'i are of low to moderate toxicity. The only chemicals used in Hawaiian golf course maintenance which are highly toxic to birds are the organic phosphate insecticides, especially chloropyrifos. However, chloropyrifos are strongly adsorbed on the thatch layer of turf and move little from the site of application.

Because of the absorption of organic phosphate insecticides on organic layers in turf and their rapid breakdown, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions strictly prohibit their direct application to streams and ponds. In addition, other insecticides with reduced toxicity can be substituted for chloropyrifos with little loss of effectiveness.

C. Mitigative Measures

No significant impact is expected to occur to any wildlife species on the property; however, several measures will be implemented that will minimize effects on wildlife due to project development.

Re-Vegetation of Cleared Areas: Re-vegetation of cleared areas will occur, with approximately 86 acres being replanted with turf and the remainder of the 173 acres of golf course area planted with landscaping vegetation or remaining in natural ground cover. Extensive ornamental and native landscape vegetation species will be planted for buffer and perimeter areas. These landscaped areas will again serve as habitat areas for some wildlife species.

Pesticide Controls: Use of pesticides will be controlled on the site with special care to avoid impacts on wildlife. Only those pesticides which are approved for golf courses will be applied. Application will be supervised by a Certified Golf Course Manager.

4.10 ARCHAEOLOGICAL AND HISTORIC RESOURCES

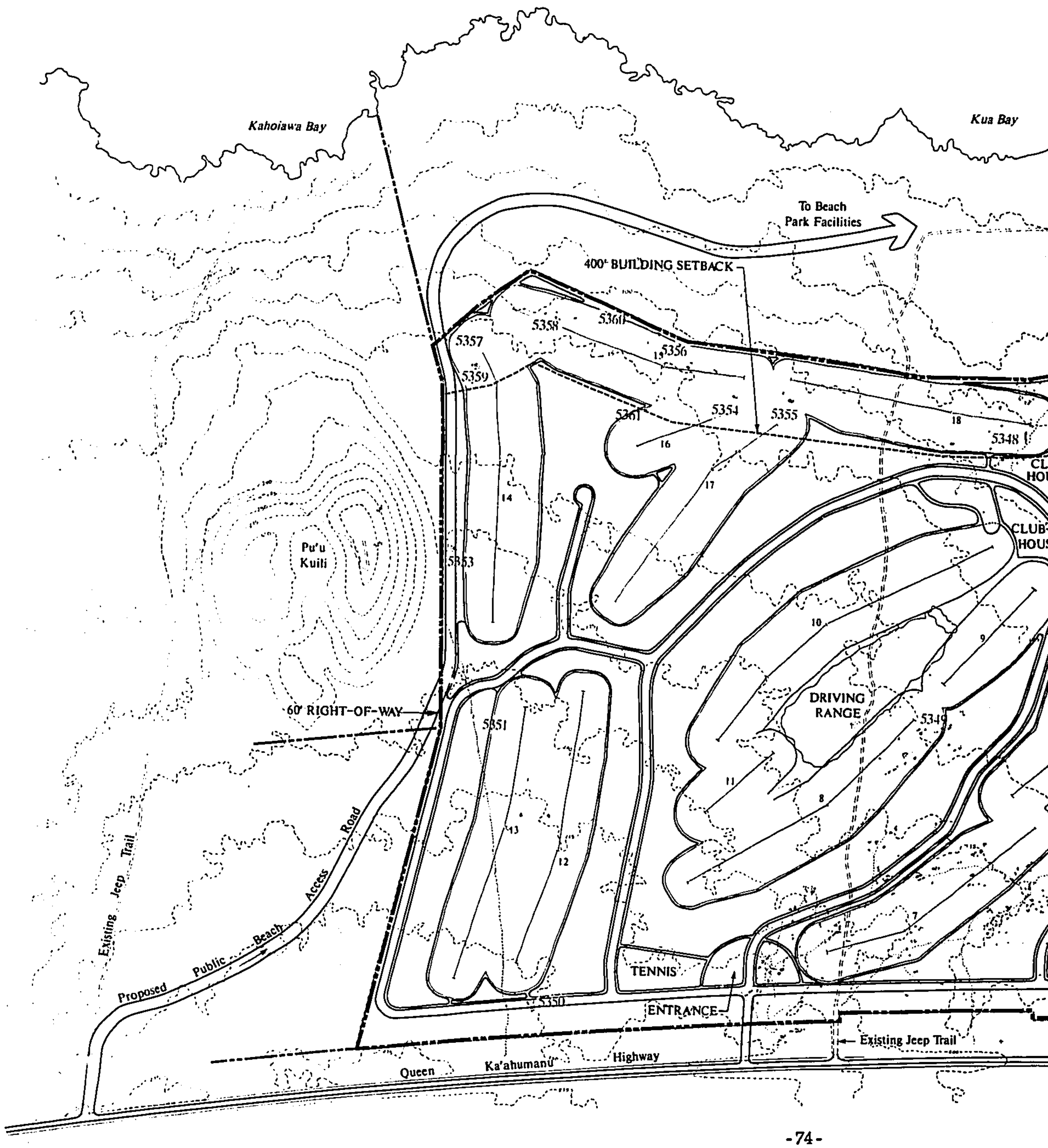
An investigation of archaeological and historic features was conducted on the project site by the *Applied Research Group, Bishop Museum*, during the period from March to May 1991. The work, led by Jeff Pantaleo, included a historical literature and documents research, informant interviews, burial assessment, laboratory procedures, and testing of selected features. The significance evaluations of sites and general mitigation plans have been approved by the Department of Land and Natural Resources-Historic Preservation Division (DLNR-HPD). Final editorial revisions of the Bishop Museum report is being concluded in coordination with DLNR. The archaeological inventory findings are summarized in the following discussion, and the preliminary report is included as Appendix J. Figure 13 shows the archaeological sites overlayed on the project conceptual Master Plan.

A separate Addendum Report addressing burials found on this site has been submitted to the State DLNR-HPD, as well as the DLNR Hawai'i Island Burial Council. NKDG cannot disclose detailed information on the extent of burials to the public without the consent of these two groups.

A. Existing Conditions

Previous Archaeological Work: Several archaeological investigations have been conducted in the general region of the project area, in Kuki'o 1 (Renger 1970; Cordy 1978; Walter and Rosendahl 1985; Bower 1991); in Kuki'o 2 (Cordy 1978; Soehren 1982a, b; Ladefoged 1990; Sinoto and Pantaleo 1990).

The most recent study was conducted by Sinoto and Pantaleo (October, 1990). They relocated previously recorded sites by Lagefoged (1990) in the Manini'owali/Kuki'o 2



Kahoiawa Bay
Kua Bay
To Beach
Park Facilities
400' BUILDING SETBACK
5357
5358
5360
5356
5359
5361
5354
5355
5348
18
16
17
14
Pu'u
Kuili
5353
CLUB
HOUSE
10
9
DRIVING
RANGE
5349
60' RIGHT-OF-WAY
5351
11
8
13
12
7
Existing Jeep Trail
Proposed Public Beach Access Road
TENNIS
5350
ENTRANCE
Existing Jeep Trail
Queen Ka'ahumanu Highway

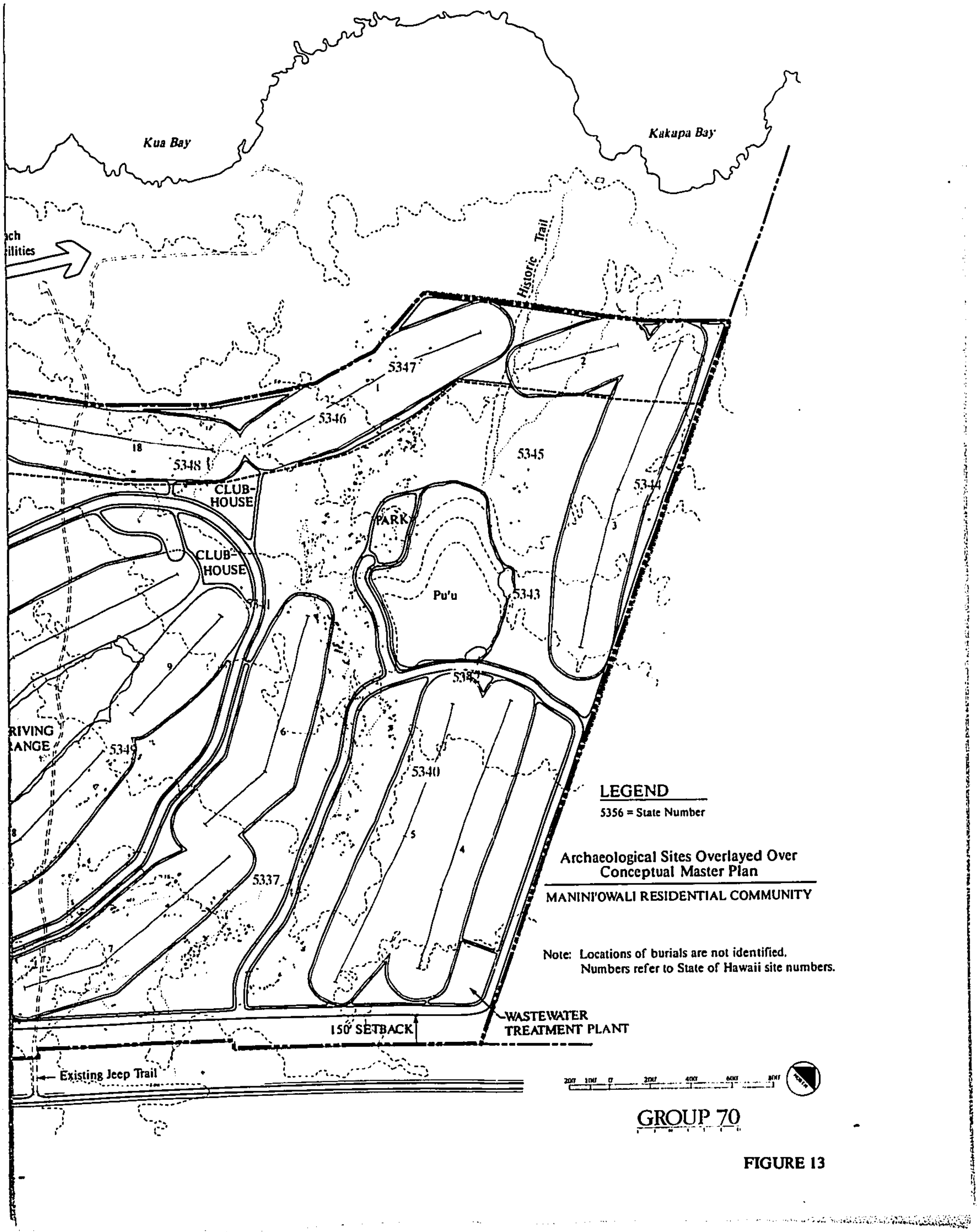

Kua Bay
Kakupa Bay
Historic Trail
5347
5346
18
5348
CLUB-
HOUSE
CLUB-
HOUSE
PARK
5345
5344
Pu'u
5343
9
6
5340
5349
5337
5
4
7
150' SETBACK
WASTEWATER
TREATMENT PLANT
Existing Jeep Trail
LEGEND
5356 = State Number
Archaeological Sites Overlayed Over
Conceptual Master Plan
MANINI'OWALI RESIDENTIAL COMMUNITY
Note: Locations of burials are not identified.
Numbers refer to State of Hawaii site numbers.
GROUP 70

FIGURE 13

project area (including the NKDG exchange parcel). The purpose of that study was to apply appropriate initial significance evaluations for preparation of a cultural resources management plan, which will include data recovery and site preservation plans. Rosendahl (1973) characterized the archaeology of the North Kona region as consisting of three major zones: a narrow, arid coastal habitation zone associated with the exploitation of various marine resources; a sloping, barren middle zone characterized by exposed *a'a* and *pahoehoe* rocklands, and largely devoid of soil or vegetation other than grasses; and an upland habitation zone associated with agricultural exploitation. The project site is located in the barren middle zone. Recent work confirms that this pattern is accurate for the area of North Kona from Keahole Point south (Cordy 1985). However, in the area north of Keahole Point, in which Manini'owali and Kuki'o 2 lie, no documentation has yet been recovered on any major upland agricultural system or associated permanent habitation in prehistoric times. The coastal zone pattern (which lies within the State's parkland) is one of scattered, small clusters of permanent habitation sites with a few small *heiau* and shrines, all of which appear to date to late prehistory, the AD 1300's-1400's on (Cordy 1978; Donham 1987; Walker & Rosendahl 1985; Sinoto & Pantaleo 1990). Associated burials are found in the seaward portions of the middle zone. Temporary habitation sites in the form of caves, small platforms, pavings, and enclosures are found in the coastal zone and seaward portions of the middle zone. These sites seem to have been used by people for short, often repeated, periods of time while exploiting marine resources. Dates from Kaupulehu show this temporary use as far back as the A.D. 1000's (Walker & Rosendahl 1988). Additionally, trails lead inland from the coast and have associated temporary habitation sites. The inland terminal points of these trails are currently unknown.

Archaeological and Historic Findings: The results of the archaeological inventory survey by Bishop Museum (Pantaleo, et al., July, 1991) provide significant contributions to the prehistory of the North Kona region. A total of 25 archaeological sites, comprised of 1,311 features (mostly small pits), have been recorded, mapped, and their spatial relationships determined. Figure 13 shows the location of archaeological site complexes with respect to the proposed conceptual land use plan. Test excavations in five features provided important information on the function and chronology of the sites. Sufficient information has been generated to evaluate the significance of all the archaeological sites and for the development of general mitigation plans, which have been approved by the State Historic Preservation Division.

The results of the mapping and recording of archaeological features show a common pattern in the seaward portions of the middle zone of a few inland heading trails and associated temporary habitation. However, results show unexpected cultural activity in the form of numerous pit features in the middle zone, more than hypothesized by Rosendahl. The occurrence of the numerous pit features (more than 1,100) especially along one trail section indicates some form of specialized activity. Initial evaluation of these pit features, based upon archaeological research in other projects in North Kona and test results, suggest multiple functions, including quarry, agriculture, and storage.

Two temporary habitation features contained abundant midden and artifacts (50-10-18-5348 and 50-10-18-5354). Their location inland (over 1,000 feet from the coast) suggests that exploitation of marine resources took place over an extended period of time. Artifacts recovered include coral abraders and *opihi* shell scrapers, indicating exploitation of marine resources. Even though no fishhooks were actually found, these types of artifacts suggest fishhook manufacture.

Also, one site (50-10-18-5355) is interpreted as a possible religious shrine. It is a low rock platform containing branch coral, midden, and lithic debitage. Initial interpretation indicates specialized use. Additional testing in the next phase of the archaeological work will be performed to verify the function of this site.

Radiocarbon dates obtained from test excavations revealed a long-term span of use in the Manini'owali and Kuki'o 2 *ahupua'a*. The dates range between A.D. 1020 - 1280 and A.D. 1729 - 1808. This settlement pattern fits into Kirch's (1975) expansion period, defined as small settlements springing up on leeward coasts.

Significance Assessments: To facilitate State and County review, Bishop Museum's proposed significance assessments for the 25 sites identified within the project area during the reconnaissance survey are summarized in Table 5. All of the recorded sites are considered significant under Criterion D of the National Register criteria. The burial sites and trail segments are also given a significance rating of E. Some types are excellent examples of site types (Criterion C). DLNR-HPD uses significance criteria to evaluate eligibility for both the Hawai'i State and National Register of Historic Places. Criterion C is defined as excellent examples of site types. Criterion D is defined as significant resources which have yielded, or may be likely to yield, information important in prehistory or history. Criterion E is defined as resources of significant cultural value. The review of the proposed significant assessments has been concluded and approved by the Historic Preservation Division.

B. Anticipated Impacts

Twenty-two of the 25 archaeological sites identified by Bishop Museum will be directly affected by the development of the proposed project. Figure 13 shows an overlay of the project master plan areas and archaeological sites on the property. Of these 22 sites, 13 are found within golf course areas (50-10-18-5359, -5356, -5357, -5358, -5360, -5354, -5355, -5346, -5347, -5344, -5340, -5349, -5352, portion -5337); five are found in residential areas (-5361, -5345, portion -5337, -5339, -5351); three are located in roadways (-5341, -5350, 5353); and one located in a landscape area (-5338).

It is proposed to appropriately treat the 25 significant historic sites through preservation or data recovery. This will be addressed in the cultural resources management plan which will be reviewed by the DLNR-HPD and the County of Hawai'i. The plan would result in a "no adverse effect" determination.

C. Mitigative Measures

Several mitigative measures have been proposed to minimize potential impacts to archaeological resources. Significant sites will undergo data recovery or be preserved

TABLE 5

SUMMARY OF SIGNIFICANT ARCHAEOLOGICAL SITES

State Site No.	Significance Evaluation	To Be Preserved	To Undergo Data Recovery
50-10-18-5337	C, D, E	X	
50-10-18-5338	C, D, E	X[1]	X (por)
50-10-18-5339	D, E	X[2]	
50-10-18-5340	D		X
50-10-18-5341	D		X
50-10-18-5342	D		X
50-10-18-5343	D		X
50-10-18-5344	D		X
50-10-18-5345	D		X
50-10-18-5346	D		X
50-10-18-5347	D		X
50-10-18-5348	D, E	X	
50-10-18-5349	D		X
50-10-18-5350	D		X
50-10-18-5351	D		X
50-10-18-5352	D, E	X[3]	X (por)
50-10-18-5353	D		X
50-10-18-5354	D		X
50-10-18-5355	D, E*	X[4]	
50-10-18-5356	D		X
50-10-18-5357	D		X
50-10-18-5358	D		X
50-10-18-5359	D		X
50-10-18-5360	D		X
50-10-18-5361	D		X

C= References sites reflecting distinctive architectural characteristic or type, period, or method of construction, or presenting the work of a Master, or possessing high artistic value.

D= Applies to sites which have yielded, or are likely to yield, information important to further understanding of traditional culture, history or pre-history.

E= Specifies sites or places which have significant historic or cultural value to an ethnic group of the State, as proposed.

* Features 1 and 2 of Site -5355 require further testing to confirm function.

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1 [fe. 402 (burial) and other features (pits, temporary habitation)]
2 fe. 146
3 fe. 2
4 fe. 1 and fe. 2 (f function is verified)

Source: Bishop Museum (January 1992)

following DLNR-HPD recommendations. General mitigation plans for sites which will be preserved and data recovered have been approved by DLNR-HPD. The next phase of archaeological work will include the completion of a detailed mitigation plan for data recovery and site preservation; this report will be submitted to DLNR-HPD for their review and approval.

Preservation: Preservation Commitments are shown in Table 6. At this point it has been agreed to preserve sites 50-10-18-5337 (trail), -5348 (burials), portions of -5338 (a burial and representative examples of temporary habitations and pits), and two other isolated burial sites (50-10-18-5339 and -5352). In the event that preservation of site 5337 (trail) creates a conflicting use with portions of the land plan, the developer will coordinate with DLNR-HPD and Na Ala Hele to determine appropriate treatment of these trail sections. Site 50-10-18-5355, a possible habitation or a small shrine, will require additional testing to verify its function. If it is determined to be a shrine, the site will be preserved.

The applicant will propose that the cinder cone and sections of the trail and site 50-10-18-5338 be incorporated into a public interpretation program. Representative pit features and temporary habitations in site -5338 will be preserved along a section of a trail.

Eventual preservation plans for the sites to be preserved will include the establishment of appropriate permanent and construction period buffer zones.

Data Recovery: Data recovery will address the portions of significant sites not recommended for preservation. Data recovery will be conducted to recover a reasonable and adequate amount of the site significant information. These proposed general treatments have yet to be reviewed by DLNR-HPD. Numerous sites, primarily quarry pit features in the *pahoehoe*, have been surveyed and tested for presence or absence of burials, stratigraphy, and chronological sequences.

4.11 ROADWAYS AND TRAFFIC

This section includes a presentation of the existing roadways and traffic conditions at the project site and its surrounding area. The potential impact of the proposed project on future conditions was prepared by the Traffic Management Consultant (TMC) (October 1991) (Appendix L).

A. Existing Conditions

1. Roadway Conditions

The proposed development is adjacent to the Queen Ka'ahumanu Highway. Dedicated in 1975, the highway extends 38 miles along the North Kona and South Kohala coast from Kailua-Kona to Kawaihae. The Queen Ka'ahumanu Highway is the primary arterial highway in the region. It is a Class I, limited access, two lane, two-way State highway with a posted speed of 55 miles per hour and a two-way capacity of 2,000 vehicles per hour. The road is designed with a 24-foot pavement width within a 300-foot right-of-way.

TABLE 6

SITES RECOMMENDED FOR IN-SITU PRESERVATION

State Site No.	Feature No.	Description
50-10-18-5337	1	*mauka-makai* trail
50-10-18-5338	402	burial
-5338 (portions)	---	pits, overhang shelters, lava tubes, cupboards
50-10-18-5339	146	burial
50-10-18-5348	1	habitation
	2	habitation
	3.1	habitation
	3.2	habitation
	3.3	habitation
	3.4	habitation
	3.5	burial chamber
	3.6	burial platform
	3.7	burial
	4 - 37	habitation, quarry, exploratory, agriculture
50-10-18-5352	2	burial
50-10-18-5355*	1	possible shrine
	2	possible shrine

* Features 1 and 2 of Site -5355 require further testing to confirm function.

SOURCE: Bishop Museum (January 1992)

Mamalahoa Highway is a two lane, two-way County highway located generally parallel with Queen Ka'ahumanu Highway approximately 3-1/2 miles *mauka*. The traffic study assumes that Mamalahoa Highway will not be significantly affected by the proposed project. The only existing *mauka-makai* connector roadways between the two highways are located at Waikoloa and Keahole.

Located between the Waikoloa and Keahole connector roadways, the project site is closer to the Keahole Airport Access Road. It is located approximately five miles north of Keahole Airport. Traffic counts are ordinarily collected at major road intersections. Table 7 presents traffic data for existing AM and PM peak hours traffic flows on Queen Ka'ahumanu Highway with respect to these two connector road intersections.

2. Observed Traffic Conditions

The peak hour of traffic in the study area occurs between 6:30 AM and 7:30 AM, and between 3:15 PM and 4:15 PM, with PM peak hour flow greater than AM peak hour flow. During the AM peak hour, Queen Ka'ahumanu Highway south of its intersection with Waikoloa Road carries more traffic southbound than northbound, and conversely, Keahole Airport Access Road carries more traffic northbound than southbound. During the PM peak hour, Queen Ka'ahumanu Highway south of its intersection with Waikoloa Road carries only slightly more traffic southbound than northbound, but Keahole Airport Access Road also carries more traffic southbound than northbound.

B. Anticipated Impacts

Analysis Methodology: The focus of the TMC (1991) traffic impact analysis was to determine the short-term impacts of at-grade improvements at the intersection of the project access roadway and Queen Ka'ahumanu Highway. Total traffic volumes were estimated with and without the project, assuming complete development by the year 2006. Forecasts were made for morning and afternoon peak periods. Analyses of both signalized and unsignalized conditions were completed.

The State Department of Transportation (DOT) is currently undertaking a planning study for the widening of Queen Ka'ahumanu Highway that would determine the location of additional interchanges and functional aspects of a frontage road system. Queen Ka'ahumanu Highway is planned for expansion from a two lane to a four lane highway by the State DOT. In the interim, the State DOT will not allow traffic signals at the Manini'owali project entrance in keeping with their policy to upgrade Queen Ka'ahumanu Highway to a high-speed limited access highway according to State DOT correspondence dated 7 January 1992. The original TMC analysis for the Draft EIS included only a signalized alternative. For comparison purposes, both the signalized and unsignalized conditions are addressed in the Final EIS.

The ultimate access configuration for the project will depend on the outcome of the State DOT planning for the expanded highway. Discussions between State DOT and the affected property owners to locate the future interchange to serve the Kaupulehu/Kuki'o resort node and the proposed Manini'owali project are presently

TABLE 7

EXISTING TRAFFIC VOLUMES AND LEVELS-OF-SERVICE

QUEEN KA'AHUMANU HIGHWAY SEGMENTS	VEHICLES PER HOUR (VPH)		LEVEL-OF-SERVICE (LOS)	VEHICLE-TO-CAPACITY RATIO (V/C)
AM Peak Hour				
South of Waikoloa	770		D	0.37
Northbound		333		
Southbound		437		
North of Ke-ahole	563		C	0.27
Northbound		329		
Southbound		234		
PM Peak Hour				
South of Waikoloa	909		D	0.43
Northbound		427		
Southbound		482		
North of Ke-ahole	783		D	0.39
Northbound		284		
Southbound		499		

SOURCE: Traffic Management Consultant (October 1991) underway. NKDG is proposing at-grade roadway improvements for their project in the interim period until the planning for the Kaupulehu/Kuki'o/Manini'owali *ahupua'a* is finalized by the State DOT. The traffic volumes were forecasted for full build-out in 2006 of a channelized, at-grade intersection of Queen Ka'ahumanu Highway with the project access road. Ultimately, project access would be provided along the proposed frontage road system or, possibly, at an interchange located near the proposed interim project access location. It is always possible that development of the interchange(s) and frontage road system could be completed before 2006, however, no firm timetable for these improvements has been set.

The original TMC analysis for the Draft EIS included only a signalized alternative. The signalized condition was found to be necessary for traffic flow and safety considerations. It is uncertain when the State DOT will implement its long range plans for this section of Queen Ka'ahumanu Highway, therefore, without signals the new intersection would allow free-flowing travel on the highway, but left turns into and out of the development would be unprotected (discussed further in this section). For comparison purposes, both the signalized and unsignalized conditions were studied.

A public roadway access to the State's coastal lands at Manini'owali and Kua Bay will also be provided in both the short- and long-term, as discussed in Section 2.5. Analysis for this roadway will be considered in the State's planning process for the the proposed Shoreline Wilderness Park of which the Manini'owali Beach area will be a part.

Future Ambient Traffic: West Hawai'i is experiencing rapid growth, as several resort and residential projects have received substantial approvals. To the north these include the Waikoloa Village and Resort, Kaupulehu Resort, and the Huehue Ranch project at Kuki'o. Several residential and resort projects are proposed to the south, including: residential project, the State housing project at Kealakehe, and the Queen Lilioukalani Trust project. The construction of these resorts and residential projects are expected to contribute to the increase in ambient traffic on Queen Ka'ahumanu Highway in the project area and the region.

The recently completed <u>Island of Hawai'i Long Range Highway Plan</u> (May 1991) includes a travel forecast for the year 2010, based upon a land use forecast developed by the County of Hawai'i. This travel forecast has been adopted for the purpose of establishing future baseline traffic conditions from which to analyze the traffic impacts resulting from the proposed project. A growth factor of 1.81 was used in projecting 2006 traffic demands over the existing conditions.

Trip Generation: The trip generation characteristics of the project are based upon the land uses shown in the Conceptual Master Plan (Figure 5). Estimates of the number of vehicles entering and exiting the development is based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in <u>Trip Generation</u> (5th edition). The ITE trip rates for residential and commercial projects are developed empirically, by correlating the vehicle trip generation data with various land use characteristics, such as vehicle trips per dwelling unit. Table 8 shows the breakdown of vehicle trips generated by the project.

TABLE 8

TRIP GENERATION SUMMARY

LAND USE	LAND USE INTENSITY	AM PEAK HOUR(1) ENTER	AM PEAK HOUR(1) EXIT	AM PEAK HOUR(1) TOTAL	PM PEAK HOUR(1) ENTER	PM PEAK HOUR(1) EXIT	PM PEAK HOUR(1) TOTAL
Single-Family Dwellings	700 DU(2)	90	257	347	323	174	497
Multi-family Dwellings	300 DU	21	102	123	102	53	155
Golf Course and Clubhouse	18 Holes	41	8	49	31	29	60
Tennis Center	4 Courts	3	3	6	6	6	12
TOTALS		155	370	525	462	262	724

(1) Vehicles per Hour
(2) DU=Dwelling Units

SOURCE: Traffic Management Consultant (October 1991)

Approximately 75 percent of the single-family and multi-family homes will be occupied by full-time residents. The remainder of the housing units occupied less than full-time will consequently have a lesser impact on the traffic conditions in the area than if all 1,000 units were occupied full-time.

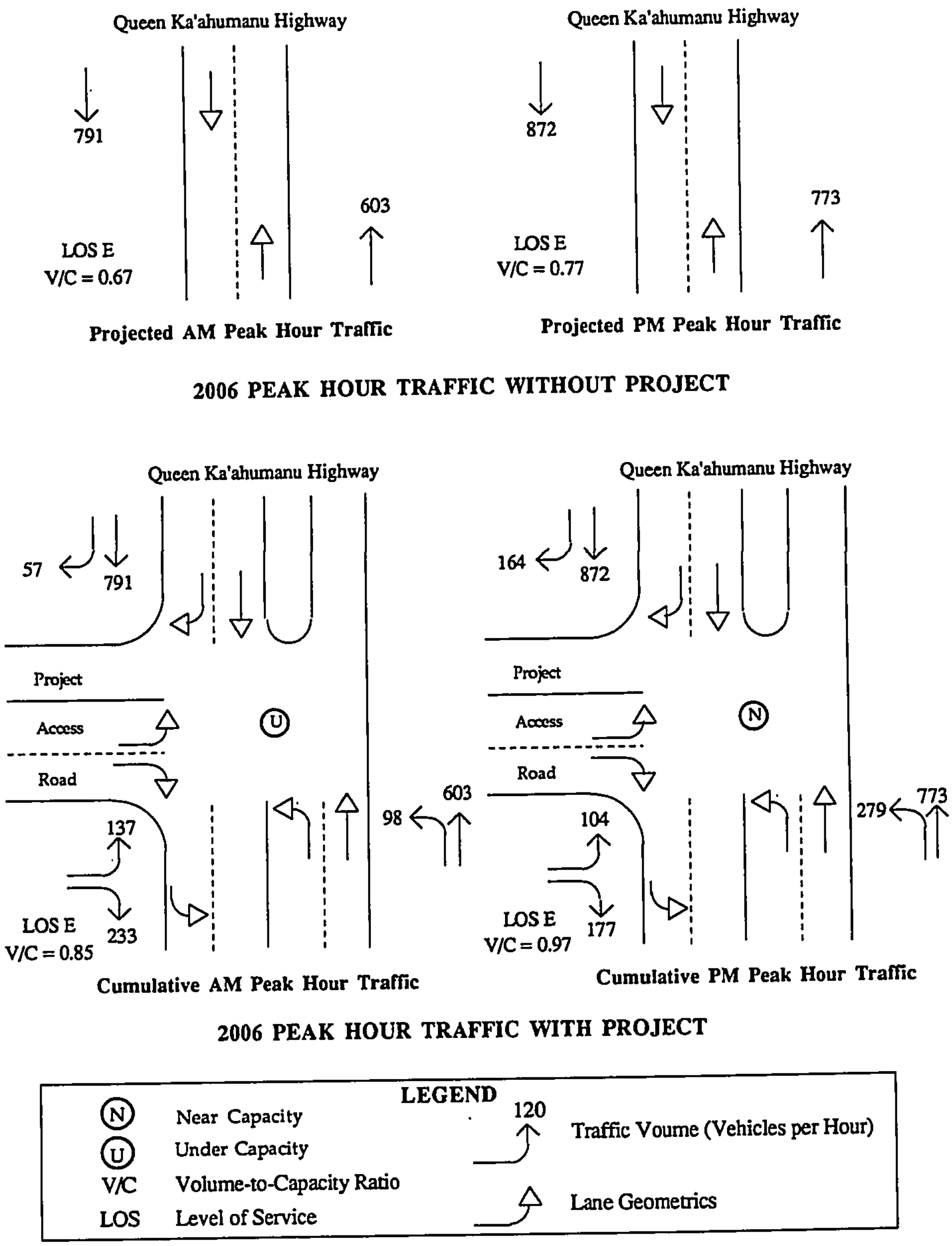
A total of 586 vehicle trips are projected for the PM peak hour which represents the worst-case period. A portion of the vehicle trips generated by the development are expected to be internal trips. The golf course and tennis, as well as the clubhouse and convenience store, will attract many of the project's residents that would otherwise leave the development for other external attractions.

Short-Term Traffic Impacts: In the short-term, operation of construction equipment, trucks, and worker vehicles may temporarily impede traffic along Queen Ka'ahumanu Highway during the construction period. Trucks will be hauling construction materials to the site such as cement, pipes, lumber, crushed rock, and asphalt concrete. During the on-site roadway construction period, trucks will be hauling asphalt concrete to the project. During the golf course construction period there will also be trucks entering and exiting the site hauling imported soil.

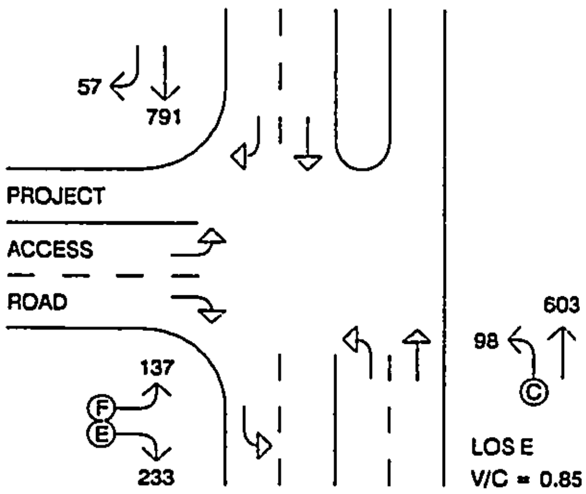
Traffic generated by construction workers will occur during the early morning hours and when workers leave the project in the afternoon. Workers commuting to the project site each workday, are expected to contribute towards increased vehicle trips during the morning and afternoon peak hours. Contracted companies will be encouraged to transport their employees on company trucks from construction company base yards.

At-Grade Intersection 2006 Traffic Conditions: Impacts of the forecasted increase in traffic were assessed by the change in Level-of-Service (LOS) for conditions without the project traffic and with the project traffic. The project intersection exists in the "With Project" scenario only, since the project creates the need for a new intersection with Queen Ka'ahumanu Highway. The intersection was analyzed for at-grade signalized and unsignalized conditions. Signalized traffic flow patterns at the project entrance and the results of the LOS analysis for "With" and "Without" conditions are shown in Figure 14. Unsignalized traffic flow patterns for AM and PM peak hour (2006) traffic are shown in Figure 15.

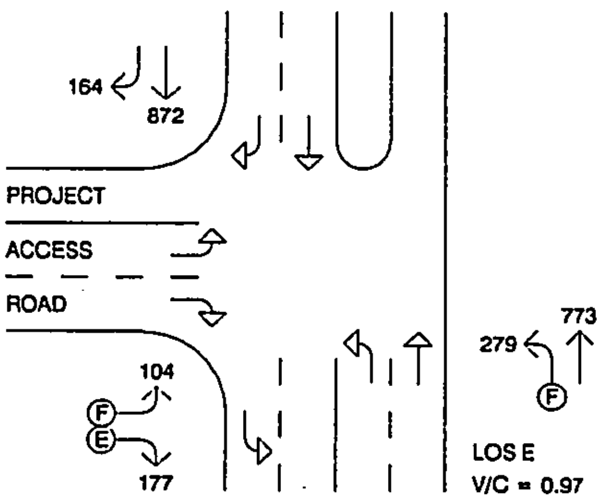
"Without" the project by 2006, Queen Ka'ahumanu Highway would operate under capacity at LOS E during both AM and PM peak traffic hours. With the project completed by 2006, during both AM and PM peak hours, the intersection would also operate under capacity with either signalized or unsignalized conditions. Queen Ka'ahumanu Highway south of the project access road would operate at LOS E in the AM and PM peak hour under signalized conditions. Without signals, left-turns into and out of the project will operate at LOS F. Safety conditions would be worse in the unsignalized condition, due to vehicles attempting to make left turns through gaps in approaching traffic from both directions.



2006 Peak Hour Traffic With and Without Project Traffic



CUMULATIVE AM PEAK HR TRAFFIC



CUMULATIVE PM PEAK HR TRAFFIC

LEGEND

90	TRAFFIC MOVEMENT VOLUME (VPH)
	LANE CONTROL
LOS	LEVEL OF SERVICE (TWO LANE HWY)
V/C	VOLUME-TO-CAPACITY RATIO
Ⓐ	LEVEL OF SERVICE (UNSIGNALIZED CONDITIONS)

CUMULATIVE PEAK HOUR TRAFFIC (UNSIGNALIZED) **SOURCE: TMC**

MANINI'OWALI RESIDENTIAL COMMUNITY **FIGURE 15**

Vehicles associated with the Manini'owali Residential Community using Queen Ka'ahumanu Highway and other local roadways are expected to slightly affect through traffic flow on the highway during the short-term at-grade intersection access period. Based upon evaluation criteria for highway deficiencies established in the Long Range Highway Plan , Queen Ka'ahumanu Highway would require widening to four lanes. Impacts on traffic as a result of the project will be reduced substantially once Queen Ka'ahumanu Highway is improved to four lanes and the intersection is removed. Until the proposed interchange and frontage road are constructed, it is assumed that an at-grade access will be provided at a channelized intersection without traffic signal control (per request by DOT). AS compared to a signalized condition, the unsignalized intersection would allow better through-traffic flow but would reduce the operation of project traffic movements.

The study by TMC does not consider the improved public access roadway to the Kua Bay area which is shown on the Conceptual Master Plan. This roadway is shown at Queen Ka'ahumanu Highway entering through the State land at Awake'e and bearing north through the NKDG project site and onto the State's Manini'owali parkland. While NKDG will be involved in the construction of this roadway, subject to obtaining all applicable State and County approvals and permits for its proposed development, the final alignment will depend on State DOT highway planning and State DLNR park planning, including an archaeological study.

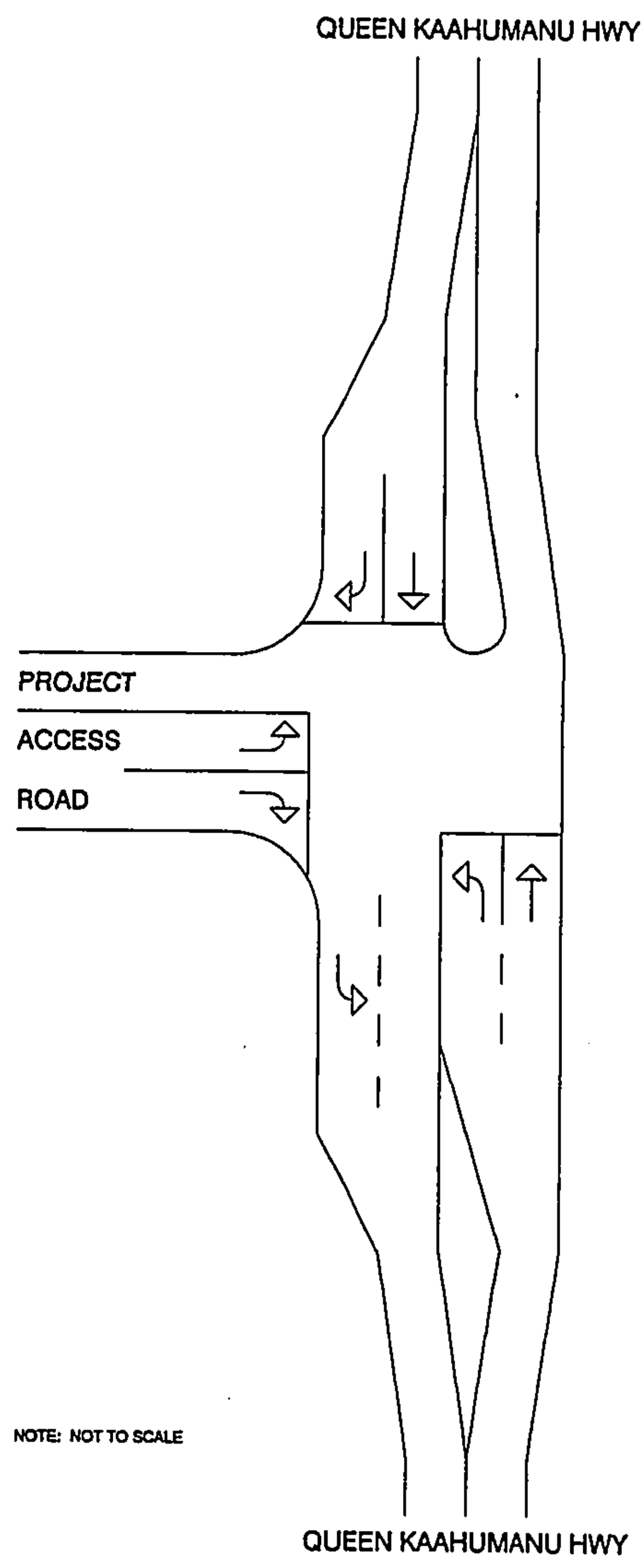
C. Mitigative Measures

Several mitigative measures are planned for implementation to minimize the impact of traffic generated by the project, as discussed below. Proposed improvements to the Queen Ka'ahumanu Highway are shown in Figure 16.

Left Turn Storage Lane on Queen Ka'ahumanu Highway: An exclusive left turn storage lane (northbound) will be constructed at the intersection of Queen Ka'ahumanu Highway and the project access road. This improvement will alleviate possible delays or back-ups on Queen Ka'ahumanu Highway caused by vehicles turning left into the project access road. This should also help minimize rear-end collisions with vehicles slowing down or stopping to turn left into the project access road.

Turning Lanes Into and Out of Project Entrance: An exclusive right turn acceleration lane on Queen Ka'ahumanu Highway for vehicles exiting from the project access road will be provided to allow vehicles turning right (southbound) onto Queen Ka'ahumanu Highway to safely merge with through-traffic. Also a right turn deceleration lane will be provided southbound on Queen Ka'ahumanu Highway to allow vehicles entering the development from the north to slow down without impeding through-traffic behind them. These turning lanes will help traffic flow and improve safety at the intersection.

Signal Warrant Study: As traffic conditions build in the futureNKDG will prepare a signal warrant study upon the request of the State DOT for the interim intersection of the project access road with Queen Ka'ahumanu Highway. A warrant study would be required by State DOT prior to installation of traffic signals at an intersection.



Proposed At-Grade Intersection Improvements

SOURCE: TMC

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 16

Construction Traffic: The number of worker vehicles traveling to and from the site during the heavy construction period will be minimized by the use of company trucks and vans to carry workers from construction company base yards. Truck and heavy equipment travel to and from the site will be conducted during non-peak traffic hours to minimize the impact on local and commuter traffic. During construction phases of the project, special duty police officers shall be employed to assist in directing traffic and the movement of heavy equipment and supplies at the intersection of the project access roadway and Queen Ka'ahumanu Highway.

4.12 NOISE

Existing noise conditions and potential future noise conditions at the project and its surrounding areas were evaluated by Darby & Associates (June 1991). This technical report is included in its entirety as Appendix M. The report is summarized for the following discussion of noise conditions.

A. Existing Conditions

Noise from sources such as traffic is commonly measured in "A" weighted decibel units (dBA). The A weighting refers to the emphasis of certain sound frequencies over others to simulate the sensitivity of the human ear. The decibel scale is logarithmic, and a 10-fold increase in sound energy results in an increase of 10 dBA corresponding (approximately) to a subjective doubling of loudness. Doubling of the sound energy results in an increase of three dBA, while the smallest change in noise level considered to be noticeable is about 2 dBA.

Ambient noise level measurements were performed at several locations on the project site on 3 June 1991. Noise from vehicular traffic along the Queen Ka'ahumanu Highway dominate at locations near the highway. At locations away from the highway, natural sound sources, such as wind in the foliage, birds and surf, are dominant. Noise level measurements made at a distance of about 350 feet from the highway yielded Equivalent Continuous Sound levels, Leq's (average) ranging from 45 to 52 dBA. At locations away from the highway, natural sounds measured ranged from 38 to 41 dBA Leq.

Noise arising from aircraft originating from Keahole Airport, located approximately six miles to the south of the subject parcel, were barely audible and did not increase the ambient noise levels. Aircraft takeoffs using Runway 35 were not measured, but are expected to generate significantly higher noise levels than those of Runway 17 which were measured. However, the project site is located well outside of the 55 dB Ldn contour lines for both the existing (1990) and the future (2005) years. This is considered to be a "minimum risk level" according to State Department of Transportation guidelines. Aircraft generated 60 dB Ldn is a maximum recommended level for residential use without any special mitigation measures.

There are no currently existing sensitive noise receptors at the adjoining lands; although the Regent Kona Coast project at Kukio will include some new residential development to the north of the project.

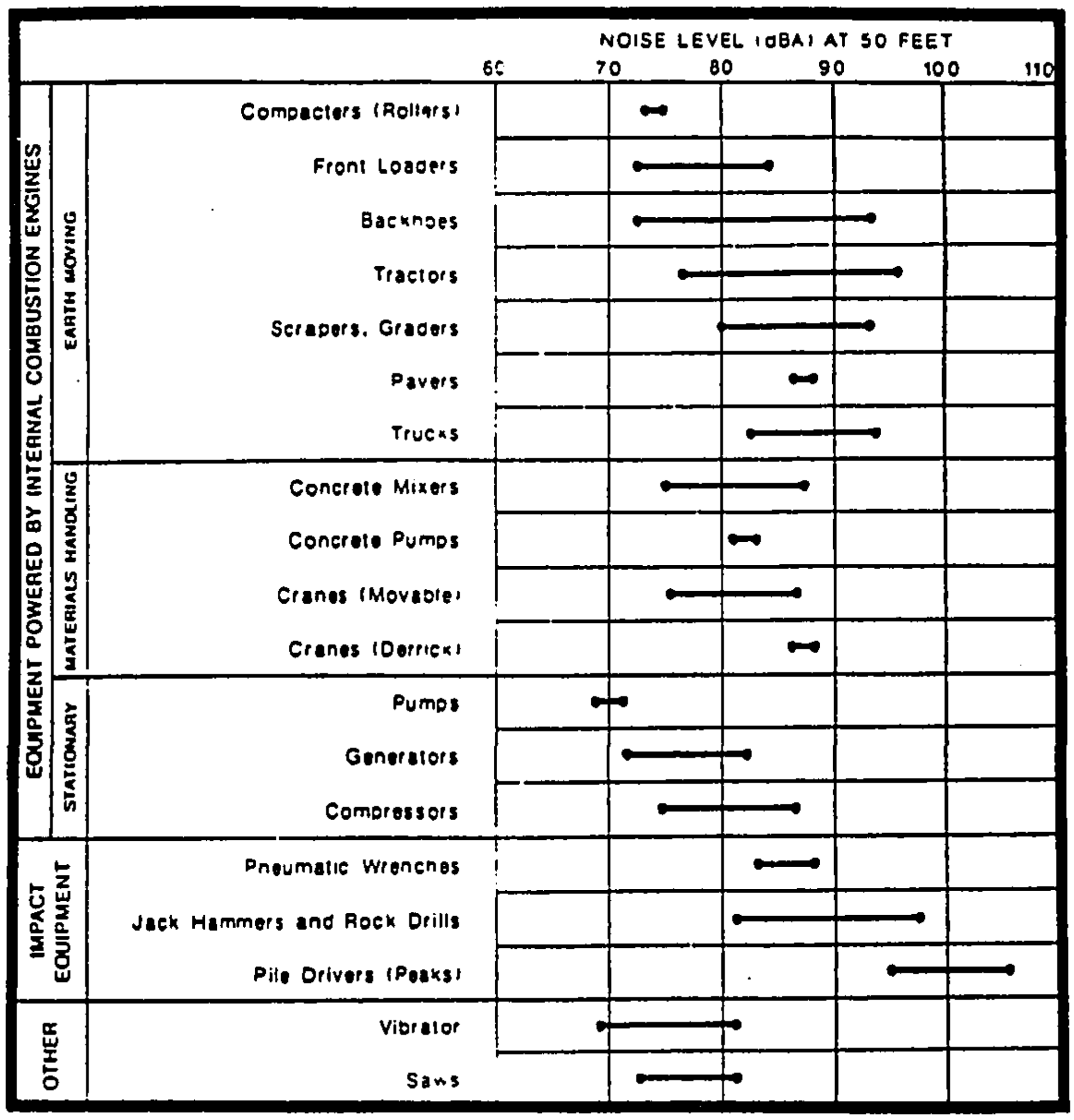
B. Anticipated Impacts

Future activities at the project were evaluated with respect to potential noise generators. These activities include: construction activities, project-generated traffic, golf course maintenance equipment operations, clubhouse and tennis center activities, and stationary equipment operation (such as air conditioners and pumps). Potential noise impacts on off-site park facilities and on new, proposed residences within the project and outside the project at the adjacent Regent Kona Coast development were also considered.

Construction Impacts: In the short-term, significant increases in noise levels may result from construction activities. Development of the project will involve clearing, grubbing, grading and the construction of infrastructure and buildings. The actual amounts of noise generated in construction are dependent on the methods employed during each construction phase. Earth moving equipment, such as bulldozers and diesel powered trucks, will probably be the loudest equipment used in construction. Typical construction equipment noise levels are shown in Figure 17.

Rock removal will be required over most of the graded areas of the site. Equipment typically used for rock removal include rock hammers and drills, as well as blasting equipment. Equipment using impact to break rock is noisy, as shown in Figure 14 where 82 to 98 dBA at 50 feet is typical of jack hammers and rock drills. The breaking of rock by explosion usually creates a muffled "thump" sound. Noise created during rock removal may affect the several nearby beach parks where camping activities may occur. These are presently the only noise-sensitive areas in the vicinity of the project site. However, most of these camping areas are exposed to high sound levels of surf and wind noise, with Ldn levels probably exceeding 70 dB, depending on the weather condition. The natural sounds will probably mask the construction-related noises much of the time. In any case, this impact will be short-term in duration, and the actual time period required for drilling and blasting will be assessed after final design and geotechnical studies are complete.

Traffic Noise: Over the long term, some additional noise will be generated by the project which will cause a very slight increase in noise levels along the Queen Ka'ahumanu Highway. Federal Highway Administration (FHWA) highway traffic noise modeling results showed that the increases in the future traffic noise levels due to project-generated traffic are at most 1.0 dBA. An increase in noise level of 1.0 dBA is usually not detectable by a person with normal hearing, and therefore, it is not considered a significant noise impact. About a 4.0 dBA increase in the highway traffic noise is expected due to the region's overall future growth. However, contribution from the project-generated traffic to this overall increase is considered negligible.



Note: Based on Limited Available Data Samples

Source:

U.S. Envionmental Protection Agency, 1972

Construction Activity Noise Levels

MANINI'OWALI RESIDENTIAL COMMUNITY **FIGURE 17**

The nearest of the project's residential areas to Queen Ka'ahumanu Highway are to be located at a distance of approximately 400 feet. At such a distance, the Ldn level is estimated to be at most about 65 dB, and is therefore in compliance with Federal Department of Housing and Urban Development (HUD) site acceptability standards. Similar calculations for interior roads indicate that at a distance of 100 feet from the centerline of the roadway, the traffic noise levels are less than 60 dBA, assuming "soft site" characteristics of single-story homes with dirt or grassy intervening grounds, and no concrete or asphalt between houses. Assuming a 35 mile per hour speed, and one percent heavy and one percent medium truck mix, analyses indicate that residential structures provided with setback distances of 40 feet or more from the centerline of the interior roadway, regardless of either "soft" or "hard" site conditions, will conform to the HUD standard of no more than 65 dB Ldn sound pressure.

Golf Course Ground Maintenance Noise: Noise associated with ground maintenance equipment, such as lawn mowers and leaf blowers, could have an adverse impact on the proposed residential areas, particularly when the equipment is near the housing. However, noisy equipment is also incompatible and disruptive with golf play. All equipment powered by internal combustion engines will be fitted with adequate exhaust mufflers, and schedules will limit noisier maintenance activities until after 7:00 AM. Noise from ground maintenance operations should not be "unreasonable" or "excessive" as defined by the State Department of Health (DOH).

Clubhouse Noise: Noise sources from clubhouse operations could include kitchen equipment, fans, air conditioners, refrigeration equipment, pool pumps, as well as sound systems for announcements and music. Noise from the clubhouse could potentially impact the nearby future residential areas in the immediate vicinity of the clubhouse. The sound from the above mentioned sources should not create a significant noise impact to the closest possible future residences of neighboring projects, which will be at least 2,000 feet distant.

Tennis Center Noise: The primary source of noise from tennis games are racquet-to-ball impact, shoe screech, shouting and yelling. Noise generated by such activities may affect the proposed homes located adjacent to, or near, the tennis center. For example, a typical doubles tennis game could generate an L10 level (10 percent exceedance level) of about 58 dBA at a court fence-line. Although not enforceable in Hawai'i County, such a level exceeds both the DOH's daytime (7:00 AM to 10:00 PM) and the nighttime (10:00 PM to 7:00 AM) noise limit of 55 and 45 dBA, respectively. Adequate setbacks will be provided between the courts and the project's residential lots to reduce the tennis noise impacts to a level of insignificance. It is not expected that spectator tennis matches will be held at which crowd cheering and a public address sound system would create sound levels exceeding DOH noise regulations.

Stationary Equipment Noise Noise from air conditioning equipment, pool pumps, exhaust fans, trash compactors, and any other stationary equipment at the golf clubhouse, tennis center, and residences will not exceed the noise levels allowable by State DOH noise regulations. Noise from equipment at the project's buildings will not be audible off-site. Trash pick-up and delivery vehicles are typically operated and scheduled to cause minimum disturbance to neighboring residential units. These operations are expected to meet the requirements of State noise regulations.

Existing Noise-Sensitive Areas: Similar to what is stated above concerning construction-related impacts, noise created by activities within the development may be noticeable at the State's beach park where camping activities may eventually occur. However, most of the park area is exposed to high sound levels of surf and wind noise, with Ldn levels probably exceeding 70 dB, depending on the weather condition. Due to this natural masking sound, the project-generated noise is not expected to cause any significant noise impact at the beach park.

C. <u>Mitigative Measures</u>

Several measures will be implemented to minimize potential noise impacts at off-site receptors.

Construction Noise Control: Compliance with existing regulations as enforced on Oahu will mitigate construction noise generated by the project to acceptable levels. State DOH regulations have been established to limit construction noise generation and the intent of these regulations will be followed. Required permit conditions for construction activities include the following:

"No construction activities creating excessive noise... before 7:00 AM and after 6:00 PM of the same day."

"No construction activities which emit noise in excess of ninety-five dB(A)...except between 9:00 AM and 5:30 PM of the same day."

"No construction activities which exceed the allowable noise levels on Sunday and on...(certain) Holidays. Activities exceeding ninety-five dB(A) shall (also) be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers. Construction vehicles using local roadways will satisfy the noise level requirements defined in Hawai'i Administrative Rules, Title 11 (1981).

Blasting Measures: During rock removal, the immediate blast area is covered by a blast mat with the purpose of directing the explosive energy into the rock, muffling the air-borne pressure pulse, and controlling flying debris. The actual blast will be perceived as a muffled "thump" sound and should cause minimal vibration through the ground.

Long-Term Operational Noise Control: The design of the golf clubhouse, golf course maintenance, and waste treatment facilities will include noise mitigation measures in the planning of the location and orientation of the air conditioning equipment, exhaust fans, pool pumps and other equipment, such that local noise regulations will be satisfied.

Ground maintenance equipment will be powered by internal combustion engines with exhaust mufflers. Schedules for maintenance will be arranged so noisier operations do not occur near residences (on and off the project area) before 7:00 AM or after 5:00 PM.

Golf Clubhouse and Community Facility Noise Control: The site planning for the golf clubhouse, tennis center, and other recreational or community facilities shall incorporate adequate setback distances, respecting existing residential areas. Proper sound insulation measures shall be incorporated into the building design. Events which propose the use of amplified sound outside the building shall notify the community and be scheduled at hours which do not conflict with the neighboring residential areas.

4.13 AIR QUALITY

An air quality study of the proposed project has been prepared by Barry D. Neal and Associates (June 1991). The information provided by this study is summarized below, and the complete report is included in Appendix N.

A. Existing Conditions

Present air quality in the project area is mostly affected by air pollutants from natural and/or vehicular sources. There are no industrial or agricultural air pollution sources nearby. Natural sources of air pollution that may affect the air quality of the site include ocean sea spray, aero-allergens from plants and wind-blown dust from bare soil areas. At present the largest intermittent natural contributor to air pollution is eruptive activity at Kilauea volcano, more than 50 miles east of the project site. Since 1989, the American Lung Association has had a monitoring station at Captain Cook in South Kona for a vog (volcanic smog) characteristic study. Preliminary results indicate that sulfate levels are up to five times higher in the Kona area compared to Hilo. Potential impacts on human health from the vog are still under study.

Queen Ka'ahumanu Highway, adjacent to the project site, is a major arterial roadway. Depending upon the prevailing wind direction, emissions from motor vehicles traversing Queen Ka'ahumanu Highway may also be carried over the project site.

The Department of Health maintains monitoring stations in Hilo and Honoka'a, about 60 miles east-south east of the site, but the data collected are specific to those localities and cannot be correlated to the subject property. The County does not monitor key automobile pollutants, such as carbon monoxide (CO) and nitrogen oxide (NOx). Based on what little data are available, it appears likely that both State and National ambient air quality standards are currently being met despite the persistent vog.

B. <u>Anticipated Impacts</u>

Construction Activity There will be two types of short-term direct air quality impacts from project construction: fugitive dust generation and on-site emissions from construction equipment. There will also be short-term indirect impacts occurring off-site from slow-moving construction equipment traveling to and from the project, and from an increase in local traffic caused by commuting construction workers.

Fugitive dust emissions will arise from grading and dirt moving activities within the project. A rough estimate of uncontrolled fugitive dust emissions from construction activity has been provided by the U.S. EPA (1987), estimated at 1.2 tons per acre per month under conditions of "medium" activity and moderate climatic conditions. Uncontrolled fugitive dust emissions from construction at this project would probably be somewhere near this level, without implementation of the planned watering program. In any case, State of Hawai'i Air Pollution Control Regulations require that fugitive dust emissions be controlled to such an extent that no visible emissions of fugitive dust from construction activity should occur beyond the property line.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The larger types of equipment are usually diesel-powered. Nitrogen oxide 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 very low and should be relatively insignificant compared to normal vehicular emissions on nearby Queen Ka'ahumanu Highway.

Vehicular Traffic: There will be a potential long-term indirect impact on air quality along the project area's roadways due to project-related traffic. By serving as an attraction for increased motor vehicle traffic, the project is considered to be a potential indirect air pollution source. In order to evaluate this potential impact, a carbon monoxide modeling effort was carried out. Carbon monoxide was selected for modeling because it is both the most stable and the most abundant of the motor vehicle generated pollutants, and it is also the air pollutant with the greatest likelihood of violating Ambient Air Quality Standards (AAQS).

Three scenarios were selected for the carbon monoxide modeling study: year 1991 with present conditions, year 2006 without the project, and year 2006 assuming the project is built and complete. To begin the modeling study, critical air quality receptor areas in the vicinity of the project were identified for analysis. Without the project, it was assumed that there would be no roadway improvements. With the project, it was assumed that a project access road would be constructed forming a T-intersection with Queen Ka'ahumanu Highway. The results of the air quality modeling effort are presented in Table 9.

Although the traffic impact assessment report indicates that traffic volumes both are and will be higher during the afternoon than during the morning peak period, worst-case

TABLE 9

AIR QUALITY MODELING RESULTS

Estimated Worst-Case 1-Hour and 8-Hour Carbon Monoxide Concentrations At Intersection of Queen Ka'ahumanu Highway and Project Access Road (milligrams per cubic meter)

SCENARIO	1991 Present	2006 Without Project[a]	2006 With Project[b]
1-Hour	0.6	1.2 (AM Peak)	6.0(AM Peak)
8-Hour	0.3	0.6 (AM Peak)	3.0(AM Peak)

Hawaii State AAQS: 10
National AAQS: 40

(a) Assumes through traffic only on Queen Ka'ahumanu Highway
(b) Assumes left turn lane provided both on Queen Ka'ahumanu Highway and on Project Access Road

SOURCE: Barry D. Neal and Associates (October 1991) emission and and meteorological conditions typically occur during the morning hours in West Hawaii.

The carbon monoxide concentration predicted with the project is higher than without the project due to the assumed presence of a signalized intersection. Intersections tend to have a higher concentration of vehicular emissions due to increased congestion and traffic queuing. However, even though concentrations with the project may increase significantly, one-hour concentrations in the project area should remain well within State and national AAQS of 10 mg/m^3 and 40 mg/m^3, respectively. Worst-case eight hour carbon monoxide concentrations were estimated by multiplying the worst-case one-hour values by a conversion factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than one hour peak values, and (2) meteorological dispersion conditions are more variable (and hence, more favorable) over an eight hour period than they are for a single hour.

It is important to note that the worst-case meteorological conditions used for modeling have a very low probability of occurrence. The assumed worst-case meteorological condition of a wind speed of one meter per second with a steady direction for one hour may only occur once a year or less. A slight increase in the assumed worst-case wind speed from one meter per second to two meters per second would reduce the predicted carbon monoxide concentrations to about one-half of the levels stated above.

Pesticides Impact on Air Quality: The pesticides used on golf courses are at relatively low mammalian toxicity, ranging from hundreds to several thousand milligrams per kilogram of body weight. Because they are not highly volatile and are applied in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas, there is little likelihood of toxic levels in the atmosphere. In addition, the use of ground spray equipment with low spray pressures (20 to 40 psi) and coarse spray droplets further reduces the potential for creating airborne fine droplets. Spray applications are only made in late afternoon or early morning hours when golfers are not on the golf course, which reduces the risk of any exposure of people to airborne spray particles (Murdoch and Green, 1991).

On-site long-term direct air quality impacts are not expected to be significant. Application of chemical fertilizers and pesticides to maintain the golf courses will be required. The primary risk of using these chemicals is to the applicator rather than to individuals at possible receptor sites down wind. Should any individual at down-wind sites encounter airborne concentrations of these chemical substances, it would be in greatly diluted form. Precautions will be taken in the application, as described in the following mitigative measures discussion.

Wastewater Treatment Facility Odors: The proposed wastewater facility will utilize an activated sludge treatment process. Effective odor control measures will be in place at the main treatment facility and the pump stations throughout the project. No noticable odors should be detected at the boundary of the wastewater treatement area.

Electrical Demand: The annual peak electric demand of the project when fully developed is not expected to exceed about 4.215 megawatts. The present generating capacity on the Big Island is 161 megawatts with most of this power supplied by oil-burning generating units. Island-wide peak power demand is currently about 120 megawatts. Average annual electrical demand of the project when fully developed is not expected to exceed about 15 million kilowatt-hours. As a consequence of electrical power usage, the proposed project will contribute to indirect air pollution emissions from power generating facilities, most probably provided by expanding and/or additional burning of fuel in oil-fired generators. The project power demand would result in about a three percent increase in emissions from the electrical utility if all power is derived from fuel oil.

Solid Waste Disposal: Solid waste generated by the project when fully developed is not expected to exceed seven tons of refuse per day. Presently, the refuse district handles about seven tons per day. Most, if not all, refuse from this community would likely be hauled away and either landfilled, or burned at another location.

If this refuse is not landfilled and all or part is burned at a municipal incinerator or other facility (such as H-power), disposal of solid waste from the project will also result in emissions of particulate, carbon monoxide and other contaminants from the incineration facility. If all refuse is landfilled, the only air pollution emissions associated with solid waste disposal (assuming problems similar to those which currently exist at the Kailua Landfill are avoided) would be due to exhaust fumes and fugitive dust from trucks and heavy equipment used to place the refuse in the landfill.

Long-term, quantitative evaluations of these impacts were not made, but it is likely to be relatively small. Several measures have been proposed to minimize potential air quality impacts.

C. Mitigation Measures

Several mitigation measures will be implemented to minimize potential air quality impacts, as listed below.

Dust Control: During construction of the project, adequate fugitive dust control will be accomplished by establishing a frequent watering program to keep bare dirt surfaces in work areas from becoming significant dust generators. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and establishment of landscaping as early as possible in the construction process will also be done to lower the potential for fugitive dust emissions.

Construction Equipment Transport: Indirectly, slow-moving construction vehicles on Queen Ka'ahumanu Highway can obstruct the normal flow of traffic to such an extent that overall vehicular emissions of carbon monoxide are increased. This impact will be mitigated by moving heavy construction equipment during periods of low traffic volume whenever possible.

Roadway Traffic: Roadway improvements recommended by the traffic consultant will be implemented to move traffic efficiently through the project area and to help maintain good air quality.

Pesticide Application Controls: There are certain precautions that must be followed by pesticide applicators in order to prevent significant down-wind drift when spraying. Primary among these are the use of a coarse rather than a fine spray and application under low wind speed conditions when the wind direction will not contribute to drift towards the clubhouse area or to nearby residences. Off-hours application scheduling and buffer establishment will also minimize pesticide effects on air quality. Spray hoods will be used as necessary to contain spray during windy-periods. When proper safety precautions are followed, the potential for serious air quality degradation from chemical spraying for golf course maintenance will be minimal.

Odor Control: Odor control measures will be included in the design of the wastewater treatment facility. There will be no odor generated by irrigation disposal of diluted, advanced secondary treated effluent.

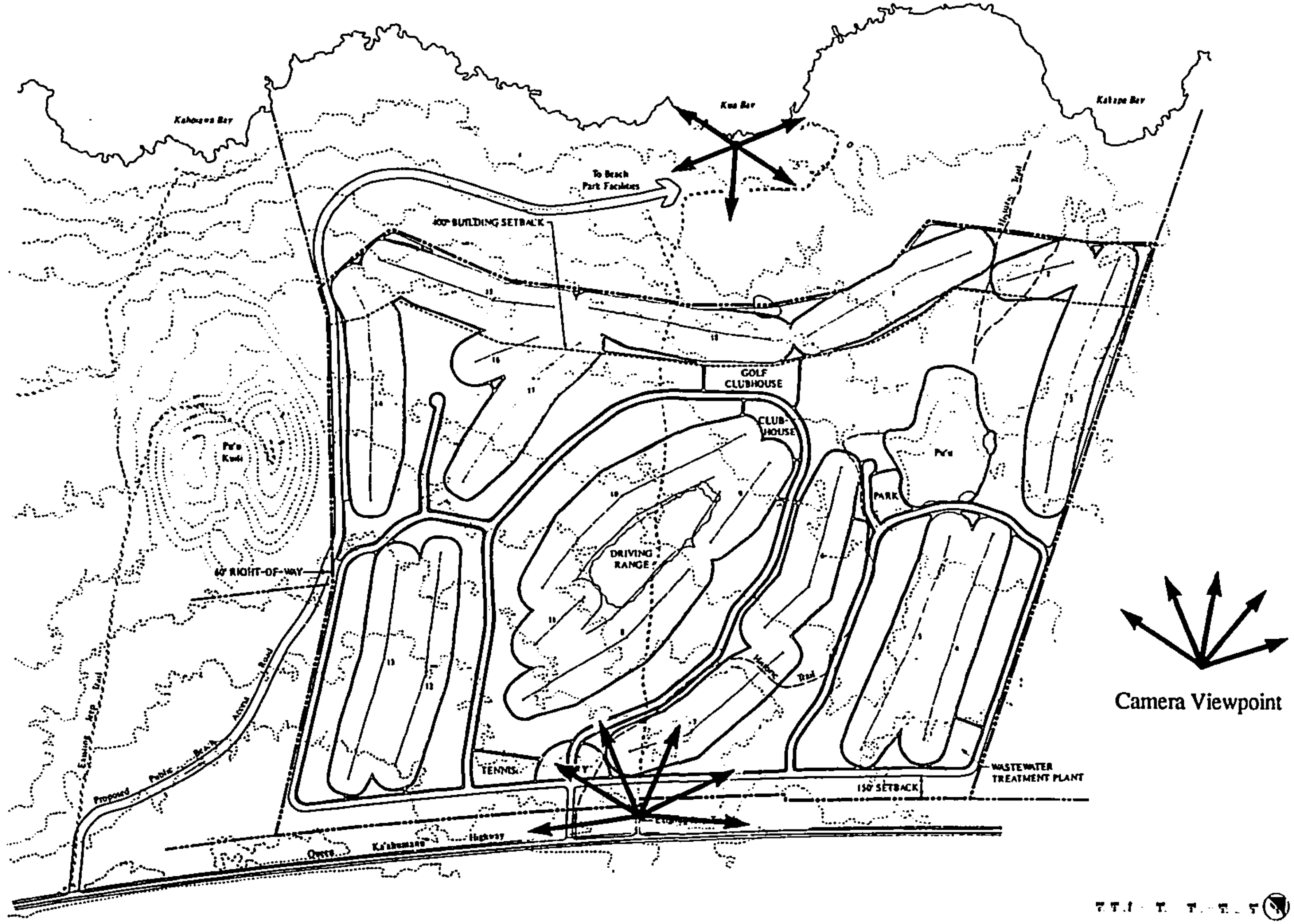
4.14 VISUAL RESOURCES

Existing views of the project site from the surrounding area have been inventoried in this section, both descriptively and through photographs. Short-term and long-term effects on views of the site which could potentially result from development of this project are assessed, and measures are proposed to minimize adverse effects.

A. Existing Conditions

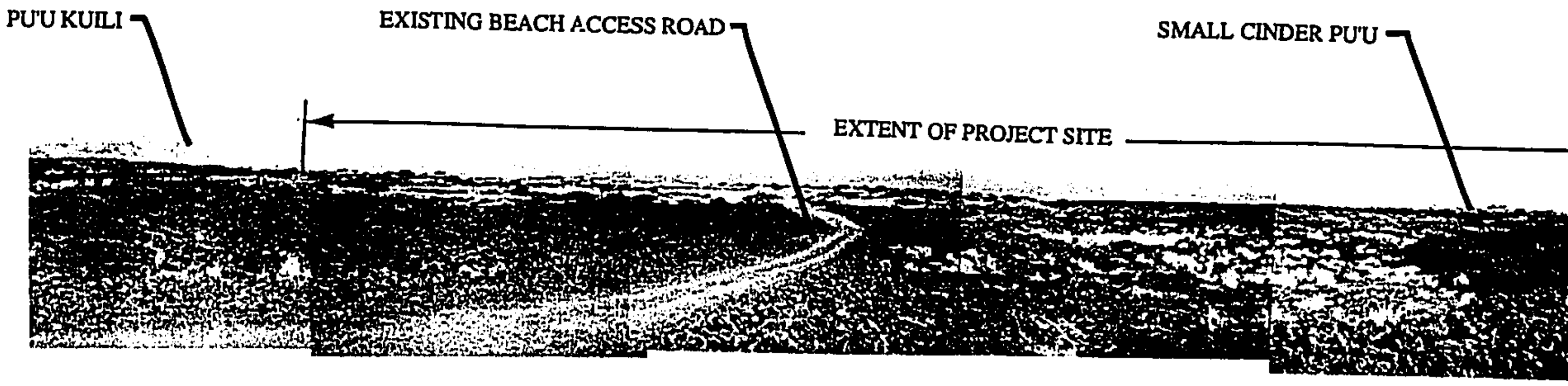
Views of the project site are presently available from the east at Queen Ka'ahumanu Highway, the existing dirt roadway through the middle of the property which leads to Kua Bay, from the south at Awake'e, from the adjacent north at Kuki'o 1 and from the makai State-owned portion of Manini'owali, as well as offshore ocean locations. Existing views of the project area are of vacant expansive barren lava land similar to other coastal lands along the Queen Ka'ahumanu Highway within the North Kona and South Kohala districts. A photograph key map (Figure 18) identifies locations for panoramic photographs showing *mauka* and *makai* views of the project site, which are included in Figures 19 and 20.

Along the highway near the project site, the most prominent natural feature is the Pu'u Kuili cinder cone at Awake'e which rises to 342 feet above msl. Generally, the view from the highway approaching the property from the south is obstructed by the rise in the topography and Pu'u Kuili. This represents the highest point of the NKDG property which is approximately 280 feet above msl. From the highway approaching from the north, one can directly overlook the northeastern quadrant of the site, and experience a distant view of the *makai* portion of the site.

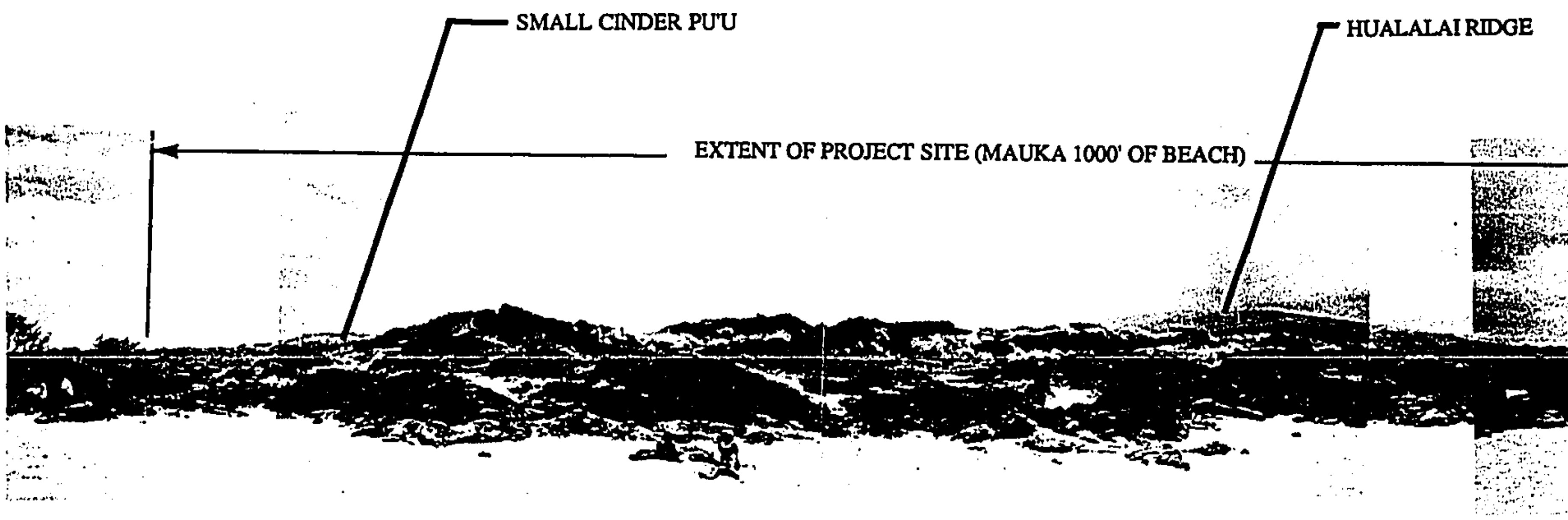


Location Map for Views of Project Site

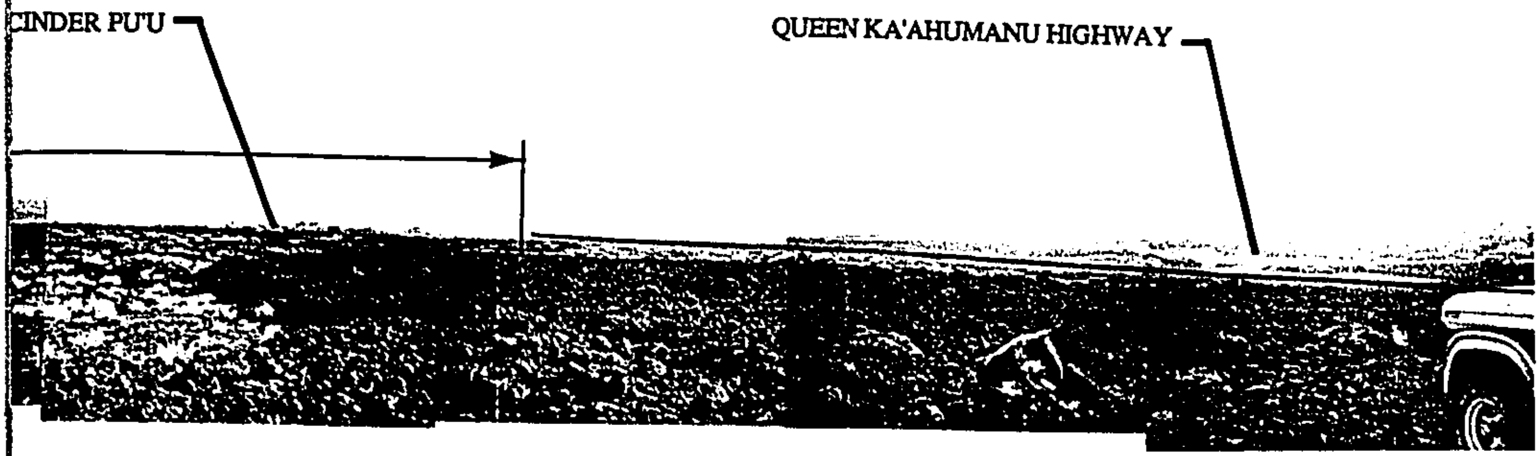
MANINI'OWALI RESIDENTIAL COMMUNITY **FIGURE 18**



View of the Project Site from Queen Ka'ahumanu Highway



View Towards the Project Site from Manini'owali Beach (Kua Bay)


CINDER PU'U
QUEEN KA'AHUMANU HIGHWAY

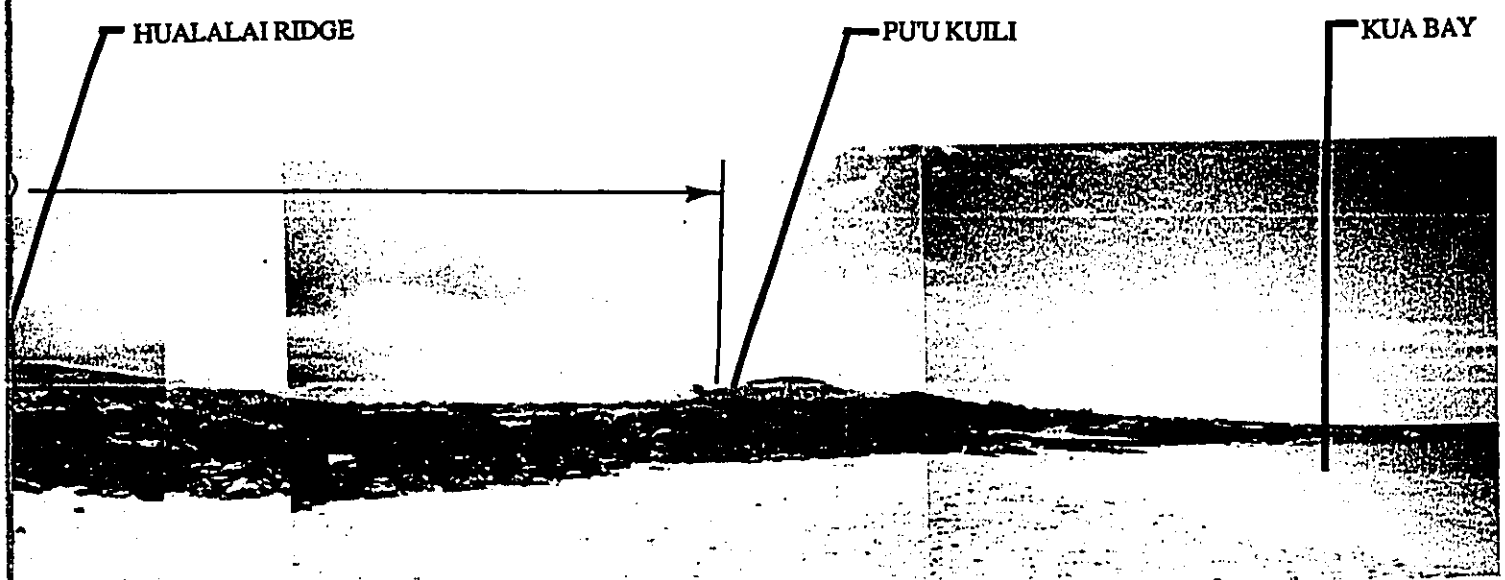
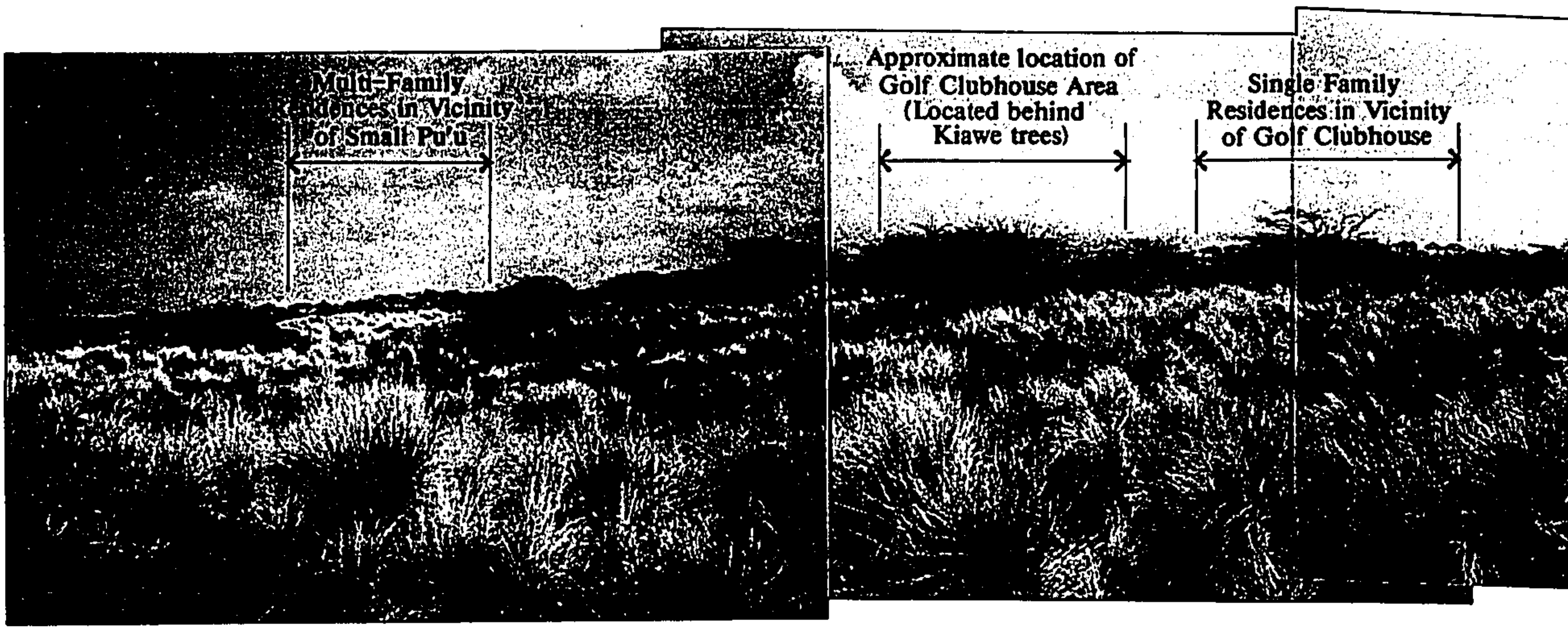

HUALALAI RIDGE
PU'U KUILI
KUA BAY

FIGURE 19



View Toward the Project Site From the Private Parcels at Kua Bay

MANINI'OWALI RESIDENTIAL COMMUNITY

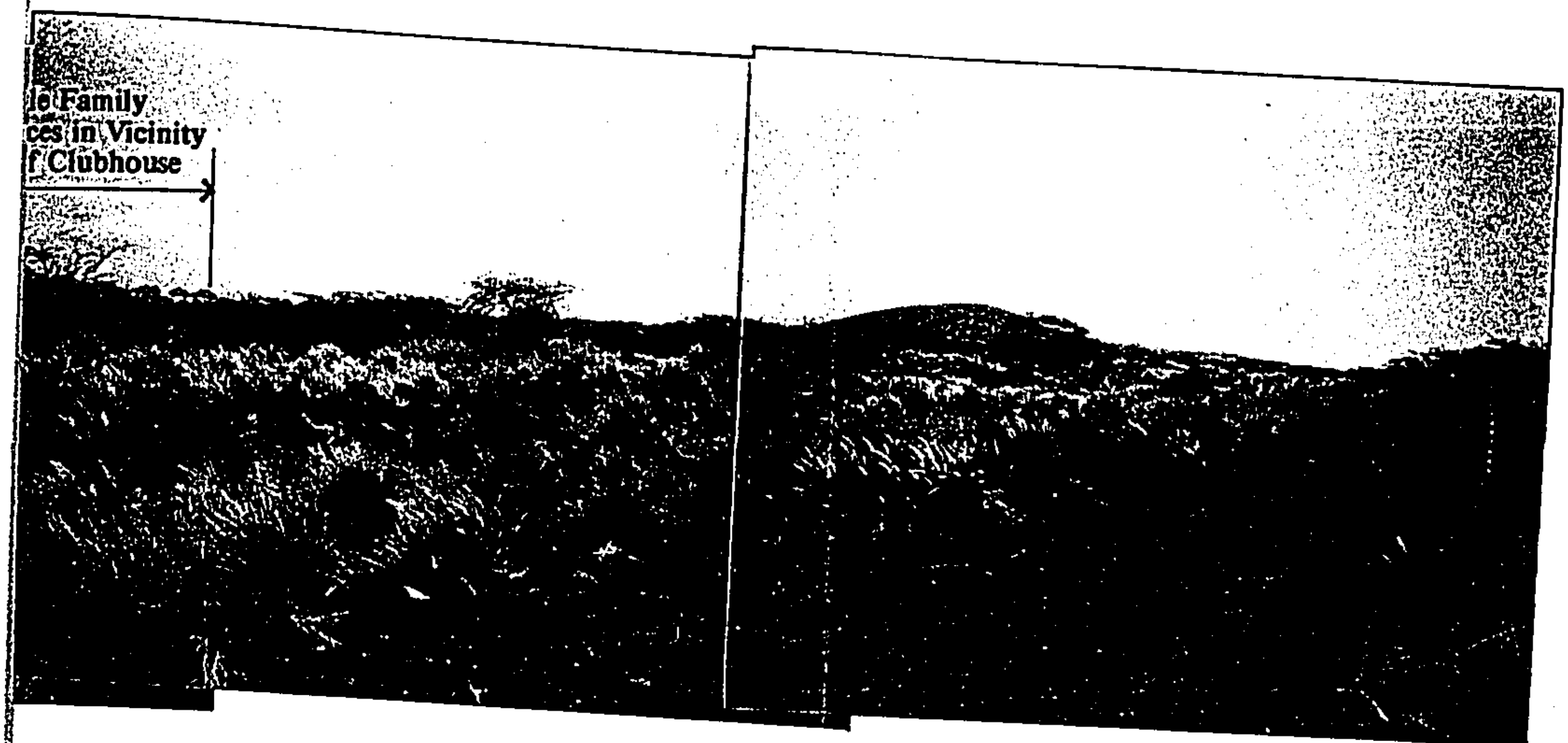


FIGURE 20

Views from locations makai of the site (on State portion of Manini'owali) are presently of the barren lava land and the small cinder cone at the northern end of the property near Kakapa Bay. From Manini'owali Beach at Kua Bay, the property is not visible due to a ridge which begins approximately at the *makai* property boundary. From the south (Awake'e), a portion of the property is seen up to Pu'u Kuili. From offshore locations, boaters are able to view some sections of the project area above the bluff.

From most locations on the NKDG property, views are expansive along the coast as well as towards Hualalai. The property is gently sloped toward the ocean, allowing ocean views from most of the parcel as well as mountain views. Views from the site currently include the undeveloped barren lava flow landscape and Pu'u Kuili on Awake'e.

B. Potential Impacts

Short-Term Visual Impacts: In the short-term, the visual character of the area will be affected by the presence and operation of construction equipment. The heavy construction involved with site preparation and infrastructure development will extend for about two years. The housing construction will be phased over a period of 12 years, beginning in 1994 to 1995. All residential construction is scheduled to be completed by the year 2006.

Construction activities will create some adverse effects on the views of the project site. Construction of the access road and highway improvements, portions of the golf course, some of the residential structures and support facilities will be visible from Queen Ka'ahumanu Highway. Vegetation clearing and grading involved with construction will be visible, as will the construction of buildings and the installation of utilities. Because the development will be phased, future users of the site will also be exposed to views of construction activities. Some of the construction activities may also be visible from the *makai* State parkland and some offshore ocean locations.

The most apparent changes in the views of the project site will be the construction of the entrance, the access road, the tennis center, portions of golf course fairways and residential buildings close to the highway. Many of these features will be visible from the southbound lane on the highway. Cleared vegetation, bare soils in graded areas and stored construction equipment will be evident during much of the construction period. Buildings and exposed soil and rock surfaces will be visible until the landscape plantings have been established.

Long-Term Visual Impacts: Long-term visual effects will result from the proposed project when it is completed. Replacing the barren lava landscape in many areas will be a low-to medium-density residential development planned around a golf course and preservation areas. Because of topographic conditions, few structures will be visible from most locations on the State lands *makai* of the site. The golf course will integrate natural lava and landscaped areas. Extensive landscaping will be incorporated along boundaries with adjoining lands and the highway, which will serve to shield or buffer off-site views of the completed project. Building siting, heights, materials, colors and landscaping will be carefully considered in design. A non-obtrusive *kama'aina* architectural style will be followed, creating aesthetically-pleasing homes and support facilities. Views of vehicle traffic, the project entrance and some lighting will be noticeable at the entry road.

A preliminary view study was prepared to examine the potential visual effect of the new residential community when viewed from a site near Manini'owali Beach on the State-owned land *makai* of the project, approximately 200 to 300 feet from the ocean. This view point was selected because this is a logical location for the proposed beach park support facilities, which will become a gathering place and recreational area for the public. Potential views of the new residential community from *makai* locations has been noted as a concern by several reviewers of the project.

From positions on the beach (near sea level) looking *mauka* toward the residential community, individuals will generally not experience views of structures on the NKDG site. As shown in Figure 20, low-angle views *mauka* from the beach are limited because these views are generally influenced by the lava mounds, low grassy dunes and *kiawe* trees in the foreground at the *mauka* edge of the beach area. These foreground features tend to set the line of sight above the nearby NKDG lands, only allowing views of higher elevation lands such as Pu'u Kuili and the more distant slopes of Hualalai.

Views from the potential site for the beach park support facilities were studied in Figure 19. The elevation of this view point is approximately 25 feet above sea level. It is evident from this panoramic photograph that foreground features such as lava mounds and *kiawe* trees are present which tend to screen portions of the views of the nearby NKDG land. Portions of some structures on the project site may be visible in three limited sectors, which are defined in the photograph shown in Figure 20.

To the northeast, portions of the condominium buildings may be visible from the proposed park site in the range of the small cinder cone. The condominium buildings are assumed to have the greatest height of all structures at this development, with a maximum height of approximately 45 feet. To the east and southeast, some portions of single-family residences near the clubhouse may also be visible. Single-family residences will likely be built within a maximum height of 25 feet. The golf clubhouse roof peak will rise to a maximum height of 35 feet, however, this structure would be screened by natural vegetation on the State land along the line-of-sight examined in this study.

The results indicate that existing land forms and vegetation will limit the potential views of structures at the new community to only the upper portions of some structures through small sectors of the *mauka* view panorama. From the beach, virtually no structures will be noticeable. Major factors which eliminate potential views from these *makai* locations are the prevailing low angle line-of-sight and the substantial distance to the new residential structures. The distance from the beach to the closest structure would be approximately 1,500 feet, which is the equivalent of five football fields. Distance alone will minimize the potential influence of the new structures on the *mauka* view experienced.

Future views will also be largely dependant on the extent of landscaping established on the State Park land, and on the new golf course and along the makai edge of the new residential area. Palm trees of 25 to 45 feet in height and other lower landscaping vegetation are planned to be established along sections of the *makai* side of the structure development areas. The line of sight to these areas from the area of Manini'owali Beach would be generally above the roof peaks of structures. Trees and other lower landscaping vegetation will partially or completely screen views of structures from all off-site locations. There will be view channels established *makai* of residences and the clubhouse to allow for ocean and coastal views. The density of landscaping and position of on-site view channels will be project design issues which can only be addressed later in the planning process, when greater site planning, architectural design and landscaping design information becomes available.

The beach park access roadway to the State's planned shoreline park will be travelled by the public on their way to and from Manini'owali Beach and the coastal area. The alignment and design of this roadway, and the other features of the shoreline park, will be the subject of future planning efforts to be undertaken by State Parks Division planners. The view of the new residential community from this roadway could be screened effectively by establishing low berms with landscaping vegetation along the north side of the roadway, and also by depressing the elevation of the roadway surface. NKDG is obligated to participate in the development of park facilities at the State's coastal land, and will continue to coordinate with the State Parks Division concerning their plans for the shoreline park, and measures which could mitigate views of the residential community.

C. Mitigative Measures

Several mitigative measures have been proposed to minimize the impact on visual resources at this project.

400-Feet No-Structures Zone: In the land exchange process, NKDG and the State agreed on a 400-feet zone at the makai end of the property where no structures would be allowed; golf course fairways and landscaping are allowed. The no-structures zone extends 400 feet *mauka* of the property line which separates the State parkland from the NKDG private property. This zone was established, in part, to create a visual buffer from the makai State parkland. The existence of this buffer zone provides a major mitigation measure with respect to potential views from the primary public area, which is the Kua Bay/Maniniowali Beach area of the State's Shoreline Park.

Construction Period Measures: During construction, equipment will generally be contained in storage areas which are generally out of sight from Queen Ka'ahumanu Highway. To minimize a variety of impacts including visual effects, work on the intersection with the highway will be completed in the shortest possible time period. Access road construction, especially in the area of the bluff crossing, will also be completed as quickly as possible.

Minimized Vegetation Clearing: To preserve existing views, vegetation clearing along the entrance, access road and bluff will be limited to only those areas which are necessary. Revegetation and new landscape planting will be accomplished as soon as possible to screen and protect bare soil and rock areas.

Entrance Design: Design of the entrance will be tasteful and complement the existing rural atmosphere and style. Lighting of the entrance, access and internal roadways and the clubhouse will also be subdued to avoid adverse glare and other lighting effects on nearby properties and night-time visibility in the general area.

Highway Setback: Along the Queen Ka'ahumanu Highway a 150-feet setback is proposed where only landscaping will be established. This will provide open space along the highway corridor.

Public Access to the Property from the State Parkland: Another visual-related measure that will be provided is the establishment of the public hiking trail from the State land to the natural cinder cone feature which will be preserved. This historic trail will provide views of the natural areas, the completed project, archaeological sites and spectacular shoreline views from the top of the cinder cone.

Project Design Considerations: NKDG intends to minimize adverse visual effects by locating facilities to fit the North Kona coastal environment. No structures will be higher than the 45-feet limit imposed in the regulations for this area. The required setbacks will be followed to minimize views. Building heights, locations, materials, colors and surrounding landscaping will be in keeping with the natural setting.

4.15 SOCIAL AND ECONOMIC CHARACTERISTICS

This section includes a presentation of the social and economic conditions in the project area, and potential impacts of the project. Some of the new data from the 1990 U.S. Census have been compiled: specifically, information relating to the Census Designated Places (CDP) of Kalaloa, Kailua-Kona, Puako and Waikoloa. Therefore, information sources primarily reflect the 1980 U.S. Census and available recent survey data. Economic factors and employment are also considered in this section, as well as government expenditures and revenues. A brief discussion of lifestyles is also presented.

4.15.1 Population

A demographic study was conducted for the project by Earthplan (October 1991), included as Appendix N Information from this report is summarized in this section. Also included is additional demographic information which was collected and analyzed for the Market Assessment by (Zapotocky, October 1991). A copy of this report is included in Appendix A.

A. Existing Conditions

Since the 1960's, North Kona and South Kohala District have been the site for most of the major commercial and luxury resort development in the County. The Employment patterns reflect a transition in the County's economy. In 1950, over half of the people in Kona listed their occupations as farmer, farm laborer, or farm manager. By 1980, only 8.2 percent listed their occupation as agriculture related. Tourism is now the primary revenue generator.

The County of Hawai'i in general, and the North Kona and South Kohala Districts in particular, have grown dramatically in recent years. Population growth has been fueled by the growth of tourism and the recent construction boom. While the spectacular levels of growth in the past few years are unlikely to continue, a strong long-term growth trend for the County of Hawai'i and the North Kona/South Kohala area, in particular, are forecast by State and County planners to continue.

The resident population of North Kona and South Kohala has increased by 10 percent between 1970 and 1980 and 5.5 percent between 1980 and 1999.

	1970	Ave. Annual Growth Rate (Percent)	1980	Ave. Annual Growth Rate (Percent)	1990
County of Hawai'i	63,385	3.8	92,028	2.7	120,317
North Kona/South Kohala	7,142	9.9	18,355	5.5	31,424

The Department of Business and Economic Development and Tourism (DBED-T) estimates that the County population will increase to 160,400 in the year 2000; 180,800 in the year 2005; and 206,100 in the year 2010. This represents an average overall increase of almost 4,300 persons annually, or about 3.6 percent. This growth rate is comparable to the rate of population growth experienced by the County between 1970 and 1990. As in the recent past, much of this growth is expected to be concentrated in the Noth Kona and South Kohala districts of the Big Island.

The County of Hawai'i projects several different growth scenarios for the North Kona/South Kohala area. If the sugar industry ended and there was modest expansion of the visitor industry, North Kona and South Kohala would grow at a collective rate of 3.6 percent, for a 2005 population of 53,500 persons. In the highest growth scenario, assuming the supply of hotel rooms increases by 17,800 units plus the addition of condominium units, the study area is projected to have a population of 93,100 persons by the year 2005. This latter scenario represents a population growth rate of 7.5 percent, a rate comparable to what has been experienced over the past twenty years in these districts of the County.

The ethnic composition of the population has shifted as dramatically as the population has increased. In the Kona area, Caucasians have become the majority of the population, and Hawaiians now comprise almost one-quarter of the whole. The population of ethnic Japanese, Chinese, and Filipino people have declined from their previous concentrations. The declining proportion of the ethnic Japanese is significant.

A major shift has also occurred in education of residents (age 25 years or more) of West Hawai'i between the 1970 and 1980 Censuses. Most notably, there was an increase in the numbers of people attending college.

The age composition of the Kona Coast population is generally the same as the County as a whole, with the majority of the population between the ages of 18 and 64. The trend from 1970 to 1980 was for the aging of the population. The proportion of young persons from 5 to 17 years old has declined and the population in the productive years of 18 to 64 has increased. The proportion of very young and the old have changed only a little.

B. Anticipated Impacts

The development of 900 to 1,100 residences within the proposed residential community could add approximately 1,670 full-time residents and 560 part-time residents by 2006. It is expected that approximately 25 percent of the residents will be part-time residents, in that many will be retired people who purchase a residence in the project as a second home, and others will purchase a residence as a vacation home.

The buyers of homes for primary residence will include local executives, professionals, and small business owners. North Kona is a major employment center and Manini'owali is within an easy commute of their likely place of work in Kailua. Also some retirees from O'ahu who have accumulated equity in their homes may be attracted to sell and buy new homes for their retirement years at Manini'owali. The Manini'owali Residential Community is also likely to attract a large percentage of second home buyers. These second home buyers are particularly like to be out-of-state, or from another country. Overall, these residents are expected to be older than average for the County or North Kona area, with an average age of 55 years. The number of school-age children in the community's population is expected to be very small.

An increase to the residential population may also result from in-migration necessary to fill permanent project-related jobs. The total number of permanent employees is expected to be approximately 120. Since the present unemployment rate is very low, most of these job positions are expected to be filled by persons migrating to the area from elsewhere to work, or filled by existing residents who leave their present positions to become employed on-site. In-migrant workers will be accompanied by household members, resulting in approximately 330 new residents added to the area's population. Workers employed at Manini'owali Residential Community and their families are expected to be an age, ethnicity, education, and household size which are similar to the State or County-wide distributions in these categories.

By the time the project is fully built in 2006, the Manini'owali Residential Community and its permanent employees and their families are projected to account for approximately three percent of the projected population of the North Kona/South Kohala area.

C. Mitigative Measures

The project has been proposed in a manner consistent with the goals of the Office of State Planning (OSP) West Hawai'i Regional Plan. Urban expansion and the associated population in the section of West Hawaii will be focused at the Kaupulehu/Kona Village/Kuki'o Resort Node. Proposed in the context of these expected settlement patterns, the Manini'owali Residential Community will be seen as a compatible extension of the resort node, both visually and in the type of residential community.

4.15.2 Lifestyles and Community Issues

A detailed study was conducted regarding the social impact of the project by Earthplan (October 1991) (Appendix N). Information from this report is summarized in this section. Earthplan conducted 50 interviews with people who live or work near the project site, are active in regional affairs, or whose services would be affected by the implementation of this project. Earthplan talked to people with a variety of interests and from different walks of life. These interests included members of the environmental and cultural organizations, ocean recreation groups, community organizations, public and social service organizations, and those affiliated with neighboring resorts. Also interviewed were people who could provide specific information about how the nearby shoreline is used.

A. Existing Conditions

Lifestyles: The area's current lifestyle may be characterized as having primarily four components: (1) the agricultural/rural legacy, (2) the retirement communities, (3) resort workers, and (4) the growing executive/professional group. Nearly all residents of the North Kona/South Kohala area prize "country" living. People value the open ranges mauka and makai of the highway. They like being able to see no buildings while driving or while picnicking at a secluded beach. The diverse topography and vegetation enriches the experience of the natural setting - ranging from the shoreline, to the cinder cones, to the mountains.

Many people live in towns where all know each other, and where residents have felt part of a community for generations. The aloha spirit is alive and well in Kohala and Kona. People are sharing, kind, and protective of each other.

Recreation, too, is considered part of the Kona way of life, whether it is picnicking at the beach, hiking along the coast, fishing, or participating in ball games, or playing at the playground. Swimming and sunbathing are the most popular beach activities. Water clarity in the nearshore waters is important, and fishing and other food-gathering activities is a way of life for many.

Overview of Preliminary Community Issues on the Project: Earthplan (October 1991) conducted 50 interviews with people who live or work near the project. The interviews were conducted for issue identification and analysis. Whereas social impacts are social changes which are likely to occur, social issues are reactions to community events, changes and problems. Issues change over time, as people's priorities and values change. A cross-section of interests were represented in the community interviews, including: (1) members of environmental and cultural organizations; (2) ocean recreation people; (3) members of community organizations and non-organization referrals; and (4) members of public or social service agencies. An overview of community issues (as of September 1991) is presented below.

Non-project issues included community problems, such as the lack of adequate infrastructure, a shortage of recreational facilities, the influx of newcomers to the region, environmental problems, and the loss of cultural resources. Desires for the future include: funding for public improvements, control of development, enforcement of environmental laws, increase in political clout, and timely developer contributions. These issues are further clarified in Section 5.2 of the Social Impact Study by Earthplan, Appendix N.

Positive issues relating to the Manini'owali Residential Community included: the proposed improvements for Kua Bay, the 1,000-foot property setback from the shoreline, contiguity to the approved development node, open space nature of land plan, lack of hotels and minimized impact on public services due to project's level of residential pricing. Potential problems and concerns about the project included; cumulative regional impacts, golf course impacts, addition of new residents, exclusivity, visual impact, preservation of archaeological sites, and loss of seclusion at Kua Bay.

B. Anticipated Impacts

The Manini'owali Residential Community will, like the other development projects proposed and already approved in the region, will increase resort and business development, and provide additional resort residential units and affordable housing. By doing so, this project and others will supplement and continue the types of lifestyles mentioned above. This lifestyle impact may be seen as a logical one to those who have accepted the existing and projected growth. For those who wish to retain a rural or agricultural lifestyle, however, the Manini'owali project will make no contribution to this way of life.

The proposed project will be compatible with the proposed uses in the adjacent developments. Although there would be some degree of competition among the developments, there will also be some complementary relationships. Residents of the project will probably patronize the nearby hotel restaurants, shopping areas, and resident-oriented facilities. The residents and guests at the Kaupulehu, Kona Village, and Kuki'o Resorts will benefit from the additional golf course, tennis courts, and other recreational facilities at Manini'owali. The area's housing supply will also be positively impacted by the proposed project. The on-site housing of the Manini'owali Residential Community represents a six percent increase over the existing housing count for the

North Kona/South Kohala area. Off-site, NKDG will either directly increase the supply of affordable residential units, or contribute funds as appropriate.

The design and operation of the development is planned to complement the existing country atmosphere of West Hawai'i. The intent is for the new project not to intrude on the existing community, but to blend into the surrounding area and become an integral part of West Hawai'i. The varied recreational elements offered by the project at the development's community center will add to the rural and recreational-oriented lifestyle of North Kona/South Kohala area. A new hard-paved two-lane road, part of which is located on the site and part adjacent to it on State-owned land, will add new public access and scenic views (at no fee) to the Manini'owali Beach which has been until the present inaccessible except by way of a four-wheel drive vehicle, or a mile-long hike on foot.

The overall affect of Manini'owali Residential Community on lifestyles in the North Kona/South Kohala area will be a continuation of the current housing development patterns and trends, and an enhancement of recreational opportunities and community facility resources. This community will be designed to satisfy a somewhat lower end of the housing market, and because of its proximity to Kailua, provide opportunities for more local buyers compared with neighboring resort developments.

4.15.3 Economic Activities and Employment

This section includes a discussion of existing conditions, anticipated impacts, and proposed mitigative measures regarding the relationship of the project to economic activities and employment in the area. Zapotocky (October 1991) and Earthplan (September 1991) contain analyses of economic conditions and employment. Information from these reports are summarized below.

A. Existing Conditions

Tourism is the major economic activity in North Kona and primarily centered in Kailua. North Kona currently has twelve hotels for a total of 2,543 hotel units. In addition, 1,535 condominium units provide visitor accommodations. Seven hotels with 3,049 units, 256 condo units, ten bed-and-breakfast units, and twelve apartment/hotel units provide visitor accommodations in South Kohala.

Coffee production has been economically important, too, in North Kona. Agricultural activities in this district also include cattle ranching and the growing of fruit, macadamia nuts, and vegetables. Cattle ranching uses most of the land in South Kohala; the headquarters for the Parker ranch is in Waimea. Waimea is also one of the most productive centers for vegetable crops on the island.

Timber and fishing are small industries in Kona. The Kailua Harbor is considered a center for big-game fishing. Education and scientific research activities contribute toward South Kohala's economy.

Approximately 72 percent of the residents in the North Kona/South Kohala area are part of Hawaii's work force (1980 Census) as compared to 61 percent for the County residents as a whole. The State Department of Labor and Industrial Relations cites 2.9 and 2.8 percent for the two census tracts in North Kona in 1990. South Kohala had an unemployment rate of 3.4 percent. Both are lower than the County-wide rate of 3.8 percent.

Compared to Hawai'i County, North Kona and South Kohala were highly represented in service type occupations. North Kona had slightly more people in management and professional occupations than the County, and technical, sales, and administration were also favored in North Kona. Also, consistent with the predominant visitor industry, North Kona and South Kohala were highly represented in the personal, entertainment, and recreational industries. Though agriculture in North Kona has given way to hotel/resort, recreational, and residential development, this trend has not been as prevalent in South Kohala. Ranching and agriculture are still important in South Kohala. As would be expected, the construction industry has flourished in the North Kona/South Kohala area, except during periods of economic downturns, such as the late 1970's.

B. Anticipated Impacts

It is estimated that personal income paid to Hawai'i residents due to development of the project could be expected to amount to about $11.9 million per year during construction from 1994 through 2006. In the ensuing years, it could amount to $2.6 million per year, as construction activity subsides and operational employment demands increase.

Visitors to, and residents of, the community would make direct expenditures for golf-related fees and rentals and for purchases of food, beverages, other goods and services. These expenditures would, in turn, require those establishments serving direct visitor demands to purchase goods and services from other establishments in the State. The latter expenditures are considered indirect effects of the original visitor expenditures. Induced expenditures are those made by employees and proprietors with income derived from establishments benefitting from these new direct and indirect expenditures.

Direct and indirect types of employment opportunities can be expected to be created by the project. Direct employment effects would be those created by building construction and consumer expenditures generated by the project. The indirect effects would be realized through spending multipliers throughout the the State, as those people directly employed due to the project spend money for goods and services from individuals and businesses not supported by the project.

Approximately 295 direct construction jobs will be created annually in the 12-year build-out period, from 1994 through 2006 (Table 10). A total of 3,500 man-years of construction-related employment will be generated. More than 400 additional indirect jobs will be created, based upon the 1.4 multiplier used in the State's Input-Output

TABLE 10

PROJECTED DIRECT AND INDIRECT CONSTRUCTION AND OPERATIONAL EMPLOYMENT

	CONSTRUCTION PHASE (12 YEARS)	ONGOING OPERATIONS
DIRECT EMPLOYMENT		
Golf Course, Clubhouse, and Infrastructure [a]	295	75
Retail [b]	-	20
Residential Management and Maintenance [c]	-	25
TOTAL DIRECT EMPLOYMENT	295	120
INDIRECT EMPLOYMENT		
Construction (1.4 multiplier) [d]	413	-
Operations (0.5 mulitplier)	–	60
TOTAL DIRECT AND INDIRECT/EMPLOYMENT	708	180

(a) Operational employment includes clubhouse, food and beverage, and retail facilities as well as course management and maintenance.

(b) One employee for every 500 square feet of retail space

(c) One owners' association employee for every 40 residential units

(d) Based on the Hawai'i State Department of Business and Economic Development, (DBED) Input-Output Model

SOURCE: John Zapotocky (October 1991)

model for construction jobs. Thus, a total of approximately 700 direct and indirect jobs is anticipated being generated as a result of building construction for the project.

The majority of direct operational employment at the development will occur in the golf-related facilities. The golf course and landscaped areas will create many jobs which are similar to some agricultural types of employment. Including the clubhouse, the golf course will employ approximately 75 people. The small commercial facilities are estimated to generate a total 20 jobs, and residential management and maintenance will generate approximately 25 jobs. Thus, the residential community is expected generate a total of about 120 full-time equivalent direct operational positions by completion in 2006. Also, it is estimated that an additional 60 jobs will be created indirectly based upon the State's multiplier of 0.5.

C. Mitigation Measures

The impacts of the project on economic activities and employment will be beneficial to the area residents and businesses. Consequently, no mitigative measures are needed or recommended.

4.15.4 Government Revenues and Expenditures

This section includes a discussion of existing conditions, anticipated impacts, and proposed mitigative measures regarding the relationship of the project to State and County government revenues and expenditures. A Fiscal Impact Assessment has been prepared by Zapotocky (October 1991) has been prepared for the project which address these issues. Information from this report is summarized below, and the complete report is included in Appendix P.

A. Existing Conditions

The project site is currently vacant and NKDG currently pays approximately $33,500 per year in County property taxes. There are no current public expenditures being made for direct services to the site.

B. Anticipated Impacts

Development of the proposed residential community will bring additional tax revenues to the County and State governments. A comparison of projected public revenues and expenditures attributable to the project's development is given in Table 11. County government revenues would be principally in the form of real property taxes on the new facilities. Revenues to the State government would be composed principally of general and specific excise taxes and personal income taxes paid by new State residents and the general excise tax on sales revenues attributable to day visitors to the community.

New residents and visitors attracted by the project would also necessitate additional expenditures of State and County public resources. Residents and day visitors will

TABLE 11

SUMMARY OF ESTIMATED STATE AND COUNTY FISCAL IMPACTS

STATE FISCAL IMPACT	ESTIMATED VALUE (a)
Construction Phase	
Construction Activity	$36.1 million
State Full Development	
Primary Residents (75% of residents)	
General Excise Tax	1.6 million
Income Tax	4.7 million
Other	0.8 million
Second Home Residents (25% of residents)	
General Excise Tax	0.4 million
Income Tax	0.0
Other	0.0
Annual State Revenue Upon Full Development	7.3 million
Estimated Annual Expenditures ($1,736 per resident)	1.6 million
Net State Annual Revenue	**$5.7 million**
COUNTY FISCAL IMPACT	
County Full Development	
Property Taxes	
Residential	6.0 million
Golf Course	0.3 million
Retail	0.03 million
Total Property Tax Revenue	6.3 million
Other Revenue	0.8 million
Annual County Revenue upon Full Development	7.1 million
Estimated Annual Expenditures ($730 per resident)	1.6 million
Net County Annual Revenue	**$5.5 million**

(a) Numbers have been rounded

SOURCE: John Zapotocky (July 1991)

increase the average daily population of the area, requiring public expenditures in terms of public safety, maintenance of highways, health and sanitation, recreation, and special capital improvements. In-migrant residents would incur public costs in terms of public safety, maintenance of highways, recreational facilities and natural resources, health and sanitation measures, special capital improvements, education, retirement and pension funds, public welfare, and other government functions.

Additional County revenues generated by the proposed project will amount to about 3.5 times the operating expenditures incurred by the County government after full development. Additional State revenues generated by the proposed project will also amount to about three and one-half times the operating expenditures incurred by the State government.

C. Mitigation Measures

Future tax revenues that will be collected by the County and the State are expected to offset the costs of providing public services for this new community specific facility expansion requirements are being addressed for the provision of school facilities and fire protection. No additional mitigation measures are considered necessary with respect to government expenditures.

4.15.5 Housing

This section includes a discussion of existing conditions, anticipated impacts and proposed mitigative measures regarding housing. Findings of Zapotocky (October 1991) and Earthplan (October 1991) relevant to housing conditions are summarized below, and the complete reports are enclosed in Appendices A, M, and N.

A. Existing Conditions

The total stock of housing on the island of Hawai'i has increased markedly in the past two decades, from almost 19,000 in 1970 to over 50,000 in 1990. The growth in units in the North Kona/South Kohala area has been even greater on a percentage basis due to the concentration of economic and population growth there. The total year-round housing units for North Kona in 1980 (6,894 units) was 3.5 times the 1970 supply; in South Kohala, the 1980 housing supply of 1,960 units was 2.5 times the 1970 count. Because of the tremendous growth in recent years, the housing stock is, for the large part, relatively new.

Despite the tremendous growth in housing in the North Kona/South Kohala area, there still exists a housing shortage in West Hawai'i. The tightness of the present housing market is demonstrated by a rental vacancy rate of only one percent in the Kona area. The supply is inadequate to meet the existing and future needs of the expanding resort areas. The inadequate supply is due to high land costs, the presence of many resort and high-priced market units, and pent-up demand for affordable housing. High prices and a lack of available units help to explain why there appears to be widespread overcrowding and house sharing in the study area.

The demand for housing has been influenced by several factors. Among them is the trend of decreasing household sizes at national, State, and County-wide levels. The County's average household size has decreased from 3.61 persons/household in 1970 to 3.09 persons/household in1980. These changes are being driven by the aging population, the change in lifestyle, and a variety of other reasons. Other factors affecting housing in the North Kona/South Kohala area include economic cycles, inflation, and financing. Of particular importance in the project area is the second home and vacation home market.

The area has grown more affluent generally as evidenced by the fact that home-ownership increased from 1970 and 1980, and the proportion of renter-occupied units has fallen. In North Kona, the percentage of renter-occupied units decreased from 55 percent to 45 percent, in South Kohala, from 51 to 41 percent. The median rents in 1980 were higher in the study area than in Hawai'i County. For North Kona, the median monthly rent was $331, and South Kohala's was $307. Both were much higher than Hawai'i County's $223 median monthly rent.

As of 1990, there were 1,224 government controlled units, or about 2.5 percent of the housing stock. While this figure may to grow modestly in coming years, there is nevertheless substantial government participation in housing development with the planned County Waikoloa and and State Kealakehe housing projects. The Kealakehe Planned Community being developed by the State's Housing Finance and Development Corporation (HFDC) is being planned as fourteen villages containing a total of approximately 4,200 residential units, 60 percent of which will be designated affordable.

B. <u>Anticipated Impacts</u>

Future demand for housing is expected to be affected by existing shortages, population growth, future household sizes, desired vacancy factors, and affordability of the product to the persons needing the housing. The estimated need in West Hawai'i is for 1,475 units per year, consisting of a demand for resort use of 500 units per year and permanent resident use of 975 units per year. Of the permanent housing need, 680 affordable units per year are needed (49 percent of total housing unit demand, or 72 percent of the permanent housing). The Manini'owali Residential Community will involve the creation of approximately 80 to 100 units per year for a total of 900 to 1,100 new residential units upon project completion 12 years after commencement (beginning in 1994 and ending in the year 2006). The proposed project will help meet a significant part of this presently unmet need.

The Manini'owali Residential Community will add approximately 150 very low density single-family, 550 low density single-family, and 300 multi-family units to the study area's housing supply. These units will be priced from $500,000 to over $1 million for the resort market. Approximately 75 percent of the residences are expected to be occupied full-time by permanent residents. About 25 percent of the residences will be second homes, of which approximately 40 percent will be permanently occupied. Some owners of residences at Manini'owali will be retired people who purchase a residence as a second home, and others who purchase a residence as a vacation home.

Some employees of the Manini'owali Residential Community will likely move into the North Kona/South Kohala area, attracted by the jobs created by this project. Lower-priced, affordable residences are needed to house these employees and their families.

C. Mitigative Measures

Affordable Housing: Determining the project's affordable housing requirement is an ongoing process, one which will continue throughout the land use approval proceedings. The process for determining these requirements is designed to ensure that new developments provide a fair share of affordable residences. Hence, regardless of the quantity or location of the affordable housing, project impacts will likely be an overall positive one because the supply will be increased. NKDG will provide or contribute towards the development of affordable housing in this region, upon the satisfactory receipt of appropriate State and County agencies.

4.16 INFRASTRUCTURE

The existing conditions of the public infrastructure and services and potential impacts of the project are identified in this section. This information has been provided primarily by the civil engineering consultant, Park Engineering (October 1991). Their report is included in its entirety in Appendix B.

4.16.1 Roadways

A. <u>Existing Conditions</u>

The major roadway providing access to Manini'owali is Queen Ka'ahumanu Highway. Queen Ka'ahumanu Highway is a two-lane, Class I, State Highway, designed for a 70-mile per hour vehicle speed. It is a limited access highway within a 300-foot right-of-way. Dedicated in 1975, the highway extends 38 miles along the North Kona and South Kohala coast from Kawaihae to Kailua-Kona. An unimproved dirt road, normally passable only by 4-wheel drive vehicles, presently provides access to the interior of the project site to the Kua Bay area.

B. <u>Anticipated Impacts</u>

The State Department of Transportation (State DOT) is planning the expansion of the Queen Kaahumanu Highway to a four-lane highway with a system of interchanges and service roads. The proposed project will be required to modify its access in the future to connect to the improved Queen Ka'ahumanu Highway. Until that time, a proposed at-grade intersection at the project entrance and the highway will create some traffic impacts. Additional information concerning anticipated traffic impacts is presented in

Section 4.11. Improvements required to establish the new intersection will be made by NKDG with the approval of the State.

Interior roadways of the residential development will have a minimum right-of-way of 24 feet and a minimum pavement width of 18 feet. Street dimensions, pavement, shoulder, swale, and sidewalk materials and thicknesses will be as specified in the Standard Details for Public Works Construction. All work related to excavating and grading of the road prism (section of road between right-of-way lines and including cut or fill slope sections outside of the normal right-of-way lines) will conform to the requirements of Section 12 of the Standard Details for Public Works Construction. These roadways will not be dedicated to the County, and will remain under private ownership and maintenance.

According to conditions of the land exchange, NKDG will construct a public roadway to the Kua Bay area and the new public park facilities upon development of the subject parcel. The proposed route for the shoreline access follows part of the route of the existing jeep trail on State land at Awake'e, passing north of *Pu'u* Kuili, and extending inside the southern boundary of the NKDG property, then turning north on State land towards Kua Bay. This NKDG proposed route is only a proposed access route, and will need to be approved by the appropriate State and County agencies. This road will be dedicated as a public roadway.

C. Mitigative Measures

Proposed acceleration and deceleration lanes on Queen Ka'ahumanu Highway and left turn storage lanes on both the highway and the project entrance at the proposed intersection will help maintain the efficiency of through-traffic flow, as well as ensuring greater safety for vehicles making turns.

4.16.2 Potable and Brackish Water

A. Existing Conditions

The County of Hawai'i has water systems to the Ke-ahole Airport, approximately six miles south of the subject parcel. The *mauka* water system is to be extended to the southern boundary of the Hu'ehu'e Ranch. Current County water commitments exceed availability and transmission line capacity. New private wells are proposed at the 1,500 to 1,800 feet msl elevation for the resort developments within the Kuki'o/Kaupulehu resort node.

The Keauhou and Kiholo aquifer systems have an estimated 38 million gallons per day (mgd) and 14 mgd sustainable yield, for a total sector yield of 52 mgd. The existing demand for water from the Kiholo aquifer system, in which the project site is located, is approximately 5.41 mgd or 39 percent of the estimated sustainable capacity.

B. Anticipated Impacts

A dual water system will supply both potable and non-potable water to residences, the golf clubhouse and maintenance facility, tennis center and the on-site park areas. Non-potable, brackish water will be used for irrigation of the golf course and common landscaped areas. The golf course will use treated wastewater effluent from the residential community and golf course facilities mixed with brackish water pumped from nearby wells; the common landscaped areas around residential sections will be irrigated with brackish water alone.

The project has a calculated average daily demand of 0.43 million gallons per day (mpd) for potable water, and average daily demand of 0.96 mgd of non-potable water for irrigation, part of which will be recycled wastewater (0.29 mgd) and R.O. by-product water (0.43 mgd). The total maximum daily demand of potable and non-potable water amounts to approximately 1.1 mgd.

Potable and non-potable water supply development for the project is described in Sections 2.1.9, 2.1.10, and 4.5.

C. Mitigative Measures

There are several mitigative measures that will be implemented to minimize the impact on water supply infrastructure, as listed below.

Off-Site Water Facilities Construction: Mitigation of nuisances during construction of off-site water transmission facilities such as dust, noise, and traffic disturbances will be accomplished by use of wind breaks and watering to reduce dust; and observance of approved traffic control plans.

Private Water Source Development and Desalinization Plant: The dual water system developed to supply the project will not adversely affect the existing or proposed County infrastructure for water supply. Desalinization of brackish water will help conserve potable water in the region.

4.16.3 Wastewater

A. Existing Conditions

Manini'owali is not within reasonable range of an existing public sewer system. The closest public sewerage system is a small 0.04 mgd package treatment plant maintained by the State of Hawai'i at the Keahole Airport to serve airport operations. A new County wastewater treatment facility with a design capacity of 2.8 mgd is currently being designed for a site near the Honokohau Harbor approximately 10 miles from the project site. This plant is intended to replace the Kailua-Kona Treatment Plant, servicing the Kailua-Kona area and limited sections of Ali'i Drive. Private wastewater treatment plants are also proposed for the Kaupulehu and Kuki'o resorts.

B. Anticipated Impacts

There will be no impact on municipal wastewater infrastructure as a result of this project because wastewater will be treated and disposed through private on-site facilities. Wastewater treatment facilities for the proposed development are described in Sections 2.1.8.

C. Mitigative Measures

Because public wastewater facilities will not be affected by this project, there will be no mitigative measures required for public facilities. Back-up measures will be provided for on-site facilities.

Back-up Features for Wastewater Treatment and Disposal: Back-up measures will be taken with wastewater treatment and disposal facilities to ensure the safety and environmental sanctity of the community in the case of a mechanical or electrical failure. The following are the safeguards proposed for the wastewater treatment facility and sewage pumping stations:

- Odor control measures are not expected to be needed however, contingency provisions will be included in the design and the budget to incorporate odor abatement facilities, should the need arise.
- Stand-by power will be provided to each sewage pumping station and the Wastewater Treatment Facility in case of electrical power outage. (Depending on location, some sewage pumping stations may share generators.)
- Storage vaults will be used for wastewater overflow and storage.
- Alarms and telemetering will be installed to provide warnings to indicate high/low liquid level conditions, equipment malfunction and other emergency conditions. Signals will be transferred through telephone lines by telemetry to the homes of key maintenance personnel as an additional safety measure during non-working hours.
- Alarms will be installed at each pump station indicating high/low liquid level conditions, equipment malfunction, and other emergency conditions.
- Pump stations, and the treatment facilities will be fenced to restrict public access. Additionally, these facilities will be landscaped or otherwise shielded from direct view.
- Effluent reuse facilities, including piping and appurtenances, in areas subject to public access will have warning signs that irrigation water is not fit for consumption. Piping and appurtenances will be labeled to distinguish the product as reclaimed sewage effluent.

The effluent will be tested to meet criteria stated in the proposed Hawai'i Administrative Rules, Title 11, Department of Health, Chapter 62, Wastewater Systems.

The irrigation ponds will be designed to accommodate ample storage for treated effluent during periods of high precipitation.

4.16.4 Drainage Facilities

A. Existing Conditions

The geologic formation in the project area is generally comprised of highly permeable rocks of the Hualalai volcanic series, the last active flow of which occurred in 1800-1801. This highly permeable formation lacks definitive drainage ways, indicating that surface runoff is virtually non-existent. Drainage areas *mauka* of the Highway and immediately above the NKDG site were designated in a 1971 drainage study for the planning and design of the Queen Ka'ahumanu Highway. Drainage Basins 3A, 3B, and 3C are located here, to control runoff rates of 80, 210, and 50 cubic feet per second respectively. Based on this analysis, three pipe culverts were installed under the Highway *mauka* of Manini'owali to accommodate discharge of peak storm runoff.

B. Anticipated Impacts and Mitigative Measures

An increase in storm water runoff will be created on-site by the development of paved areas and roofs, which will be controlled on-site. No impact on municipal drainage facilities will result from the project, and hence no mitigative measures are proposed. Details regarding potential drainage impacts are discussed in Section 4.4.1.

The proposed project will provide the necessary drainage facilities required for the access roadway connecting to the Queen Ka'ahumanu Highway.

4.16.5 Solid Waste Disposal

A. Existing Conditions

It is estimated in the *West Hawai'i Regional Plan* that for the next three to four years, the requirements for solid waste disposal can be met by the County sanitary landfill at Kealakehe in Kailua. When this municipal landfill reaches its capacity, a new landfill site proposed for Pu'uanahulu is planned to be opened in 1993. The Pu'uanahulu landfill is expected to serve the needs of the area for many years. Solid waste generated at the project will be hauled by a private contractor to the new landfill site.

B. Anticipated Impacts

The proposed project will generate approximately seven tons per day of solid waste. The new landfill site will receive these wastes, creating a small impact on future landfill capacity. The air quality impacts associated with solid waste disposal are discussed in Section 4.13.

C. Mitigative Measures

Recycling: Cleared trees that cannot be preserved on-site will be mulched for re-use within the project. Separation of garbage, or other island-wide programs for recycling, will be supported by NKDG in the operation of community facilities.

Solid Waste Disposal: It is expected that County revenues derived from the completed project will be sufficient to finance the project's fair share of the cost for major capital improvements, such as solid waste disposal facilities.

4.16.6 Electrical Power

A. Existing Conditions

Existing electrical service in the surrounding area is provided by Hawai'i Electric Light Company (HELCO) via a 69-KV overhead transmission line located approximately 3,000 feet mauka of Queen Ka'ahumanu Highway. HELCO is currently planning to install a new Switching Station at Po'opo'omino in 1993, within the area of the proposed project. This Switching Station will serve the approved resorts at Kaupulehu and have the capability to be upgraded to serve the proposed Manini'owali Residential Community. Therefore, new transmission lines and easements to connect to the existing 69 KV line will not be required.

In recent years, there have been periodic brownouts and blackouts on the Big Island. HELCO is planning the development of new island-wide power generating and distribution facilities to maintain the demands of present growth. To prevent further rolling blackouts of distribution circuits, HELCO plans to install a 20.8 megawatts combustion turbine in Puna in 1992 and another 20.8 megawatt combustion turbine in West Hawai'i in 1994.

B. Anticipated Impacts

The proposed project will be connected to the HELCO transmission lines. The project could require an electrical demand of approximately 4.215 megawatts. The electrical distribution system will require the appropriate off-site and on-site utility easements, separate transformers and off-site transmission facilities, including switchgear to support the project. NKDG will participate in paying for the necessary improvements to provide its project with electrical energy.

The project is not expected to adversely affect the regional or island power supply due to the timing of project implementation and HELCO's development of additional power generation combustion turbines.

The air quality impacts associated with HELCO electrical power generation are discussed in Section 4.13.

C. Mitigative Measures

Energy efficient and conservation features suitable to reduce the peak electrical demand will be designed into the project. Energy conservation measures will be designed into the project where feasible. These will include the use of energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours, whenever possible. Solar energy use and heat exchanger units for portions of the project are also being considered.

NKDG will coordinate it's subsequent development planning efforts with HELCO's planning efforts to supply power to the area. NKDG will participate in providing necessary improvements to the electrical distribution system required to serve its development at Manini'owali.

4.16.7 Telephone

A. Existing Conditions

Telephone service to the surrounding area is provided by Hawaiian Telephone Company. They share the same utility corridor with HELCO facilities.

B. Anticipated Impacts and Mitigative Measures

Telephone service will be supplied to the project utilizing HELCO poles or by sharing direct burial trenches and concrete encased ducts for electric lines. No mitigative measures are necessary or proposed.

4.17 PUBLIC SERVICES

4.17.1 Postal Service

A. Existing Conditions

A total of 33 post offices and stations are located around the island. The Federal post office nearest to the project area is located in Kailua-Kona.

B. Anticipated Impacts and Mitigative Measures

This public service will be slightly affected by the additional mail generated and received by project residents. No mitigative measures are necessary or proposed.

4.17.2 Police

A. Existing Conditions

Police protection for North Kona is provided by the Hawai'i County Police Department from its new regional headquarters in Kealakehe, about seven miles south of Manini'owali.

B. Anticipated Impacts

The Manini'owali Residential Community will increase the population and therefore increase the demand for police protection services. The new residential development will be served, by a private security force, thus eliminating the need for expanded patrols by County police onto the project. Police will be called to the site only under emergency conditions. The project is envisioned as a gated community and visitors will be monitored by the security force.

C. Mitigative Measures

Tax revenues generated by the project should more than cover the costs of additional police services attributable to the development (Zapotocky, October 1991).

4.17.3 Fire

A. Existing Conditions

The Hawai'i County Fire Department would provide fire protection services to Manini'owali out of the Kailua-Kona station, with an approximate response time of 15 minutes. The Kailua-Kona Station is located on Palani Road above the Queen Ka'ahumanu intersection approximately 12 miles from the project site. It is presently composed of one engine company, one ladder company, one tanker, a medical unit and a rescue boat. The current staff is 33 firefighters operating in three shifts. The ladder truck, as well as the rescue boat, may be relocated along with 15 personnel to a tentatively planned Keauhou Fire Station. A crash/rescue unit is maintained by the State Airports Division at the Ke-ahole Airport; however, the equipment and personnel are restricted to airport emergencies.

B. Anticipated Impacts

The proposed project will increase the demand for fire fighting capabilities in the area. However, tax revenues generated by the project should more than cover the cost of additional services required of the fire station attributable to the development (Zapotocky, July 1991).

C. Mitigative Measures

Water lines and storage with adequate fire fighting capacity will be installed by the applicant within the project. The location of fire hydrants will be reviewed and approved by the Department of Water Supply and the Fire Department.

Buildings and facilities within the project will be designed with adequate attention to the principles of fire safety, and will also be built to follow necessary County fire protection standards. Safety precaution measures, such as the installation of sprinkler systems and smoke detectors in buildings, will also be undertaken where required by the building code.

4.17.4 Health Care Services

A. Existing Conditions

Emergency ambulance service is provided by the State Department of Health. Advanced life support ambulance units are located at the Lucy-Henriques Medical Center in Waimea, the Kailua-Kona Fire Station, the South Kohala Fire Station in Waimea, and at the Captain Cook Fire Station. The Kailua-Kona Fire Station is presently equipped for off-shore emergencies, however, the rescue boat may be moved to a tentatively planned Keauhou Fire Station.

The Kona Hospital, operated by the State Department of Health and the nearest to the project site, has 61 licensed beds, 44 of which are for acute care. The hospital also houses a basic life support ambulance unit. Currently Kona Hospital is undergoing Phase 1 of renovations, which include a new wing for operating rooms and surgery, a new coronary intensive care unit, and physical and occupational therapy facilities. Phase 2 includes a new wing for administration and laboratory work, renovation of the existing services, and an increase in floor space for support services.

In the long range scheme, the hospital system for the northern and western portions of Hawai'i island is being planned for major changes. The North Hawai'i Community Hospital (NHCH) is a 50-bed facility to be located in Waimea adjacent to the Lucy Henriques Medical Center. It is scheduled to begin operations in 1994, and will replace the 27 licensed beds located in Honoka'a. The West Hawai'i Regional Health Center (WHRHC) will be near the project site in the Keahole area of North Kona. It would contain 120 beds, of which 90 would be for acute care and 30 would be swing beds. The WHRHC would eventually replace the acute care services at Kona Hospital; the latter would continue to provide emergency services and its acute care beds would be converted to long-term care and specialty care beds.

B. Anticipated Impacts

The project will place a small additional demand on emergency health care services due to the added population. The proposed project could also add to the number of patients treated at Kona Hospital due to the expanded population that will be located in the service area. The schedule for development of this residential project fits with the timing of the planned hospital expansion and construction projects.

C. Mitigative Measures

Tax revenues generated by the project should more than cover the cost of additional emergency health care and hospital services attributable to the development (Zapotocky, June 1991).

4.17.5 Schools

A. Existing Conditions

The North Kona District is serviced by three public schools and two private schools. The major public high school for the region, Konawaena, is located in Captain Cook, south of Kailua-Kona. Manini'owali would be serviced by Kealakehe Elementary (K-5), Kealakehe Intermediate (6-8), and Konawaena High School (9-12). These school are all operating beyond capacity. New schools are being proposed for West Hawai'i.

Two new schools are being planned for the area. A new Konawaena Elementary School on a ten-acre site one-half mile south of the existing Konawaena intersection. The school is planned to open in 1993. Land aquistion problems may delay or alter these plans. A new high school is being planned on a 45-acre site in the Kealakehe Planned Community with operations to begin by the 1995-1996 school year.

B. Anticipated Impacts

The number of school children associated with the project is expected to be low due to the second-home and retirement home emphasis of the project, and the relatively high anticipated age of permanent residents. The State Department of Education (DOE) has made its own assessment of potential school age children generated by the project. Based upon an an assumption of an average of 1,000 single and multi-family residential units to be built on the project site, DOE estimates that 135 students would be added to local schools. This is a reduction from the DOE's earlier estimate of 220 students. The project will likely generate much fewer students due to the large number of retirement-age and second-home buyers.

C. Mitigative Measures

A portion of projected State tax revenues generated by this project will be allocated to education, which should defray additional operational expenses (Zapotocky, October 1991). The actual number of residential units built and the number of school children attending school will be determined at a later stage in project planning. NKDG intends to discuss with DOE its fair share contribution.

4.17.6 Recreational Facilities

A. <u>Existing Conditions</u>

Recreational facilities in North Kona include a golf course, beaches, small boat harbors, historic sites, hunting areas and other amenities and attractions. The district has three County beach parks (Kahalu'u, Pahoehoe, and White Sands), the Old Kona Airport State Park, and the Hulihe'e Palace State Monument. Throughout the district are numerous historic sites, including fishponds, trails, *heiau* and historic buildings. The U. S. Army Corps of Engineers has established wetlands at Honokahau and Kiholo Bay. Several hiking trails are also available in the North Kona District. Bikeways are proposed throughout most of the district. The Na Ala Hele Advisory Committee's Ala Kahakai trail from Kawaihae to Keahole Point is planned to extend through the State-owned coastal portion of Manini'owali.

B. <u>Anticipated Impacts</u>

Development of the Manini'owali Residential Community will create new recreational and park facilities on-site for its residents and visitors. These facilities include an 18-hole golf course, golf driving range, tennis center, small swimming pool and a park. In addition, historic trails on the property will be accessible by the public. These trails will connect the coastal trail along a *mauka-makai* route to the cinder cone *pu'u* preservation area. Jogging paths and bike lanes are also being considered as part of the concept plan.

The proposed golf course will help reduce the existing shortage of golf facilities, as substantiated in the Market Assessment for the project. The recreational facilities of the golf course, the tennis center, and the clubhouse complex will be open to the public at special *kama'aina* rates. Thus, the Manini'owali Residential Community will positively impact recreational opportunities for the area's population.

Also, area ocean and beach recreation enthusiasts will benefit from the development of the new shoreline park at Kua Bay, for which NKDG will make significant contributions, or develop itself if the project proceeds as planned. Separate planning studies will be the responsibility of the DLNR State Parks Division. NKDG has initiated a planning process in coordination with the Division of State Parks by sponsoring an Coastline/Nearshore Recreation Workshop in Kona. An improved, access road, bathroom facilities and parking area are planned to be developed. Manini'owali Beach (located at the head of Kua Bay) is one of the few significant white sand beaches in West Hawai'i. Manini'owali Beach attracts or allows for boating, bodysurfing and bodyboarding, camping, fishing, hiking, kayaking and canoeing, skimboarding, snorkling and scuba diving, swimming, and sunbathing. Beach park development will generally have positive impacts. Restroom facilities and a litter disposal system will eliminate the present sanitation and litter problems. It is anticipated that paved pedestrian paths, roads, and parking lots will minimize the current destruction of natural terrain by four-wheel drive vehicles driving off the access road. Opening up the beach to more people may also present some new problems: The increase in numbers of swimmers, bodysurfers, and bodyboarders, many of whom will be tourists unfamiliar with the ocean, may endanger themselves during medium and high surf conditions. Increasing ocean user densities will lead to conflicts between users. Increased boating also has the potential of damaging coral reefs at Puialoa and Paiha Points.

Based upon the size of the beach and park guideline standards, Manini'owali Beach should be able to accommodate 400 or more sunbathers (the low-density carrying capacity guideline). This is consistent with usage patterns at White Sands Beach Park on Ali'i Drive in Kailua-Kona.

Existing recreational facilities in the area may also be affected by the development of residences at the project. Approximately 2,230 full-time residents will live at the project at full occupancy. Besides using the new facilities for recreation at the project, these residents will utilize public beaches and parks in the area. The project will have no direct vehicle access to the park. The addition of these people is not expected to create a burden on these beach park facilities. The primary recreational interest of the residents is likely to be satisfied by the new facilities within the development. It is expected that some residents will enjoy the use of hiking trails and Kua Bay on the State-owned *makai* portion of Manini'owali.

C. Mitigative Measures

Overall, the project will have a positive effect on the availability of recreational opportunities in West Hawaii. The State's proposed Wilderness Park from Keahole to Manini'owali is planned to include campgrounds, hiking trails and swimming beaches. NKDG will participate in the development of park facilities at Kua Bay and provide an improved access roadway as described in Section 2.

4.18 CUMULATIVE IMPACTS

Cumulative impacts are those associated with existing, approved, and reasonably anticipated future projects producing related or additive impacts. For most of the environmental effects of the proposed project, a reasonable list of "cumulative" or "related" projects would include existing, approved, and proposed infrastructure or development projects in the vicinity of the proposed project, and primarily those development projects having potentially additive effects on the area's environment and infrastructure systems serving the area.

There are several projects which have some approvals, or are under construction, which could generate cumulative effects on the environment in the direct vicinity of the project site. The developments in the Kaupulehu/Kuki'o resort node are in this category, including the Kona Village Resort, Kuki'o, and Kaupulehu. Other resorts are also planned in the West Hawai'i region and may occur independent of the Manini'owali Residential Community. Below is a compilation of major existing and proposed resort, residential, and commercial/industrial developments at, or in the vicinity of, the Office of State Planning designated Resort Destination Nodes.

Mauna Kea Node:

The **Mauna Kea Beach Resort** presently has 310 existing hotel units. Its developer is proposing to build an additional 250 resort/residential units. This project has obtained State Land Use Commission (LUC) approval for development.

The **South Kohala Resort** is a new, proposed resort with 350 hotel and 450 resort/ residential units. This project has also obtained State Land Use Commission (LUC) approval for development.

Nansay Hawai'i is the developer of two projects in the South Kohala area. The **Puako Residential Golf Community** will feature six golf courses on 3,000 acres at Waikoloa. The community will contain over 2,000 market-priced single- and multi-family units, a golf academy, and a commercial center. Nansay was selected by Hawai'i County as the master developer of 1,200 affordable homes, commercial uses, a park, and schools on 165 acres in Waikoloa; however, recent economic events have caused Nansay to reconsider and backdown from this development.

Mauna Lani/Waikoloa Node:

The **Mauna Lani Bay Hotel** has 351 existing hotel units and 92 existing resort/ residential units. It is proposing to build an additional 1,000 hotel units and 1,948 resort/residential units. This project has received State LUC approval.

The **Ritz-Carlton** is a new, 650-room hotel.

The **Waikoloa Beach Resort** is an existing resort with 543 hotel rooms and 117 resort/residential units. An additional 1,197 hotel units and 2,863 resort/residential units are proposed, all of which have been approved by the State LUC.

The **Hyatt Regency Waikoloa** has 1,260 existing hotel units; it is not presently proposing any additional units.

Waikoloa Highlands is a proposed 761-acre development adjacent to and *mauka* of the existing Waikoloa Village. Rezoning for the project permits an 18-hole golf course and 400 one- and two-acre house lots.

Kaupulehu/Kona Village/Kuki'o Resort Node:

The **Kona Village Resort** has 125 existing hotel units and 25 additional units are proposed. This project has received State LUC approval.

The **Kaupulehu Resort** is a new, proposed resort with 600 resort/residential units and 900 hotel units planned. The hotel and a golf course are currently under construction. All units in this project have received State LUC approval.

The **Kuki'o Resort** is also a new, proposed resort planned by Hu'ehu'e Ranch, to accommodate 1,350 hotel units and 1,958 resort/residential units. One of its two golf courses is presently in the design stage; a 350-unit hotel has received SMA permit. All proposed units have received State LUC approval.

A **Veterans Cemetery** is being considered for Pu'u'o'o, which is mauka of the Manini'owali Residential Community project site. A two- to three- acre site is under consideration.

Keahole-Keauhou Node:

At **O'oma II**, which is south of Ke-ahole Airport, Kahala Capital Corporation wants to develop 600 hotel rooms, a shopping area, a golf course, an office/industrial park, and a "sea-space center." The project is currently seeking Urban designation from the State LUC.

Kohanaiki Resort is just south of O'oma II, near the Kaloko-Honokohau National Park. This project includes 1,250 hotel units, a golf course, 300 multi-family residential units, and 380 single-family residential units. The project's developer, Nansay Hawai'i, has received a Special Management Area (SMA) use permit, but this permit is currently being contested by community groups.

The **Kailua-Kona Resort** presently has 1,294 hotel units and 1,511 resort/residential units. It is proposing an additional 200 hotel rooms and 200 resort/residential units. This project has received State LUC approval.

The **Keauhou Resort** presently has 1,291 hotel units and 448 resort/residential units. Its developer is proposing to develop 1,285 new hotel rooms and 2,703 resort/residential units. This project has also received State LUC approval.

Kohanaiki Mauka is a proposed development on 70 acres by Kama'aina Eight Partnership. The project includes developing light industrial and commercial lots *mauka* of Queen Ka'ahumanu Highway about five miles north of Kailua-Kona.

Pu'uhonua is a proposed new community by HASEKO to be located *mauka* of the Ke-ahole Airport and south of the Kona Palisades subdivision. The project includes single-family residential lots, townhouses, a neighborhood commercial center, and a two-acre park. Sixty percent of the residential units will be affordable.

The State Housing Finance and Development Corporation (HFDC) has begun to develop the **Kealakehe Planned Community.** This community is planned as a support community to primarily house employees of the resort destination nodes. Fourteen villages in the community will contain a total of 4,158 residential units. Sixty percent of these units will be affordable. This project also includes a public golf course, three parks, two natural preserves, an elementary school, and a high school, as well as sites for churches and day care centers, and commercial areas.

The Queen Liliuokalani Trust proposes to develop a business district *makai* of the Queen Ka'ahumanu Highway and just north of Kailua-Kona. Plans for **Keahuolu** include a proposed hospital, hotel, government center, office buildings, light industrial space, and a 145-acre regional shopping center. The project site recently received Urban designation from the State LUC.

There is no guarantee that any or all of these projects will be built as proposed. The *West Hawai'i Regional Plan*, for instance, assumes about half as many resort residential units and about two-thirds as many hotel units will be built by the year 2005 as the numbers proposed by individual developers. The following is an analysis of potential cumulative impacts of the Manini'owali project, considering the fact that additional development will likely occur in some portions of the West Hawai'i region in the foreseeable future.

Land Use Character: Portions of the West Hawai'i coast are undergoing a gradual land use change from the open space provided by lava fields to resort or urban-related land uses. The Manini'owali Residential Community, although largely residential, golf course, and community facility oriented, would contribute to this cumulative land use transformation.

Ocean Water Quality: The proposed project, located approximately 1,000 feet from the shoreline, will not create adverse ocean water quality impacts because extensive measures will be implemented to control erosion, storm water, and chemical use on the site. Wastewater effluent will be disposed on-site through an ecologically sensitive method which will not impact ocean water quality. Other developments in the area will be required to follow standard practices for construction site erosion control, and some developers may choose to follow a similar program of strict controls on their sites. Ocean water quality will be monitored periodically for evidence of degradation. If these types of ecologically sensitive measures are followed at other projects in the area (as they are encouraged and/or required to do by various State and County government agencies) and no ocean outfall is created to serve the region, ocean water quality should remain at current quality levels.

Potable Water: Manini'owali will create a small additional demand for potable water which is within the sustainable capacity of the Hualalai Aquifer System. NKDG will develop it's required potable and non-potable water supplies by desalting brackish water from off-site wells with the approval of the State Commission on Water Resources. Other future projects proposed for West Hawai'i will also require potable water. Additional source development will be necessary to draw water for future projects.

Traffic: The Manini'owali Residential Community will add to the area traffic, but this addition will represent only a small portion of the 2006 traffic volumes. Future development and population growth in the area of Manini'owali is expected to increase traffic volumes by 1.81 times on Queen Ka'ahumanu Highway, according to the *Island of Hawai'i Long Range Highway Plan*. Roadway improvements are being addressed by the State DOT, and a widened Queen Ka'ahumanu Highway has a high priority in the State's and County's transportation improvement program. Queen Ka'ahumanu

Highway is slated to be widened from two lanes to four, and constructed as a limited access roadway with frontage roads providing access to resorts from interchanges located near development nodes. DOT is currently studying the possible locations for interchanges serving the region.

Air Quality: Manini'owali will unavoidably contribute to the increase in air pollutant concentrations in the area due to increased motor vehicle traffic. Analysis of air quality was based upon the cumulative traffic impact of regional growth, and it concluded that predicted concentrations will remain within the State and National Ambient Air Quality Standards. Additional future growth will introduce additional air pollutants to the region. Air quality of West Hawai'i will not be noticeably reduced by the additional growth if roadway infrastructure is provided for individual projects, and eventually Queen Ka'ahumanu Highway is upgraded. More significant, but less predictable, are the impacts of Kilauea Volcano in the generation of "vog" which accumulates in the North Kona Region.

Noise: No adverse noise impacts will be created, except during the short-term construction phase. Although the Manini'owali traffic contribution will cause less than a 1 dBA increase in noise level and will be negligible, added traffic in the area created by overall future growth could cause up to a 4 dBA increase in traffic noise along Queen Ka'ahumanu Highway. Residences located closer to the highway will experience greater traffic noise, exceeding the 65 dBA HUD residential guidelines during peak traffic periods. A 150-feet setback from the Highway is proposed for this project, which will minimize noise at the project boundary. Residences will not be built close enough to the Queen Ka'ahumanu Highway or the Project Access Road so that noise levels will exceed HUD standards. Few, if any, existing residences will be located close enough to Queen Ka'ahumanu Highway to be adversely affected by the highway noise level.

Socio-economic characteristics: The project will contribute to cumulative population, housing, employment, and economic growth in the West Hawai'i area. The County is anticipating an increased demand for labor to serve the resort developments, only part of which can be met by the existing labor supply. In-migration is expected to close this gap. Accompanying the need for additional labor is a demand for affordable housing for employees of the resorts to be developed. Too rapid growth may create problems with County services and infrastructure keeping pace with growth. The *West Hawai'i Regional Plan* addresses these growth issues. The relationship of this proposed project to the regional plan is discussed in greater detail in Section 6.6.

Visual Resources: The visual character of the NKDG property will change due to the residential and golf course development. The change will be consistent with, and similar, to neighboring proposed developments at Kuki'o and Kaupulehu. Barren lava fields will be replaced by golf course turf and landscaping, in addition to the residential structures. A visual impact analysis has shown that the views from the expected high use areas at Kua Bay will be minimally impacted by the proposed new structures on the *mauka* land.

If future projects develop lands along Queen Ka'ahumanu Highway, this could cause additional visual impacts to the area. The County's SMA process will regulate impacts to coastal views.

Archaeology: Some areas, such as the adjacent State land at Awake'e, the coastal area *makai* portion of Manini'owali, as well as approximately 10 percent of the project site, will all be preserved in their natural state. Preservation areas include a volcanic cinder cone, historic trail, and burials. The neighboring developments may be required by the State to keep portions of their properties containing significant burials and archaeological artifacts to be preserved in their natural state.

4.19 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

The Manini'owali Residential Community will create limited adverse environmental impacts which cannot be fully mitigated by the measures planned to be implemented at the site. The following list includes those short-term and long-term impacts that are expected to be unavoidable, including those that are minor in significance.

4.19.1 Unavoidable Adverse Short-Term Impacts

1. Negligible temporary increases in soil erosion will result from construction operations; and negligible amounts of soil will be carried off-site in surface runoff water.

2. Natural vegetation will be removed from approximately 315 to 325 acres on the project site to allow for construction of project features and infrastructure. Re-vegetation will include native species of plants suitable for the location.

3. Wildlife utilizing the site and immediate adjacent areas will be displaced by construction activities into nearby undeveloped lands. Construction operations will temporarily discourage wildlife from feeding at or migrating through the site.

4. Operation of construction equipment, trucks, and worker vehicles may temporarily impede traffic in the area during the construction period.

6. Negligible releases of air contaminants will occur from construction equipment. Small amounts of dust may be generated during dry periods as a result of construction operations.

7. The visual character of the area will be affected by construction activities and by the presence and operation of construction equipment.

8. Minor increases in noise levels may result from construction activities.

4.19.2 Unavoidable Adverse Long-Term Impacts

1. Soils will be disturbed by grading, excavation, and mounding activities at the site during construction. Since soil cover on the site is very sparse, soil will be imported to cover cleared and graded land for planting landscaping materials, except for areas left in natural vegetation.

2. Modifications to the current topography will be made at the site to accommodate project development.

3. Approximately 0.9 mgd of non-potable groundwater will be utilized for irrigation of the golf course and landscaped common areas. Of this total, approximately 0.29 mgd will come from treated wastewater effluent and approximately 0.43 mgd of desalinization by-product water. An average of 0.43 mgd of potable water, desalinated from brackish water, will be used for domestic purposes.

4. Small contributions of nitrogen compounds will enter groundwater from treated wastewater effluent irrigation and fertilizer application, and very small contributions of pesticides will enter groundwater from pesticide application on the golf course.

5. It is possible that as many as 22 archaeological sites on the project site will be altered by construction, yet be data-recovered as per DLNR-HPD and County recommendations.

6. Vehicles associated with the community using Queen Ka'ahumanu Highway and other local roadways will have a minor effect on traffic flow.

7. Some additional noise will be generated by the project which will cause a slight increase in noise levels along Queen Ka'ahumanu Highway.

8. Air quality at area roadways will receive a minor addition of traffic-related emissions.

9. Views of the project site will be changed to include portions of some structures, portions of fairways and the entrance road.

10. There will be up to an additional 6 to 7 tons per day of refuse generated by the project which must be accommodated by public solid waste management facilities.

11. Minor demand on public services and utilities will result from the development, including police and fire protection and electrical needs.

4.20 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The construction and operation of the proposed residential community and golf course will involve the irretrievable commitment of certain natural and fiscal resources. The most major resource commitment will be the land required for development of the project. Money, construction materials, manpower, and energy will all be expended to complete construction. The impact of utilizing these resources should, however, be weighed against the economic, social, and recreational benefits to the residents of the region, County, and State.

Approximately 173 acres of the 388 acres at the site will be used for the the golf course, and landscaped and natural buffer areas surrounding the golf course. Approximately 134 acres will be residential development. Seventeen acres will be used for community facilities such as a driving range, clubhouse, park, tennis center, wastewater treatment facility, etc. Road right-of-ways and the development's entrance area will comprise about 23 acres. The remaining area will remain as preservation area and open space.

There will be a permanent commitment of private funds and resources to plan, design, construct, and operate the golf course and related facilities. This will result in a permanent increase of about 95 jobs and other employment-related benefits and resources. It is expected that increased tax revenues will be generated, along with increased economic activity and appreciated value of the community.

Beyond the on-site improvements constructed and operated by the developer, there will be an increased usage of public facilities such as the Queen Ka'ahumanu Highway for project-related traffic, an increased demand on the Hualalai Aquifer System for potable and non-potable water, and a greater load on the County solid waste facilities.

The commitment of resources required to accomplish the project includes labor and materials, which are mostly non-renewable and irretrievable. The operation of the project will also include the consumption of petroleum-generated electricity which also represents an irretrievable commitment of resources.

SECTION 5 – Alternatives

5.0 ALTERNATIVES

Three alternatives for the project have been considered which would utilize the land for several different purposes. A no-action alternative was considered, which would leave the project site under the existing conditions. A second alternative of higher density residential subdivision without the golf course is also considered. A third alternative considered would include a 36-hole golf course development. The three alternative concepts are evaluated in this section for each of the environmental factors addressed in Section 4. A comparison of each alternative with the proposed project is also included.

5.1 NO ACTION ALTERNATIVE

The no-action alternative would involve no changes to the project area for the foreseeable future. The current public access condition would remain the same, limiting access to those who hike or have four-wheel drive vehicles. The owner would continue to pay property taxes ($33,500 per year in 1991). This land would remain open and would likely be sold by the current owner. Another potential developer would be the likely buyer, who would probably attempt to obtain land use changes which would enable a higher use of the land.

Anticipated Impacts

There would be few adverse environmental impacts generated by the no-action alternative. The site's topography, soils, drainage, groundwater, vegetation, and wildlife would not change. Other factors that would not be affected under the no-action alternative would include traffic, noise, air quality, population, employment, government expenditures, infrastructure, and public services.

The lack of a development on the project site would prevent the creation of additional employment, personal income, and recreational opportunities for residents of the Big Island. The no-action alternative would force the owner to continue paying property taxes without gaining an offsetting income from the site. It is possible that the State or County could arrange to purchase this land for conservation purposes, however, there are no known plans for this to occur.

The construction of an access roadway to the shoreline State park is conditioned on development of the proposed Manini'owali Residential Community. Hence, the no action alternative means that the existing rugged dirt road which runs adjacent to the property and leads to Maniniowali Beach would continue to be utilized by hikers and those with 4-wheel drive vehicles. Residents desiring access but without the appropriate vehicles would continue to rely on hiking almost a mile from Queen Ka'ahumanu Highway to utilize Kua Bay as a recreational resource area. In addition, it is likely that the archaeological resources found on the site would continue to be degraded and vandalized. No State or County benefits would result under this proposal.

As compared to the proposed project, the no-action alternative would create less potential environmental effects. However, expected social and economic benefits, as well as substantial recreational and resource preservation benefits, would not be generated by the no-action alternative.

5.2 RESIDENTIAL SUBDIVISION ALTERNATIVE

A residential subdivision including approximately 2,000 residential units could be proposed for this site at an average density of approximately eight units per acre. In this scenario, the mix of permanent home and second home residents would probably change. Preservation zones would be retained as required by the land exchange conditions, including the cinder cone *pu'u* and burials.

Anticipated Impacts

Topographic modifications would be required over most of the site to develop a 2,000 unit residential subdivision and its support infrastructure. About six inches of soil would be imported to support growth of landscape materials. As required by the land exchange conditions, burials would be preserved.

The 2,000 residential units in this alternative would generate up to 720,000 gpd of wastewater, depending on household size and the permanent/second home resident mix. This volume of wastewater would be more than twice that expected for the proposed project. The wastewater treatment and disposal system to be used for this alternative could be designed to dispose of treated effluent through either an ocean discharge, disposal wells, leaching fields, or transmitted to a neighboring development for use in golf course irrigation.

Some fertilizers and pesticides would be applied by individual residents to maintain their landscaped yards, but at an indefinite and uncontrolled rate. Fertilizer and pesticides could be carried away from the site of application, and runoff would be channeled to drainage basins and drywells on-site. Some unknown amount of fertilizers and pesticides would leach into groundwater, and could potentially reach the ocean at low concentrations. It is not likely that the residential alternative project would cause an adverse effect on the nearshore ocean water quality.

The average daily demand for potable water use by this development would be 0.86 mgd. The average daily demand for non-potable, brackish water use would be approximately 1.58 mgd. Irrigation water would be applied to landscaped areas at a rate of approximately 0.72 mgd. This amount of water is approximately 1.5 times the amount required to support the proposed project.

Traffic generated by the residential subdivision is expected to include about twice the volume of cars, as compared to the proposed project. The project intersection with Queen Ka'ahumanu Highway would still operate at under-capacity under signalized conditions during the AM peak hour, and near-capacity during the PM peak hour.

Queen Ka'ahumanu Highway south of the Project Access Road would operate at LOS "E" during the AM peak hour, and it would operate at LOS "F" during the PM peak hour traffic.

Noise effects of this alternative would involve construction and operational effects from traffic and maintenance activities. The construction noise impact of this alternative project would be comparable to the proposed project in terms of equipment operations for clearing, grubbing, grading, and building. The Queen Ka'ahumanu Highway traffic noise increase generated by the alternative would be slightly higher than that generated by the proposed project.

Air quality effects of the residential subdivision would involve short-term construction and long-term operational activities. The construction air quality impact of this alternative project would be comparable to the proposed project in terms of equipment operations for clearing, grubbing, grading, and building. Because peak hour traffic volumes are forecast to increase with the roadway operating at or near capacity, long-term air pollution concentrations could be somewhat higher than with the proposed project. State and Federal ambient air quality standards would likely be met.

Some views of residential buildings from Queen Ka'ahumanu Highway would be expected under this alternative, as with the proposed project. Maintenance of clear viewplanes from the mountains to the ocean would be difficult, if not impossible, with *a development of this size and density. Since no golf course open space would be* included, as with the proposed project, the project would probably appear as an urban center, rather than an open space character community. Because the value of the homes without the golf course amenity would probably be much less in this alternative than that with the proposed concept, less attention would be given to overall project design quality, building and landscaping materials, and may be noticable from off-site.

Full-time residential population of the alternative development would be approximately 6,000 persons, or more than twice that anticipated for the proposed project. Few long-term employment opportunities would be created by this development beyond the construction phase. Jobs created would be primarily for grounds maintenance and security. There would be approximately 500 direct, short-term construction jobs available during a 12-year development period. An additional 350 indirect jobs would be created, based upon the 1.4 multiplier used in the State's Input-Output model for construction.

Public services that would be required by the alternative development would include schools, police and fire protection, health care, and recreational facilities. Because there are more homes and more full-time residents, the alternative plan would generate more school children and demand upon other public facilities and services than would the proposed project.

Without the attraction of a golf course, home values would be substantially less than the proposed project. Annual property taxes would likely be comparable to the proposed project due to the increased number of units. Government expenditures for this development would probably be at least twice as great compared to the proposed project, because of the larger number of permanent resident households that will need to be provided with public services.

In summary, the residential subdivision could create greater adverse impacts than the proposed project. The housing provided would be more affordable for present County residents than the proposed project. It would not include a golf course yet it would create nearly twice as much traffic and other comparable effects. Large open spaces, provided by the golf course in the proposed project, would not be included under this alternative, and the impact on views from the Queen Ka'ahumanu Highway would increase. Greater traffic, wastewater, demand on potable water supply, and public services impacts would result as compared to the proposed project.

5.3 36-HOLE GOLF COURSE ALTERNATIVE

Development of a 36-hole golf course project is considered, addressing the potential for developing two 18-hole courses within the project. Because no residential component would be included, this alternative would be viewed as a "stand alone" golf course project. Such courses could potentially be developed in the Conservation District, possibly eliminating the need for a reclassification of the land to the Urban District.

Anticipated Impacts

It is estimated that over 300 acres of the project site would be cleared and graded to create the golf courses, driving range, clubhouse, maintenance facility, and other golf course-related structures and infrastructure. Preservation zones would be retained as required by the land exchange conditions, including the cinder cone *pu'u* and burials. Since the cleared area of the site would be about the same as the proposed project, impacts to existing vegetation and wildlife would also be about the same.

Although less impervious surfaces would be developed in this plan, potential surface water runoff and drainage impacts would be comparable to the proposed project since the cleared and landscaped areas are similar. There would be a need for importing up to twice as much soil cover to support the additional the golf course turf area. Golf course development would require nearly twice the amount of soil importation to the site, as compared to the proposed project. The two golf courses would have fertilizers and pesticides applied with approximately twice the amount expected for the proposed project. These chemicals would likely cause some additional input to groundwater and the ocean. As with the proposed project, it is likely that no adverse effect on the nearshore ocean water quality would occur as a result of this chemical use.

As with the proposed project, this alternative would derive potable and non-potable water from the existing aquifer system from on-site wells, or a combination of on-site and off-site wells. Much less potable water and much more non-potable water would be required for this alternative. The estimated average daily demand for potable water would be roughly 60,000 gpd. The estimated average daily demand for non-potable water would be about 1.3 mgd, or slightly greater than the proposed project. The available aquifer resources would be sufficient to meet this anticipated demand.

The wastewater facilities for this alternative would be minimal since there would be no on-site residential population. The only wastewater generators would be the golf clubhouse and maintenance facility used by employees and club members. As in the proposed project, treated wastewater effluent could be used for irrigation of the golf courses and other landscaped areas.

There would be a single project entrance/access road, as with the proposed project. Traffic impacts on Queen Ka'ahumanu Highway due to the golf courses alternative would be less due to the lower daytime population. A traffic signal might not be warranted under these lower traffic conditions. Air quality impacts would also be less than the proposed project, following the reduction in traffic at the peak hours. Noise impacts would also be slight due to reduced traffic volumes. The noise impact, likewise, would be reduced considerably since there would be a much smaller daytime population.

The visual impact of the golf courses alternative would be less than that of the proposed project since there would be few structures rising above the ground. However, as in the proposed project, the ground cover itself would be augmented. Land that is now barren lava field would be covered with soil, irrigated, and planted with turf and landscaping. Long-term visual impacts will result from the golf course, entrance road and the clubhouse and maintenance facilities.

There would be little increase in resident population of West Hawai'i in this scenario, except possibly a few families who immigrate to Kona to work at this project. No affordable housing units would be contributed into the regional stock, because no residential development is included. The golf courses alternative would create roughly 100 operational jobs and approximately 140 indirect jobs. Long-term personal income resulting from operational jobs could be twice as much as that created by the proposed project. The economic viability of this alternative is questionable at present. A high percentage of foreign memberships at exorbitant prices would be required. The market for these types of memberships has reduced substantially during 1991.

This project would create substantially less government revenues through property and sales taxes than the proposed project. The construction costs would be substantially less, resulting in lower sales taxes for construction materials and services. The increased property valuation would be less than one-quarter that achieved by the proposed project. However, the cost of public services provided police and fire protection, and schooling for children, would also be very small.

In summary, the golf development alternative would comparatively create some equal and greater environmental impacts, and it would contribute less to the local economy. Market and affordable housing needs for the West Hawai'i region would not be aided by this project. The economic viability of this alternative is questionable at present. A high percentage of foreign memberships at exorbitent prices would be required. The market for these tpes of memberships has reduced substantially during 1991.

SECTION 6 – Relationship to Existing Policies and Plans for the Area

6.0 RELATIONSHIPS OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROLS FOR THE AFFECTED AREA

This section lists the land use plans and policies which are relevant to the proposed project and the affected area. These include the Hawai'i State Plan, the Hawai'i State Plan Functional Plans, the County of Hawai'i General Plan, the Hawai'i Coastal Zone Management Program, the County of Hawai'i Special Management Area rules, and community and regional plans. Policies to be addressed are selected based on their relevance to the proposed project in terms of land use, location and planning.

6.1 HAWAI'I STATE PLAN

An assessment of the conformity of the requested actions to the applicable goals, objectives, and policies of the Hawai'i State Plan, Chapter 226, Hawai'i Revised Statutes, and applicable priority guidelines will be covered under this section. Priority guidelines relating to the economy, housing, population growth, transportation, facility systems, and the physical environment (land based, shoreline, and marine resources; scenic, natural beauty, and historic resources; land, air, and water quality) will be discussed as they relate to the proposed residential community.

6.1.1 Objectives and Policies

Section 226-5 Objective and policies for population.

(b)(1) Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county.

(b)(2) Encourage an increase in economic activities and employment opportunities on the Neighbor Islands consistent with community needs and desires.

Discussion: Buyers of homes in the proposed residential community who migrate from the Mainland U.S. and foreign countries will directly increase the population of the area. Increased demand for labor caused by development of the project, and other resort development projects in the region, will indirectly contribute to local population growth as state of Hawai'i (as well as possibly some out-of-State) residents living outside of the County migrate to take advantage of increased employment opportunities. The mix of residential and golf course land uses on the subject property will contribute long-term employment opportunities, government revenue generation, additional recreational resources, an increased housing stock, and a moderate population growth in the area (Refer to Section 4.15.1). These increases in economic activity and employment opportunities are consistent with community needs and desires (Refer to Section 6.6.)

Section 226-6 Objectives and policies for the economy -- in general.

(a)(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

(a)(2) A steadily growing and diversified economic base that is not overly dependent on a few industries.

Discussion: The proposed project is expected to generate approximately 295 full-time operational jobs upon completion in the year 2006. West Hawai'i had a lower than average unemployment rate at 5.2 to 6.3 percent (U.S. Bureau of Census, 1980). The jobs expected to be generated from the construction and operation of the development should help to create new jobs in West Hawai'i (Refer to Section 4.15.2). The County of Hawai'i is preparing plans on the basis of projections that labor demand will exceed supply in the future as a result of cumulative resort development, thereby creating some in-migration to the region.

The projected average annual personal income from direct employment is estimated at $2.9 million between 1994 and 2006. The income generated from the proposed development should raise the standard of living for some West Hawai'i residents, as well as contribute to business revenues in the area (Refer to Section 4.15).

Section 226-11: Objectives and policies for the physical environment - land-based, shoreline, and marine resources:

(a)(1) Prudent use of Hawaii's land-based shoreline and marine resources.

(a)(2) Effective protection of Hawaii's unique and fragile environmental resources.

(b)(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources.

(b)(3) Take into account the physical attributes of areas when planning and designing activities.

(b)(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(b)(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.

(b)(8) Pursue compatible relationships among activities, facilities, and natural resources.

(b)(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

Discussion: The project site at Manini'owali is characteristic of other North Kona/South Kohala land situated inland from the coastline. The project has been designed with consideration of the natural features on the site and, where possible, their preservation. The *pololei* fern found on the State land adjacent to the site is a candidate endangered species that will be preserved and protected in park development planning.

One of the purposes of the development is to offer golf and other recreational activities which involve the natural environment. The compatible mixture of uses and activities will provide ample opportunity for the residents and public to enjoy and learn of the natural resources of Manini'owali.

Section 226-12: Objectives and policies for the physical environment - scenic, natural beauty, and historic resources:

(a) Enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.

(b)(1) Promote the preservation and restoration of significant natural and historic resources.

(b)(2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

(b)(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

(b)(4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage.

(b)5) Encourage the design of developments and activities that complement the natural beauty of the islands.

Discussion: The Bishop Museum, Applied Research Group has made recommendations concerning the treatment of 25 archaeological sites on the subject parcel. NKDG is working with DLNR-DPD to develop a historic preservation mitigation plan.

The natural beauty of the islands as it exists in the Manini'owali area is precisely why a residential, golf and open space oriented development is proposed. Scenic views and open space will be maintained and enhanced for the benefit of homeowners and the regional residents who will have access to the site for passive and active recreation purposes. The developed aspects of proposed residential community will take care to complement the aesthetics of the West Hawai'i region.

Section 226-13 Objectives and policies for the physical environment - land, air, and water quality.

(b)(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

(b)(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

(b)(7) Encourage urban developments in close proximity to existing services and facilities.

Discussion: The land and water resources of the project site will be properly managed. A host of mitigation measures will be designed and implemented to assure that land, air, and water are not significantly impacted by the project. Storm water runoff will be controlled through the use of detention basins and drywells. The project will not exceed the water resource capabilities of the aquifer. Fertilizer and pesticide application at the golf course will be professionally managed by a certified Golf Course Superintendent. An Integrated Pest Management (IPM) program will be instituted to employ strict management and overall reduced pesticide usage (Refer to Sections 4.5 and 4.6).

The NKDG's affiliated partner, Davidson Communities, is an award-winning developer noted for its sensitive treatment of the environment. This project is being planned to be compatible with the natural environment and other developments in the area. Landscaping will utilize non-potable water for irrigation. A xeriscape program utilizing native plants where appropriate will be incorporated in the project landscape design. The landscaping and site planning of the residential community will attempt to minimize the visual impact and be in accord with the semi-arid climate and vegetation of the area (Refer to Section 4.14). The project design will ensure that noise and air quality levels at the project will be well within government standards (Refer to Sections 4.12 and 4.13.).

The proposed project is adjacent to the urban Kaupulehu/Kona Village/Kuki'o resort node and within fifteen minutes of Kailua-Kona and five miles from the Ke-ahole Airport.

Section 226-14 Objective and policies for facility systems -- in general.

(b(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with State and County plans.

Section 226-15 Objectives and policies for facility systems -- solid and liquid wastes.

(b)(1) Encourage the adequate development of sewerage facilities that complement planned growth.

__*Section 226-16: Objective and policies for facility systems -- water.*__

(b)(1) Coordinate development of land use activities with existing and potential water supply.

(b)(3) Reclaim and encourage the productive use of runoff water and waste water discharges.

(b)(6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.

__Discussion__: A private wastewater treatment system is proposed for the project which will adequately treat the wastewater generated by the project without reliance upon existing County facilities. NKDG will employ an activated sludge secondary treatment system with chlorination which will remove up to 99 percent of the bacteria and viruses in sewage effluent. The system will generate treated wastewater effluent of a quality which will exceed State Department of Health criteria, and be diluted and re-used as irrigation water for the golf course, thereby reclaiming the water. Operational guidelines will be established for use of non-potable water for irrigation and the use of drought-tolerant landscaping (xeriscape program). The potable and non-potable water needs of the project are within the available capacities of the aquifer (Refer to Sections 2.1 and 4.5.).

__*Section 226-17 Objectives and policies for facility systems - transportation.*__

(b)(1) Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter.

__Discussion__: The proposed project will connect into the improved transportation network of the State as it develops. At the time Queen Ka'ahumanu Highway is widened the proposed Manini'owali Residential Community is planned to be connected to Queen Ka'ahumanu Highway via an interchange and frontage road system which would be developed simultaneously by the State. NKDG will participate and coordinate with the other developers of the adjacent resort node in locating and paying for a portion of the development costs of the planned highway interchange. Until that time, the developer proposes a channelized intersection (with traffic signals, if necessary) at the junction of the Queen Ka'ahumanu Highway (Refer to Section 4.16.1).

__*Section 226-18. Objectives and policies for facility systems -- energy/telecommunications.*__

(a)(1) Dependable, efficient, and economical statewide energy and telecommunication systems capable of supporting the needs of the people.

(a)(2) Increased energy self-sufficiency.

(c)(1) Support research and development as well as promote the use of renewable energy sources.

(c)(3) Promote prudent use of power and fuel supplies through conservation measures including (A) Development of cost-effective demand-side management programs: (B) education; and (C) adoption of energy-efficient practices and technologies.

Discussion: The proposed development of residential homes and a golf course will do its part to contribute towards the State's goals for energy self-sufficiency through the following measures. To conserve energy, design efforts will be made to use energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. The feasibility of solar energy use for several components of the project are also being explored.

Section 226-19. Socio-Cultural Advancement -- Housing

(a)(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals.

(a)(2) The orderly development of residential areas sensitive to community needs and other land uses.

(b)(1) Effectively accommodate the housing needs of Hawaii's people.

(b)(3) Increase home ownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.

(b)(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.

Discussion: The choice of housing for the proposed residential community considers and reflects the density of the proposed adjacent resort hotel and residential communities. The provision of 900 to 1,100 units of high quality, higher end market housing increases the County's housing supply. NKDG will also develop, or participate in development with other developers, the construction of affordable housing off-site to accommodate the market for homes for Manini'owali and other resort employees, as well as other local residents.

Although, admittedly serving an affluent clientele, some of which will be migrating from the Mainland U.S. and other foreign locations, the provision of additional housing at Manini'owali can have a positive ripple effect in the local housing market. As local home owners become "move-up" buyers at Manini'owali, their previous, lower-priced homes will be vacated and enter the market. As outside money enters the local economy, the indirect economic benefits of increased employment opportunities and income created by the development will enable more local people to become homeowners themselves, or move up in the size and quality of their homes (Refer to Section 4.15.3).

Section 226-23: Objective and policies for socio-cultural advancement - leisure.

(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

(b)()2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.

(b)(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.

(b)(5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.

Discussion: The proposed project is concerned with the fulfillment of the above objective and policies for recreation. The potential for recreation in an area of scenic, open space is maximized through the development of a golf course, driving range, clubhouse, tennis center, and other community facilities on the site. Clubhouse facilities will include a practice putting green, a swimming pool, tennis courts, and landscaped gardens. Ocean and mountain views will be part of the experience.

Use of the above facilities will be available at a *kama'aina* rate to the public. The primary users of the recreational facilities, however, will be the project residents who will be charged at a lower rate. Portions of the project site at the cinder cone (*pu'u*) will be preserved; other portions of the site, such as at golf course buffer areas along property boundaries and separating some residential areas, will be enhanced through the re-introduction of native or endemic plant species, eventually providing a valuable botanical resource.

In addition to the above facilities, NKDG is committed to providing improvements to the park access road, as well as other contributions toward development to the State park along the shoreline area *makai* of the project site.

6.1.2 State Plan Priority Guidelines

The purpose of the State Plan priority guidelines is to address areas of State-wide concern. The following discussion provides an assessment of how the proposed project conforms to the relevant priority guidelines.

Section 226-103: Economic Priority Guidelines:

(e)(2): Encourage the improvement of irrigation technology and promote the use of non-potable water for agricultural and landscaping purposes.

Discussion: The project proposes to develop a dual water system for its potable and non-potable water requirements. Brackish water wells off-site are planned to be developed, as well as a desalination plant for the production of 0.43 million gallons per day of potable water. Additionally, 0.95 mgd of non-potable water (average day demand) will be drawn from these off-site wells for irrigation of the golf course and other landscaping purposes. Refer to Sections 2.1 and 4.5 and Appendix B. Approximately 30 percent of irrigation water will be recycled treated wastewater, and 45 percent of irrigation water will be desalinization plant by-product water.

Section 226-104 Population growth and land resources priority guidelines

(a)(1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.

(a)(2) Manage a growth rate for Hawaii's economy that will parallel future employment needs for Hawaii's people.

(a)(3) Ensure the adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.

Discussion: The proposed project is appropriately timed to parallel future employment needs in the region. Adequate support services and facilities already exist or can be reasonably provided.

Section 226-104. Population growth and land resources priority guidelines.

(b)(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

(b)(9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.

(b)(10) Identify critical environmental areas in Hawai'i to include but not be limited to, the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.

(b)(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.

Discussion: The State Plan encourages decentralizing growth from O'ahu to appropriate areas on the Neighbor Island. The proposed project, which is located on Hawai'i Island, also conforms with other location guidelines of the State Plan; adequate public facilities already exist or can be reasonably provided, the land has no agricultural value, the site is contiguous to existing urban land, the site contains no critical environmental resources, and the site is not located on the shoreline. The planned development of brackish water wells, a desalinization plant, and a dual potable and non-potable water distribution system, in addition to water conservation measures, will contribute towards the regional goals of water conservation.

Land Resource Priority Guidelines: Section 226-104

(b)(2): Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

Discussion: As previously noted, this area is marginal and non-essential for agricultural use due to poor soil types (Refer to Section 4.3). The proposed urban uses are appropriate at this site since it is contiguous to a designated resort development node.

Other Land Resource Priority Guidelines: Section 226-104

(b)(6): Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.

(b)(13): Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.

Discussion: The applicant will build necessary infrastructure, such as highway channelization and left-turn lanes, on-site roadways, potable and irrigation water supply systems, a wastewater treatment and disposal system, and drainage and erosion control systems. The scenic views of and from within the site will be maintained and protected as a natural resource and asset to the maximum extent possible within the development (Refer to Section 4.14).

Section 226-106: Affordable housing.

(1): Give higher priority to the provision of quality housing that is affordable for Hawaii's residents and less priority to development of housing intended primarily for individuals outside of Hawai'i.

Discussion: In addition to the market priced homes proposed, NKDG will also provide affordable homes at an unspecified location to augment the regional supply of lower and moderate priced homes.

6.2 STATE FUNCTIONAL PLANS

The Hawai'i State Plan Functional Plans include objectives and policies to implement the broad goals of the Hawai'i State Plan. At the time the Draft EIS was published in November 1991, the then-current plans were reviewed as well as the 1990 Draft functional plans. Since then, many of the functional plans were finalized and dated 1991. Each of the 1991 Functinal Plans has been reviewed for consistency. The relevant policies to the proposed project are discussed. Of special note is the Transportation Functional Plan which outlines new directions for the expansion and improvement of the Queen Ka'ahumanu Highway. Other significant Functional Plans include Tourism, Housing, and Conservation.

State Tourism Functional Plan

Objective II.A.: Development and maintenance of well-designed visitor facilities and related developments which are sensitive to the environment, sensitive to neighboring communities and activities, and adequately serviced by infrastructure and support services.

Policy II.A.5.: Improve the availability of affordable housing for those employed in the visitor industry.

Discussion: The proposed Manini'owali Residential Community is not a tourist destination, rather it is master planned residential community. The project will be compatible with the neighboring resort developments in the Kaupulehu/Kona Village/Kuki'o Resort Node. The proposed golf course would provide an additional recreational alternative for the neighboring resorts, while the residential units would provide housing opportunities. The affordable residential units which would be required by the State and County, will provide a number of affordable housing units into the regional stock at an off-site location.

Policy II.A.7. Improve the quality of existing parks and recreational areas, and ensure that sufficient recreational areas --including scenic byways and corridors-- are available for the future.

Action II.A.7.c.: Acquire beaches in the following areas for expansion of existing beach parks, and development of future beach parks:
Hawaii: Wailea Bay, 'Anaeho'omalu Bay to Kaupulehu, and Kua Bay.

Action II.A.7.f.: Develop plans for the State's Trail and Access System (Na Ala Hele Hawai'i).

Policy III.A.1.: Assist in preserving and maintaining recreational resources.

Discussion: As a condition of the land exchange with the State, as described in Section 1.3, the landowner of the project site, NKDG, is required to contribute towards the development of the State park at Kua Bay in conjunction with the Division of State Parks. The DLNR's coastal demonstration trail (Ala Kahakai) of the Na Ala Hele program includes segments of ancient trails which will be linked to a trail segment leading to the small *pu'u* on the project site. Interpretation will be provided at an appropriate location to be determined with the State Division of State Parks.

State Housing Functional Plan

Policy A(2: Encourage increased private sector participation in the development of affordable for-sale housing units.

A(2)(c): IMPLEMENTING ACTION. Encourage the use of opportunities and incentives in the State Land Use redistricting process to provide lands or homes for affordable or assisted housing development.

Policy A(3: Ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable home ownership opportunities.

Discussion: The project will provide 900 to 1,100 single family detached and condominium type housing units. NKDG proposes to build market housing at this site. Affordable homes priced to accommodate employees of the project and the adjacent resorts will be developed at an off-site location in the area in numbers and at locations yet to be determined. NKDG may participate in joint development of affordable housing with neighboring resort developers, or the County or State governments.

State Transportation Functional Plan

Policy I.A.2: Improve regional mobility in areas of the Stae experiencing rapid urban growth and road congestion.

Implementing Action I.A.2.a: Plan, design, and construct the road infrastructure for West Hawai'i including improving Queen Ka'ahumanu Highway and developing a supporting local road network.

Policy II.A.2. Support tourism and economic development.

Implementing Action II.A.2.a.: Support the development of West Hawai'i by developing the transportation facilities and infrastructure in the area.
- *Queen Ka'ahumanu Highway widening and improvements*

Policy III.A.2.: Pursue private sector participation in the financing of transportation systems, developments and projects.

Discussion: At the time of the this writing, the State Department of Transportation and the County Department of Public Works have not determined the location of the proposed grade separated interchange, nor the precise timing of the proposed widening of Queen Ka'ahumanu Highway. Until the time the highway improvements plans are completed, NKDG is proposing an interim single channelized intersection at Queen Ka'ahumanu Highway at its project access. NKDG will provide the funds for the improvements it is proposing.

State Energy Functional Plan

Policy A(1): Promote and stimulate greater energy efficiency and conservation in non-transportation sectors.

Action A(1)(d): Provide technical assistance for energy conservation/efficiency projects for residential and commercial projects.

Policy B(1): Displace oil and fossil fuels consumption through the application of appropriate alternate and renewable energy resources and technologies.

Policy C(1): Support energy-related educational programs and activities which focus upon professionals in the energ y field, schools and general public.

Discussion: The proposed development of residential homes and a golf course will do its part to contribute towards the State's goals for energy self-sufficiency through the following measures. To conserve energy, design efforts will be made to use energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. The feasibility of solar energy use for several components of the project is also being explored.

State Conservation Lands Functional Plan

Policy IIC(2): Expand and enhance outdoor recreation opportunities and other resource uses.

Implementing Action IIC(2)a: Upgrade and enhance the State's outdoor recreational infrastructure of roads, trails, and shelters.

Implementing Action IIC(2)e: Provide and improve public access tot he shoreline and to mauka areas as condition on leases, executive orders, easements, and other encumbrances on lands with recreation[al] and/or educational potential.

Policy IID(1): Develop and expand resources to protect natural shorelines and wilderness recreation areas.

Policy IID(3): Develop recreational and archaeological resources on the shoreline and mauka areas.

Implementing ActionIID(3)a: Acquire and/or develop areas for historic preservation.

Implementing ActionIID(3)b: Establish a State-wide trails and access system.

Discussion: When the State Board of Land and Natural Resources (BLNR) exchanged the Manini'owali property for the Awake'e property in the land exchange described in Section 1.3, it consolidated its ownership of coastal lands in this area, and furthered its goal of developing a shoreline wilderness park along the North Kona coast, from Keahole Point to Kua Bay. An ancient shoreline trail is also included within this shoreline park area owned by the State. NKDG is committed to providing improvements to the access road to the shoreline park according to the conditions attached to the land exchange.

NKDG also was required to preserve the cinder cone (*pu'u*) located within the Manini'owali parcel. Since the finalization of the land exchange, the developer's archaeological consultant has discovered burials, trails, habitation remnants, and other ancient Hawaiian artifacts in the area of the cinder cone. NKDG concurs with the archaeologists' recommendation that this portion of the site comprising of approximately 10 acres should be preserved.

State Recreation Functional Plan

Policy I-A(1): Acquire additional beach parkland and rights-of-way to remaining undeveloped shorelines to provide increased capacity for future public recreational use.

Implementing Action I-A(1)a: Acquire beaches in the following areas:*
Hawai'i: Wailea Bay, 'Anaeho'omalu to Kaupulehu, and Kua Bay.

Comments: ...Kua Bay (Manini'owali) in North Kona is another potential site. Targeted for beach park use for 20 years, it has a beautiful white sand beach - a valued resource on the Big Island.

Policy II-A(3): Proceed with planning, acquisition, and development of trails.

Discussion: As stated above NKDG, in addition to developing the proposed residential community at Manini'owali will participate in the development of facilities at Kua Bay in conjunction with the State Parks Division.

Objective II-B: Meet special recreation needs of the elderly, the disabled, women, single-parent families, immigrants, and other groups.

Policy II-B(1): Involve the public in the planning, development and operation of recreational facilities and programs.

Implementing Action II-B(1)a: Establish linkages with existing community groups and form committees to advise on recreation matters.

Discussion: To assist the State DLNR in its planning for the beach park at Manini'owali, NKDG sponsored a Coastline/Nearshore Recreation Workshop. Included among the speakers was the Administrator of the Division of State Parks. People active in ocean recreation were invited to a one day workshop held in Kona on November 23, 1991. Thirty-seven participants representing Kona and South Kohala community groups, including citizens with physical disabilities, environmental organizations, recreation professionals and government agencies shared ideas and information regarding planning considerations for the shoreline from Kikaua Point to Mahai'ula, with an emphasis on Manini'owali Beach at Kua Bay. A follow-up workshop is planned by NKDG for 1992. The workshop findings will be summarized in a report which will be submitted to the DLNR.

Implementing Action II-C(1)f: Provide opportunities for golf at reasonable cost by planning new municipal courses and by assuring that privately developed courses have provision for play by residents at "kama'aina rates."

Discussion: The proposed golf course will be available for public play at special "kama'aina rates" which will be worked out at a later stage in the permit approval process.

Objective III-A: Prevent the loss of access to shoreline and upland recreation areas due to new development.

Policy III-A(1): Require land use permit applicants to fully address the impact of their projects on trails and public access.

Discussion: A condition of the land exchange, conveyance deed requires NKDG to provide continual public access through its property to the Kua Bay area. However, a condition states that at the time when all approvals for the requested permitted uses are received, NKDG must construct a public roadway from the Queen Ka'ahumanu Highway to Kua Bay at an agreed upon route with the BLNR. This roadway will be subject to a separate DLNR study. Further, if the State precedes NKDG in constructing the roadway, NKDG will reimburse the State in an amount not to exceed the maximum sum of $2.5 million. Public access to the shoreline is legally assured, in perpetuity, and NKDG will particpate in improving access conditions.

Objective III-B: Resolve the problem of landowner liability that seriously hampers public access ofver private lands.

Discussion: The Conceptual Master Plan indicates that a trail links the State Park land with the small *pu'u* on its property. This trail will be open for public use during specified times to be determined later in the approval process. Landowner liability is a concern regarding this aspect.

Objective IV-B: Prevent degradation of the marine environment.

Policy IV-B(1): Enhance water quality to provide high-quality ocean recreation opportunities.

Implementing Action IV-B(1)a: Regularly monitor the water quality at key ocean recreation sites.

__Discussion__: As noted in Section 4.5 and 4.6, NKDG will conduct periodic groundwater and marine monitoring and testing of the andrialine pond (near Kua Bay on parkland) and nearshore ocean water.

__State Historic Preservation Functional Plan__

Almost all of the policies and implementing actions in the State Historic Preservation Functional Plan are directed at State agencies, especially the Department of Land and Natural Resources (DLNR). An archaeological inventory survey of the project site has been completed. The Historic Preservation Division (HPD) has approved the significance evaluations and the general mitigation plans. Additional work will provide specific data recovery and preservation plans for the review and approval of the HPD. (Refer to Section 4.10) The project Master Plan includes preservation areas for important natural features and significant archaeological sites.

__State Health Functional Plan__

The State Health Functional Plan focuses primarily on public health programs under the jurisdiction of the State Health Department. Several of the implementing actions relate to operating Department of Health permit programs to which the proposed project is subject. These include reviewing private wastewater treatment systems, discharges to the air or groundwater, new sources of drinking water, and air conditioning/mechanical ventilation systems for buildings that are used by the public. The proposed project will comply with all necessary permit requirements of the Department of Health and take measures to prevent degradation to water quality.

__State Water Resources Development Functional Plan__

This functional plan primarily affects State operations. The proposed water supply for this project is discussed in Sections 2.9 and 2.10.

__State Agriculture Functional Plan__

The entire project site is not considered suitable for cultivation, and therefore not designated as important land on the ALISH maps. Consequently, the implementing actions of the State Agricultural Plan do not pertain to the proposed project.

The remaining functional plans -- State Educational Functional Plan, State Higher Educational Functional Plan, State Employment Functional Plan, State Human Services Functional Plan -- are directed at governmental agencies and are not directly relevant to the proposed project.

6.3 COUNTY OF HAWAI'I GENERAL PLAN

The County General Plan LUPAG map currently designates the project site as Conservation and Open Area. The proposed General Plan amendment requests a change in designation from Conservation to Urban Expansion. The following discussion provides an assessment of how the proposed project conforms to and implements the pertinent objectives and policies of the General Plan.

Economic Development

The County of Hawai'i shall encourage the development of a visitor industry which is consistent with the social, physical, and economic goals of the residents of the County.

The County of Hawai'i shall encourage the continuing development of the retirement industry.

Discussion: The proposed development will be marketed to, and is expected principally to be composed of older families. The projected buyer markets include Hawai'i and western U.S. residents seeking a primary home in West Hawai'i, other U.S. residents seeking a retirement home, and other U.S. and foreign residents seeking a second home.

Environmental Quality

The County shall encourage the State to establish air and water quality monitoring stations in areas of existing and potential growth.

Discussion: Projected traffic volumes are not expected to generate air quality impacts which will exceed State or National EPA standards for carbon monoxide concentration. Carbon monoxide is the only one of the regulated air pollutants likely to be sufficiently concentrated to pose a potential health hazard to residents of the area. NKDG will establish stations for periodic monitoring of the groundwater, anchialine pond and nearshore ocean *makai* of the project site.

Flood Control and Drainage

It is the responsibility of both the government and the private sector to maintain and improve existing drainage systems and to construct new drainage facilities.

Discussion: The developer, NKDG, will be responsible for constructing all drainage improvements on-site, as well as for the access roadway connecting to Queen Ka'ahumanu Highway. There will be no effect on off-site drainage conditions as a result of this project.

Historic Sites

The County of Hawai'i shall require both public and private developers of land to provide a historical survey prior to the clearing or development of land when there are indications that the land under consideration has historical significance.

Discussion: An archaeological reconnaissance survey has been conducted by a team from Bishop Museum, and its findings and recommendations have been submitted to the State Department of Land and Natural Resources (DLNR) Historic Preservation Division for review and approval. A historic preservation mitigation plan will be formulated prior to construction, per DLNR Administrative Rules (Refer to Section 4.10).

Natural Beauty

The County shall consider structural setback from major thoroughfares and highways and shall establish development and design guidelines to protect important view planes.

Discussion: A setback area of 150 feet from Queen Ka'ahumanu Highway is proposed to remain as Open Area. Landscaping along the *makai* portion of the setback is anticipated.

Natural Resources and Shoreline

The County shall encourage the public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.

Encourage the use of native plants for screening and landscaping.

Discussion: The project's master plan and specific design plans attempt to minimize adverse environmental effects and depletion of resources caused by development through a variety of means. Measures to be implemented include: large natural buffer areas, preserve zones, dual water system, IPM program, extensive landscaping with native plants and xeriscaping.

Housing

GOAL: Attain a diversity of socio-economic housing mix throughout the different parts of the County.

GOAL: Maintain a housing supply which allows a variety of choice.

The County shall encourage a volume of construction and rehabilitation of housing sufficient to meet growth needs and correct existing deficiencies.

The County shall work with, encourage, and support the private sector efforts in the provision of affordable housing.

Discussion: The proposed development will provide a total of 900 to 1,100 units of single-family and multi-family residential units. Project-developed homes will be high quality market-priced units with the recreational amenities of a golf course and tennis facility. The developer, NKDG, will also develop, or participate in developing with other developers or government agencies, the construction of affordable homes, as required.

Public Utilities

Water. *A systematic program by the County, State, and private interest shall identify sources of additional water supply to ensure the development of sufficient quantities of water for future needs of high growth areas.*

Discussion: Dual potable and non-potable water systems will be developed to meet the project's water needs. NKDG proposes to develop brackish water wells and a desalinization plant to produce its potable water. The existing aquifer system has adequate capacity to serve potable and non-potable water requirements of the existing and proposed projects within the aquifer region (Refer to Sections 2.9, 2.10 and 4.5).

Sewer. *Private systems shall be installed by land developers for major resort and other developments along the shorelines and sensitive higher inland areas, except where connection to nearby treatment facilities is feasible and compatible with the County's long range plans, and in conformance with State and County requirements.*

Discussion: NKDG proposes to construct a private wastewater treatment facility on its site (Refer to Sections 2.1.8 and 4.16.3).

Recreation

Public access to the shoreline shall be provided in accordance with an adopted program of the County of Hawai'i.

Discussion: The exchange deed specifies that should the project site be developed for any of the permitted uses, the landowner shall construct a public roadway from Queen Ka'ahumanu Highway to the Kua Bay area and public park facilities. This is subject to the landowner obtaining all applicable State and County approvals and permits. The roadway and improvements may be considered in satisfying all or part of any such requirements which may be imposed by the State Land Use Commission and/or the County of Hawai'i. In the event that the State constructs the public access roadway and the park facilities, NKDG shall reimburse the State for the full cost of the roadway and park facilities in an amount not to exceed the maximum sum of $2,500,000.

<u>*Transportation*</u>

<u>*Thoroughfares and Streets*</u>. *The County shall investigate various methods of funding road improvements, including private sector participation, to meet the growing transportation needs of the island.*

Discussion: NKDG will fund the cost of connection of its access road intersection with Queen Ka'ahumanu Highway. NKDG is interested in mitigating those traffic impacts caused directly by the proposed project.

<u>*Land Use*</u>

Zone urban- and rural-types of uses in areas with ease of access to community services and employment centers and with adequate public utilities and facilities.

Allocate appropriate requested zoning in accordance with existing or projected needs of neighborhood, community, region, and County.

The County shall encourage the development and maintenance of communities meeting the needs of its residents in balance with the physical and social environment. [Proposed updated policy].

<u>*Single Family Residential*</u>. *The County shall encourage more innovative uses of land with respect to geologic and topographic conditions through the use of residential cluster and planned unit developments. The clustering of residential units in sloping areas is a means of minimizing grading and drainage problems, preserving the natural appearance of the topography, preventing strip development, and making optimum uses of the terrain for buildings and open space.*

<u>*Multiple Residential*</u>. *Appropriately zoned lands shall be allocated as the demand for multiple residential dwellings increases. These areas shall be allocated with respect to places of employment, shopping facilities, educational, recreational and cultural facilities, and public facilities and utilities.*

<u>*Open Space.*</u> *Protect designated natural areas.*

Discussion: The project site has locational advantages which make it appropriate for designation for urban land use. The site is adjacent to the Kaupulehu/Kona Village/Kuki'o Resort Node, a prospective major resort destination area. Hence, the project conforms with the County General Plan policies of having housing and support areas in close or reasonable proximity to sources of employment. The project is accessible by major road networks, and hence readily accessible to other regional support communities/functions (e.g., Kawaihae port facilities, Waimea agricultural resources, Kailua-Kona commercial and office facilities).

Since the site is presently vacant, a well-planned community can be started from "scratch". Its size (388 acres) and approximately rectangular shape also lend themselves to a well-planned community. The site is also buffered by State lands to the south, west and east. The State lands to the west and south are planned to become a portion of a wilderness regional park. Because the project site adjoins the resort node, the opportunity for a major interchange nearby exists without making another major break into the Queen Ka'ahumanu Highway. Furthermore, because of the burgeoning resort activities on the *makai* side, this new community would not create an appearance of an isolated community with no visual or functional relationship to existing or planned resort uses. Given the land ownership pattern in this area, the potential for similar proposals would be diminished. Much of this area is controlled or owned by the State. Furthermore, the areas around Kawaihae are controlled largely by trusts, the State, or the Department of Hawaiian Home Lands. Opportunities to accommodate reasonable urban development in the area become somewhat less likely.

From a regional context, this development can help reduce the pressure for urbanizing some of the better agricultural lands in Waimea. The proposed project will not generate unnecessary public infrastructural burdens. The proposed project is projected to be a net revenue source for State and County governments. Tax revenues will greatly exceed public service and infrastructure costs (Refer to Section 4.15.4).

In planning the residential areas of the project and the golf course, consideration of the natural slopes and features in the topography have been respected. Clustering of dwelling units in most sections of the projects will preserve the open space character.

6.4 HAWAI'I COASTAL ZONE MANAGEMENT PROGRAM

The objectives of the Hawai'i Coastal Zone Management Program, Section 205A-2, HRS, are to protect valuable and vulnerable coastal resources such as coastal ecosystems, special scenic and cultural values, and recreational opportunities. The objectives of the program are also to reduce coastal hazards and to improve the review process for activities proposed within the coastal zone.

The entire project site is within the Special Management Area and will require the County of Hawai'i approval of a Special Management Area Use permit. The following are the applicable objectives of the Hawai'i Coastal Zone Management Program and an assessment of how the proposed project relates to them.

A. *Historic Resources Objective*

Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Discussion: As noted in Section 6.1.1, a comprehensive archaeological inventory survey has been done for the project site. Recommendations for data recovery, preservation, and interpretive development will be reviewed by the State Historic Preservation Office. Appropriate actions will be taken to preserve significant resources.

B. *Scenic and Open Space Resources Objective*

Protect, preserve and, where desirable, restore, or improve the quality of coastal scenic and open space resources.

Discussion: The project includes undisturbed open space around the periphery of golf fairways, along the highway setback, and at the cinder cone; an 18-hole golf course; a driving range; tennis center; and a park. This open space and outdoor recreational area represents approximately 65 percent of the total 388-acre site. See also the earlier discussion of General Plan objectives and policies related to the natural environment, and to culture and recreation.

C. *Coastal Ecosystems Objective*

Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

Discussion: The project is located over 1,000 feet from the coast. Storm water runoff will be controlled on the site at drywells and golf course turf areas. Due to the extreme porosity of the soil and geology of the site, there will be negligible off-site runoff generated by the project. Runoff will be absorbed on-site as groundwater, and groundwater flows underground to the ocean. It is expected that groundwater seepage at the shoreline will have little potential for creating adverse water quality effects on the ocean. Any fertilizers or pesticides leached into groundwater will have to travel thousands of feet to reach the shoreline, where they will then be mixed and dispersed (Refer to Section 4.6.1). Mitigative measures include Integrated Pest Management and utilization of slow-release nitrogen fertilizer to minimize potential impacts.

D. *Coastal Hazards Objective*

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Discussion: The project site is located over 1,000 feet from the shoreline and outside of the 100-year and 500-year flood hazard areas as defined by the Federal Emergency Management Agency, Flood Insurance Rate Map. Stream flooding of residential areas will not occur on the project site, nor will the site be affected by storm waves or tsunami. It is not necessary to undertake measures to avoid flood hazards at this development (Refer to Section 4.7).

6.5 SPECIAL MANAGEMENT AREA RULES AND REGULATIONS OF THE COUNTY OF HAWAI'I

The Special Management Area (SMA) extends along Queen Ka'ahumanu Highway in the area of the project. The entire project site is located within the SMA. The County Planning Department and County Council will review this proposed development, which is located in the Special Management Area, according to the County's rules and guidelines. These guidelines are derived from Section 205A-26, HRS. The consistency of the proposed project with the guidelines are discussed below.

9-7(A.) The Council shall seek to minimize, where reasonable:

(1.) Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;

(2.) Any development which would reduce the size of any beach or other area usable for public recreation;

(3.) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management area and the mean high tide line where there is no beach;

(4.) Any development which would substantially interfere with, or detract from, the line of sight toward the sea from the State highway nearest the coast;

(5.) Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land."

Discussion: There is no shoreline associated with the project site, which is located approximately 1,000 feet from the coast. With development of the project, a new 60-foot wide public access roadway will be built to the beach park area. As discussed in Sections 4.5 and 4.6, the project will not have an adverse effect on groundwater and ocean water quality. With respect to line of sight views toward the sea from the Queen Ka'ahumanu Highway, some views of the completed project features will be noticeable. However, the height of no building on the site will exceed 45 feet from finished grade. View planes toward the ocean from the highway will be maintained as much as possible as an asset for the public, as well as the future residents.

9-7(C.) All development in the Special Management Area shall be subject to reasonable terms and conditions set by the Council in order to ensure that:

(1.) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles;

(2.) Adequate and properly located public recreation areas and wildlife preserves are reserved;

Discussion: The proposed project will generally be consistent with the above-stated policy. With the project's development, NKDG is required to provide an improved access road to the coastal area *makai* of the project site which the State plans to develop as part of a shoreline wilderness park.

> (3.) *Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon special management area resources;*

Discussion: Wastewater treatment off-site is discussed above in Section 6.1.1 (Also refer to Sections 2.1 and 4.5). Solid waste will be disposed of by a private contractor at a County landfill.

> (4.) *Alterations to existing land forms and vegetation, except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of earthquake.*
>
> (5.) *Adverse environmental or ecological impacts are minimized to the extent practicable; and*
>
> (6.) *The proposed development is consistent with the objectives, goals, policies, and standards of the General Plan.*

Discussion: Scenic resources will be preserved where practical, consistent with the vegetation clearing, grading, and re-landscaping necessary for a quality residential community. Native plant species will be utilized as part of the landscape plan to minimize irrigation water demand and harmonize with the natural surroundings. About 65 percent of the total project site will comprise of open or recreational spaces. These recreation space uses include an 18-hole golf course, driving range, putting green, swimming pool and tennis center, to which the public will have access.

Unavoidable adverse environmental effects that will occur in this area include: soil erosion, vegetation clearing, wildlife disturbance, traffic, construction noise, and dust and exhaust emissions, topography modifications, automobile emissions, negligible noise impacts, minimal fertilizer and pesticide leaching, and archaeological resource disturbance. There will also be short-term and long-term visual impacts. All of the above adverse effects will be minimized to the maximum extent practicable through the implementation of mitigative measures specified in Section 4.

6.6 COMMUNITY/REGIONAL PLANS

Several community or regional plans have been written for the region which includes the project site. The most recent, the *West Hawai'i Regional Plan* (Office of State Planning 1989), is the most comprehensive work which responds to the rapid rate of development in the region.

West Hawai'i Regional Plan. The following are the applicable Strategies and Actions and an assessment of how the proposed project relates to them.

Strategy -- Resort Destinations Nodes

Cluster resorts in "Resort Destinations Nodes" in the following areas:

1. *Mauna Kea Resort Node*
2. *Mauna Lani/Waikoloa Resort Node*
3. *Kaupulehu/Kona Village/Kuki'o Resort Node*
4. *Keahole-Keauhou Resort Node*

Actions:

- *Develop the concept of Resort Destination Nodes as "employment centers."*
- *Identify other ancillary activities and services which support the concept of Resort Destination Nodes serving the employment generation centers.*
- *Provide economic incentives for private sector involvement in financing and developing social and physical infrastructure systems.*
- *Use the defined Resort Destination Nodes as a basis for developing State positions on land use petitions before the Land Use Commission.*
- *Conduct a study of cumulative fiscal, social, and environmental impacts of resorts to determine the optimal size for Resort Destination Nodes.*

__Discussion:__ The project site is located adjacent to the south of the Kaupulehu/Kona Village/Kuki'o Resort Node. Thus the project is positioned to take advantage of the efficiencies of resort co-location for financing and developing physical infrastructure systems and public services. The cumulative fiscal, social, and environmental impacts of the Manini'owali Residential Community in the context of regional resort development are discussed in Section 4.18.

Strategy--Support Communities
Designate and develop appropriate primary and secondary support communities to house employees working at the Resort Destination Nodes and other employment generators in the West Hawai'i region.

Actions:

- *Where feasible, coordinate development efforts with the private sector and governmental agency developments.*
- *Encourage the County and residential developers to provide residential support facilities and programs that will foster a sense of community.*

__Discussion:__ NKDG has an interest in developing primary and secondary support communities to house employees of its development and other resorts and area employment generators. NKDG will cooperate with the State and County governments in developing, or participate in developing with others, appropriate affordable homes for employees. The number of homes and their precise location will be determined later in discussions with State and County officials.

Strategies--Outdoor Recreation Resources

Protect from conflicting uses those areas necessary for providing parklands, wilderness, and beach reserves, areas of value for recreational purposes, and other related activities.

Action:

- *Establish more public parks or park reserves in places with high outdoor recreation resource potential. Sites recommended for new public parks include... Manini'owali Beach (Kua Bay).*

Discussion: At the initiative of NKDG, it exchanged its Awake'e land with the previously State-owned Manini'owali parcel. The public benefit of the exchange resulted in State ownership of a more consolidated parcel of oceanfront land on which to establish a shoreline wilderness park. NKDG, as a condition of the land exchange will participate in constructing a new shoreline access road and park facilities, pending receipt of all necessary approvals for their project.

Strategies--Heritage Resources

Recognize and protect scenic areas, natural landmarks, open space, and viewsheds as amenities that: improve the quality of life of Hawaii's residents; support the visitor industry; and influence land use patterns.

Identify and manage areas of cultural importance in ways that enhance and promote an appreciation of our cultural heritage.

Actions:

- *Designate ...Awake'e for its prominent Pu'u Kuili and the anchialine pond complex together with its relationship to adjacent proposed park areas at Makalawena and Manini'owali... as Heritage Areas.*
- *Evaluate the potential impact of land use proposals on the visual quality of the landscape, including the view plane and open space considerations.*
- *Protect views afforded from Queen Ka'ahumanu Highway and from the shoreline.*

Discussion: NKDG, in its land exchange with the State, furthered the objective of preservation of important cultural resources on the Awake'e site. The project site at Manini'owali also contains some burials, a smaller volcanic cinder cone, and some culturally-significant archaeological remains which will be preserved per DLNR review and approval. View planes from Queen Ka'ahumanu Highway to the shoreline will be preserved where practical.

Strategies--Public Access

Support the Na Ala Hele *trail system or other access system that is coordinated and comprehensive.*

Encourage the continued provision of public shoreline access for developments along the coastline.

Enhance public access through State-owned lands and increase public awareness of available public accesses.

Actions:

- *Support the implementation of a Statewide trail and access system.*
- *Conduct a comprehensive study to identify areas for public shoreline access. Until such time that a study is completed, applicants for development permits and approvals shall be required by the regulatory agencies to identify areas of high and moderate recreation value to include, but not limited to: shoreline fishing; spear fishing; and ingress and egress for scuba diving, snorkeling, board surfing, and windsurfing.*

Discussion: Should this project proceed, NKDG will construct an improved roadway and beach park facilities in coordination with the State. Manini'owali Beach, although seasonal, is considered one of the best swimming beaches on the Big Island, according to John Clark, author of *Beaches of the Big Island.*

The project will have no effect on the shoreline trails on coastal lands *makai* of the site which will integrate with the State Na Ala Hele's demonstration trail Ala Kahakai. Of the trails found on the project site, NKDG is committed to preserving a trail extending *makai* of the cinder cone *(pu'u)*, as recommended by the archaeological team that conducted a reconnaissance survey of the site. Remnants of other historic trails will be preserved to the extent practical by incorporating them with planned open spaces to be left with their natural vegetation. However, clearing and grading of land for golf course and residential development will probably affect some of these inland trails.

Strategies--Water Quality
Ensure the high quality of the groundwater is maintained.

Ensure that the high quality of the region's nearshore and coastal wasters is maintained as assets for recreation, the economy, and natural biological systems.

Actions:

- *Adopt the Department of Health's draft groundwater protection strategy.*
- *Expand the Department of Health's water quality monitoring program to include toxic monitoring, biomonitoring, and biosurveys.*

Discussion: The potential for surface water pollution is negligible on this site due to the extreme porosity of the soil and underlying geology. Stormwater runoff will be directed to open turf areas on the golf course, and to drywells scattered throughout the site. Runoff will eventually become groundwater, and groundwater flows underground and eventually seeps into the ocean at the shoreline. NKDG will provide for groundwater, pond and ocean monitoring as required by DOH (Refer to Sections 4.5 to 4.6.).

Strategies--Job Training and Employment Services
Support the continued coordination of effective services which meet both employer and employee labor shortage needs. One-stop service centers, collocation of existing services, mall-front job help stores, a DLIR quick response team, job fairs, recruitment fairs, literacy support groups, and other timely outreach efforts should be considered for application in the West Hawai'i region.

Actions:

- *Leverage private sector funds and commitment to develop and participate in employment training programs.*
- *Assist in retraining/upgrading programs for existing employees to facilitate hiring of residents for upper level positions.*
- *Identify, encourage, and develop innovative transportation programs to facilitate efficient on-island access to the job market from labor surplus areas.*
- *Establish links between the schools, educational support services, and private sector economic development proposals to streamline hiring of existing residents in quality jobs.*

Discussion: NKDG has an interest in promoting job training and employment services, and expects to work closely with the County government in ways that they may be mutually supportive. The developer concurs in the need to place local residents into upper level positions of responsibility, as well as in the development of an efficient transportation program to serve the needs of employees working off-site of the development.

Strategy--Public Safety
Coordinate State and County efforts to provide increased services to address the projected public safety needs.

Actions:

- *Support County efforts to expand fire and police services in West Hawai'i.*
- *Encourage all firefighting units and land-owners to improve and expand their capabilities and prevention efforts to deal with wildfires in West Hawai'i.*

Discussion: The Manini'owali Residential Community will hire its own security personnel. In emergency situations only will it call on the police. The development will include a system of fire hydrants and a water storage system, designed according to the County's standards, to be used in fighting fires.

Strategies-Energy and Power Facilities:
Minimize the negative impact of changes in the fuel and power generation and delivery systems on existing and new communities of residents and visitors.

Minimize the resorts' impact on energy supply.

Encourage the use of climate-appropriate architecture, vegetation, and landscaping.

Minimize transportation fuel consumption.

Action:

- *Actively support efficient transportation methods for residents, visitors, and resort workers, such as buses, safe bicycling routes, van pooling, and car pooling, to minimize traffic and fuel supply problems.*

Discussion: The Manini'owali Residential Community will be using climate-appropriate architecture incorporating energy efficient technology and design, and appropriate vegetation and landscaping to moderate climatic effects. Working with the County, it hopes to participate in finding and encouraging energy efficient methods for transporting employees to their place of work.

Strategies-Sewage Disposal Systems:
Provide sewage disposal systems that will foster continued regional growth.

Ensure that the high quality of offshore and coastal waters and the groundwater are maintained.

Action:

- *Include buffer zones and disclose possible public exposure to the effluent in proposals to reuse sewage effluent.*
- *Ensure compatibility between adjacent land uses and the siting of, and zoning for, sewage treatment plants.*
- *State and County land use planning agencies should require the utilization of low-water consumption toilets and other appliances, explore the viability of waterless toilet systems, and encourage recycling wastewater for irrigation. Other measures to reduce wastewater generation should be developed and evaluated.*

Discussion: NKDG will construct its own on-site wastewater treatment facility. The secondary treatment system of the type under consideration will not present an odor nuisance. Odor control measures will be employed in designing the wastewater treatment plant. Treated wastewater effluent will be diluted and used for irrigation of the golf course. Landscaped areas around residential areas will be irrigated with brackish water only.

Other Community and Regional Plans:

No regional plan has been prepared for South Kohala. However, regional plans have been prepared for nearby communities:

North Kohala Community Development Plan (Phillips Brandt Reddick, November 1984). This plan makes numerous references to the employment opportunities and economic base which the South Kohala resorts provide for North Kohala residents. The South Kohala job opportunities filled the gap left by the closure of North Kohala sugar plantations. In turn, the South Kohala resorts have depended upon North Kohala as a source of employees. The plan mentions that a certain amount of additional residential housing is expected in North Kohala for visitor industry employees. The plan also mentions the need for expanded public bus service between North Kohala towns and the South Kohala resorts.

Kona Regional Plan (County of Hawaii Planning Department, November 1983). This plan acknowledges the interdependence, as well as the competition, between the Kona and South Kohala visitor facilities. Opportunities for industrial growth north of Kona would be fueled by the expanding South Kohala Resorts. The South Kohala resorts would also generate direct and indirect employment opportunities for Kona residents.

Waimea Design Plan (Phillips Brandt Reddick, May 1984). This plan makes one brief mention of the prospects for continued growth in the town due to the resort developments on the coast.

SECTION 7 – Unresolved Issues

7.0 SUMMARY OF UNRESOLVED ISSUES

During the past year, public informational meetings and individual interviews have provided substantial input of issues and concerns realtive to the proposed development of the Manini'owali Residential Community. All of the issues raised have been addressed in this Final Environmental Impact Statement, although several issues may be considered as unresolved at present. These issues are listed below, along with a brief discussion regarding the difffernt opinions that exist on these issues.

1. **State Park Access Route** - The ultimate alignment of the proposed access route to the new State shoreline park at Manini'owali Beach and Kua Bay has yet to be determined. The current routing is based on decisions made following a series of discussions with State Parks officials, and the final alignment must be approved by the County and State. Actual park planning by the State has yet to begin, and the shoreline access route will be planned as part of this process. An upcoming workshop sponsored by North Kona Development Group (NKDG) will help to facilitate the beginning of the park planning process.

2. **Affordable Housing** - The residential community planned at Manini'owali does not include on-site affordable housing units. NKDG fully intends to participate in the development of affordable housing in the region, either through direct development at an appropriate site or contribution of its fair share of funds dedicated towards development of affordable housing.

3. **Brackish Water Wells on State Lands** - NKDG has formally requested the use of State land mauka of its site on Manini'owali and Awake'e for development of six brackish water wells. Preliminary discussions are being held with State officials regarding this proposed use. NKDG proposes to utilize the brackish water partly for domestic use after deslinization, and partly for irrigation use.

4. **Intersection with Queen Ka'ahumanu Highway** - The proposed project will require a connection with this highway for access, howvever, it is understood that there are plans to upgrade the highway to a limited-access freeway with frontage roadways and regional interchanges serving nearby development. The location of an interchange for the Kukio/Kaupulehu node has not been determined at this time. For the interim period until the highway improvements are planned, designed and constructed, an at-grade channelized intersection is planned to allow access. It is impossible for NKDG to analyze the future condition of the roadway network until a pending DOT planning study is completed.

5. **On-Site Burial Preservation Measures** - Following the recommendations of the Hawai'i Island Burial Council, NKDG proposes in-situ preservation for all burials on their land. The dimensions of buffers for construction and long-term maintenance will be decided by the DLNR-HPD, and the Council and the County at a later point in the approval process.

SECTION 8 – Consulted Parties, List of Preparers, Comments and Responses

8.0 CONSULTED PARTIES, LIST OF PREPARERS, COMMENTS AND RESPONSES

This section includes lists of the various agencies, individuals, and organizations who have been consulted for the preparation of the Draft EIS and the Final EIS, the names of preparers and technical consultants who have contributed to producing this document, and the comments and responses to the Notice of Preparation / Environmental Assessment and the Draft EIS.

8.1 LIST OF AGENCIES AND INDIVIDUALS CONTACTED IN PREPARATION OF THE ENVIRONMENTAL IMPACT STATEMENT (EIS)

The following list includes governmental agencies, individuals, and organizations who have been contacted as part of the planning and analysis process for the preparation of the Draft EIS and the Final EIS.

County of Hawai'i

- Planning Department
- Department of Parks and Recreation
- Hawa'i'i County Fire Department - Kailua-Kona Station

State of Hawai'i

- Department of Transportation - Highways Division
- Department of Land and Natural Resources
  - Historic Preservation Division
  - Division of State Parks
  - Division of Water and Land Development
  - Division of Land Management
  - Division of Forestry and Wildlife/Na Ala Hele Program

Public Utilities

- Hawaii Electric Light Company, Inc.

Organizations

- Hawai'i Island Burial Council
- American Lung Association - West Hawai'i Branch
- Na Ala Hele

Individuals

- Bobby Camara
- Hannah Kihalani Springer
- Michael Tomich

8.2 LIST OF PREPARERS OF DRAFT EIS

This Environmental Impact Statement has been prepared by the planners and environmental analysts at GROUP 70 INTERNATIONAL, INC. Architects • Planners • Interior Designers, 924 Bethel Street, Honolulu, Hawaii 96813, Telephone (808) 523-5866. The staff involved in the preparation of this document included:

Francis S. Oda, AIA, AICP	Chairman of Group 70
Jeffrey H. Overton, AICP	Project Manager/Senior Planner
Yukie Ohashi	Planner
Terry L. Hildebrand, AICP	Planner
Edith Masaki	Graphics
Kathy Hida	Graphics
Wendy Reeves	Production

Several technical consultants were employed to provide specific assessments of environmental factors for this project. These consultants, their company affiliation (if any), and their specialty are listed below:

Clarence Tanonaka, P.E.	Park Engineering	Civil Engineering
Cris Takushi	Park Engineering	Civil Engineering
John Stubbart	Waimea Water Services	Water Supply
Steve Bowles	Waimea Water Services	Water Supply
Gordon L. Dugan, Ph.D.	Consultant	Storm Water Runoff
Charles L. Murdoch, Ph.D.	Murdoch & Green	Fertilizer/Pesticides
Richard E. Green, Ph.D.	Murdoch & Green	Fertilizer/Pesticides
Patrick Sullivan, Ph.D.	Oceanit Laboratories, Inc.	Marine Environment/ Groundwater Impact
Winona P. Char	Char and Associates	Botany
Phillip Bruner	Consultant	Wildlife
Jeff Pantaleo	B. P. Bishop Museum	Archaeology
Ronald Darby, P.E.	Darby & Associates, Inc.	Noise
Barry D. Neal, C.C.M.	B.D. Neal & Associates	Air Quality
Randall Okaneku, P.E.	The Traffic Management Consultant	Traffic Assessment
Berna Cabacungan	Earthplan	Socio-Economics Issues
Michael P. Mays	Earthplan	Demographics/Community
John Clark	Earthplan	Ocean Recreation
John Zapotocky	Consultant	Fiscal/Marketing

8.3 CONSULTED PARTIES FOR NOTICE OF PREPARATION / ENVIRONMENTAL ASSESSMENT AND THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Listed below are the agencies and organizations consulted in the preparation of the Draft EIS. The table indicates with an "X" those who submitted written comments or letters stating they have no comments. This is followed by their comment letters and the responses of the applicant's planning consultant.

	Comments on N.O.P.*	Comments on Draft EIS
A. FERAL AGENCIES		
Department of the Army		
U.S. Army Engineer District	–	X
Department of the Navy	–	X
B. STATE LEGISLATORS		
Senator Andrew Levin	–	–
Senator Richard Matsuura	–	–
Senator Malama Solomon	–	–
Representative Jerry Chang	–	–
Representative Harvey Tajiri	–	–
Representative Wayne Metcalf	–	X
Representative Dwight Takamine	–	–
Representative Virginia Isbell	–	–
Representative Mike O'Kieffe	–	–
C. STATE AGENCIES		
Office of State Planning	–	X
BLNR Chairman William Paty	X	X
DLNR/Historic Preservation Division	–	X
DLNR/Division of Forestry and Wildlife	X	X
DLNR/Division of Water and Land Development	–	–
DLNR/Division of State Parks	–	–
DLNR/Division of Land Management	X	–
Department of Agriculture	X	X
Department of Defense, Hawaii Air National Guard		X
Department of Education	X	X
Department of Health	X	X
Department of Transportation	X	X
Department of Budget and Finance, Housing Finance and Development Corporation	X	X

	Comments on N.O.P.*	Comments on Draft EIS
C. STATE AGENCIES (CONT..)		
Department of Business and Economic Development, Land Use Commission	X	X
Department of Business and Economic Development, Energy Division	–	X
University of Hawaii, Environmental Center	–	X
Department of Accounting and General Services, Division of Public Works	X	X
Office of Environmental Quality Control	X	X
Office of Hawaiian Affairs	–	–
D. COUNTY COUNCIL		
Mr. Russell S. Kokubun, Chairman	–	–
Mr. James Arakaki	–	–
Mr. Brian De Lima	–	–
Mr. Takashi Domingo	–	–
Ms. Helene H. Hale	–	X
Ms. Merle K. Lai, Vice-Chairwoman	–	–
Mr. Robert H. Makuakane	–	–
Mr. Harry S. Ruddle	–	–
Mr. Spencer K. Schutte	–	–
E. COUNTY AGENCIES		
Office of the Mayor	X	–
Civil Defense Agency	–	–
Planning Department	X	X
Department of Water Supply	X	X
Department of Public Works	–	–
Departments of Parks & Recreation	X	–
Department of Human Services	–	–
Office of Housing and Community Development	–	–
Police Department	X	X
Fire Department	X	–

	Comments on N.O.P.*	Comments on Draft EIS
F. COMMUNITY ORGANIZATIONS		
Alu Like, Inc.	–	–
American Lung Association of Hawai'i	X	–
Hawai'i Island Board of Realtors	–	–
Hawai'i Island Chamber of Commerce	–	–
Hawai'i Island Contractors Association	–	–
Big Island Business Council	–	–
Hawai'i Island Economic Development Board	–	–
Hawai'i Visitors Bureau, Big Island	–	–
Hawai'i Leeward Planning Conference	–	–
Hawai'i Conference Foundation	–	–
Japanese Chamber of Commerce and Industry	–	–
Kona Board of Realtors	–	–
Kona Farm Bureau Federation	–	–
Kona-Kohala Chamber of Commerce	–	–
Life of the Land	X	–
West Hawai'i Sierra Club	X	X
Hawai'i Audubon Society	–	–
Greenpeace Hawai'i	X	–
Native Hawaiian Legal Corporation	–	–
Na Ala Hele	–	–
Public Access Shoreline Hawai'i	–	–
Sierra Club Legal Defense Fund, Inc.	–	–
G. INDIVIDUALS		
Keola Childs	X	–
Mark van Pernis		X
H MISCELLANEOUS		
Hawaiian Electric Light Company	–	X
GTE Hawaiian Telephone	–	–
The Gas Company, Inc.	–	–

*N.O.P. stands for Notice of Preparation

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: 548-6100

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

RECEIVED
JUL 19 1991
GROUP 70
LIMITED

July 15, 1991

Mr. Jeff Overton
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813

Dear Mr. Overton:

Subject: Environmental Impact Statement Preparation Notice (EISPN) Maniniowali Residential Community, North Kona, Hawaii Applicant: North Kona Development Group
TMK: 7-2-04:17
Area: 388.057 acres

The Department of Agriculture has reviewed the subject document and has the following comments.

The applicant proposes to develop a resort-style residential community immediately makai of Queen Kaahumanu Highway at Maniniowali, North Kona, on the island of Hawaii. Elements of this resort-style development include an 18-hole golf course, club house, driving range, and tennis facilities. The applicant also plans to construct 900-1,100 single- and multi-family units amid the golf course fairways. Other developments include an access and roadway network, a wastewater treatment and disposal system, a potable water supply and fire protection system, and a non-potable water irrigation system.

The applicant also proposes to construct either an on-site private wastewater treatment plant, or by cost sharing arrangement, to use a wastewater facility to be built for the Huehue Ranch and Kaupulehu (Four Seasons) resort developments.

References to the Soil Conservation Service Soil Survey, Land Study Bureau Detailed Land Classification, and the Agricultural Lands of Importance to the State of Hawaii (ALISH) Maps are correct.

As the subject development boundaries lie entirely within the state conservation district, we have no comment regarding the location of the development.

Island Fresh

We have concerns relating to impacts of increased withdrawal of groundwater in the region. The applicant states that "there is evidence of high volumes of groundwater extrusion" (page 25, section 4.9, paragraph 3) in the subject area. Conveyance of herbicides and pesticides, fertilizer residues, and treated residential wastewater from the development through the Shoreline Management Area toward the marine environment (Class AA waters) are likely to create long-term negative impacts. Mitigation of these impacts should be addressed in the Draft EIS. Also, potential adverse impacts to agriculture in the region caused by groundwater withdrawal should be addressed.

Thank you for the opportunity to comment.

Sincerely,

Yukio Kitagawa

YUKIO KITAGAWA
Chairperson, Board of Agriculture

c: Norman K. Hayashi, Planning Director
County of Hawaii
William Wong, Acting Chief,
Safe Drinking Water Branch, Dept. of Health
Robert Boesch, DOA Pesticides Program Manager

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Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawai'i
1428 Sounth King Street
Honolulu, Hawai'i 96814-2512

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Kitagawa:

Thank you for your July 15, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Fertilizer and Pesticides Use

The proposed golf course at this community will require the use of fertilizer to enhance turf growth, and some pesticides to control pest populations. As part of the Draft Environmental Impact Statement (Draft EIS), the potential infiltration of fertilizer nutrients and pesticides into groundwater and eventually into the ocean has been studied by Oceanit Laboratories. Their findings show that small quantities of fertilizer nutrients and non-detectable quantities of pesticides may be introduced to the ocean through groundwater discharges. According to Oceanit, the addition of these fertilizer nutrients and pesticides compounds is not expected to affect nearshore water quality or the marine ecological community along this coast.

The Draft EIS presents numerous mitigative measures planned to minimize the use of fertilizers and pesticides, such as the planned Integrated Pest Management (IPM) program, reduced turf areas, low demand turf types, computer controlled irrigation, and slow-release fertilizers. With these measures in place, fertilizer nutrients and pesticides will have no noticable impact on coastal waters quality or ecology.

The proposed wastewater treatment facility, and disposal of treated effluent through golf course and landscaping irrigation is an environmentally-sound practice which is strongly encouraged by the State Department of Health for this project. Nutrients in wastewater will actually replace some of the fertilizer contribution needed for the golf course.

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-58?4

B. Groundwater Withdrawal

Use of brackish groundwater from new wells proposed on State lands at the 600 foot elevation in Manini'owali and Awake'e will not have an adverse impact on agricultural water uses in this area. The project's use of approximately one million gallons per day (mgd) of brackish water will increase the total water demand from the aquifer well to approximately 6-8 mgd, abot one-half of its estimated maximum sustainable yield of 14 mgd. The proposed project, therefore, will not preclude the further use of this aquifer by agricultural or other uses. An analysis of groundwater availability and use was prepared for the Draft EIS by Waimea Water Services, and their report will provide you with additional detail on this subject.

Thank you again for your comments. Please feel free to call either me or, Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

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JUL 1 [illegible]

GROUP 70
LIMITED

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

July 10, 1991

OFFICE OF THE SUPERINTENDENT

Mr. Jeff Overton
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

SUBJECT: Manini'owali Residential Community
Manini'owali and Kuki'o, North Kona,
Island of Hawaii

Our review of the proposed subject development indicates that it will have a significant enrollment impact on the schools in the North Kona area. The proposed 1,100 residential units consisting of single and multi-family units will generate approximately 220 students in grades K-12.

Since the area schools (Kealakehe Elementary, Kealakehe Intermediate, and Konawaena High and Elementary) are operating beyond capacity, the projected enrollment will affect our ability to accommodate these students.

We will request that the County of Hawaii support our position on requiring the developer to contribute a fair-share contribution for the construction of school facilities as a condition for county zoning and building approval. We estimate the developer's share to be $1,450,539 to mitigate the impact to the affected schools.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:jl

cc: T. Nakai
A. Garson
N. Hayashi

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Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Charles Toguchi, Superintendent
Department of Education
State of Hawai'i
P. O. Box 2360
Honolulu, Hawai'i 96804

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Tagouchi:

Thank you for your July 10, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The projections which you provided concerning student enrollment impact of the residential development proposed within the Manini'owali Residential Community have been included in the Draft Environmental Impact Statement (Draft EIS). Due to the second home and retirement home emphasis of the project, and the relatively high anticipated age of the permanent residents, we believe very few school-aged children will be expected to be generated by this project.

We recognize the existing operational condition of the area schools and look towards accomodating the increase in the student enrollment attributable to this project. NKDG would like to hold further discussions with DOE regarding its fair share contribution.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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JOHN WAIHEE
GOVERNOR OF HAWAII

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

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

In reply, please refer to:
91-3-209X

August 20, 1991

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813-4398

Dear Mr. Overton:

Subject: Manini'owali Residential Community
Manini'owali and Kuki'o 2, North Kona, Island of Hawai'i
TMK: 7-2-04: Portion 17

We have reviewed the material on the subject property submitted by your office. Our comments are identified by the branch or office that made them.

<u>Clean Water Branch</u>

The environmental assessment indicates that the project area consists of approximately 388 acres of open land in the North Kona District, Island of Hawaii. 40 Code of Regulations Parts 122, 123, and 124 require that those proposing construction activities including cleaning, grading, and excavation activities that result in the disturbance of more than five (5) acres of total land area, must apply for a National Pollutant Discharge Elimination System (NPDES) permit. The applicant shall submit the NPDES permit application to the Department of Health, Clean Water Branch, at least 90 days before the date on which construction is to commence.

Questions regarding the NPDES permit process should be directed to Alec Wong, Clean Water Branch, at telephone 543-8309.

<u>Environmental Planning Office (Nonpoint Source)</u>

1. Due to the existing site conditions described in the Environmental Assessment (evidence of high volumes of groundwater extrusion, virtually no surface runoff/highly permeable surface material), the potential for groundwater contamination and discharge to the nearshore coastal waters

is extremely high. It is important that the study to be conducted by Oceanit Laboratories consider the impact on marine life and coastal water quality due to groundwater contaminated with nutrients and pesticides.

2. The Coastal Zone Management Act of 1990 requires states with approved Coastal Zone Management (CZM) programs to incorporate nonpoint source pollution management into the program. The State Nonpoint Source Pollution Management Plan to incorporate the new CZM requirements will include enforceable management mechanisms, as required by the Act. This should be considered by the applicant.

If you should have any questions regarding the Nonpoint Source Program, please contact Carolyn Thompson, Environmental Planning Office, at telephone 543-8337.

<u>Safe Drinking Water Branch</u>

We have reviewed the document and have listed our comments under separate section review.

<u>Underground Injection Control (UIC)</u>

1. The project site is located below the UIC line.

2. The DOH's Eight Golf Course Conditions (EGCC) will be applicable to the proposed golf course(s). The EGCC should be a condition of the reclassification of the property from Conservation District to Urban District.

3. A UIC permit must be obtained for the operation of any rainfall drainage drywells and any sewage effluent injection wells.

The following comments are not related to UIC issues; however, we wish to include these comments as part of our response to the Environmental Assessment (EA).

4. Indigenous and especially endemic trees and plants of Hawaii should be extensively used in all landscaping efforts; especially for the golf course. The use of these types of trees and plants should be attempted first, before other exotic plants are used. Whenever safe and legal acquisition of endangered trees and plants are possible, such trees and plants that are endemic to the project's environment, those trees and plants should be extensively propagated through the landscaping efforts. All trees and plants of significance in a golf course should be identified, in

appropriate locations, with a sign bearing its Hawaiian name, common name and scientific name.

5. Solid waste management has only been superficially addressed in the EA. Of specific concern is the disposal of lawn and landscape plant trimmings from the golf course. In our opinion, the offsite disposal (trucking to a landfill) of such trimmings is not acceptable. The facility should develop a composting program that would involve shredding, composting and the use of the processed material (shredded material or humus) so as to eliminate the need for landfill disposal of plant trimmings. It is very important to recognize in the planning stages that this task must be undertaken and that adequate facility space must be dedicated to implement the task. (An area to set-up a portable shredder and an adequate area and location to build compost piles.)

Drinking Water

1. It is stated that NKDG is considering several on-site and off-site water supply alternatives. If a new potable water system is developed, and it serves 25 or more individuals at least 60 days per year or has a minimum of 15 service connections, then the water system will be classified as a "public water system." Public water systems must comply with Department of Health Administrative Rules, Chapter 11-20, "Potable Water Systems."

2. Section 11-20-29 of Chapter 20 requires that any new source of potable water serving a public water system (such as a well) be approved by the Director of Health prior to its use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements stated in Section 11-20-29.

3. Section 11-20-30 requires that new or substantially modified distribution systems for public water systems be approved by the Director. Such approval depends upon the submission of plans and specifications for the project prior to construction and the demonstration that the new or modified portions of the system are capable of delivering potable water in compliance with all maximum contaminant levels as set down in Chapter 20. In other words, if the development decides to hook up with an existing water system, the plans would need to be approved by the Director.

4. We strongly recommend that the potable and non-potable water systems be kept strictly separate in order to eliminate the possibility of cross-connecting the two systems. In

addition, all non-potable spigots should be clearly labeled in order to prevent the inadvertent consumption of nonpotable water.

Questions regarding our UIC or Drinking Water policies should be addressed to Chauncey Hew, Safe Drinking Water Branch, at telephone 543-8258.

Sanitation Branch

We concur with the proposed development of an on-site wastewater treatment plant. However, please be advised that all food establishments must meet the requirements of Department of Health Administrative Rules, Chapter 1-A, "Food Service and Food Establishment Sanitation Code."

If you should have any questions, please contact Kelvin Sunada, Sanitation Branch Chief, at telephone 548-3225.

Wastewater Branch

The subject project area, which is situated below the 100-foot elevation contour line, is located within the proposed critical wastewater disposal area (CWDA) and the subject project area located above the 100 foot elevation contour line is located within the proposed non-CWDA, both determined by the Hawaii County Wastewater Advisory Committee. Consequently, no new cesspools will be allowed in the area below the 100-foot elevation contour line.

There is no current municipal sewer service system available for the subject project. Therefore, the Department of Health (DOH) concurs with the concept of developing a wastewater treatment plant to serve their resort needs or cost-share with the Kuki'o 1 (Huehue Ranch) and Kaupulehu (Four Seasons) resort developments.

DOH strongly supports the concept of utilizing treated wastewater for irrigating community landscaping areas and golf course.

Regardless of the process you select we reserve the right to review the detailed wastewater plans for conformance to the DOH Administrative Rules, Chapter 11-62, "Wastewater Systems."

If you should have any questions, please contact Mr. Harold Yee of the Wastewater Branch at telephone 543-8287.

Very truly yours,

Thomas S. Geizumi

for JOHN C. LEWIN, M.D.
Director of Health

c: Norman K. Hayashi, Planning Director, County of Hawaii

GROUP 70
LIMITED

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
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Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

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

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Dr. Lewin:

Thank you for your August 20, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. National Pollutant Discharge Elimination System (NPDES) Permit

Agents for the developer will submit an NPDES permit application to the Clean Water Branch at least 90 days prior to the commencement of construction, currently planned for late 1993 or early 1994.

B. Marine Life and Coastal Water Quality

Although the project is located over 1,000 feet from the coast, groundwater flowing under the project site will receive minor contributions of fertilizers and pesticides from the operation of the golf course. Oceanit Labs looked at both the groundwater conditions and the nearshore ocean conditions to assess the potential for impact on the marine environment. There findings show that the nearshore water quality and ecology will not be adversely affected by the introduction of extremely small quantities of fertilizers and pesticides. Furthermore, the Oceanit study does not account for the significant mitigative measures proposed to reduce the use of pesticides through an Integrated Golf Course Management (IPM) program. The proposed use of slow-release nitrogen fertilizers which minimize leaching to groundwater. Coastal waters and marine life will not be adversely affected by this project.

C. Underground Injection Control and Eight Golf Course Conditions

NKDG will satisfy the requirements of the DOH's Eight Golf Course Conditions, and will accept this as a condition of the reclassification of the property from Conservation to Urban. The applicant's agents will also file for a UIC permit for the installation of rainfall drainage drywells planned for the

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site. There is no plan to inject treated wastewater, rather the plan is to provide advanced secondary treatment and irrigation disposal on the golf course.

D. Recommendations for Landscaping With Native Plants and Composting of Lawn and Landscaping Materials

NKDG will have detailed landscaping plans developed for the golf course and common areas, which will make use of indigenous and endemic trees and plants as practicable in the project landscaping. A composting program will be developed at this project to eliminate the need for landfill disposal of plant trimmings. The likely site for this facility will be at the proposed golf course maintenance facility.

E. Drinking Water

NKDG intends to develop its own water supply system based on the use of desalinized brackish water derived from wells on state land mauka of the project site. The new potable water system at this community will serve more than 25 individuals, and therefore classified as a "public water system." It is understood that the Director of Health must approve of any new source of potable water serving a public water system. Engineering reports will be submitted at the appropriate point in the design and approval process.

Potable and non-potable water systems will be planned strictly separate in order to eliminate the possiblity of cross connections. The clear labelling of non-potable water spigots will also be planned, as recommended.

F. Wastewater Treatment and Disposal

NKDG plans to construct its own wastewater treatment plant and utilize treated wastewater for irrigating community landscaping areas and the golf course. Detailed facility plans will be submitted at the appropriate point in the design and approval process.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
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RECEIVED
JUL 11 1991
GROUP 70 LIMITED

July 9, 1991

Group 70 Limited
924 Bethel Street
Honolulu, HI 96813
Attention: Jeff Overton

Subject: Manini'owali Residential Community

Dear Mr. Overton,

The statewide Trails and Access program known as Na Ala Hele is deeply concerned over the proposed Manini'owali Residential Community for North Kona, Hawaii. Na Ala Hele recognizes that there are ancient trails running through your proposed project. (see footnotes below) Furthermore, the May 1991 Na Ala Hele Program Plan describes a 50 mile demonstration trail "Ala Kahakai" (Trail by the Sea) that we are proposing to develop along the coastline fronting your property.

Na Ala Hele is concerned because the conceptual master plan fig. 5 of the environmental assessment indicates the ancient trails running through the proposed golf course fairways, along or on the projects proposed road system, and in the proposed residential areas. It is not clear at this time if any of the trails or historic sites will be prserved, or made available for use by the general public. We are deeply interested in maintaining trail access to historic sites and the shoreline. We propose that you work closely with our program and our advisory group on the island of Hawaii to provide trail access that would benefit the entire community.

Group 70 Limited report for North Kona Development Group, Environmental Assessment Awake'e/Maniniowali Land Exchange, October 12, 1990 Section 4 M describes and mapped out Archeological and Historical Resources

Army Corps of Engineers, West Hawaii Coral Reef Study 1981 describes well-known ancient trails on the property.

Enclosed for your information is a list of Na Ala Hele Advisory members on Hawaii. Rod Oshiro is the district Na Ala Hele representative on Hawaii and he can be reached at 933-4217. Christina B. Meller is the Na Ala Hele program manager for the entire State she can be reached at 587-0062. Please involve them in your trail access planning process.

Sincerely,

Michael G. Buck

Michael G. Buck, Administrator
Division of Forestry and Wildlife

cc Christina Meller
Leilani Hino
Sue Rutka
Charles Wakida
Rod Oshiro
Don J. Hibbard
Norman Hayashi

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Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Michael G. Buck, Administrator
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96806

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Buck:

Thank you for your July 9, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

Several trails were found in the Bishop Museum field studies, located on the North Kona Development Group (NKDG) property and the makai State portion of Mainin'owali. NKDG has worked closely in the conceptual planning phase with local community representatives and individuals from the Na 'Ala Hele Advisory Group, including Michael Tomich and Bobby Camarra. The preservation and treatment of these trails is discussed in the Draft Environmental Impact Statement (Draft EIS). NKDG is proposing to preserve the significant trails in the conceptual master plan. We will continue to meet with Na Ala Hele representatives and the Historic Preservation Program staff to finalize plans for trail preservation. The preserved section of the mauka-makai trail will provide access from the coast to a small pu'u on-site. This trail will also provide access to several significant archaeological sites.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA:SKK

AUG 2 1991

FILE NO.: 91-559
DOC. NO.: 1240E

GROUP 70 LIMITED
924 Bethel Street
Honolulu, Hawaii 96813

Attn: Jeff Overton

Dear Mr. Overton:

SUBJECT: Environmental Assessment and Notice Of Preparation of an Environmental Impact Statement
Location: Manini'owali Residential Community, North Kona District, Hawaii
TMK: (3) 7-2-04: 17 (por.)

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.

Forestry and Wildlife Comments:

1) We recognize that there are ancient trails running through the proposed project. Furthermore, the May, 1991 Na Ala Hele Program Plan describes a 50-mile demonstration trail, "Ala Kahakai" (Trail by the Sea), that we are proposing along the coastline fronting the property.

2) We are deeply interested in maintaining trail accesses to historic sites and the shoreline.

3) It is recommended that the developer work closely with the Na Ala Hele Advisory Group of the island of Hawaii.

4) A more extensive botanical inventory should be included in the EIS.

5) Any and all threatened and endangered plant species should be listed and a plan should be listed and a plan should be drawn to address the management of any T&E species.

From our Department's Division of State Parks viewpoint, the current general siting of the proposed park access roadway is a major improvement from that previously proposed by North Kona Development Group (NKDG). As NKDG is probably aware of, the final siting, however, must take into consideration the survey results of several other factors including topography, park planning considerations, significant archaeological resources,and rare and endangered biota.

If there are any questions regarding our comments, contact Wayne H. Souza, Planner, at x8-2627

Thank you for your cooperation in this matter. Please feel free to call me or Sam Lemmo at our Office of Conservation and Environmental Affairs, at 548-7837, should you have any questions.

Very truly yours,

WILLIAM W. PATY, Chairperson
Department of Land and Natural Resources

cc: County of Hawaii, Planning Dept.
OEQC

GROUP 70
LIMITED

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
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Danilo M. Herrera

5 November 1991

Mr. William W. Paty, Chairperson
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96806

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Paty:

Thank you for your July 14, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Trails System

Several trails were found in the Bishop Museum field studies, located on the North Kona Development Group (NKDG) property and the makai State portion of Mainin'owali. NKDG has worked closely in the conceptual planning phase with local community representatives and individuals from the Na 'Ala Hele Advisory Group, including Michael Tomich and Bobby Camarra. The preservation and treatment of these trails is discussed in the Draft Environmental Impact Statement (Draft EIS). NKDG is proposing to preserve the most significant trails in the conceptual master plan. We will continue to meet with Na Ala Hele representatives and the Historic Preservation Program staff to finalize plans for trail preservation.

NKDG is also participating actively in the planning and development of a shoreline park on the makai State land portion of Manini'owali. The shoreline park will include a segment of the Ala Kahakai demonstration trail. NKDG will be holding a ocean recreation park planning workshop on November 23, 1991 in Kona to further include the community in planning for trails preservation and enhancement at Manini'owali.

B. Botanical Inventory

For the Draft EIS, Winona Char completed a detailed botanical inventory which is included as an appendix to the EIS and summarized in the main body of the text. There are no threatened or endangered species found on the NKDG property. Off-site on the State's makai portion of Maini'owali, Char found a specimen of the pololei fern, a candidate endangered species. This plant is not expected to occur on the NKDG site, nor will it be affected by development of this project.

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C. Park Access Roadway

The current proposal for siting the public park access roadway has not changed from the alignment most recently reveiwed by State Parks. We believe this alignment will best serve the public by retaining the wilderness feeling of the park entrance route while preserving the integrity of the slopes of Pu'u Kuili. NKDG is aware that the final alignment must account for siting constraints listed in your letter.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED
AUG - 8 '91
GROUP 70 LIMITED

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
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STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:SKK

AUG 7 1991

FILE NO.: 91-559
DOC. NO.: 1298E

Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Attn: Jeff Overton

Dear Mr. Overton:

Subject: Additional comments regarding the Environmental Assessment and Notice of Preparation of an Environmental Impact Statement.
Location: Manini'owali Residential Community
North Kona District, Hawaii
TMK: 7-2-04: 17 (por.)

Thank you for giving our Department the opportunity to comment on this matter. We have additional comments regarding the Manini'owali Residential Community Development.

HISTORIC PRESERVATION PROGRAM CONCERNS:

The archaeological inventory report for this proposed residential community, golf course and associated facilities has just been submitted to our office. We will not be able to determine if the project will have an "adverse effect" on historic sites until we have reviewed the report. We expect to officially comment on the adequacy of the survey, the significance evaluations of all identified sites and the proposed mitigation measures (data recovery and preservation plans) during review of the Draft Environmental Impact Statement.

We did, however, review the documents prepared for the Environmental Assessment and the Notice of Preparation of an Environmental Impact Statement. We concur with the general intent of their statements regarding archaeological and historical resources. They acknowledge the presence of significant historic sites on the property and commit themselves to an appropriate mitigation plan once it is approved. Our major concern is that the Draft EIS clearly reiterates all conditions of the land exchange which apply to historic sites.

Thank you for your cooperation in this matter. Please feel free to call me or Sam Lemmo at our Office of Conservation and Environmental Affairs, at 548-7837, should you have any questions.

Very truly yours,

WILLIAM W. PATY

cc: County of Hawaii, Planning Dept.

GROUP 70

LIMITED

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Danilo M. Herrera

5 November 1991

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

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Paty:

Thank you for your August 7, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The Historic Preservation Program has made several comments on the EA. HPP plans to officially comment on the adequacy of the Bishop Museum survey report, and the significance evaluations and the proposed mitigation measures during the review of the Draft Environmental Impact Statement (Draft EIS). The EA acknowledges the presence of significant historic sites, and commits NKDG to implementing an appropriate mitigation plan. The Draft EIS clearly reiterates the various conditions of the land exchange applying to historic sites.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

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

IN REPLY REFER TO:

HWY-PS
2.7939

RECEIVED
JUL 29 1991
GROUP 70
LIMITED

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

July 26, 1991

Mr. Jeffrey H. Overton
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

Environmental Assessment (EA) for Manini'owali Residential Community, North Kona, Hawaii
TMK: 7-2-04, 388 acres

Thank you for your letter of June 25, 1991, requesting our review of the above project EA.

We have the following comments:

1. We intend to have the existing Queen Kaahumanu Highway serve as the high-speed, limited-access highway for the region.

2. We will allow access to the highway only at major interchanges. All other roadways will have to access onto a system of frontage roads on both sides of the highway which will then carry the local traffic to the interchanges.

3. A fully channelized intersection with street lights shall be provided in the interim period until a Queen Kaahumanu Highway grade-separated interchange closest to the site is constructed. An engineering study to determine the specific location for interchanges along Queen Kaahumanu Highway from Kailua to Kawaihae is in progress.

4. The developer should coordinate with the adjacent developers to determine the best location of their interconnecting internal roadway system and related roadway infrastructure.

5. A traffic impact analysis report must be submitted to us for our review and approval.

6. Plans for construction work within the State highway right-of-way must be submitted for our review and approval. All costs incurred for roadway improvements shall be borne by the developer.

7. All utilities within the Queen Kaahumanu Highway right-of-way shall be placed underground and outside the edge of pavement. Bikepaths and highway landscaping should also be discussed.

8. Additional regional traffic mitigation measures required as a cumulative result of this and other projects in the area should also be provided by the developer. The developer should commit to the funding and construction of such regional traffic improvements on a prorata basis as determined by the State Department of Transportation.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
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James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Edward Y. Hirata, Director of Transportation
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813-5097

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Hirata:

Thank you for your July 26, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Project Access

The access from this project is proposed to connect with the planned frontage road system for the expanded Queen Ka'ahumanu Highway. As we discovered in meeting with your Planning Division, there is no definitive location of an interchange(s) to serve the Kukio/Kaupulehu node. For the interim period, North Kona Development Group (NKDG) will provide a fully channelized intersection until the expanded highway system is on-line. We look forward to seeing the results of your engineering study of potential interchange locations. NKDG and its representative have already begun a dialogue with the neighboring developers regarding the proposed interchange location.

B. Traffic Impact Analysis Report

Traffic Management Consultants (TMC) have completed a traffic impact study of this proposed project, which has been forwarded to your office for review. This study is included in the Draft Environmental Impact Statement (Draft EIS), which your office will receive in formal distribution of the document.

C Construction Plans, Costs and Related Issues

Plans for construction work within the State right-of-way will be submitted to the DOT for review and approval. Costs incurred for roadway development specifically relating to this residential community will be borne by NKdG. Our land plan does consider internal bike paths and landscaping along the highway frontage area.

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D. Regional Traffic Mitigation

NKDG intends to address improvements that are required to mitigate traffic that is generated by the project.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813

July 2, 1991

RECEIVED
JUL 3 1991
GROUP 70
LIMITED

Mr. Jeff Overton
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton,

SUBJECT: Manini'owali Residential Community
Manini'owali and Kuki'o 2, North Kona, Island of Hawaii

We have reviewed the Environmental Assessment for the above subject and offer the following comment:

1. Please discuss the impacts that would be caused by project related construction activities.

If you have any questions, please call Jeyan Thirugnanam at 586-4185. Thank you.

Sincerely,

Brian J.J. Choy

copy: Mr. Norman K. Hayashi

GROUP 70
LIMITED

November 5, 1991

Mr. Brian J. J. Choy
Office of Environmental Quality Control
State of Hawai'i
220 South King Street, Fourth Floor
Honolulu, Hawai'i 96813

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Choy:

Thank you for your July 2, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

Construction-related impacts are discussed in several sections of the Draft Environmental Impact Statement (Draft EIS), including roadways and traffic (4.11), noise (4.12), air quality (4.13), and unavoidable adverse impacts (4.19). The most tangible impact of construction from off-site locations could be the traffic generated by worker vehicles and truck deliveries of supplies. Construction site dust will also be a consideration, requiring establishment of an effective road watering program during construction. Views of the site during construction will reveal graded areas, building activities and construction equipment operations.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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Lorraine R. Inouye
Mayor
Charmaine L. Kamaka
Director
Alan R. Parker
Deputy Director

Department of Parks and Recreation

25 Aupuni Street, Room 210 • Hilo, Hawaii 96720 • (808) 961-8311

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JUL 18 1991
GROUP 70
LIMITED

July 15, 1991

Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813
Attn: Jeff Overton

Subject: Manini'owale Residential Community
EIS Preparation Notice, North Kona, Hawaii
TMK: 7-2-04:por. 17

The following comments are offered for your consideration:

1) The proposed 900-1100 residential unit development can be expected to generate a population of 2500-3000 persons. Based on a standard of 5 acres of park per 1000 population, park acreage of between 12.5-15.0 acres would be required;

2) For the non-golf/tennis interests, other recreational activities, e.g. swimming pool, jogging paths, community center, etc. should be considered; and

3) The County's proposed development impact regulations should be reviewed.

Thank you for the opportunity to review the EIS preparation notice.

Sincerely,

Charmaine L. Kamaka

Charmaine L. Kamaka
Director

cc: Planning Department, County of Hawaii

GROUP 70

LIMITED

5 November 1991

Ms. Charmaine L. Kamaka, Director
Department of Parks and Recreation
County of Hawai'i
25 Aupuni Street, Room 210
Hilo, Hawai'i 96720

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Ms. Kamaka:

Thank you for your July 15, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The proposed golf course, driving range, tennis facilities, and clubhouse swimming pool, as shown in the Master Plan, will easily exceed the required acreage of 12.5 to 15 acres of park acreage. Other facilities are also under consideration, such as hiking/jogging trails along the golf course perimeter, and bike lanes on the internal roadway system. All of the proposed recreational facilities within the Manini'owali Residential Community are currently proposed for private ownership and operation. With direct access to the proposed shoreline park, extensive opportunities for hiking, fishing, snorkeling and swimming will be available. NKDG will be playing an active role in the planning and development of the shoreline park facilities on the State portion of Manini'owali.

The County's proposed development impact regulation has been reviewed, as you recommended. However, since it is not yet public law, no reference to it has been made in the Draft EIS.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

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JUL 17 1991
GROUP 70
LIMITED

July 12, 1991

Group 70, Limited
ATTENTION: MR. JEFF OVERTON
924 Bethel Street
Honolulu, HI 96813

EIS PREPARATION NOTICE
MANINI'OWALI RESIDENTIAL COMMUNITY
TAX MAP KEY 7-2-04:17 (PORTION)

Applicable provisions of the County of Hawaii Resolution No. 698-83 shall be complied with. Also, pursuant to Section 23-84 of the Hawaii County Code, the water system shall be constructed in accordance with the Department's Water System Standards and Rules and Regulations.

The following shall be submitted at the appropriate time:

1. Well Completion Report as required by the Division of Water Resource Management (DWRM) of the State Department of Land and Natural Resources for each well.

2. As-built construction plans of each well. Plans shall include, but not be limited to, sectional drawings, plot plans and maps showing the exact locations for all wells, and construction specifications.

3. Complete pumping test records for all wells. Records shall include, but not be limited to, time, pumping rate, drawdown, chloride content, and water quality data.

4. Engineer's and hydro-geologist's report on the sustainable yield of the groundwater aquifer where the wells are located.

5. Engineering Report which satisfactorily addresses the concerns and requirements of Section 11-30-29, Chapter 20, Title II, Administrative Rule, of the State Department of Health (DOH) for each source.

6. DOH's approval of each potable water source serving a community water system.

7. Water allocation and demand from the water sources.

8. Master plan of the required off-site and on-site water system improvements.

... Water brings progress...

9. Water system design calculations.

10. Water system construction costs and time schedule.

H. William Sewake
Manager

QA

cc - Planning Department

GROUP 70
LIMITED

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hitoshi Hida, AIA

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Michael A. Garni
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. H. William Sewake, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Sewake:

Thank you for your July 12, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

As discussed in the Draft Environmental Impact Statement (Draft EIS), NKDG has requested permission to withdraw brackish water from land located on State land mauka of Queen Ka'ahumanu Highway in Awake'e and Manini'owali. The project proposes use of a dual water system, with desalinized brackish water used for potable needs and brackish water for irrigation needs (including desalinization plant by-product water). For more details on this proposed system, please refer to the Draft EIS Section 2 and appended reports from Waimea Water Services (WWS) and Park Engineering.

At the appropriate time following the discretionary approval process involving the State and County, the developer's agents will submit the reports, plans and supporting information required in your items 1 to 10. At this point in the planning process, only some of the required information is available in a preliminary form, as discussed in the WWS and Park reports and summarized in the Draft EIS.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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Lorraine R. Inouye
Mayor
Victor V. Vierra
Chief of Police
Francis C. DeMorales
Deputy Chief of Police

Police Department

349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • Fax (808) 961-2702

July 12, 1991

RECEIVED
JUL 16 1991
GROUP 70
LIMITED

Group 70 Limited
924 Bethel Street
Honolulu, HI 96813

Attention: Mr. Jeff Overton

Dear Sir:

SUBJECT: ENVIRONMENTAL ASSESSMENT AND NOTICE OF PREPARATION FOR AN ENVIRONMENTAL IMPACT STATEMENT
MANINI'OWALI RESIDENTIAL COMMUNITY
MANINI'OWALI AND KUKIO 2, NORTH KONA, HAWAII

The EIS Preparation Notice has been reviewed and we recommend the developer provide for a deceleration, acceleration and left turn lanes for the proposed development.

Thank you for the opportunity to provide input.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

JD:sk

cc: Norman Hayashi, County Planning Director
Kona Police

5 November 1991

GROUP 70
LIMITED

Mr. Victor V. Vierra, Chief of Police
Police Department
County of Hawaii
349 Kapiolani Street
Hilo, HI 96720-3998

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Vierra:

Thank you for your July 12, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The proposed residential community will provide deceleration, acceleration and left-turn lanes at the temporary intersection of the access roadway with Queen Ka'ahumanu Highway. As you are probably aware, the State is planning the improvement of this highway to a limited access freeway system.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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Lorraine R. Inouye
Mayor
Daniel Ayala
Fire Chief
Harding Fragas, Jr.
Deputy Fire Chief

Fire Department

466 Kinoole Street • Hilo, Hawaii 96720-2983 • (808) 961-8297 • Fax (808) 961-6920

July 3, 1991

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JUL 5 1991
GROUP 70
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Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Attention: Jeff Overton

Gentlemen:

Subject: Manini'owali Residential Community
Manini'owali and Kuki'o 2, North Kona, Island of Hawaii

For your information, the project site is approximately 20 miles from Kailua Fire Station and 15 miles from South Kohala Fire Station. Both of these stations provide 24-hour protection and advance life support services (ambulance).

South Kohala Station has a 1,500 gpm pumper with 1,000 gallons of water and a staff of 18 men divided into three shifts. They also have an ambulance and an old military 2-1/2 ton 1,000-gallon tanker.

Kailua Fire Station has a staff of 33 personnel, again divided into three shifts. Their equipment consist of a 1,500 gpm pumper with 1,000 gallons of water; a 750 gpm tanker with 1,200 gallons of water; an ambulance; a 26-foot Radon rescue boat; and a 65-foot aerial ladder truck carrying 500 gallons of water. The ladder truck, as well as the rescue boat, however, may be relocated along with 15 personnel to a tentative Keauhou Fire Station.

It is the Fire Department's determination that the proposed project will have some significant impacts on our services and should be addressed.

Sincerely,

Daniel Ayala

DANIEL AYALA
Fire Chief

DA/mo

cc: Norman Hayashi, Planning Director

GROUP 70
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Francis S. Oda, AIA, AICP
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Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Daniel Ayala, Fire Chief
Fire Department
County of Hawaii
466 Kinoole Street
Hilo, HI 96720-2983

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Ayala:

Thank you for your July 3, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The development of this proposed residential community will require fire fighting services from your department. Your statement regarding the adequacy of your existing fire fighting capabilities, and the potential impact of this project, has been noted by NKDG. All of these developments will likely be served by the Kailua-Kona Fire Station. A portion of the substantial new County revenues that will be generated from property taxes at this project should be allocated to fire fighting equipment and operational support in the Kailua-Kona area. This project is planned to become part of the entire residential and resort development node at Kukio/Kaupulehu. If desired, NKDG representatives would be glad to meet with you to discuss your projected needs for the future.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

39 Ululani St., Hilo, HI 96720 • Telephone (808) 935-1206, Fax (808) 935-7474
73-4177 Kilapa St., Kailua-Kona, HI 96740 • Telelphone (808) 325-5339

AMERICAN LUNG ASSOCIATION *of Hawaii*
The Christmas Seal People®

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JUL 15 1991
GROUP 70
LIMITED

July 10, 1991

Mr. Jeff Overton
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

Subject: EIS Preparation Notice
Manini'owali Residential Community

Thank you for your letter of June 25th and copy of the EISPN for the subject project. Pursuant to the State EIS Rules (Chapter 200), we do wish to be a consulted party for this project and receive a copy of the Draft EIS when it is published.

We note from the EISPN that an air quality study is being conducted and trust that the following air pollution sources will be fully addressed in that study:

- cumulative impact of increased traffic due to the project;
- cumulative impact due to increased fuel use by power plant(s) to meet the project's energy demands;
- pesticide drift from the proposed golf course;
- emissions from the wastewater treatment facility (WWTF)
- short-term emissions due to construction (onsite/offsite)
- impact, if any, of the surrounding environment on the project (e.g., vog, landfills, power plants, etc.)

Where impacts are identified, appropriate mitigation measures should also be presented and implemented by the project developer.

Thank you for providing this opportunity for early input to the environmental review process. We look forward to seeing the Draft EIS.

Sincerely,

Ann M. Nies
West Hawaii Program Assistant

cc: Planning Director

Christmas Seals Fight TB, Asthma, Emphysema, Air Pollution

GROUP 70
L I M I T E D

5 November 1991

Ms. Ann M. Niess, West Hawaii Program Assistant
American Lung Association
73-4177 Kilapa Street
Kailua-Kona, HI 96740

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Ms. Niess:

Thank you for your July 10, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A detailed air quality impact study has been prepared for this project by Barry Neal, C.C.M. In this study, Neal has addressed each of the points raised in your letter. The Draft Environmental Impact Statement (Draft EIS) will include this report in its entirety as an appendix, and a summary of the findings will be presented in the main body of the text. Mitigative measures are also proposed in the Draft EIS.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

Keola Childs
75-5648C Mamalahoa Hwy.
Holualoa, HI 96725
ph: 324-7465

COPY

July 2, 1991

RECEIVED
JUL 3 1991
GROUP 70
LIMITED

Attention: Jeffrey Overton
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813

RE: Manini'owali Residential Community

Dear Mr. Overton:

In response to the E.I.S. preparation notice published in the OEQC Bulletin of June 23, 1991, I have the following comments:

1. The document should contain a view plane study over portions of the site:

   - from Queen Kaahumanu Highway, from both the existing two lanes and based on the highway being widened to four or six lanes, as is planned to occur eventually. As I understand the present highway alignment, the lane expansion will be makai of the existing lanes and thus will move traffic closer to the development boundary.

   - from the public trail and practical use zones (any developed park areas) within the state oceanfront lands below the subject site,

   - along the public access route to the shoreline and park areas.

2. Within those portions of the site visible from public use zones, scenic impact mitigation measures should be outlined as such. This would include vegetative aspects, roofing materials, building heights.

3. The complete design concepts for the public improvement areas and items, sufficient to avoid later, separate EIS requirements, should be included in this document. Although the Preparation Notice references this requirement, it is unclear as to whether these items will be sufficiently presented in the EIS to actually allow final design and construction to follow.

4. In order to properly comment on those proposed access and park area improvements, the EIS should include, as an Exhibit, the relevant excerpt from the land exchange agreement.

Group 70 Limited
July 2, 1991
Page 2

For example, based on the BLNR public hearing of the proposed exchange last fall, I had understood facilities were proposed, for park use purposes, within the northern end of the Awake'e ahupua'a; perhaps these facilities are simply being relocated to the north side of Kua Bay, into the next (Manini'owali) ahupua'a, but this is not clear.

I realize that most or all of these concerns may have already been included in the E.I.S. scope.

Thank you for this opportunity to comment.

Sincerely,

Keola Childs

cc: County of Hawaii Planning Department
North Kona Development Group

GROUP 70
L I M I T E D

Francis S. Oda, AIA, AICP
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Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Keola Childs
75-5648C Mamalahoa Highway
Holualoa, Hawai'i 96725

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Childs:

Thank you for your July 2, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. View Plane Study

The potential visual impact of the project is addressed in Section 4.14 of the Draft Environmental Impact Statement (Draft EIS). Public views of this land will be affected by the proposed project, including views from Queen Ka'ahumanu Highway, the coastal section of Manini'owali, and from the planned public access route to the coast. Views from two locations are presented in the Draft EIS, including mauka and makai views of the land. From the highway, the project will be most visible when approaching from the north, and views of residential structures, the golf course and landscaped common areas will be noticable. Landscaping will be used where needed to help screen views of home from the highway. Views from the coast will be minimal because of the 1,400 foot distance separating the coast and the makai-most project structures. Views from the public access road will likely be screened by landscaping along the access roadway, although the details of the access roadway design will be discussed in greater detail during the shoreline park planning process.

Discussed also in Section 4.14 are the maximum heights of buildings and the proposed landscape treatment. The development theme for the residential project is intended to use a non-obtrustive *kama'aina* architectural style. At this stage in the design process, specific details of the types of building materials to be used have not been considered. Vegetation cover, roofing materials and building heights will all be considered during the design process. Typical residential area heights will be maintained, with the maximum height for multi-family residential building at 45 feet.

B. Shoreline Park Improvements

The public improvements to the State's shoreline park to be developed *makai* of the NKDG property is not part of this project, and is therefore not included in the Draft EIS. The State government is responsible for the planning of a wilderness park at Awake'e, Manini'owali, and other areas along the Kona coast, as well as the environmental disclosure for this separate park development project. NKDG is obligated by terms of the land exchange to provide acceptable public access to the park and park facilities in conjunction with development of its community, or contribute up to $2.5 million if the development of the State park preceeds the project. Conditions required under the land exchange are cited in the Draft EIS. The shoreline park planning process will be initiated by NKDG at a planning workshop to be held in Kona on November 23, 1991.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

GREENPEACE HAWAII PO BOX 10909 HILO HAWAII 96721
(808) 935-0770

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JUL 3 1991
GROUP 70
LIMITED

July 2, 1991

Mr. Norman Hayashi
Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

RE: DRAFT ENVIRONMENTAL IMPACT STATEMENT/MANINI'OWALI RESIDENTIAL COMMUNITY

We have concerns regarding the negative impacts of this project on the marine environment, specifically development and maintenance of the proposed golf course and driving range, and landscaping for 900 - 1,100 single and multiple family residential units, clubhouse and tennis center. We are particularly concerned that the E.I.S. address fertilizer, herbicide, insecticide and pesticide runoff into adjacent nearshore waters as this relates to an increase in ciguatoxin; i.e., ciguatera fish poisoning. We are equally concerned about the potential negative impacts from this chemical runoff on water quality and marine life such as, but not limited to, abundance, diversity and distribution of stony and soft corals, motile benthos (echinoderms) and pelagic species (reef fish).

Impacts on the marine environment resulting from proposed infrastructure facilities, including the wastewater treatment and disposal system and non-potable water irrigation system, must also be addressed, as well as identifying "other utilities systems" for assessment of impact.

Thank you for the opportunity to comment on this project. We would appreciate your adding Greenpeace Hawaii to the list of Consulted Parties for the Draft Environmental Impact Statement.

Sincerely,

Denver A. Leaman
Executive Director

/lg

cc: North Kona Development Group
Group 70 Limited

GROUP 70
LIMITED

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
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Jen-Chih "Jack" Lee, AIA
Michael A. Garni
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Denver Leaman, Executive Director
Greenpeace Hawaii
P.O. Box 1090
Hilo, HI 96721

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Leaman:

Thank you for your July 2, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

The proposed golf course at this community will require the use of fertilizer to enhance turf growth, and some pesticides to control pest populations. As part of the Draft Environmental Impact Statement (Draft EIS), the potential infiltration of fertilizer nutrients and pesticides into groundwater and eventually into the ocean has been studied by Oceanit Laboratories. Their findings show that small quantities of fertilizer nutrients and very small or non-detectable quantities of pesticides may be introduced to the ocean through groundwater. According to Oceanit, the addition of these fertilizer nutrients and pesticides compounds is not expected to affect nearshore water quality or the marine ecological community along this coast.

The Draft EIS presents numerous mitigative measures planned to minimize the use of fertilizers and pesticides, such as the planned Integrated Pest Management (IPM) program, reduced turf areas, low demand turf types, computer controlled irrigation, and slow-release fertilizers. With these measures in place, fertilizer nutrients and pesticides will have no noticable impact on coastal waters quality or ecology. Also, our investigation of the current ciguatera problem (as studied by the state DOH) shows no evidence golf course chemical use has any relationship to the incidence of ciguatera in coastal fish.

The proposed treatment facility, and disposal through effluent irrigation is a sound practice which is strongly encouraged by the State Department of Health for this project. Nutrients in wastewater will actually replace some of the fertilizer contribution need for the golf course.

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Mr. Norman Hayashi
County Planning Director
25 Aupuni Street
Hilo, HI 96720

July 14, 1991

Dear Mr. Hayashi;

On behalf of Life of the Land, Big Island chapter, I write in regard to the Manini'owali project which appears in the current OEQC bulletin. We would like to be a consulted party in the preparation of the EIS.

One particular concern is the cost/benefit analysis which is generally included in the EIS's we have seen. The EIS's for recent resort developments have generally indicated a strong postitve economic return to both the county and state. Note the Ritz-Carlton EIS. However, in practice we are finding a growing infrastructure shortage due to the lack of economic resources to support the development that is occurring. Thus we would suggest that you require an economic analysis done in a way which is realistic and which will explain the shortfall that has been occurring.

In regard to the marine environment, the migration to the ocean of golf course fertilizer nutrients is a concern. The state DOH has done recent work on the probable influence of nutrients in the proliferation and worsening of the ciguatera problem. Also, Brock has shown at Waikoloa that the nutrients are indeed entering the ocean. Please make sure that these issues are not addressed summarily only, but are given the depth of treatment that they merit.

Thank you,

Bill Graham

Bill Graham, 889-5957
for Life of the Land
P.O. Box 155
Hawi, HI 96719

GROUP 70
LIMITED

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Norman G.Y. Hong, AIA
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Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

November 5, 1991

Mr. Bill Graham
Life of the Land, Big Island Chapter
25 Aupuni Street
Hilo, HI 96720

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Graham:

Thank you for your July 14, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Economic Analysis

The Draft Environmental Impact Statement (Draft EIS) includes a fiscal impact study of the proposed residential community prepared by John Zapotocky, Consultant. The fiscal study indicates that the project will have a positive impact on county and state revenues. The study used conservative estimates of potential revenues and expenses in their calculation of net fiscal impacts.

B. Fertilizer Migration

The proposed golf course at this community will require the use of fertilizer to enhance turf growth. As part of the Draft EIS, the potential infiltration of fertilizer nutrients into groundwater and eventually into the ocean has been studied by Oceanit Laboratories. Their findings show that small quantities of fertilizer nutrients may be introduced to the ocean through groundwater discharges. According to Oceanit, the addition of these fertilizer nutrients is not expected to affect nearshore water quality or the marine ecological community along this coast. In addition, the Draft EIS presents numerous mitigative measures planned to minimize the use of fertilizer, such as reduced turf areas, low demand turf types, computer controlled irrigation, and slow-release fertilizers. With these measures in place, the impact of fertilizer nutrients on coastal waters will be minimal. Also, our investigation of the current ciguatera

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

problem (as studied by the state DOH) shows no evidence that golf course chemical use has any relationship to the incidence of ciguatera in coastal fish.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Enclosures

Forests

The West Hawaii Sierra Club

Seas

Monday, June 17, 1991

North Kona Development Group
Attn: Michael J. Hands
1600 Ala Moana Boulevard, Suite 2306
Honolulu, HI 96815

Dear Mr. Hands,

The West Hawaii Sierra Club requests participation in the EIS process for your proposed Manin'owali Residential Community. We understand this proposed project would include an 18 hole golf course and up to 1,100 residential units.

The Executive Committee of the West Hawaii Sierra Club has passed a resolution asking that developers subscribe to the "Valdez Principles". Enclosed is a copy of the Valdez Principles for reference. Should you have any questions concerning the Valdez Principles, please contact us.

Finally, we expect to have additional comments as the EIS process unfolds; please put us on your mailing list.

Thank you for your attention in this matter,

Jay Hanson Phone 322-7268 or 329-6645 Fax 322-7869
Program Chair, West Hawaii Sierra Club,
78-6622 Alii Drive
Kailua-Kona, HI 96740

The Valdez Principles

By adopting these Principles, we publicly affirm our belief that corporations and their shareholders have a direct responsibility for the environment. We believe that corporations must conduct their business as responsible stewards of the environment and seek profits only in an manner that leaves the Earth healthy and safe. We believe that corporations must not compromise the ability of future generations to sustain their needs.

We recognize this to be a long-term commitment to update our practices continually in light of advances in technology and new understandings in health and environmental science. We intend to make consistent, measurable progress in implementing these Principles and to apply them wherever we operate throughout the world.

1. Protection of the Biosphere

We will minimize and strive to eliminate the release of any pollution that may cause environmental damage to the air, water, or earth or its inhabitants. We will safeguard habitats in rivers, lakes, wetlands, coastal zones and oceans and will minimize contributing to the greenhouse effect, depletion of ozone layer, acid rain, or smog.

2. Sustainable use of Natural Resources

We will make sustainable use of renewable natural resources, such as water, soils and forests. We will conserve nonrenewable natural resources through efficient use and careful planning. We will protect wildlife habitat, open spaces and wilderness, while preserving biodiversity.

3. Reduction and Disposal of Waste

We will minimize the creation of waste, especially hazardous waste, and wherever possible recycle materials. We will dispose of all wastes through safe and responsible methods.

4. Wise Use of Energy

We will make every effort to use environmentally safe and sustainable energy sources to meet our needs. We will invest in improved energy efficiency and conservation in our operations. We will maximize the energy efficiency of products we produce and sell.

5. Risk Reduction

We will minimize the environment, health and safety risks to our employees and the communities in which we operate by employing safe technologies and operating procedures and by being constantly prepared for emergencies.

6. Marketing of Safe Products and Services

We will sell products or services that minimize adverse environmental impacts and that are safe as consumers commonly use them. We will inform consumers of the environmental impacts of our products or services.

7. Damage Compensation

We will take responsibility for any harm we cause to the environment by making every effort to fully restore the environment and to compensate those persons who are adversely affected.

8. Disclosure

We will disclose to our employees and to the public incidents relating to our operations that cause environmental harm or pose health or safety hazards. We will disclose potential environmental, health or safety hazards posed by our operations, and we will not take any action against employees who report any condition that creates a danger to the environment or poses health and safety hazards.

9. Environmental Directors and Managers

We will commit management resources to implement the Valdez Principles, to monitor and report upon our implementation efforts, and to sustain a process to ensure that the Board of Directors and Chief Executive Officer are kept informed of and are fully responsible for all environmental matters. We will establish a Committee of the Board of Directors with responsibility for environmental affairs. At least one member of the Board of Directors will be a person qualified to represent environmental interests to come before the company.

10. Assessment and Annual Audit

We will conduct and make public an annual self-evaluation of our progress in implementing these Principles and in complying with applicable laws and regulations throughout our worldwide operations. We will work toward the timely creation of independent environmental audit procedures which we will complete annually and make available to the public.

The Valdez Principles were forged by the Coalition for Environmentally Responsible Economics (CERES), a consortium of the Social Investment Forum and 14 national environmental groups. The Social Investment Forum is a national trade association of money managers, brokers, bankers, analysts, and other socially concerned investors that control about 150 billion investment dollars.

The ten Valdez Principles are structured to reward responsible corporate actions with investment dollars, and to withdraw dollars from irresponsible corporations. For example, a state pension fund might eventually sell off stocks in companies that did not pledge to support the principles.

Investors, consumers, and employees can influence corporate behavior by supporting corporations that subscribe to the Valdez Principles. More and more corporate leaders are learning that environmental responsibility is good for business. Vigorous public participation will shorten their learning curves.

GROUP 70
LIMITED

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hitoshi Hida, AIA
Roy H. Nihei, AIA, CSI
Linda M. Aniya
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Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Garni
Eric G. Crispin, AIA
Danilo M. Herrera

5 November 1991

Mr. Jay Hanson, Program Chair
West Hawaii Sierra Club
78-6622 Ali'i Drive
Kailua-Kona, HI 96740

Re: **Environmental Assessment for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Hanson:

Thank you for your June 17, 1991 letter concerning the Environmental Assessment for the Manini'owali Residential Community. The following is offered in response to your comments.

We have reviewed The Valdez Principles which you provided us along with your letter. The proposed Manini'owali Residential Community is planned to become a model project in terms of its sensitivity to the environment. North Kona Development Group's development partner Davidson Communities, based in San Diego, CA., has developed several residential projects which have required special sensitivity to the local environmental conditions. These principles will be considered by NKDG in its development of this residential project.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

Lorraine R. Inouye
Mayor

Barry T. Mizuno
Managing Director

David Fuertes
Deputy Managing Director

Office of the Mayor

County of Hawaii • 25 Aupuni Street, Rm. 213 • Hilo, Hawaii 96720 • (808) 961-8211 • Fax (808) 961-6553

July 10, 1991

RECEIVED
JUL 16 1991
GROUP 70 LIMITED

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813-4398

Dear Mr. Overton:

General Plan Amendment
North Kona Development Group
Manini'owali Residential Community
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for the opportunity to provide comments on the preparation notice for the Manini'owali Residential Community EIS. We will be coordinating our response through the Planning Department at the Draft EIS stage.

Should you have any concerns in the meantime, please do not hesitate to contact my office or the Planning Department.

Aloha,

LORRAINE R. INOUYE
Mayor

Lorraine R. Inouye
Mayor
Norman K. Hayashi
Director
Tad Nagasako
Deputy Director

Planning Department

25 Aupuni Street, Room 109 • Hilo, Hawaii 96720 • (808) 961-8288

June 28, 1991

RECEIVED
GROUP 70 LIMITED

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813-4398

Dear Mr. Overton:

Notice of Preparation of an Environmental Impact Statement
Manini'owali Residential Community

This is to acknowledge receipt of your June 25, 1991, letter, requesting a two-week extension of the public review period for the Environmental Assessment (EA) of the Manini'owali Residential Community development. Given that copies of the EA were recently sent to the various representatives, agencies and organizations, we hereby grant you the time extension from July 8, 1991, to July 23, 1991, in order to allow additional time for the public to review and comment on the document.

By a copy of this letter, we will inform the Office of Environmental Quality Control of the extension of the public review period.

Should you have any questions, please feel free to contact Alice Kawaha of this office.

Sincerely,

NORMAN K. HAYASHI
Planning Director

AK:smo
2269D

cc: Office of Environmental Quality Control (w/copy of letter)

Lorraine R. Inouye
Mayor
Norman K. Hayashi
Director
Tad Nagasako
Deputy Director

Planning Department

25 Aupuni Street, Room 109 • Hilo, Hawaii 96720 • (808) 961-8288

RECEIVED
JUL 31 1991
GROUP 70
LIMITED

July 29, 1991

Mr. Michael J. Hands
North Kona Development Group
1600 Ala Moana Boulevard, Suite 2306
Honolulu, HI 96815

Dear Mr. Hands:

EIS Preparation Notice
Manini'owali Residential Community
TMK: 7-2-4:Portion 17

The enclosed July 14, 1991, letter from Mr. Bill Graham is forwarded to you for your appropriate action and direct response to him with regards to his comments.

Please be informed that Mr. Graham's letter was received in this office prior to the July 23, 1991, deadline date.

Should you have any questions, please contact Alice Kawaha of this office.

Sincerely,

NORMAN K. HAYASHI
Planning Director

AK:mra
2590(2)

Enclosure

cc: ~~Jeffrey~~ H. Overton, AICP (w/encl)
West Hawaii Office

JOHN WAIHEE
GOVERNOR

RUSSEL S. NAGATA
COMPTROLLER
ROBERT P. TAKUSHI
[redacted]
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
DIVISION OF PUBLIC WORKS
P. O. BOX 119, HONOLULU, HAWAII 96810

LETTER NO. (P)1705.1

JUL -5 1991

RECEIVED
JUL 8 1991
GROUP 70
LIMITED

Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Jeff Overton

Gentlemen:

Subject: Manini'owali Residential Community
North Kona, Hawaii
EISPN

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 contract Mr. Ralph Yukumoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

RY:bk
cc: Mr. Norman Hayashi, Hawaii County
Office of Environmental Quality Control

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 548-4611

RECEIVED
JUL 10 1991
GROUP 70
LIMITED

July 8, 1991

Mr. Jeff Overton
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

Subject: Manini'owali Residential Community
Manini'owali and Kuki'o 2, TMK No.: 7-2-04:
portion of 17, North Kona, Island of Hawaii

We have reviewed both the Environmental Assessment and Notice of Preparation of an EIS for the subject project and confirm that the subject parcel is designated within the State Land Use Conservation District.

For your information, the parcels to the immediate north (TMK No.: 7-2-04: 16 and portion of 5) were reclassified to the Urban District from the Conservation District for a resort/ residential community by the Land Use under LUC Docket No. A86-603/Huehue Ranch.

The Land Use Commission under LUC Docket No. A85-597/ Kaupulehu Developments (TMK No.: 7-2-03: portion of 1) had previously reclassified approximately 575 acres adjacent to and north of the Huehue parcel to the Urban District for intermediate resort/residential and golf course uses.

We have no other comments at this time. Thank you for the opportunity to comment on this matter.

If you have any questions, please call me or my staff at 548-4611.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:to

cc: Norman Hayashi, Director
Hawaii County Planning Dept.

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF LAND MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER RESOURCES MANAGEMENT

July 8, 1991

Mr. Jeffrey H. Overton, AICP
GROUP 70 LIMITED
924 Bethel Street
Honolulu, O'ahu, Hawai'i 96813

Ref. to: HA-91:487

Dear Mr. Overton:

Subject: Environmental Assessment for General Plan Amendment to the Proposed Manini'owali Residential Community, Manini'owali/Kuki'o 2, North Kohala, Hawai'i; Tax Map Key: 7-2-04: Portion 17

This is to acknowledge receipt of the subject environmental assessment for the proposed Manini'owali Residential Community. Please be informed that a copy has been forwarded to our Hawai'i District Land Office for their perusal and comment.

Upon receipt of their findings, we will forward our combined comments to your office. In the interim, should you have any questions, please contact either Mr. Glenn Taguchi of our Hawai'i District Land Office at (808) 933-4245 or Mr. Glenn Abe in Honolulu at 548-6460.

Very truly yours,

W. Mason Young

W. MASON YOUNG
Land Management Administrator

cc: HDLO
Board Member

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

December 13, 1991

REPLY TO
ATTENTION OF:

RECEIVED
DEC 16 ...
GROUP 70
LIMITED

Planning Division

Mr. Norman K. Hayashi, Director
County of Hawaii Planning Department
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Manini'owali Residential Community, North Kona District, Island of Hawaii (TMK 7-2-04: por.17). 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. There are no known streams or anchialine ponds at the project site; therefore, a DA permit is not required.

b. The flood zone designation (Zone X) which is cited on page 67 of the DEIS is correct.

Sincerely,

ORIGINAL SIGNED

Ray Jyo
Acting Director of Engineering

Copies Furnished:

Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

North Kona Development Group
Attention: Mr. Michael Hands
2877 Kalakaua Avenue, Suite GF#1
Honolulu, Hawaii 96815

Group 70 International
Attention: Mr. Jeffrey H. Overton, AICP
924 Bethel Street
Honolulu, Hawaii 96813

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
11000
Ser 00F2/2774
14 NOV 1991

County of Hawaii
Planning Department
Attn: Mr. Norman Hayashi, Director
25 Aupuni Street
Hilo, HI 96720

RECEIVED
NOV 15 1991
GROUP 70

Gentlemen:

MANINI'OWALI RESIDENTIAL COMMUNITY

We have reviewed the subject DEIS and have no comments to offer. Since we have no further use for the DEIS, it being returned to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. Liu

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
North Kona Development Group
(Mr. Michael Hands)
Group 70 International
(Mr. Jeffrey H. Overton AICP)
OEQC (w/DEIS)

NOV 21 1991

November 17, 1991

Engineering Office

Norman Hayashi, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Subject: Draft Environmental Impact Statement for Proposed Manini'owali Residential Community, North Kona, Hawaii, TMK: 7-2-04: por. 17

Dear Mr. Hayashi:

Thank you for providing us the opportunity to review the above mentioned Environmental Impact Statement.

We have no comments to offer at this time regarding the project.

Sincerely,

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting and Engineering Officer

Enc.

c: Office of Environmental Quality Control
Group 70 International
North Kona Development Group

HOUSE OF REPRESENTATIVES
THE SIXTEENTH LEGISLATURE

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

November 12, 1991

RECEIVED
NOV 15 1991
GROUP 70
LIMITED

Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813-4398

Dear Mr. Overton:

I acknowledge receipt of and thank you for the copy of the Draft Environmental Impact Statement for the proposed Maniniowali Residential Community.

I appreciate your taking the time to send me this material.

With warm personal regards.

Sincerely,

WAYNE METCALF
Chairman
House Committee on Judiciary

WCM:gkk

Jeff

RECEIVED
NOV 18 1991

(P)2235.1

NOV 14 1991

County of Hawaii
Planning Department
25 Aupuni Street
Hilo, Hawaii 96720

Attention: Mr. Norman Hayashi

Gentlemen:

Subject: Manini'owali Residential Community
Draft EIS

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,

T. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

RY:jk
cc: North Kona Development Group
✓Group 70 International
Office of Environmental Quality Control

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 548-4611

RECEIVED
NOV 13 1991

November 8, 1991

Mr. Norman K. Hayashi
Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

Subject: Draft Environmental Impact Statement for the Manini'owali Residential Community, North Kona District, Hawaii

We have reviewed the subject draft Environmental Impact Statement (DEIS) for the Manini'owali Residential Community project and confirm that it is designated within the State Land Use Conservation District. Based on the DEIS, we understand that a petition for reclassification of the subject property will be filed with the Land Use Commission.

As mentioned in our letter dated July 8, 1991 on the Environmental Assessment for the subject project, there have been two major projects in the general area for which the Land Use Commission has approved reclassification from the Conservation District to the Urban District, LUC Docket No. A86-603/Huehue Ranch and A85-597/Kaupulehu Developments. We suggest that the Final EIS include a map of the proposed Manini'owali Residential Community in relation to the State Land Use Districts.

We have no other comments at this time. We appreciate the opportunity to comment on this matter.

If you have any questions, please call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:to

cc: Michael Hands
Jeffrey H. Overton
OEQC

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hitoshi Hida, AIA
Roy H. Nihei, AIA, CSI
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Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

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

Re: **Draft Environmental Impact Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Ms. Ueda:

Thank you for your 8 November 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community.

We have prepared a map of the project area which depicts the State Land Use Districts in relation to the surrounding properties. Designated on this map are the Urban areas which include the developments at Kaupulehu and Kuki'o 1. The map is included in the Final EIS as Figure 8.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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 587-2848
Planning Division 587-2824

Ref. No. P-2634

Jeff

December 24, 1991

RECEIVED
DEC 30 1991
GROUP 70 LIMITED

The Honorable Norman Hayashi
Planning Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

Subject: Draft Environmental Impact Statement for the Proposed Manini'owali Residential Community, North Kona, Hawaii, TMK: 7-2-04:17

We have reviewed the subject petition relative to the Hawaii Coastal Zone Management (CZM) Program objectives and policies and have the following comments.

The applicant provides mitigation for control of pesticides and fertilizers to minimize leaching and accumulation to groundwater through Integrated Pest Management (IPM) program and application schedules, sediment basins, vegetation swales, drywells, including lysimeter tests to quantitatively determine the extent of leaching below the turf level. We understand that groundwater flows through lava tubes and enters the ocean in Kua Bay. This process is evident from lower salinity levels and increase in silicate and natural nitrate levels in the surrounding Class AA waters of Kua Bay. We recommend that the applicant implement a water quality monitoring program in Kua Bay to monitor the impacts on marine life and endangered Hawksbill and Green Sea turtles from fertilizer and pesticide use.

The project proposes construction of a desalinization plant to reclaim brackish water for irrigation and conservation of potable water. We are concerned about the potential run-off and seepage of waste by-products into groundwater that may eventually enter the Class AA waters of Kua Bay and impact marine life. More information is required on the methods of containment and disposal of waste by-products generated from desalinization, including a plan for implementing mitigation measures.

The project will involve extensive cutting, grading, excavating and filling for a golf course and the community development. Adverse impacts on the indigenous and endemic Hawaiian plants should be avoided. The project design should also avoid adverse impacts on archaeological sites and trails of historical significance. More information on these concerns should be included in the EIS, and reasonable mitigation measures should be proposed if the adverse impacts cannot be avoided entirely.

We appreciate the opportunity to comment on this Draft Environmental Impact Statement. If you have any questions, please feel free to call our CZM office at 587-2883.

Sincerely,

Harold S. Masumoto
Director

cc: North Kona Development Group
Group 70 International
Office of Environmental Quality Control

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hitoshi Hida, AIA
Roy H. Nihei, AIA, CSI
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Walter K. Muraoka
George I. Atta, AICP
Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

Mr. Harold S. Masumoto, Director
Office of State Planning
Office of the Governor
PO Box 3540
Honolulu, HI 96811-3540

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Masumoto:

Thank you for your 24 December 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Ocean Water Quality

Potential changes to nearshore water quality as a result of the proposed project have been considered by Oceanit Laboratories, Inc. (OLI); their report is included in the Final EIS as Appendix F. OLI's findings indicate that nearshore ocean water could receive some minor input of ground water containing minor concentrations of fertilizer and treated effluent nitrogen. Some extremely minute or non-detectable concentrations of pesticides could be present in ground water released along this coast. The introduction of these small concentrations of fertilizer and pesticide compounds will not cause adverse effects on the nearshore water quality or the marine ecology due to the active ocean water mixing at the nearshore or offshore ground water discharge points.

Baseline monitoring of Kua Bay and the nearshore ocean waters off Manini'owali has already been initiated by OLI. North Kona Development Group (NKDG) is willing to comply with requirements for long-term monitoring of nearshore water quality and the anchialine pond near Kua Bay. Details of an ocean water monitoring program will be developed in coordination with the State Department of Health and the DLNR - Division of Aquatic Resources.

B. Desalinization Plant By-Product Water

The underlying brackish ground water contains approximately 1,000 ppm chlorides. Desalinization by Reverse Osmosis (RO) is the planned method for supplying potable water supply to this project. The by-product water generated by the reverse osmosis plant will have a chlorides concentration of

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approximately 2,300 ppm. Despite this relatively high level of chlorides, the water is viewed as a resource for this project. The by-product water will be diluted with treated wastewater effluent (250 ppm chlorides) and brackish ground water. This mixture of waters will produce an irrigation water with approximately 1,240 ppm chlorides. Residential areas will be irrigated with brackish groundwater only, containing no treated wastewater effluent. Salt-tolerant plants are planned to be used for the golf course turf and for the project's landscaping.

The desalinization plant by-product water will be blended with treated effluent and brackish water within an irrigation storage pond on the project site. This pond will be lined to prevent infiltration and loss to ground water. There will be no seepage of by-product water into the ground water, nor will there be any potential runoff of by-product water.

Slight changes to the salinity of the ground water beneath the project site could potentially result due to the elevated chlorides content of the irrigation water. Potential effects on nearshore salinity have been considered by OLI. OLI's findings indicate that nearshore ocean water could receive some minor input of ground water with higher than average salinity as a result of the project's irrigation practices. The introduction of water with slighlty greater salinity is not expected to cause adverse effects on the nearshore water quality or the marine ecology. The higher salinity ground water will be rapidly mixed with the surrounding ocean waters at the nearshore or offshore discharge point.

C. Clearing and Grading Activities

The vegetation occuring at the Manini'owali project site has been inventoried by Char and Associates (October 1991), as presented in the Draft EIS. This study indicates that on this property, there are indigenous plants (*pili*, *'ilima*, *alena* and *a'ali'i*) and endemic plants (*'iwa'iwa*, Cyperaceae sedge, native panic grass, *nehe* and *puakala*). The native species found on the site occur throughout the islands in similar environmental conditions. Clearing and grading activities for project development will result in the disturbance or elimination of much of the existing vegetation on the site. The proposed development will not have a significant negative impact on the total island populations of these species. In fact, the proposed residential community, including the golf course, will establish native plant species as part of the landscaping, such as *wiliwili*, *nehe*, *maiapilo*, *a'ali'i*, *'ilima*, *alahe'e* and the *pololei* fern (a candidate endangered species).

D. **Impact on Archaeological Sites and Significant Trails**

The proposed project will avoid adverse impacts to significant archaeological sites and trails of historic significance on this property. Substantial effort has been made in documenting existing features on the site, presented in a report by the Bishop Museum Applied Research Group. The final DLNR-approved report of the Archaeological Inventory Survey has been included as Appendix J of the Final EIS.

Several of the archaeological features of the site will be data recovered or preserved. All burials found on the property will remain untouched with in-situ preservation. Protective measures have been taken to seal off these sites from potential disturbance by unauthorized visitors. Long-term preservation plans for the significant sites will be formulated in the Cultural Resources Management Plan, to be prepared and submitted to the DLNR later in the planning process. This plan will include two components, a preservation plan and a data recovery plan. Data Recovery is expected to be extensive at significant sites which will be disturbed by project development.

NKDG is working with the Na Ala Hele Advisory Council to determine preservation plans for the historic trails found on this site.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED
10 1991
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LIMITED

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA:SKK

DEC 9 1991

FILE NO.: 92-277
DOC. NO.: 2181E

The Honorable Norman K. Hayashi
Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. ~~Hayashi~~: Norman

Subject: Draft Environmental Impact Statement (DEIS) for the Manini'owali Residential Community - North Kona, Hawaii
TMK: (3) 7-2-4: 17

Thank you for giving our Department the opportunity to review this draft EIS. Our comments are as follows:

Brief Description:

The applicant plans to construct a medium density residential community with recreational amenities including a golf course, clubhouse, tennis center and supporting infrastructure. The project area is about 388 acres, mauka of Kua Bay, approximately 1,000 feet from the shoreline, five miles north of the Keahole Airport.

The developer will provide continued and improved access to Kua Bay and provide park improvements at the State-owned coastal portions of this site as required by the terms of the land exchange between the State of Hawaii and the applicant.

DIVISION OF AQUATIC RESOURCES COMMENTS:

The Draft EIS has provided some information on mitigating possible impacts of drainage water, landscaping and agriculture chemicals, waste disposal, and nutrient enrichment. However, the Department should have the opportunity to review more detailed provisions of forthcoming plans for irrigation and other wastewater disposal when these are completed, especially if a desalination system is proposed. Should a desalinization system be selected as the source of potable water, the impacts of brine or high salinities to coastal resources should be addressed. A monitoring program to identify and mitigate potential adverse impacts to offshore water quality and a nearby anchialine pond should be required.

Finally, any plans for beach or shoreline modifications on the State-owned coastal portion which may affect aquatic resource values should be submitted to the Department for review.

HISTORIC PRESERVATION DIVISION COMMENTS:

Pages 72-78 accurately present the historic preservation status of this project. This section is quite good in presenting the general historic sites patterns of this area, and the reader can easily see the sites found within the project and site patterns. The applicant also indicates their general plans for mitigation. However, as the section states, our division has sent back the archaeological inventory survey report for revisions, and we will not finalize the significance evaluations or approve mitigation plans until the revised report is submitted. This means that historic preservation review has not yet completed the initial steps of identifying significant sites or agreeing upon general mitigation commitments. Until these steps are concluded, we will be recommending no decision be made on any rezoning petitions by the County, State Land Use Commission or DLNR.

DIVISION OF STATE PARKS COMMENTS:

Many of these concerns were mitigated through the conditions and covenants incorporated into the exchange deed (e.g., 400-foot wide open space buffer at the makai boundary, a 60-foot wide park roadway and utility easement, and connection to NKDG's water system). In addition, the master plan proposals include other considerations that from a state park's viewpoint is considered positive. This includes locating the wastewater treatment plant away from the coast and the proposed state park, designing of land uses and facilities to avoid changes in topography as much as possible, minimizing adverse visual effects (e.g., structure height limitations, and material and color selection in keeping with the natural setting), proposed routing of the park access along the historic trail to the small puu within the project site form the proposed state park.

Coordination on matters of common concern have been good. However there is another matter that was probably overlooked or jurisdiction was unclear. We should be included as one of the consulted parties regarding any trail that will connect or direct people to the proposed state park because of the direct affect it will have on our planning and management of the area.

DIVISION OF LAND MANAGEMENT COMMENTS:

Land Management Division has no objections, as long as the landowner complies with the terms and conditions contained in the exchange deed entered into with the State of Hawai'i, in addition to the following:

1. Construction and placement of any buildings in the 400-foot buffer zone be prohibited;

2. All improvements, including the golf course, be wholly within the landowner's property;

3. Landowner be required to provide public use/play on the golf course 50% of the time during week days and weekends at green fees comparable with County of Hawai'i.

Land Management also has concerns as to the water usage/availability to the project.

DIVISION OF WATER RESOURCE MANAGEMENT COMMENTS:

The location of the proposed wells should be coordinated with DWRM to prevent impacts among the existing and proposed wells.

DIVISON OF FORESTRY AND WILDLIFE COMMENTS:

Thank you for allowing the Division of Forestry and Wildlife to comment on the draft EIS regarding the Manini'owali Residential Community. I understand that you are working with the Big Island Na Ala Hele Advisory Group on resolving any issues regarding access and trails. At this time, we have no further comments to make except that you continue to work with the Advisory Group. Should you have any questions regarding this draft EIS, please feel free to call Ms. Christina Meller, Na Ala Hele Program Manager, at 587-0062.

OFFICE OF CONSERVATION AND ENVIRONMENTAL AFFAIRS COMMENTS:

According to the Draft EIS, the North Kona Development Group (NKDG) will submit a Conservation District Use Application (CDUA) for the proposed subdivision of parcel 7-2-04: 17 pursuant to, but not limited to, the conditions and agreements established under the Awakee land exchange between the Applicant and the State Department of Land and Natural Resources (DLNR). Additionally, the applicant would be required to obtain a State Land Use District Boundary Amendment prior to the initiation of any work on the premises. Furthermore, to ensure compliance with the conditions and covenants established pursuant to the Awakee land exchange, we would ask the State Land Use Commission (LUC) and the County of Hawaii to incorporate the above conditions into any subsequent state or county approval or permit affecting the subject property and surroundings.

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

Very truly yours,

WILLIAM W. PATY

cc: OEQC
NKDG
Group 70

5 February 1992

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Honorable William W. Paty, Chairperson
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96806

Re: **Draft Environmental Impact Statement Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Paty:

Thank you for your 9 December 1991 letter concerning the Draft Environmental Impact Statement for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Aquatic Resources

As planning for this project progresses, additional detailed design information on the wastewater disposal system and desalinization system will become available. As these detailed plans are completed, we would gladly forward this infomration for your consideration.

Desalinization is the method of potable water supply that will be selected for this project. The by-product water generated by the reverse osmosis plant will have a higher salinity than the underlying brackish ground water. Prior to use for irrigation, the by-product water will be substantially diluted with treated wastewater effluent to create a less saline water for irrigation use. Several types of salt-tolerant plants will also be included in some portions of the project landscaping, which will enable direct use of the by-product water, if necessary.

Potential changes to the aquifer salinity due to the project's irrigation, and potential effects on nearshore salinity have been considered by Oceanit Laboratories report included as Appendix F in the Draft EIS. Oceanit's findings indicate that nearshore ocean water could receive some minor input of ground water with higher than average salinity as a result of the project's irrigation practices. The introduction of water with slighlty greater salinity will not cause adverse effects on the nearshore water quality or the marine ecology. The higher salinity ground water will be rapidly mixed with the surrounding ocean waters at the nearshore or offshore discharge point.

NKDG is willing to comply with requirements for monitoring of nearshore water quality and the anchialine pond near Kua Bay. Details of an ocean water monitoring program will be developed during a later stage of the planning process, in coordination with the State Department of Health and your Division of Aquatic Resources.

Shoreline park improvements are currently being considered by your State Parks Division. In November 1991, North Kona Development Group (NKDG) sponsored a meeting of government representatives, elected officials and community representatives to consider preliminary ideas for park facilities along this section of the coast. As stipulated in the Exchange Deed, NKDG will construct or contribute towards these facilities following the plans reached by the State Parks Division, which will undoubtedly include the input of the Division of Aquatic Resources.

B. Historic Preservation Division

The Archaeological Inventory Survey prepared by the Bishop Museum Applied Research Group has been revised and approved by the HPD. The revised report is included in the Final EIS as Appendix J. Site significance evaluations presented in this document have been finalized with agreement from HPD. General mitigation measures are presented in the Final EIS, however, detailed preservation and mitigation plans will continue to be worked in coordination with HPD staff. This document will be completed in the coming year.

C. Division of State Parks

NKDG is proud to be assisting the State Parks Division in the planning and development of the proposed Shoreline Park at Manini'owali. We would be glad to include the State Parks Division in the discussion regarding mauka-makai trails between the State lands and the NKDG land. To date, we have been coordinating trail planning efforts with the Big Island Na Ala Hele Advisory Group.

Preliminary planning for foot trail connections between the NKDG land and the makai State-owned park area has currently identified one historic *mauka-makai* trail segment near Kikapa Bay which will be maintained and possibly enhanced where appropriate. This trail will have public access, allowing visitors to the site to hike to a scenic viewpoint on the small *pu'u*. Additional foot trails connecting the NKDG land to the State land are being considered to provide additional routes for project residents to access the State lands of Manini'owali and Awake'e. The routes and use character for the additional trails are under preliminary consideration, and they have not been plotted on the Conceptual Land Use Master Plan for the residential community.

D. Division of Land Management

NKDG has agreed to pursue approval for its residential community based on compliance with the terms and conditions contained in the Exchange Deed. The 400-foot no-structures zone will only be utilized for landscaping and golf course play areas, with no structures included. All improvements of the residential community will be within the 388-acre NKDG land at Manii'owali, excepting required off-site roadway improvements at the project access connection with Queen Ka'ahumanu Highway.

Public use of the golf course and green fees for *kama'aina* players will be available at this development, with further details to be determined later in the planning process.

E. Division of Water Resource Management

The location of NKDG's proposed brackish water wells on State lands *mauka* of the NKDG land will be coordinated with DWRM to address and minimize potential effects on existing and proposed wells.

F. Division of Forestry and Wildlife

NKDG fully intends to continue working with the Big Island Na Ala Hele Advisory Group resolving issues regarding access and trails.

G. Office of Conservation and Environmental Affairs

NKDG intends to submit a Conservation District Use Application (CDUA) for the proposed subdivision of parcel 7-2-04:17. NKDG also intends to comply with the terms and conditions of the land exchange. We understand that the DLNR may consider additional conditions relating to the subdivision request, which we hope will be consistent with the exhange conditions imposed to date. NKDG will also be filing a State Land Use District Boundary Amendment to request State Urban District designation for its residential community.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Senior Planner

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November 22, 1991

LOG NO: 4084
DOC NO: 3269C

MEMORANDUM

TO: Roger Evans, OCEA

FROM: Don Hibbard, Administrator
State Historic Preservation Division

SUBJECT: Draft EIS for LUC Petition and County General Plan Amendment -- Manini'owali Residential Community (North Kona Development Group) File No. 92-277
Maniniowali & Kukio 2, North Kona, Hawaii
TMK: 7-2-04: part 17

HISTORIC PRESERVATION PROGRAM CONCERNS:

Pages 72-78 accurately present the historic preservation status of this project. This section is quite good in presenting the general historic sites patterns of this area, and the reader can easily see the sites found within the project and site patterns. The applicant also indicates their general plans for mitigation. However, as the section states, our division has sent back the archaeological inventory survey report for revisions, and we will not finalize the significance evaluations or approve mitigation plans until the revised report is submitted. This means that historic preservation review has not yet completed the initial steps of identifying significant sites or agreeing upon general mitigation commitments. Until these steps are concluded, we will be recommending no decision be made on any rezoning petitions by the County or State Land Use Commission.

RC:jle

NOV 27 1991

bcc: Planning Department, County of Hawaii

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Danilo M. Herrera

5 February 1992

Mr. Don Hibbard, Administrator
State Historic Preservation Division
33 South King Street, Sixth Floor
Honolulu, HI 96813

Re: **Draft Environmental Impact Statement Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Hibbard:

Thank you for your 22 November 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The Archaeological Inventory Survey prepared by the Bishop Museum Applied Research Group has been revised in accordance with your staff review and comments and approved by your Division. The revised final report is included in the Final EIS as Appendix J. Site significance evaluations presented in this document are now finalized with agreement from your Division. General mitigation measures have been presented in the Final EIS, however, detailed preservation and mitigation plans will continue to be worked on with your staff. These will be presented in a cultural resources management plan which will be prepared and submitted to you in the next stage of project planning. The plan will include two components, a preservation plan and a data recovery plan.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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KEITH W. AHUE
MANABU TAGOMORI

DAN T. KOCHI
AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER RESOURCES MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

NOV 2 ? 1991

20 November '91

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813-4398

SUBJECT: Review of the Draft Environmental Impact Statement for the Proposed Manini'owali Residential Community, North Kona, Hawaii
TMK: 7-2-04: por 17

Dear Mr. Overton:

Thank you for allowing the Division of Forestry and Wildlife to comment on the draft EIS regarding the Manini'owali Residential Community. I understand that you are working with the Big Island Na Ala Hele Advisory Group on resolving any issues regarding accesses and trails. At this time, we have no further comments to make except that you continue to work with the Advisory Group. Should you have any questions regarding this draft EIS, please feel free to call Ms. Christina Meller, Na Ala Hele Program Manager, at 587-0062.

Very truly yours,

Michael G. Buck
Administrator

cc: Roger Evans, OCEA
Chris Meller, Na Ala Hele/w EIS
Rodney Oshiro, Hawaii DOFAW

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Danilo M. Herrera

5 February 1992

Mr. Michael G. Buck, Administrator
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street
Honolulu, HI 96813

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Buck:

Thank you for your 20 November 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. North Kona Development Group and its representatives have been working with the Hawai'i Island Na Ala Hele Advisory Council and will continue to do so through this project and, as appropriate, during the State park planning process for the adjacent State lands.

Thank you again for your letter. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Senior Planner

NA ALA HELE
Hawai'i Trail & Access System

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DEC 2 3
GROUP 70
LIMITED

December 23, 1991

Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813

Attn: Jeff Overton

Dear Mr. Overton:

Subject: Comments on Draft EIS
Location: Manini'owali Residential Community
North Kona District, Hawaii
TMK: 7-2-04: 17 (por.)

Thank you for giving the Na Ala Hele Hawaii Island Advisory Council the opportunity to comment on this matter. We have the following concerns:

1) That all the conditions of the land exchange regarding trails and other archaeological sites be enforced.

2) That the proposed medium density of the project will detract from the present rural setting of the area and that this density may not allow enough of a buffer zone around the trails on the project site.

We look forward to continuing to work with you in coordination with the Historic Preservation Program to ensure the continued existence of a functional network of historic trails in the region.

Very truly yours,

Michael P. Tomich

Michael P. Tomich
Chairman, Hawaii Island
Advisory Council

Division of Forestry & Wildlife • Dept. of Land & Natural Resources • P.O. Box 4849 • Hilo, Hawaii 96720-0849

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Michael A. Gami
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Danilo M. Herrera

5 February 1992

Mr. Michael P. Tomich, Chairman
Na Ala Hele, Hawai'i Island Advisory Council
Division of Forestry and Wildlife
Department of Land and Natural Resources
PO Box 4849
Hilo, HI 96720-0849

Re: **Draft Environmental Impact Statement for Manini'owali Residential Community Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por. 17)**

Dear Mr. Tomich:

Thank you for your 23 December 1992 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

1. Enforcement of Land Exchange Conditions

North Kona Development Group (NKDG) has been working closely with the Historic Preservation Division in finalizing the significance assessments and the general mitigation plan for archaeology sites on the property. NKDG will also continue to discuss with your Na Ala Hele Advisory Council members to further determine the treatment of the significant sites on the property which have been surveyed by the Bishop Museum Applied Research Group.

2. Density of Residential Units

Generally, the Conceptual Master Plan for the project indicates that 134 acres of the 388-acre parcel will be utilized for the development of 900 to 1,100 homes; this is equivalent to an overall average of approximately 4 units per acre. In the next phase, specific site planning will consider the relationships between structures, archaeology sites and historic trails in greater detail. This and possible additional studies will enable us to determine the size of buffer zones around trails and other sites.

Thank you again for your comments. We look forward to meeting with your Council soon. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR

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BRIAN J. J. CHOY
Director

GROUP 70
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STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

December 20, 1991.

Mr. Norman K. Hayashi
Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

Subject: Manini'owali Residential Community, North Kona District, Island of Hawaii - Draft Environmental Impact Statement.

We have reviewed the above document and would like to offer the following comments:

1. Pursuant to section 11-200-17(b), Administrative Rules, Department of Health, please discuss unresolved issues in the Summary Sheet.

2. Pursuant to section 11-200-17(k), Administrative Rules, Department of Health, please discuss the possibility of environmental accidents, if any.

3. The statement on page 121 discloses potential danger to users (of the beach) and potential conflicts between different users - are any mitigation measures contemplated?

Thank you for the opportunity to comment on the proposed project.

Sincerely,

Brian JJ Choy

Brian J.J. Choy
Director

BC:et

c: Mr. Michael Hands
North Kona Development Group
2877 Kalakaua Ave., #G.F.1
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Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

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

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Choy:

Thank you for your 20 December 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community. The following responses are to your specific comments.

Regarding the unresolved issues which are presented in Section 7.0 of this Final EIS, the following additional information is provided.

1. **Unresolved Issues**

- **State Park Access Route.** The existing dirt access roadway to the Kua Bay area will remain until a superior roadway is constructed. The route of the new roadway is shown on the Conceptual Master Plan on page 2 of this document. We are working with the Division of State Parks on park planning including the routing of the access road which must ultimately receive the approval of the Board of Land and Natural Resources.

- **Affordable Housing.** The proposed project will offer market priced residential housing units on the 388-acre site. North Kona Development Group (NKDG) will also participate in developing affordable housing units at a location which is, at this time, still undetermined. NKDG is discussing alternatives with appropriate State and County agencies to be able to move forward on this issue. The coordination for the affordable housing component is in the inquiry stage.

- **Brackish Water Wells on State Lands.** The process of receiving the approvals to develop brackish water wells on the adjacent mauka State lands will require further discussions between the NKDG and the DLNR and approvals from the Board of Land and Natural Resources and the Water Commission. These processes are on-going and will continue until the permits and approvals are obtained.

- **Project Access Intersection with Queen Ka'ahumanu Highway.** The recently released State Department of Transportation (State DOT) report, *Island of Hawaii Long Range Highway Plan* (May 1991) states: Improve Queen Ka'ahumanu Highway to a four-lane access controlled freeway with grade-separated interchanges. Two-lane frontage roads should also be constructed to provide local access and circulation to surrounding properties. Discussions with the State DOT by Manini'owali project team consultants as well as by the adjacent projects in the Kaupulehu/Kona Village/Kuki'o resort node have resulted in the preliminary decision to design one interchange to service the developments located within the Kaupulehu, Kuki'o and Manini'owali *ahupua'a*. Specific siting of the interchange will require study by the State DOT. We are not aware that an implementation schedule has been established by DOT at the present time.

- **On-Site Burial Preservation Measures.** The burials on the project site are proposed for in-situ preservation with buffer zones as recommended by the Hawai'i Island Burial Council. Detailed studies and site planning to establish buffer zones will be prepared at a later point in the approval process and will again be reviewed by the Burial Council.

2. **The Possibility of Environmental Accidents.**

Potential environmental accidents which could occur at this residential community include: wastewater treatment system failure, pesticides spill, and fuel or other chemical spill. Response plans for various types of accidents will be prepared at the appropriate point in the process.

The wastewater facility will have back-up measures in the event of a power loss or system malfunction. Effluent overflow storage vaults will be present at pump stations and the treatment plant. Back-up power generators will also be installed with alarm systems alerting facility operators.

To protect groundwater from the unlikely event of a chemical spill, maintenance, mixing and storage areas will be confined to sealed control chemical areas. The maintenance area drainage system will be designed to trap and filter water-borne contaminents in equipment wash zones and loading zones. Rapid percolation in natural lava areas and lava soils make it difficult to contain an accidental spill that could occur on project roadways.

3. **Potential Danger/Conflicts to Beach Users.**

The planning and development of the State parkland which includes Kua Bay and Manini'owali Beach is the responsibility of the DLNR, Division of State Parks. NKDG is an active participant in the planning process and will make a substantial contribution towards its development. The dangers and conflicts, as stated in the Draft EIS will be studied as a part of a separate park planning process with the Division of State Parks as the lead agency.

Thank you again for your comments and concerns. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

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

OFFICE OF THE SUPERINTENDENT

November 25, 1991

Mr. Norman Hayashi
Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

SUBJECT: Draft Environmental Impact Statement
Manini'owali Residential Community
North Kona, Hawaii
TMK: 7-2-04: por. 17

Our review of the draft EIS indicates that the proposed residential development will have the following impact upon our schools. The projected enrollment impact is based on 1,000 units from the range of 900 to 1,100 residential units listed in the permit application.

Students	Grades	Students
Kealakehe Elementary	K-5	60
Kealakehe Intermediate	6-8	35
Konawaena High	9-12	40

The factors used to project the impact assume that the majority of the single and multi-family units will be retirement or second homes. The schools in the area are operating beyond their capacity and the Department cannot assure the availability of classrooms to accommodate the projected 135 students from this development.

We request that the County support our position on requiring the developer to contribute a fair-share contribution for the construction of school facilities. We estimate that the projected

135 students generated by this development will require five (5) classrooms at a cost of $1,648,340. The developer's fair share will be 50 percent of this cost or approximately $824,170.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:jl

cc: A. Suga
A. Garson

GROUP 70
INTERNATIONAL

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Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

Honorable Charles T. Toguchi, Superintendent
State of Hawai'i
Department of Education
PO Box 2360
Honolulu, HI 96804

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Toguchi:

We have received your 25 November 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The revised projection of 135 students which you provided concerning student enrollment impact of the proposed residential project has been included in the Final Environmental Impact Statement (Final EIS).

As we stated in the Draft EIS, we recognize the existing operational condition of the area schools and look towards accomodating the increase in the student enrollment attributable to this project. The North Kona Development Group would like to hold further discussions with the DOE regarding its fair share contribution towards educational facilities in the project area.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
Gove[illegible]or
MURRAY E. TO[illegible]LL
Dire[illegible]or
BARBARA KIM STANTON
Deputy Director
RICK EG[illegible]ED
Deputy Dire[illegible]or
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

91:993e

December 13, 1991

RECEIVED
DEC 18 [illegible]
GROUP 70
LIMITED

Mr. Norman Hayashi
Director, Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

SUBJECT: Draft Environmental Impact Statement (DEIS) for Manini'owali Residential Community, North Kona, Hawaii

Thank you for the opportunity to review subject DEIS.

The electrical load projected from this project is 3 MW which is expected to be met mainly through the expansion of oil-fired generating facilities. This projected demand is expected to result in a 3 percent increase in emissions from the electric utility. In view of the need to "moderate the growth in energy demand through conservation and energy efficiency" (State Energy Functional Plan, p. 13), which will indirectly cut down on emissions, we request that the developer explain, in as much detail as possible, the project's energy impacts and the energy-efficient design/technologies and renewable energy sources that will be used to help meet its energy requirements.

We note that the DEIS omits any reference to Section 226-18 HRS or to the State Energy Functional Plan. This contradicts a statement on page 143 of the DEIS, "Each Functional Plan has been reviewed, including the recent draft plans (1990)."

Omission of review of the Energy Functional Plan may impact on the developer as the plan points out that utilities are expected to be implementing demand-side management (DSM) programs. Some of these DSM program may include requirements for efficient residential lighting and pumping in off-peak hours.

Mr. Norman Hayashi
Page 2
December 13, 1991

We would suggest, therefore, that the EIS for the project include a view of the project's relationship to all relevant objectives, policies and actions of the 1991 Energy Functional Plan and the State Plan (Section 226-18 HRS).

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK/ESU:do
cc: Office of Environmental Quality Control
Michael Hands
Jeffrey H. Overton

5 February 1992

GROUP 70
INTERNATIONAL

Mr. Maurice H. Kaya, Energy Program Coordinator
Department of Business, Economic Development
and Tourism-Energy Division
335 Merchant Street, Room 110
Honolulu, HI 96813

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Kaya:

Thank you for your 13 December 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The project's estimated electrical load is projected to be 4.215 megawatts (MW). This load consists of residential lighting, residential utility and general power loads, and non-residential loads such as sewage pumps, water pumps, irrigation pumps, and golf course water feature pumps.

The electrical energy requirement of the project has been recalculated to include the energy requirement of 3.0 MW for the residential units and other project elements. The following lists the energy load estimate for the complete development:

1,000 Residential Units	3.000 MW	
Wastewater System	0.500 MW	
Golf Course		0.450 MW
Desalinization Plant		0.265 MW
TOTAL ESTIMATED LOAD		4.215 MW

To conserve energy, design efforts will be made to use energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. We are currently exploring the feasibility of solar energy use for several components of the project.

A review of the project's relationship to all relevant objectives, policies and actions of the 1991 Energy Functional Plan and Section 226-18 Hawaii Revised Statutes is presented in Section 6.0 of the Final EIS.

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeff H. Overton

Jeffrey H. Overton, AICP
Senior Planner

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

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

IN REPLY REFER :
91:PPE/5536jt

December 23, 1991

TO: Mr. Norman Hayashi, Director
County of Hawaii, Planning Department

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft EIS for the Proposed Manini'owali Residential Community

We have reviewed the subject draft EIS and offer the following comments.

Policies A(3) and B(3) of the State Housing Functional Plan seek to ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership or rental housing opportunities. The applicant has noted that it "fully intends to participate in the development of affordable housing in the region, either through direct development at an appropriate site or contribution of its fair share of funds dedicated towards development of affordable housing." While preference is for the provision of affordable housing on the project site, we are open to working with the applicant and the County of Hawaii in finding acceptable ways in which the applicant can provide affordable housing.

Thank you for the opportunity to comment.

c: OEQC
North Kona Development Group
✓Group 70 International

5 February 1992

GROUP 70 INTERNATIONAL

Mr. Joseph K. Conant, Executive Director
Department of Budget and Finance
Housing Finance and Development Corporation
Seven Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, HI 96813

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Conant:

I would like to thank you for your 23 December 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community.

As described in Section 6.2 of this report, the North Kona Development Group (NKDG) and it's development partner, Davidson Communities of San Diego, California, in addition to constructing the proposed market priced homes on its 388-acre property, will also participate in the development of affordable homes to increase the regional supply in the North Kona and South Kohala districts. NKDG will work with the appropriate County and State agencies, including your office, to fulfill this commitment.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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:

91-209

January 3, 1992

RECEIVED
JAN 10 1992
GROUP 70
LIMITED

Mr. Norman Hayashi, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

Subject: Draft Environmental Impact Statement (DEIS)
Manini'owali Residential Community
Manini'owali and Kuki'o 2, North Kona, Island of Hawaii
TMK: 7-2-04: Portion 17

We have reviewed the DEIS on the subject property submitted by your office. We have no comments, other than those already contained in the DEIS, to make at this time.

Very truly yours,

for

JOHN C. LEWIN, M.D.
Director of Health

c: North Kona Development Group
Group 70 International

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
2.0246

January 7, 1992

Mr. Norman K. Hayashi
Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 109
Hilo, Hawaii 96720

Dear Mr. Hayashi:

Draft Environmental Impact Statement, Manini'owali Residential Community (North Kona Development Group), Manini'owali, North Kona, Hawaii, TMK: 7-2-04: por. 17

We have reviewed the subject draft environmental impact statement and have the following comments:

1. Traffic signals at the project access will not be allowed, in keeping with our policy to upgrade Queen Kaahumanu Highway to a high speed, limited access facility. The analyses at the intersection and mitigation measures should be reevaluated accordingly.

   Ultimately, direct access to Queen Kaahumanu Highway will be allowed only at major interchanges. All other roadways will access onto a system of frontage roads on both sides of the highway.

2. The forecasts for this corridor from the Island of Hawaii Long Range Highway Plan are considered to be conservative as they do not reflect many of the proposed developments in the area. This study should assume the increased developmental growth.

3. Street lighting should be provided at the access intersection.

HWY-PS 2.0246

4. The developer will provide required roadway improvements at no cost to the State.

5. Plans for construction work within the State right-of-way shall be submitted for our review and approval.

6. The developer should continue coordination with adjacent developers to provide for a frontage roadway system to the Kaupulehu Interchange and for cost-sharing for the Kaupulehu Interchange.

7. The developer should participate in regional roadway improvements on a prorata basis as determined by the State Department of Transportation.

Sincerely,

A. Harano

For Rex D. Johnson
Director of Transportation

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

Mr. Michael Hands
North Kona Development Group
2877 Kalakaua Avenue, Suite GF#1
Honolulu, Hawaii 96815

✔Mr. Jeffrey H. Overton, AICP
Group 70 International
924 Bethel Street
Honolulu, Hawaii 96813

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Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

Honorable Rex D. Johnson, Director
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

Re: **Draft Environmental Impact Statement Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. Johnson:

Thank you for your 7 January 1992 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Traffic Signals

We note your comment regarding the prohibition of traffic signals at the planned interim project access intersection with Queen Ka'ahumanu Highway. New projections of traffic flow and level-of-service have been prepared for the Final EIS by Traffic Management Consultants (TMC). An interim at-grade intersection is proposed with left-turn storage lanes entering and exiting the project access road, and acceleration and deceleration lanes for vehicles traveling south.

The revised traffic flow analysis for the interim condition shows that the left-turn movements for vehicles entering and exiting the project will experience delays. Vehicles turning left into and out of the project will be forced to wait for gaps in traffic during peak periods. Through traffic on Queen Ka'ahumanu Highway will generally not be affected by the operation of the project.

B. Increased Development Growth

The traffic study prepared for this project did account for future growth of area traffic due to new developments. Those projects included in the future condition analysis are those which have received substantial discretionary approvals or are currently under construction. All of these projects are included in the *Island of Hawaii Long Range Highway Plan for 2010*. This

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

information was used to analyze future baseline traffic conditions. Specific projects included were: the Kaupulehu and Kuki'o Resorts, Waikoloa Village and Resort, the State's Kealakehe housing project, and the Queen Liliuokalani Trust project.

C. Street Lighting

Street lighting will be provided by the developer at the project access connection with Queen Ka'ahumanu Highway.

D. Roadway Improvements

All costs for the access and internal circulation roadway improvements of the project, including the Queen Kaahumanu Highway intersection, with the appropriate turning/storage lanes, will be borne by the North Kona Development Group (NKDG).

E. Construction Plan Review

All plans for construction work within the State right-of-way shall be submitted for review and approval of DOT.

F. Kaupulehu Interchange

NKDG has maintained continuous communication with its neighbors at Kaupulehu and Kuki'o regarding the plans, timing and costs for a proposed highway interchange at Kaupulehu. At this time, however, it is our understanding that the State's long-range plans for this section of highway have yet to be finalized. We look forward to continued communications with our neighbors and the DOT regarding plans for the long-term future highway improvements.

G. Regional Roadway Improvements

NKDG is willing to participate in regional roadway improvements that are directly related to the impacts of traffic generated by its residential community. We would be glad to meet with your staff to discuss the types of regional roadway improvements which relate to the project.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

THE TRAFFIC MANAGEMENT CONSULTANT
Randall S. Okaneku, P. E., Principal • 1188 Bishop Street • Suite 1907 • Honolulu, Hawaii 96813
Telephone: (808) 536-0223 • Facsimile: (808) 537-2985

February 3, 1992
Job No. 9104

RECEIVED
FEB 04 1992
GROUP 70

Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Jeff Overton

Gentlemen and Ladies:

Subject: Draft Environmental Impact Statement (DEIS)
Manini'owali Residential Community

The Traffic Report in the DEIS proposes that project access be provided by traffic signals on an interim basis, with the understanding the ultimate access would be allowed only at grade-separated interchanges or onto a frontage road system. Comments on the DEIS from the State Department of Transportation (Comment No. 1 of the January 7, 1992 letter from Mr. Rex Johnson, Director of the State DOT, to Mr. Norman Hayashi, Director of the Planning Department, County of Hawaii) note that traffic signals will not be permitted on Queen Kaahumanu Highway. DOT has requested that a revised capacity analysis be prepared for the unsignalized project access intersection, the results of which are included herein.

The results of the capacity analysis at the intersection of Queen Kaahumanu Highway and the project access road (Year 2006 unsignalized condition) is shown on the attached Exhibit S-1. During the both the AM and PM peak hours of traffic, the right turn movement from the project access road to south bound Queen Kaahumanu Highway is expected to operate near capacity. The projected traffic demand would exceed the capacity on the left turn movement from the project access road to north bound Queen Kaahumanu Highway, during both the AM and PM peak hours of traffic. During the PM peak hour of traffic, the projected traffic demand would exceed the capacity on the left turn movement from north bound Queen Kaahumanu Highway to the project access road. In general, through traffic on Queen Kaahumanu Highway would not be affected by the project access, except for the potential for traffic safety problems, as the project traffic attempts to enter Queen Kaahumanu Highway during less than acceptable gaps in traffic.

The State DOT's on-going Queen Kaahumanu Highway Master Plan would determine future interchange locations and the operation of the frontage road system. The ultimate configuration of the project access can be be determined, once these plans are finalized. Until the final plans are available and the upgrade of the highway system is completed, an interim access to this new community will be necessary, such as the scheme presented in the DEIS. Actual design and timing of the interim access connection should be worked out with State DOT over the next few years, as the planning progresses for the Queen Kaahumanu Highway improvements and the Manini'owali Residential Community.

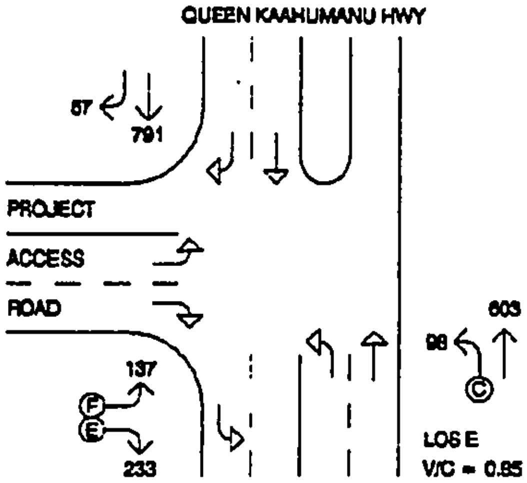
If you have any questions, please do not hesitate to call me.

Very Truly Yours,

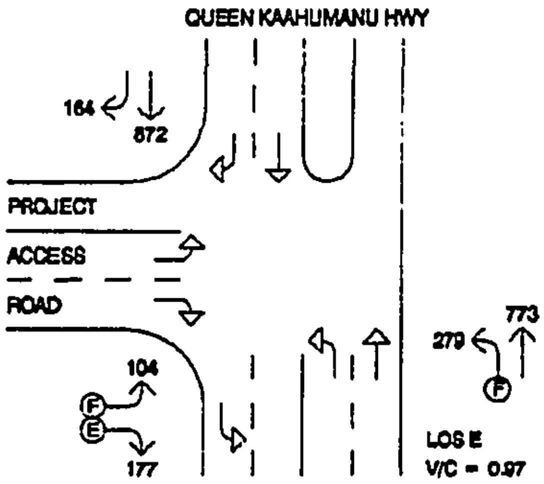
The Traffic Management Consultant

By

Randall S. Okaneku, P. E.
Principal



CUMULATIVE AM PEAK HR TRAFFIC



CUMULATIVE PM PEAK HR TRAFFIC

LEGEND

90	TRAFFIC MOVEMENT VOLUME (VPH)
	LANE CONTROL
LOS	LEVEL OF SERVICE (TWO LANE HWY)
V/C	VOLUME-TO-CAPACITY RATIO
A	LEVEL OF SERVICE (UNSIGNALIZED CONDITIONS)

EXHIBIT S-1 CUMULATIVE PEAK HOUR TRAFFIC (UNSIGNALIZED)

DEC 24 '91 12:43 ELECTIONS-HAWAII 808 961-5648 P.2

HELENE H. HALE
Councilwoman

COUNTY COUNCIL
County of Hawaii
Hawaii County Building
25 Aupuni Street
Hilo, Hawaii 96720

December 24, 1991

Jeffrey H. Overton, AICP
Senior Planner, Group 70 Limited
924 Bethel Street
Honolulu, Hawaii 96813-4398

Dear Mr. Overton:

I am sorry I was not able to study your Draft Environmental Impact Statement until today and this is just a cursory examination. I disapprove a community of 900 to 1100 homes and condominiums selling for $500,000 to over $1 million dollars. This kind of development only exacerbates the social problems generated by encouraging classes of very wealthy and very poor residents. A well planned community that incorporates all economic levels would be in the better interests of our social environment. Hawaii is already too much just a playground for the very rich, causing middle class and poorer inhabitants to be unable to afford owning their own homes, the very essence of the American dream.

I have additional concerns over the archaeological finding and the contamination of our ocean from over-development of golf courses. For the present I believe that the alternative of no action at this time is the best for our community.

Aloha,

Helene H Hale

Helene H. Hale
Councilwoman

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
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Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

Councilwoman Helene H. Hale
County Council
County of Hawai'i
25 Aupuni Street
Hilo, HI 96720

Re: **Draft Environmental Impact Statement Manini'owali Residential Community**
Maniniowali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Councilwoman Hale:

Thank you for your 23 December 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the proposed Manini'owali Residential Community. We offer the following in response to your comments.

A. Economic Disparities

In the Social Impacts Study by Earthplan (Appendix N in the Draft and Final EIS's) it is pointed out that the project and other similar developments may contribute to social problems if it exacerbates the increasing economic disparities between the "haves and have-nots." Regarding affordable and market housing and jobs, North Kona Development Group (NKDG) is working towards social integration. Manini'owali Residential Community will help achieve diversity by contributing to or developing off-site affordable housing.

Existing and approved communities which would cater to the upscale market could add to social problems. This is not a problem unique to Manini'owali. Public officials, community leaders, developers and social service agencies will need to work together to attain a healthy balance of social and economic characteristics regardless if the project is implemented.

B. Archaeology Findings

North Kona Development Group and its archaeology consultant, Bishop Museum Applied Research Group, have worked closely with the DLNR Historic Preservation Division through the various inventory surveys on the *makai* Manini'owali land. The majority of significant sites at this ahupua'a are located within the coastal area on State land. The proposed project will avoid adverse impacts to significant sites within the NKDG property. All burials will be preserved *in-situ* with setback buffers as recommended by the Hawai'i Island Burial Council. Historic trail segments and the cinder cone *pu'u* will be preserved. A cultural resources plan for data recovery and a mitigation plan will be prepared by the archaeologist for the County's and DLNR Historic Preservation Division's review and approval.

C. Ocean Water Quality

Potential changes to nearshore water quality as a result of the proposed project have been considered by Oceanit Laboratories, Inc. (OLI) in a report included in the Draft EIS as Appendix F. OLI's findings indicate that nearshore ocean water could receive some minor input of ground water containing minor concentrations of fertilizer and treated effluent nitrogen and possibly some minute concentrations of pesticides. The introduction of these small concentrations will not cause adverse effects on the nearshore water quality or the marine ecology, due to rapid mixing with the surrounding ocean waters at the nearshore or offshore ground water discharge point.

Baseline monitoring of Kua Bay and the nearshore ocean waters off Manini'owali has been initiated by OLI. NKDG is willing to comply with requirements for long-term monitoring of nearshore water quality and the anchialine pond near Kua Bay. Details of an ocean water monitoring program will be developed in coordination with the State Department of Health and the DLNR Division of Aquatic Resources.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

Lorraine R. Inouye
Mayor
Norman K. Hayashi
Director
Tad Nagasako
Deputy Director

Planning Department

25 Aupuni Street, Room 109 • Hilo, Hawaii 96720 • (808) 961-8288

December 23, 1991

RECEIVED
DEC 27 1991
GROUP 70
LIMITED

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 Limited
924 Bethel Street
Honolulu, HI 96813-4398

Dear Mr. Overton:

Draft EIS - Manini'owali Residential Community
Manini'owali and Kuki'o 2, North Kona, Hawaii
TMK: 7-2-4:Portion 17

We have reviewed the Draft EIS for the proposed subject Manini'owali project and provide the following comments:

1. Page 9: Special Management Area (SMA) Use Permit is secured from the County Planning Commission.

2. Page 21 (Figure 5): Conceptual master plan map should distinguish location of condominium versus single family residential.

3. According to written comments from the State Historic Preservation Division and conversation between Dr. Ross Cordy and Connie Kiriu of my staff, the applicant has been working closely on acceptable revisions to the archaeological inventory survey report. The revised archaeological inventory survey report will be included in the Final EIS. The accepted Final EIS will be used as a support document for the pending General Plan Amendment application filed with this office. Given this information and clarification, we have no further comments on the inventory report.

Thank you for the opportunity to review said report. Should you have any questions, please feel free to contact Alice Kawaha or Connie Kiriu of this office.

Sincerely,

NORMAN K. HAYASHI
Planning Director

AK:smo/4078D
cc: OEQC
Jan Sullivan
General Plan Section

GROUP 70

INTERNATIONAL

5 February 1992

Mr. Norman K. Hayashi, Planning Director
Planning Department
County of Hawai'i
25 Aupuni Street
Hilo, HI 96720

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Hayashi:

Thank you for your 23 December 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The Conceptual Master Plan for the proposed residential project shown as Figure 5 on page 21 of the FEIS has been modified with additional information to depict the areas planned for single family and multi-family units. This project proposes approximately 900 to 1,100 residential units on 134 acres of land. Dwelling types proposed will include approximately 700 detached and attached single-family units and 300 multi-family units.

The archaeology report by the Bishop Museum Applied Research Group has been reviewed and accepted by the State Historic Preservation Division. Significance evaluations for each of the 29 sites have been finalized. Additionally the sites which will be preserved and general mitigation commitments are described in Section 4.10 of this report. A detailed Cultural Resources Management Plan which will include two components, a preservation plan and a data recovery plan, will be submitted at a future date.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Lorraine R. Inouye
Mayor
Victor V. Vierra
Chief of Police
Francis C. DeMorales
Deputy Chief of Police

Police Department

349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • Fax (808) 961-2702

NOV 26 1991

November 22, 1991

TO : NORMAN K. HAYASHI, PLANNING DIRECTOR

FROM : VICTOR V. VIERRA, CHIEF OF POLICE

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED MANINI'OWALI RESIDENTIAL COMMUNITY
NORTH KONA, HAWAII
TMK: 7-2-04:POR. 17

We agree with the mitigated measures to minimize the impact of traffic generated by the proposed project with the Queen Kaahumanu Highway, reference 4.11,C, of D.E.I.S.

JD:sk

cc: Office of Environmental Quality Control
Mr. Michael Hands, North Kona Development Group
Mr. Jeffrey H. Overton AICP, Group 70 International
Kona Police

GROUP 70
INTERNATIONAL

5 February 1992

Mr. Victor V. Vierra, Chief of Police
County of Hawai'i
Police Department
349 Kapiolani Street
Hilo, HI 96720-2244

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Vierra:

Thank you for your 22 November 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community.

The State Department of Transportation (State DOT) will not allow traffic signals at the project access intersection with Queen Ka'ahumanu Highway. As you undoubtedly are aware, the State intends to upgrade this highway to a high speed, limited access facility. Until the State DOT plans are finalized for the construction of a grade-separated interchange for this area, no definitive long-term access design can be anticipated. As an interim measure, therefore, NKDG plans to construct a left-hand storage lane turning into the project for north-bound traffic. A right-turn deceleration lane and an acceleration lane are also planned for south-bound traffic. These proposed measures will allow for an unimpeded flow of through-traffic on the Queen Ka'ahumanu Highway, although left turns into and out of this project will likely experience delays.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

November 18, 1991

NOV 21 1991

TO: Planning Department

FROM: H. William Sewake, Manager

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED MANINI'OWALI RESIDENTIAL COMMUNITY
APPLICANT - NORTH KONA DEVELOPMENT GROUP
TAX MAP KEY 7-2-4:17
FILES EIS 7-001-0018

Please be informed that the proposed development is not within the service limits of the Department's existing water system facilities.

Please refer to our letter of July 12, 1991 to Mr. Jeff Overton of Group 70 International for our comments and requirements.

H. William Sewake
Manager

WA

cc - State of Hawaii Office of Environmental Quality Control
North Kona Development Group
Group 70 International

... Water brings progress...

5 February 1992

GROUP 70
INTERNATIONAL

Mr. William Sewake, Manager
Department of Water Supply
County of Hawai'i
25 Aupuni Street
Hilo, HI 96720

Re: **Draft Environmental Statement for Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por.17)

Dear Mr. Sewake:

Thank you for your 18 November 1991 letter concerning the Draft Environmental Impact statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The project proposes use of a dual water system, with desalinized brackish water used for potable needs and brackish water for irrigation needs (including desalinization plant by-product water). The North Kona Development Group will be installing the water system infrastructure and transmission lines upon the receipt of various government approvals, including approvals of plans for the proposed dual water system. At the appropriate time following the discretionary approval process involving the State and County, the developer's representatives will submit the reports, plans and supporting information requested in your letter of 12 July 1991.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

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

RECEIVED
DEC 2
GROUP 70 LIMITED

December 23, 1991
RE: 0597

Mayor, County of Hawaii
c/o Planning Department
25 Aupuni Street
Hilo, HI 96720

Dear Mayor Inouye:

Draft Environmental Impact Statement (DEIS)
Manini'owali Residential Community
North Kona, Hawaii

The North Kona Development Group is proposing to develop a medium density residential community consisting of 900 - 1,100 single-family and multi-family units on 388 acres of open land situated mauka of Kua Bay, approximately 1,000 feet from the shoreline and extending to the Queen Kaahumanu Highway in Manini'owali and Kukio 2 ahupua'a. The proposed project includes a 18-hole golf course, driving range, clubhouse, tennis center, a wastewater treatment facility, potable water supply, fire protection system, non-potable water irrigation system, and supporting infrastructure. The North Kona Development Group has made an agreement with the State of Hawaii in which upon receipt of all approvals and permits they have agreed to provide improved and continued access to Kua Bay and provide park improvements at the State-owned coastal portions of the Manini'owali ahupua'a.

Our comments on the Manini'owali Residential Community DEISwere prepared with the assistance of Gordon Bigelow, General Science; Jon Matsuoka, School of Social Work; Paul Ekern, (Emeritus), Yu-si Fok, Henry Gee; Water Resources Research Center; and Alex Buttaro, Environmental Center.

Socio-economic Impacts

1. Mitigative Measures (p. 103, p.111-Anticipated Impacts):
How will this development affect the availability of affordable housing on the Big Island and in North Kona? We note that item #9 of the "Beneficial Impacts" section states "Affordable housing will be provided off-site. The number and location of the units will be determined in discussions with the state and County" (page 3, #9). We would suggest that adequate assessment of the impacts of affordable housing is dependent on the related actions of the developer. At what time will the affordable housing component mentioned in #9 be resolved? If the impacts are considered insignificant or mitigatable,

on what basis is that judgement made?

What are the anticipated socio-cultural impacts of this golf course? Our reviewers note that, given the topical nature of golf course development and the strong public concern, there was a conspicous lack of discussion pertaining to socio-cultural impacts.

2. Lifestyles and Community Issues (p.103):
How were the "key informants" selected for the study? Were there systematic attempts to include a range of respondents representing different constituencies? What type of instrument (if any) was used for data collection? How were data analyzed?

3. "Non-project" issues (4th paragraph, p.104):
Given the inherent synergism between a major new development such as that proposed and an existing host community, extant "non-project" problems are likely to be exacerbated significantly. Consequently, "non-project" problems will rapidly become "project problems,' and must be addressed adequately in the EIS.

4. "Complementary Relationships" (top of p. 105):
"Residents will patronize the nearby hotel, restaurants, shopping areas, etc.". Although this may be true in part, it is based on a nebulous economic logic. Specifically, luxury housing development is viewed as a means to compensate for a lagging tourism industry. Such compensatory measures should be discusssed in the context of a deeper socio-cultural impact analysis. For example, how does the "gentrification" (an increase in the population of wealthy elite in a community) effect existing ways of life.

5. General Summary:
Our reviewers expressed concern that this DEIS was written with a tone and style which might lead the reader to conclude that every conceivable impact is mitigable. This of course cannot be the case, and therefore the information within may be misleading. The author(s) needs to more clearly describe how their proposed mitigations will influence outcomes, the extent to which outcomes will be effected, and to discuss practical issues related to implementation. Also, socio-economic and cultural impacts were inadequately addressed. The issues raised by the residential survey were not carried through the report or sufficiently considered. There are scarce ocean resources and golf course related impacts that warrant a more comprehensive analysis.

<u>Anticipated Long-term Adverse Impacts and Mitigative Measures</u>

We note a direct contradiction between the statement "No impact on ocean water quality or marine life is expected" (page 5, #2), and the statement "slight amounts of irrigation water and fertilizer nutrients and pesticides will be introduced to the ocean through groundwater seepage underground" (page 5, #7). The document then goes on to say that restrictive fertilizer and pesticide application rates, and special design features "will minimize the effects of these chemicals on marine water quality and marine ecology" (page 5, #7).

Water Supply, Irrigation and Wastewater Treatment

We note that in order for pesticides and fertilizers to be properly applied, the landscape manager should be knowledgeable about water migration. Our reviewers expressed concern over the exotic chemicals to be used and suggest that the developer needs the authority of technical expertise based on quantitative information for proper application.

Our reviewers expressed serious concern that due to inaccuracies associated with water use calculations and the parameters used in this particular case, water use may be 1.5 to twice the amount DEIS purports. Our reviewers have reason to believe that the 0.5 pan factor is a considerable underestimate and should be more realistically 0.75, or a 50% increase over the estimates provided in this DEIS. We note that the Xeroscape landscape may be lower, particularly if isolated pockets of soil and vegetation, as well as cacti and bromeliads (as non-transpiring vegetation) are incorporated into the plan. What is the basis for the water use calculation? How was a 50% pan evaporation factor chosen?

The statement is made that "The Xeriscape plan is expected to reduce irrigation water consumption by as much as 50 percent" (page 58). What is the basis for this statement?

Is the basal lens water really at 1500-1800 feet msl elevation and again at 600 feet msl?

Our reviewers note that the use of R.O. water desalinization is a new method. Additional information should be included describing design and operational processes. We suggest that a storage reservoir is needed for emergency brakedowns of the R.O. (or for monitoring) so that the many resident users will not have their water supply cut off. Another alternative is to bring in alternative sources of water during such R.O. system failures.

The statement concerning the combination of by-product water and non-desalinated brackish water for irrigation usage appears illogical (section 2.1.10, page 24). Because the by-product water will contain 1750 mg/l chloride (assuming potable will be reduced to 250 mg/l by R.O.), any mixture will result in concentrations greater than 1000 mg/l chloride. Page 54 states that irrigation water will be made of 70% non-potable (1000 mg/l chloride), and 30% treated effluent. To be effectively used, the by-product water should be diluted with treated effluent, rather than with the brackish water source.

More information should provided regarding treatment of sewage effluent and by-product water when irrigation is not needed, such as during storms.

Soil Use

We note that the nature of soil transport has important implications with regard to water percolation and nutrient transport.
In Appendix C (page 12), imported cinders are cited as the basis for runoff calculations. This imported soil is in no way compatible with the P fixation assumed by Murdoch and Green (Appendix D, page 3) and with that used as the basis for their table of water balances. We also note that silt loam water capacity does not have any relation to that for imported cinders.
What impacts will the imported soil incur, and does it fix phosphorus?

Solar Energy

Why was the potential for solar energy use not exploited in detail in this DEIS?

Summary

Our reviewers expressed serious concern over the lack of information disclosing the anticipated impacts of water use upon water quality, aquatic biota, and water supply. We note that a recently released draft of a report by the governor's Office of State Planning recommends that no golf courses be built over potable water sources because of the risk of contamination from chemicals or brackish irrigation water if it is used. Additionally, we note that the DEIS's descriptions of socio-cultural impacts, soil use, and desalinization schemes all appear to inadequately describe the significance of their effect upon the environment.

Thank you for the opporutunity to review this document and we hope you will find our comments helpful.

Sincerely,

John T. Harrison / jmc

John T. Harrison, Ph.D.
Environmental Coordinator

cc: Norman Hayashi, County of Hawaii Planning Department
Michael Hands, North Kona Development Group
Jeffry Overton, Group 70 International
Gordon Bigelow
Yu-si Fok
Henry Gee
Paul Ekern
Jon Matsuoka
Roger Fujioka
Alex Buttaro

GROUP 70
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Francis S. Oda, AIA, AICP
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George I. Atta, AICP
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James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

5 February 1992

John T. Harrison, Ph.D., Environmental Coordinator
Environmental Center
Crawford 317, 2550 Campus Road
University of Hawai'i at Manoa
Honolulu, HI 96822

Re: **Draft Environmental Impact Statement Manini'owali Residential Community**
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Dr. Harrison:

Thank you for your 23 December 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Affordable Housing

Following your comments regarding affordable housing, the following discussion has been added to the Final EIS:

> Determining the project's affordable housing requirement is an ongoing process, one which will continue throughout the land use approval proceedings. The process for determining these requirements is designed to ensure that new developments provide a fair share of affordable residences. Hence, regardless of the quantity or location of the affordable housing, project impacts will likely be an overall positive one because the supply will be increased.

B. Lifestyles and Community Issues

The issues analysis presented in the Draft EIS, and particularly in the Social Impact Assessment (Appendix N; Earthplan, November 1991), emphasizes the range and nature of issues. The issue analysis was not a statistical survey. As discussed in Section 5.1 of the Social Impact Assessment, an issues analysis differs from a statistical survey in that polls focus on the frequency of reactions, rather than the nature of the issues.

Section 5.1 also provides the process for selecting interviewees. It is pointed out that the selection of people was based on achieving a cross-section of interests, including members of environmental and cultural organizations; ocean recreation users in the area; members of community organizations and public or social service agencies; non-organization referrals; and people involved in the nearby resort destination nodes. The remaining discussion provides a summary and analysis of the findings.

C. Non-Project Issues

Your comment implying that non-project issues were presented without subsequent discussion is not valid. The social impact study consistently related the project-related issues and impacts to the independent and non-project related events and issues, as the following points illustrate.

First, the discussion on non-project issues (Section 5.2, page 58, Appendix N) was intended to provide the social context for project-related issues. The project-related issues were subsequently presented in Section 5.3 (page 62), and many of the project-related issues were similar to the non-project issues. In Section 5.4 (page 67), independent and project-related issues were analyzed and it was found that many of the project-related problems were related to cumulative regional impacts, rather than site-specific impacts.

Second, Sections 4.2 and 4.3 (pages 37 through 42) provides a full analysis of the project in the context of expected settlement patterns, the upscale nature of the project, the location of affordable units, lifestyle impacts, and relationship to nearby existing and future uses. The project's relationship to "non-project" issues was, therefore, fully explored.

Third, the reviewer's statement that non-project problems will likely be "exacerbated significantly" is an assertion with no specific examples or supporting data. Further clarification from the reviewer is needed to fully respond.

D. Complementary Relationships

Section 4.2.4 (page 40 of Appendix N) describes the major components in the study area's lifestyle and discusses the effects of adding more retirees and executive/professional residents to this setting.

E. General Summary

The reviewers appear to believe that not all impacts can be mitigated, and that "therefore the information within [the Draft EIS] may be misleading." It is the project team's intent to suggest mitigation for all significant impacts. In suggesting these mitigations, it is believed that the outcomes of these measures will either negate, minimize or offset the negative impacts. Further, the EIS process is typically in the early phase of the planning process, and it is unlikely that all the practical and political issues are resolved this early stage. In fact, the mitigation recommended in the EIS is often the first step in discussing specific approaches to addressing impacts.

The assertion that social and cultural impacts were inadequately addressed is apparently based solely on a review of the Draft EIS text. As stated above, the issues raised in the residential survey were fully disclosed in sections 5.2 through 5.4 of Appendix N. Ocean resources were discussed in Section 4.6 (pages 44 through 48), and John Clark's full report was appended to the social impact assessment. The project's golf course impacts was the topic of Section 4.5 on page 43.

F. Ocean Water Quality

Potential changes to nearshore water quality as a result of the proposed project have been considered by the Oceanit Laboratories, Inc. (OLI) report included in the Draft EIS. OLI's findings indicate that nearshore ocean water could receive some minor input of ground water containing minor concentrations of fertilizer and treated effluent nitrogen and possibly some minute concentrations of pesticides. The introduction of these small concentrations will not cause adverse effects on the nearshore water quality or the marine ecology, due to rapid mixing with the surrounding ocean waters at the nearshore or offshore ground water discharge point.

Baseline monitoring of Kua Bay and the nearshore ocean waters off Manini'owali has been initiated by OLI. North Kona Development Group (NKDG) is willing to comply with requirements for long-term monitoring of nearshore water quality and the anchialine pond near Kua Bay. Details of an ocean water monitoring program will be developed in coordination with the State Department of Health and the DLNR Division of Aquatic Resources.

G. Water Supply, Irrigation and Wastewater Treatment

Proper application of pesticides and fertilizers will be achieved under the supervision of a Certified Golf Course Superintendent. This individual will have extensive training in tropical turf grass maintenance, as well as, the principles and implementation requirements of an Integrated Pest Management (IPM) program. Preliminary quantitative information on fertilizer and pesticides use has been presented in technical studies prepared by Oceanit Laboratories, Inc. (October 1991).

The irrigation water use calculations have utilized a pan evaporation factor of 0.5, which is supported throughout the literature on tropical turf grass. It is well known that warm season grasses (including Bermuda grasses grown on golf courses in Hawai'i) use much less water than cool season grasses. According to Hadreck and Black (1986), strong growth and acceptable appearance of turf is acheived with a 0.45 to 0.55 pan evaporation. Moderate growth with acceptable appearance requires only 0.25 to 0.4 pan evaporation. Other references which support the statement that warm season grasses require only approximately 50% of pan evaporation include: Brian, Bravdo, Bushkin-Harav and Rawitz (1981); and Gibeault, Cockerham, Henry and Meyer (1989).

There is probably confusion about water use rates of turf grasses under circumstances when there is unlimited water availability and when water is properly managed. Local studies conducted by Dr. Ekern of the University of Hawai'i Water Resources Center showed that evapotranspiration of Bermuda grass turf was approximately 100% of pan evaporation. Dr. Ekern's studies were designed to obtain maximum evapotranspiration rates, as they were looking at the use of turfgrass as a way of using treated wastewater effluent. Many golf courses in Hawai'i are presently irrigating at rates much greater than 0.5 times pan evaporation, in an effort to maintain very lush growth and appearance. The 0.5 pan evaporation factor is used in the Murdoch and Green study because this is the rate which achieves adequate and efficient water management.

H. Xeriscape Plan

According to Paul Weissich, consultant to the City and County of Honolulu Board of Water Supply, implementation of a xeriscape plan for a residential community in Hawai'i can reduce irrigation water demand, as compared to irrigation water demand for traditional ornamental landscaping. Weissich notes that a xeriscape plan can reduce irrigation water demand up to 50 percent, as compared to irrigation demand for ornamentals. The Manini'owali Residential Community will landscape with native dryland species and other landscaping materials which have a low water requirement. We are also looking into low water demand turf types. Golf course irrigation will be accomplished with a mixture of treated effluent, brackish water and desalinization by-product water. Residential area irrigation will utilize brackish water only.

The basal brackish aquifer is slightly above sea level underneath the project site. Brackish ground water of lower salinity is proposed to be withdrawn from wells located on State land at the 600-foot elevation. These wells will provide for all of the water demand of the proposed project. Potable ground water is currently being withdrawn from other private lands from wells positioned at elevations of 1,500 to 1,800 feet above sea level.

I. Reverse Osmosis Water Desalinization

The Reverse Osmosis (RO) process is currently being utilized for numerous major municipal water systems throughout the world. The RO process is relatively new to Hawai'i, with experimental use of this process implemented at Ewa, O'ahu during the last two years. Investigation of manufacturers in California is currently underway for the proposed system. We have been in touch with vendors with extensive experience with these system facilities and their reliability. Additional design and operational information has been enclosed for your review.

A potable water storage reservoir is being planned for this system to meet normal County standards for the reserve storage requirement.

J. Irrigation Water Composition

The underlying brackish ground water contains approximately 1,000 ppm chlorides. Desalinization is the planned method for supplying potable water to this project. The by-product water generated by the reverse osmosis plant will have a chlorides concentration of approximately 2,300 ppm. Despite this relatively high level of chlorides, the water is viewed as a resource for this project. The by-product water will be diluted with treated wastewater effluent (250 ppm chlorides) and brackish ground water. This mixture of waters will produce an irrigation water with approximately 1,240 ppm chlorides. Residential areas will be irrigated with brackish groundwater only, containing no treated wastewater effluent. Salt-tolerant plants are planned to be used for the golf course turf and for the project's landscaping.

Treated wastewater effluent and desalted by-product water can be mixed and stored within one of the irrigation storage ponds developed on the site. This pond will have adequate freeboard to accomodate these two types of water during high precipitation periods when irrigation is not needed.

K. Soil Use

Organic-rich soils are planned to be imported to the site for use in the golf course and landscaping areas. Crushed lava and cinders will also be used with organic amendments to develop soils for these areas. Phosphorus fixation will be achieved by these organic soils, which will retard significant movement of phosphorus to ground water.

L. Energy Conservation

To conserve energy, design efforts will be made to use energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. We are currently exploring the feasibility of solar energy use and heat exchanger units for several portions of the project.

M. Office of State Planning Report

The proposed project is not located over a potable aquifer, has slopes which are less than 20 percent, it is located in a low rainfall region, and is positioned between 1,000 and 3,000 feet from the ocean. Opinions raised in the OSP report and their criteria for siting golf courses generally lack any supporting scientific or technical evidence. The OSP report also failed to address state-of-the-art measures currently being implemented to minimize or eliminate potential environmental impacts.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Attachment

REVERSE OSMOSIS INFORMATION SHEET
FOR THE MANINI'OWALI WATER SYSTEM

•Maintenance and Operations Procedure•

Reverse osmosis (RO) is a process by which pure water from a dilute saline solution flows through a semipermeable membrane. Commercially available RO membranes became available in the mid-1960's and have become an accepted commercial process for desalting brackish and sea waters. For the Manini'owali project, expected product water from a 2,200 total dissolved solids (TDS) feed is 100 TDS. The removed solids are concentrated in a by-product stream containing approximately 5,400 TDS.

RO systems work best with a clean well water supply (as opposed to surface water). Well waters are naturally filtered by soil and rock and provide a very low fouling water source for the RO membranes. One of the primary foulants negatively affecting RO membranes are suspended solids and organics common to surface waters. The Manini'owali project which will utilize brackish well water, is ideal for RO desalination.

Operation of the Manini'owali system is simplified since the RO feed pump can be eliminated. *175 to 200 psi pressure is required which reportedly can be provided from the* elevation difference between the well water storage tank and the RO system. Elimination of the high pressure pump reduces costs and eliminates the pump maintenance.

The pre-RO cartridge filters are used to protect the RO membranes from suspended particles in the feedwater. These filters will likely require replacement every 3 to 6 months.

The RO membranes will require periodic cleaning. It is estimated that cleaning would be required twice per year. Some systems operate a year or more between cleaning. RO membrane life is 3-6 years.

An antiscalant feed is required to prevent concentrated salts from precipitating in the by-product stream. The antiscalant is fed with a chemical metering pump and normally dosed at about 3.0 parts per million. Very little maintenance is required except for occasional pump calibration and changing the antiscalant drum as needed.

The operation of the RO assembly is normally controlled through the level in a RO product water storage tank. In this case, at low level a feed valve to the RO would open. When the tank is full, the valve closes. Alarms which would stop the flow to the RO system would likely be installed on the following parameters: high product water TDS, high and low product water flow, high and low by-product water flow.

Forests

The West Hawaii Sierra Club

Seas

December 16, 1991

RECEIVED
DEC 18 1991
GROUP 70
LIMITED

County of Hawaii Planning Department
25 Aupuni St.
Hilo, HI 96720

ATTN: Norman Hayashi

Dear Mr. Hayashi,

After reviewing the draft Environmental Impact Statement for the **Manini'owali Residential Community**, we find that the draft EIS fails to adequately address the cumulative impact of additional power requirements on HELCO'S energy grid.

Given HELCO'S abysmal management ability, we certainly have reason to be concerned. HELCO'S notorious power failures have cost our community many thousands of dollars due to lost business, lost productivity and damaged electric equipment.

Present insufficient capacity is evidenced by rolling blackouts, a HELCO policy of reducing maintenance time in order to maintain production, and by operating combustion turbines, which are designed for "peak-shaving", for many hours each day.

Our future energy supply is presently in grave doubt because of HELCO'S unwillingness to embrace Demand Side Management (DSM) programs, an unknown delivery date for 25 MW of geothermal power from Ormat and the community's growing opposition to HELCO'S proposed Pu'uanahulu power plant. Moreover, unless HELCO somehow manages to improve its relationship with the community, *any* plans to produce more power will provoke strong opposition.

Unless the community changes it's poor opinion of HELCO, we can expect to see lawsuits and contested cases associated with nearly anything HELCO plans to construct in the future.

Therefore, we feel that this EIS must include a detailed HELCO forecast of cumulative Big Island electric power impacts for the next ten years. Such a forecast would include the following elements:

1. Projects currently approved by the Planning Commission, but not yet built. Include the number of resorts, homes, condos, etc. Please include estimated power requirements.

2. New projects such as Manini'owali Residential Community that are planned but have not been approved. This estimate should include resorts, residential units, etc. Please include estimated power requirements.

3. A detailed HELCO forecast of electric power production capabilities for the next ten years. This forecast should include any power production facilities that would be phased-out due to obsolescence.

4. A detailed HELCO forecast of electric power savings realized from DSM programs for the next ten years.

5. A chart showing the number of power grid failures (including planned blackouts) vs shrinking surplus power capacity over the last ten years. The chart should show both the number of blackout events and number of blackout hours.

Thank You,

Jay Hanson, Program Chair,
West Hawaii Sierra Club,
78-6622 Alii Drive
Kailua-Kona, HI 96740

Phone 322-7268 Fax 322-7869

cc. North Kona Development
Group 70 International
OEQC

GROUP 70
INTERNATIONAL

5 February 1992

Mr. Jay Hanson, Program Chair
West Hawai'i Sierra Club
78-6622 Ali'i Drive
Kailua-Kona, HI 96740

Re: Draft Environmental Impact Statement for Manini'owali Residential Community
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por. 17)

Dear Mr. Hanson:

Thank you for your 16 December 1992 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The electrical demand for the proposed project is approximately 4.215 megawatts for the residential units, golf course, the golf clubhouse and tennis center, as well as for the operation of the wastewater treatment facility and desalting plant. Energy conservation measures will be designed into the project wherever feasible. These will include the use of energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. Solar energy use, heat exchanger units, waste heat recovery, flourescent and sodium lighting fixtures are also being considered for portions of the project.

We share your concerns of the recent series of blackouts and brownouts experienced by Big Island residents. The primary purpose of the Draft EIS energy discussion was to consider the impact of this proposed project on West Hawaii Energy Supply facilities, with consideration for the future regional power generating capacity. HELCO has addressed future electrical power supply in their letter of 3 February 1992, a copy of which is included in the Final EIS. In our consultation with HELCO staff, we have learned that power generation to accommodate the growth of the Big Island will be increased with the planned installation of combustion turbines in Puna and in West Hawai'i. North Kona Development Group will be participating in the development of the electrical distribution system to service its needs.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

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Danilo M. Herrera

5 February 1992

Mr. Jay Hanson, Program Chair
West Hawai'i Sierra Club
78-6622 Ali'i Drive
Kailua-Kona, HI 96740

Re: Draft Environmental Impact Statement for Manini'owali Residential Community
Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por. 17)

Dear Mr. Hanson:

Thank you for your 16 December 1992 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

The electrical demand for the proposed project is approximately 4.215 megawatts for the residential units, golf course, the golf clubhouse and tennis center, as well as for the operation of the wastewater treatment facility and desalting plant. Energy conservation measures will be designed into the project wherever feasible. These will include the use of energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. Solar energy use, heat exchanger units, waste heat recovery, flourescent and sodium lighting fixtures are also being considered for portions of the project.

We share your concerns of the recent series of blackouts and brownouts experienced by Big Island residents. The primary purpose of the Draft EIS energy discussion was to consider the impact of this proposed project on Wsst Hawaii Energy Supply facilities, with consideration for the future regional power generating capacity. HELCO has addressed future electrical power supply in their letter of 3 February 1992, a copy of which is included in the Final EIS. In our consultation with HELCO staff, we have learned that power generation to accommodate the growth of the Big Island will be increased with the planned installation of combustion turbines in Puna and in West Hawai'i. North Kona Development Group will be participating in the development of the electrical distribution system to service its needs.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1027

February 3, 1991

County Of Hawaii
Planning Department
25 Aupuni Street
Hilo, HI 96720

Attention: Mr. Norman K. Hayashi, Plannign Director

Subject: Draft Environmental Impact Statment
Manini'owali Residential Communtiy
T.M.K. 7-2-04: por 17

Thank you for the opportunity to review the subject EIS. We have the following requirements and comments:

1. In 1993, we are planning to install a new Poopoomino Switching Station in the area to serve the Four Seasons and Princess hotels. Therefore, new 69,000 volt transmission lines easements and a new substation site are not required. The developer will be required to contribute an advance to upgrade the Poopoomino Switching Station to pay for the addition of a distribution transformer and switchgear to satisfy the off-site requirements.

2. Easements for the offsite 12,000 volt electrical distribution system from the switching station to the project site are required. This is in addition to the required on-site electrical easements.

3. Due to the long lead time required to purchase and install the transformer and switchgear in the switching station, the developer's electrical consultant is urged to contact HELCO as soon as practicable to discuss the project schedule.

4. We strongly recommend that energy efficient and conservation features suitable to reduce the peak electrical demand be a part of the development's plans and requirements. We recommend that this development take full advantage of waste heat recovery equipment to recycle and reuse the waste heat rejected by air conditioning and refrigeration eqiuipment. Other energy saving devices such as fluorescent lighting and sodium lighting for parking lot and roadway lighting are also recommended.

In addition, HELCO is a participant in the Public Utilities Commission, Docket 6617, on Integrated Resource Planning (IRP). The IRP process is to develop, implement, monitor and evaluate utility resource plans that identify the optimum mix of energy resources for meeting forecasted levels of energy needs. Demand-side options include activities designed to influence customers' use of electricity in ways that will produce desired changes in load shape which can delay the addition of supply-side options.

To prevent further rolling blackouts of distribution circuits we have plans to install a 20.8MW combustion turbine at Puna in 1992 and another 20.8MW combustion turbine in West Hawaii in 1994. Thus, we will have adequate generating capacity and margin to serve the subject project scheduled for 1996.

Please call myself or H. Kamigaki if you have questions.

Very truly yours,

H. K. Kamigaki

for Clyde H. Nagata, Manager
Engineering Department

CC: Group 70 International (Y. Ohashi)
North Kona Development Group (M. Handa)
Tom Goya

GROUP 70

INTERNATIONAL

5 February 1992

Mr. Clyde H. Nagata, Manager
Engineering Department
Hawai'i Electric Light Company, Inc.
PO Box 1027
Hilo, HI 96721-1027

Re: Draft Environmental Impact Statement for Manini'owali Residential Community Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-04: por. 17)

Dear Mr. Nagata:

Thank you for your 3 February 1992 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

1. Po'opo'omino Switching Station

North Kona Development Group (NKDG) is pleased that the Po'opo'omino Switching Station infrastructure is planned in the nearby vicinity of its development and within the timeframe of its proposed residential and golf course development. NKDG will participate with HELCO in the development of the distribution transformer and switchgear to satisfy the off-site requirements.

2. On-site and Off-site Easements

NKDG will pursue obtaining utility easements from the appropriate land owner(s) prior to the installation of its electrical distribution system.

3. Consultation with HELCO

NKDG plans to meet with HELCO engineers in the near future to discuss the project schedule and to begin planning for this phase of the development.

4. Energy Conservation.

The electrical demand for the proposed project is approximately 4.215 megawatts for the residential units, golf course, the golf clubhouse and tennis center, as well as for the operation of the wastewater treatment facility and desalting plant. Energy conservation measures are planned to be designed into the project wherever feasible. These will include the use of energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible.

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-58

Solar energy use and heat exchanger units for portions of the project are also being considered.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely yours,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

cc Hal Kamigaki

G A L L U P & GVP V a n P E R N I S

RECEIVED
NOV 25 1991

November 21, 1991

Jeffery H. Overton, AICP
Group 70
924 Bethel Street
Honolulu, HI 96813

Re: Maniniowali, TMK (3) 7-2-4-17

Dear Mr. Overton:

Thank you for providing your Draft Environmental Impact Statement (dated November 1991) for my review and comments. My comments fell into five categories.

1. Consulted Parties

I note your consulted exhibits and individuals displays outdated information and is inadequate. This is exactly the sort of thing that led to a contested case proceeding before the State Land Use Commission in the recent Queen Liliuokalani Trust Land Reclassification application when the Greater Kona Community Council (which I represented) intervened to represent the West Hawaii community because the Trust and their consultants did such a poor job of getting current community input from West Hawaii.

For instance, out of 22 community organizations you list, only five appear to be West Hawaii based organizations, and of these five one is pro-development lobbying group (Hawaii Leeward Planning Conference), and two while strong organizations representative of their membership, (Kona Board of Realtors, Kona-Kohala Chamber of Commerence), they represent a very narrow segment of the community. And some of the groups you identify are East Hawaii groups with no knowledge or interest in West Hawaii, despite a name which may imply an island wide basis, who are often at odds with West Hawaii such that they cause reactions in many West Hawaiians of whatever such an organization is "for" must be bad for West Hawaii such that West Hawaii should be "against." I'm refereeing to the Hawaii Island Board of

WALLACE H. GALLUP JR. MARK Van PERNIS ATTORNEYS AT LAW A LAW CORPORATION DAVID E. SMITH GARY W. VANCIL
SUITE C-210, HUALALAI CENTER, 75-170 HUALALAI ROAD P.O. BOX 1837, KAILUA-KONA, HAWAII 96745 PHONE (808) 329-3551, FAX (808) 329-6185

Realtors, the Big Island Business Council, the Japanese Chamber of Commerence and Industry, etc.

Three organizations you have not utilized which you definitely should consult are the Hawaii Island Environmental Council, the Greater Kona Community Council, and the County's Veteran's Advisory Council (due to the proposed Veteran's cemetery site being very close to your project). I also suggest you contact the owners associations of nearby big subdivisions, such as Kona Palisades and Waikaloa.

2. Traffic/Roads

It is time to start considering overhead interchanges at the major bottleneck intersection your development and the State Park Project will create. The Veterans Cemetery also may be part of this traffic. This is what is being considered and advocated for the Queen Liliuokaliani Trust and Mauna Kea developments, and there will certainly be a need for it in the long run. Why not do it right to start with? Why shortchange the community and decrease the ease of driving and quality of life?

3. Environmental Concensus

As one who is very extensively and intimately aware of the land you now own and the area makai at Kua Bay and the shore reefs there, I know that there is very great permeability and tremendous amount of natural subsurface flow of fresh and brackish water to the ocean there. Your development presents a serious threats to ocean water quality at Kua Bay and particularly to the reefs in the area. Effluent, pesticide, fertilizer, and all other forms of waste water pollution will be a particularly severe concern here, more so than many other areas of the coast and this is where the state will have shoreline preservation and recreation areas. Before any development at all takes place, baseline shoreline water quality and reef studies must be made and appropriate shoreline determined.

4. State Shoreline Park Consideration

To date, the State has not acquired all of the previously owned Kua Bay (Maniniowale) parcels, and without them there will be no State Shoreline Park which your draft EIS presumes is to be developed.

5. Electricity

There is no question that HELCO presently does not have the generation capacity or transmission capability at this time to service you or any other major development, despite whatever their representatives may be telling you. And it is very questionable that this situation will improve soon.

These facts are now well established and known to the government and the public. HELCO's glib practice of saying they'll be ready when the time comes is no longer adequate, and you should be prepared to put on a much better case than that for your project being able to deal with electrical needs, and perhaps eves fashion a condition that HELCO's generation and transmission capabilities be proven when your time comes. A lot could be done for your project's quality and reputation, and for community support, by being a leader in energy conservation and efficiency in your development. As you may know, your project is located in one of the highest year round sun caloric energy areas in the entire state! So its perfect for photovoltaic uses.

Sincerely,

GALLUP & VAN PERNIS

By____________________
MARK VAN PERNIS

MVP/py

cc: Michael Hands, NKDG
HIEC, Jerry Rothstein
Senantor Andrew Levin
Mayor Lorraine Inouye
Representative Virginia Isbell
Representative Michael O'Kieff
County Planning Department
Earthplan, Berna Cabacungan
Office of State Planning

5 February 1992

GROUP 70
INTERNATIONAL

Mark van Pernis, Esq.
Gallop & van Pernis
Suite C-210, Hualalai Center
75-170 Hualalai Road
P.O. Box 1837
Kailua-Kona, HI 96745

Re: **Draft Environmental Impact Statement Manini'owali Residential Community** Manini'owali, North Kona, Island of Hawai'i (TMK: 7-2-4: por. 17)

Dear Mr. van Pernis:

Thank you for your 21 November 1991 letter concerning the Draft Environmental Impact Statement (Draft EIS) for the Manini'owali Residential Community. The following is offered in response to your comments.

A. Consulted Parties

North Kona Development Group (NKDG) has made every effort to contact various interest groups in the West Hawai'i community, and we feel that this effort has led to an improved understanding of the proposed project. We provided copies of the Draft EIS to numerous other West Hawai'i organizations and individuals who have participated in the planning process. A copy of the Draft EIS was also provided to the Kailua-Kona, Holualoa and Kealakekua Libraries for public review. The Office of Environmental Quality Control published notice of the availability of this document four times in their OEQC Bulletin on 8 November, 23 November, 8 December and 23 December, 1991. Of the various interest groups sent copies of the Draft EIS, we received few comments. Comments were received from the West Hawai'i Sierra Club and the Big Island Na Ala Hele Advisory Council; their comment letters and our response letters are included in the Final EIS.

B. Traffic/Roads

There is a long-range State Department of Transportation (State DOT) plan to improve Queen Ka'ahumanu Highway to a four-lane limited access highway, with grade-separated interchanges at key locations. Currently, the specific timing and location for improvements at this section of the highway have not been worked out. The DOT is conducting a study of the region as part of their planning process.

Until planning and scheduling for the interchange is finalized, an at-grade intersection at the project access roadway and Queen Ka'ahumanu Highway is proposed. The State DOT has requested that no traffic signals be placed at this intersection, to allow for smooth traffic flow conditions for through-travel on this highway during peak traffic flow periods. Without signals, long delays will be experienced by project residents making left turns into and out of the project access road. This short-term condition will have little effect on the flow of through-traffic. A left-turn storage lane turning into the project for north bound traffic and a right turn deceleration lane for south bound traffic is proposed as an interim measure until the interchanges are constructed.

NKDG understands that the future improvement of Queen Ka'ahumanu Highway will be undertaken. It is not prudent at this time, however, for NKDG to make specific commitments in major interchange and frontage road development without specific State plans in place for this section of highway. NKDG will participate in the regional roadway improvements on a pro-rata basis when State DOT plans are more specific.

C. Environmental Concerns

Potential changes to nearshore water quality as a result of the proposed project have been considered by Oceanit Laboratories. Inc. (OLI) report included in the Draft EIS. OLI's findings indicate that nearshore ocean water could receive some minor input of ground water containing minor concentrations of fertilizer and treated effluent nitrogen and possibly some minute concentrations of pesticides. The introduction of these small concentrations will not cause adverse effects on the nearshore water quality or the marine ecology, due to rapid mixing with the surrounding ocean waters at the nearshore or offshore ground water discharge point.

Baseline monitoring of Kua Bay and the nearshore ocean waters off Manini'owali has been initiated by OLI. NKDG is willing to comply with requirements for long-term monitoring of nearshore water quality and the anchialine pond near Kua Bay. Details of an ocean water monitoring program will be developed in coordination with the State Department of Health and the DLNR Division of Aquatic Resources.

D. Shoreline Park

The State has plans to establish a shoreline park along approximately seven miles of this section of the West Hawai'i coast. Several privately-owned parcels are located within this proposed park area, which the State of Hawai'i is actively pursuing to acquire. It is not known whether or not the phased development of portions of this State Park will be contingent on acquisition of all of the privately-held parcels. It is possible that the State could develop and operate beach support facilities at Manini'owali Beach with or without the acquisition of all of the privately-owned parcels at this location.

E. **Electricity**

HELCO is currently planning to expand its generating capacity for West Hawai'i. A new power generation facility is being planned near Pu'uanahulu or Kawaihae. A new switching substation will serve the approved Kaupulehu resort and residential development. According to HELCO representatives, the expanded generating capacity will be more than adequate to serve the known and proposed growth of this region, including the NKDG proposed project. NKDG will coordinate its development plans with HELCO's plans to supply power to this area.

To conserve energy, design efforts will be made to use energy efficient light sources, daylighting design, energy efficient pumps, and scheduling use of industrial loads during off-peak hours whenever possible. We are currently exploring the feasibility of solar energy use for several components of the project.

Thank you again for your comments. Please feel free to call either me or Yukie Ohashi if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Senior Planner

SECTION 9 – Technical Appendices

APPENDIX A

Market Study

Manini'owali Residential Community

Prepared for
North Kona Development Group

Prepared by
John Zapotocky

October 1991

Table of Contents

Executive Summary

The 388 acre Manini'owali parcel was acquired by the North Kona Development Group (NKDG) in May 1991 through exchange with the State of Hawaii for 333 acres of adjacent land at Awake'e formerly owned by NKDG. The State's acquisition of Awake'e allowed it to consolidate the ownership of coastal lands while NKDG obtained lands adjacent to the Kukio Kaupulehu Resort Development Node containing existing and approved resort development.

The property is located on the western side of the Island of Hawaii in the district of North Kona. Surrounding land uses include, to the north, the Kukio Kaupulehu Resort Node; to the east (mauka) Queen Kaahumanu Highway and across the highway vacant land; to the south Awakee (slated to become a State wilderness park), and to the west the Pacific Ocean and additional land slated to become part of the State wilderness park.

The NKDG proposes to develop a residential golf community consisting of approximately 1,000 residential units on approximately 134 acres of the 388 acre parcel. The remainder of the site will be used for golf course, golf clubhouse, amenities both recreational and commercial, infrastructure, and open space.

The Manini'owali Residential Community plans to offer product which is differentiated from that which is currently being offered at other Kona and Kohala Coast developments and comparable Residential Communities throughout the state. The emphasis at Manini'owali is to provide units which are typically larger than currently being offered at competing communities while offering better golf priority than is available elsewhere. Specifically Manini'owali offers a makai orientation, truly residential accommodations, the highest priority golf access, while at the same time being proximate to both resort, commercial, employment and service centers.

The proposed Manini'owali development intends to tap the residential, second home and retirement markets which eventually cluster around maturing resort communities. Manini'owali also anticipates targeting a broader spectrum of the market for residential, second home and retirement homes than the resort developments planned in the Kukio Kaupulehu Resort Node.

The NKDG has retained John Zapotocky, Consultant to prepare a market assessment for the proposed project. The purpose of the report is to satisfy the requirements of Chapter 343 (EIS requirements). In addition, the report will be used for the Land Use Commission Application as well as the County General Plan amendment application.

Numerous studies relating to the Big Island's housing needs have been undertaken particularly in the Kona area. Government planning agencies, housing and social agencies, as well as private interests, have undertaken or commissioned studies to define the quality, quantity, location and need for additional housing. Similarly, volumes have been gathered regarding the population of Hawaii and its characteristics. The analysis contained here draws upon the significant findings of recognized authorities and studies on the subject matter and presents this material as it relates to the demand for units in the Manini'owali Residential Community.

The need for housing in its simplest form consists of the need to provide shelter and thus increases as the population grows. The need for housing, however, is formed within the context of human society and, therefore goes beyond basic shelter. The function, location, type, tenancy and quality of the need is determined by societal expectations. Further the need for housing changes over time as the lifestyles, social mores and demographics of the population change.

Historical population trends provide one indication of future housing needs. The de facto population has increased significantly since Statehood (1959), an event generally recognized as a major turning point in the growth of post World War II Hawaii. Between 1970 and 1980, the de facto population of the Island of Hawaii grew from 66,600 to 99,500 persons for an average increase of 3,290 per year. As of July, 1989, the Island of Hawaii de facto population was estimated at 138,000 which represents a net increase of 71,400, a 107% percent increase since 1970.

Such rapid growth indicates that in-migration has been a major factor in the growth of population. Based on the projected continuation of growth over the next twenty years this pattern of rapid growth fueled by in-migrants will continue.

The resident population of the Island of Hawaii increased from 63,648 to 92,053 from 1970 to 1980, an increase of 45 percent in the ten-year period. During the same period, population in the North Kona District increased from 4,832 to 13,748, or 184.5 percent the highest growth rate

of any district in the State of Hawaii. From April, 1980 to July, 1989, the resident population of the Island of Hawaii increased from 92,053 to 122,300, or 32.8 percent; during the same period, the population of North Kona increased from 13,748 to 23,000, or 67.4 percent.

The North Kona District has had the greatest growth rate in population for the last two decades of any area on the Island of Hawaii and second only in growth to the District of Hanalei on the Island of Kauai, which started off with a population base one third the size of North Kona.

Future growth is expected to continue with the department of Business and Economic Development forecasting a defacto and resident population of 243,000 and 206,100 by 2010 respectively. This growth in population is driven primarily by the growth in tourism forecast for West Hawaii.

The growth in the housing stock on the Big Island has been similarly impressive with units increasing from 18,972 in 1970 to 50,019 in 1990. The growth in units in West Hawaii has been even greater on a percentage basis due to the concentration of economic and population growth in the area. Because of the tremendous growth in recent years, the housing stock is for the large part, relatively new. This is particularly true where the base of housing units was relatively small.

Other information relating to the housing stock indicates that approximately 80% of building permits issued, result in units. As of 1990 there were only 1,224 government controlled units or approximately 2.5% of the housing stock. While this figure is expected to grow modestly, government participation in the housing market is expected to grow substantially. This is due primarily to the County's Waikoloa Housing project and the State's Kealakehe project. The reason for the modest growth in government controlled units, is that most of the product to be developed in the aforementioned projects, is to be sold to persons with incomes qualifying in the "affordable range".

Housing trends and characteristics include those which follow national and statewide trends as well as those that are unique to the County of Hawaii and the West Hawaii area in particular. Primary factors impacting County and West Hawaii housing include the following:

Decreasing household sizes are a national, state and county trend. On the national level the household size deceased from 5.9 in 1790 to 2.76 in 1980. Statewide household size decreased from 3.15 in 1980 to 2.99 in 1990 and the county of Hawaii declined form 3.61 in 1970 to 3.09 in 1980. These changes are being driven by the aging population and the change in lifestyle and a variety of other reasons.

The population has aged significantly due to the baby boom generation beginning to mature. As most of the people that will be alive in the next twenty years already exist, the aging of the population is a foregone conclusion given a continuation of the trend in birthrates and life spans.

Other factors affecting housing include: economic cycles, inflation and financing. Of particular importance in the West Hawaii area is the second home and vacation home market. A significant portion of the housing units planned for the West Hawaii area are expected to be absorbed as transient accommodations or as second homes. At present HVB statistics indicate that approximately 2,200 of Big Island condominiums are utilized as transient accommodations. While this equates to less than 5% of the housing inventory, it is generally recognized by visitor industry and housing industry professionals that the self reported statistics used understate the number of housing units thus employed.

Future demand for housing is expected to be impacted by existing shortages, population growth, future household sizes, desired vacancy factors and the affordability of the product to the persons needing the housing.

According to The Hawaii State Plan - Housing (Draft) 1988, 45,000 families within the State currently reside in overcrowded units (overcrowded defined as units with more than one person per room) and 6,500 families are living in substandard units (substandard defined as lacking basic plumbing facilities). While there is undoubtedly some overlap between overcrowded and substandard units, the total number of families falling into either category is likely to be at least 50,000.

According to the "Comprehensive Housing Market Analysis Hawaii County Housing Market Area" (as of July 1, 1987) by the San Francisco Housing and Urban Development Office, the Big Island as a whole generally had an adequate housing supply, the West Hawaii Area and the employment centers of North Kona and South Kohala specifically had a housing shortage. While this study is four years old, it reconfirms earlier observations contained in "Economic Development on the Island of Hawaii - Issues and Options" DPED August 1984 which indicated that the housing supply in North Kona and South Kohala was inadequate to meet the existing and future needs of the expanding resort areas. The recently completed (September 1990) "Kealakehe Planned Community Final EIS" Belt Collins and Associates p. VI - V3 indicates that as of late 1989 the housing shortage in the West Hawaii area had deteriorated significantly between 1980 and 1989. According to the social impact section of the EIS terms such as "critical", "severe" and "drastic" were used to describe the housing situation in West Hawaii. In more analytical terms, the "Market Assessment - Kealakehe Planned Community" by Peat Marwick June 1990 outlines a very tight West Hawaii market.

Population is expected to continue to grow on the Big Island and in West Hawaii in particular with the concentration of growth occurring in the tourist industry. Household sizes are expected to continue to shrink as the population ages and as social trends which encourage smaller families continue.

Vacancy rates while not particularly low islandwide are extremely low in West Hawaii and expected to stay that way for the foreseeable future.

Affordability a key factor when translating housing needs into housing demand is likely to be enhanced by competition among various resort and housing projects which have affordable housing requirements. This competition to provide affordable housing is likely to provide an increased number of housing units in the affordable price ranges. It should be emphasized that in order to insure affordability of housing units an adequate supply is an absolute necessity. Providing units only at "affordable" prices while ignoring the demand for market units forces market unit buyers to raid "affordable" inventory to redevelop as market units thus increasing the price of the affordable housing stock.

Based on the foregoing, the County of Hawaii and the West Hawaii area in particular seem poised to experience a tremendous demand for housing units over the next twenty years.

While an adequate supply of units is forecast by County planners, a number of factors could disrupt the long term supply including: developers financial problems which could temporarily or substantially delay specific projects; social and political activism which may result in the delay or abandonment of specific projects; concentration of future housing inventory in major planned communities, which allows single developers to make decisions which impact a large portion of future inventory; and competition from second home buyers and transient accommodations investors which can often outbid permanent residential users. These forces can be counteracted by government policies which make more land available and which provide incentives for additional affordable residential development.

The demand for housing units in West Hawaii is estimated at approximately 1,439 units per year. It is further estimated that demand for affordable units is approximately 680 units per year or 49% of total housing unit demand.

An analysis of MLS sales between 1980 and 1990 on Oahu, Maui and Hawaii show a growth in the number of units priced in excess of $500,000 ($1990). Big Island sales in this category are substantially below those of Oahu and Maui, however, if only West Hawaii is considered, then a closer relationship exists. Given that the Big Island tourist industry is expected to grow at a faster rate than that of both Oahu and Maui, it is likely that the percentage of sales in the $500,000 plus category will equal or exceed those of the other islands.

A further reinforcement of the demand for market units exceeding $500,000 is the pricing of new condominium units and single family lots within West Hawaii Makai Planned Communities. Based on 1990 condominium offerings, 82% of units within West Hawaii Makai Planned Communities were priced in excess of $500,000, while 56% of the total condominiums offered were in the $500,000 plus price range. A similar observation is made of single family lots offered in West Hawaii Development Nodes. Minimum resale price is approximately $275,000 ranging to $6,000,000. Assuming a house is built of at least equal value indicates a value of at least $500,000 for house and lot within West Hawaii Development Nodes. Based on the above, it is concluded that approximately 90% of West Hawaii Planned Community demand will be satisfied with $500,000 plus units.

An analysis of residential demand indicates approximately 10% of West Hawaii sales were in the $500,000 plus category (excluding resort sales). Assuming this relationship holds an additional 100 sales per year could be expected from this source.

Manini'owali could capture between 10% and 20% of the Makai Planned Communities market assuming that competition is limited to the projects forecast in the West Hawaii plan "2005 development scenario". Manini'owali could capture between 10% and 20% of the $500,000 plus from the residential market given its dedication to the residential buyers. Combining the two markets, Manini'owali has the potential to deliver 55 to 110 units. Once approved, and assuming that Manini'owali produces units on a continuous basis, the absorption is more likely to be on the high side as it is likely that some projects will not be approved and other projects while approved may not produce units or produce units on a continuous basis.

The Manini'owali Residential Community project is in the early stages of the planning process. One of the more attractive features of the development is the readily accessible recreational facilities. These amenities include an 18-hole championship golf course and a tennis club. The purpose of this section of the report is to identify and assess

the potential need for a golf course from a market point of view, i.e., what is the estimated demand for the course?

The proposed course development would consist of an 18 hole, daily fee, championship golf course, including a golf clubhouse, parking lot, and maintenance facilities. The course would complement the residential housing development of about 1,000 units. The golf course would be ready for play sometime in 1996.

The enhancement of residential developments with golf courses is a documented way to increase the value of a project, which in turn often helps to offset the construction and operational costs of the course. Increased premiums for homes with golf course frontage are noted to be as high at 50-60% in the southwestern United States, according to a recent Leventhal study.

Nationally, the outlook for golf participation through the year 2000 is very positive. This optimism is based on the following: expected higher incomes, an aging population, early retirement, and more leisure and flex time (flexible working hours), among other factors. According to recent studies by the National Golf Foundation, there were some 24.7 million golfers in 1989, up about 8% per annum from 17.5 million golfers in 1985. If similar trends continue, it is estimated that there may be between 30-40 million U.S.-resident golfers by the year 2000. This projected growth, when analyzed from the point of view of the need for additional golf courses, shows potential demand for between 1,400 to 7,900 golf courses by the year 2000, assuming only 0% and 3% rates of growth in participation.

The prospects for increased golf participation in the State of Hawaii echo, and in some cases, amplifies, those of the national trends. The growth of golf participation in the State is tied to the growth of the resident population and tourism, as well as the annual growth in the participation of golf within each group.

Approximately 291,000 rounds were played on the Kona Coast's 5 golf courses in 1988. Of these rounds, approximately 87,000 or 29.8% were played by residents and 205,000 or 70.2% were played by visitors. Based on this information the average annual rounds played in 1988 by Kona's average resident and visitor population was 38,990 and 9,055, respectively. Using the 1988 figures and the projected growth rates for resident and visitor population as projected by State planners, alternative demand scenarios were generated by incorporating growth rates of 0%, 2%, and 5%. Use of these assumptions indicated a demand in Hawaii County for additional golf courses of 14, 25 and 50, respectively.

Characteristics which describe the County of Hawaii's unmet golf demand include: courses which operate at maximum or over capacity; and escalating green fees.

There are currently 9 golf courses under construction or nearing construction in the County of Hawaii with an additional 26 courses in various stages of planning. However, based on a number of considerations, including the ability to achieve needed governmental approvals, the physical constraints of the sites under consideration, the ability of potential developers to obtain financing and the economics of development in an environment of potential oversupply, the Consultant estimates that half of these planned courses could be developed by the year 2010.

The South Kohala, North Kona and South Kona regions (Kona Coast) is expected to account for the bulk of the residential development and visitor plant expansion thru the year 2010. Growth in golf demand is also expected to continue not only because of an increased growth in population but also due to the increase in the popularity of the sport.

Demand for golf at Manini'owali should be assured due to three factors: Location within the high golf growth Kona region; the target market for the homes within the Manini'owali Residential Community which is likely to attract buyers whose demographic profiles match that of high frequency golfers; and the location of the development adjacent to the Kaupulehu-Kukio resort development node.

The consultant estimates that the Manini'owali Residential Community is likely to supply 38,000 rounds annually at buildout. This is based on the community's likely demographic makeup which increases its likelihood of attracting high frequency golfers. In addition, other resident play is estimated at approximately 7,000 rounds annually composed primarily of half fee Kaamaina play. Demand from the adjacent Resort has been estimated at approximately 7,000 rounds based on overflow demand from the Kukio Kaupuluhu Resort Residential Community.

A golf course at Manini'owali will have advantages over other golf courses on Hawaii and in the Kona Region. These advantages include: proximity to resort development at Regent; proximity to the "executive home" development at Manini'owali; a high degree of visibility from the Queen Kaahumanu highway and topography that allows for ocean views.

The golf course being considered for Manini'owali is strongly supported from the standpoint of the existing and future demand for golf courses on Hawaii. Development of a golf course at Manini'owali will enhance the residential product being proposed by providing additional recreational

opportunities as well as aesthetic benefits to the surrounding residential development.

I. INTRODUCTION

A. Background

The 388 acre Manini'owali parcel was acquired by the North Kona Development Group (NKDG) in May 1991 through exchange with the State of Hawaii for 333 acres of adjacent land at Awake'e formerly owned by NKDG. The State's acquisition of Awake'e allowed it to consolidate the ownership of coastal lands while NKDG obtained lands adjacent to the Kukio Kaupulehu Resort Development Node containing existing and approved resort development.

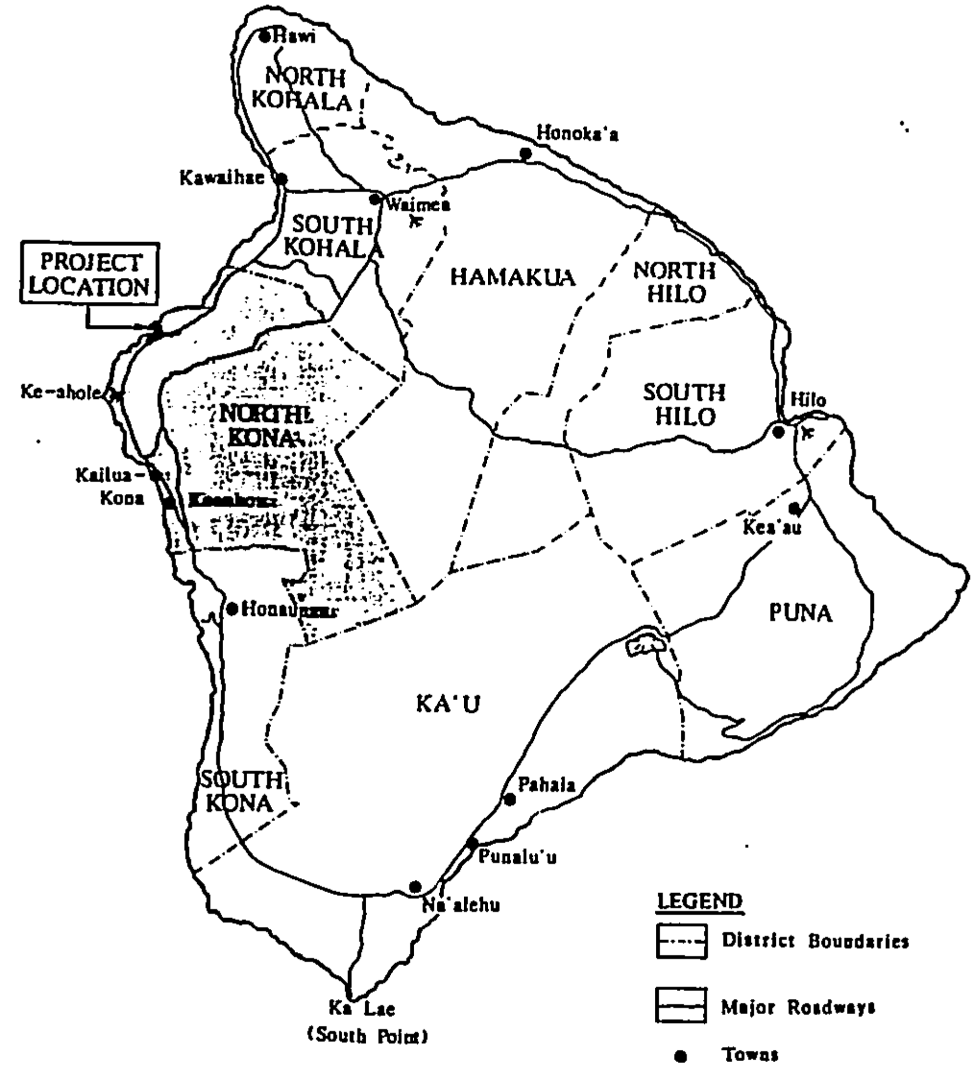
B. Location and Surrounding Uses

The Manini'owali parcel is located on the Island of Hawaii within the North Kona district and makai of Queen Ka'ahumanu Highway. (See Map 1) The parcel is adjacent to the Kukio Kaupulehu Resort Development node. (See Map 2)

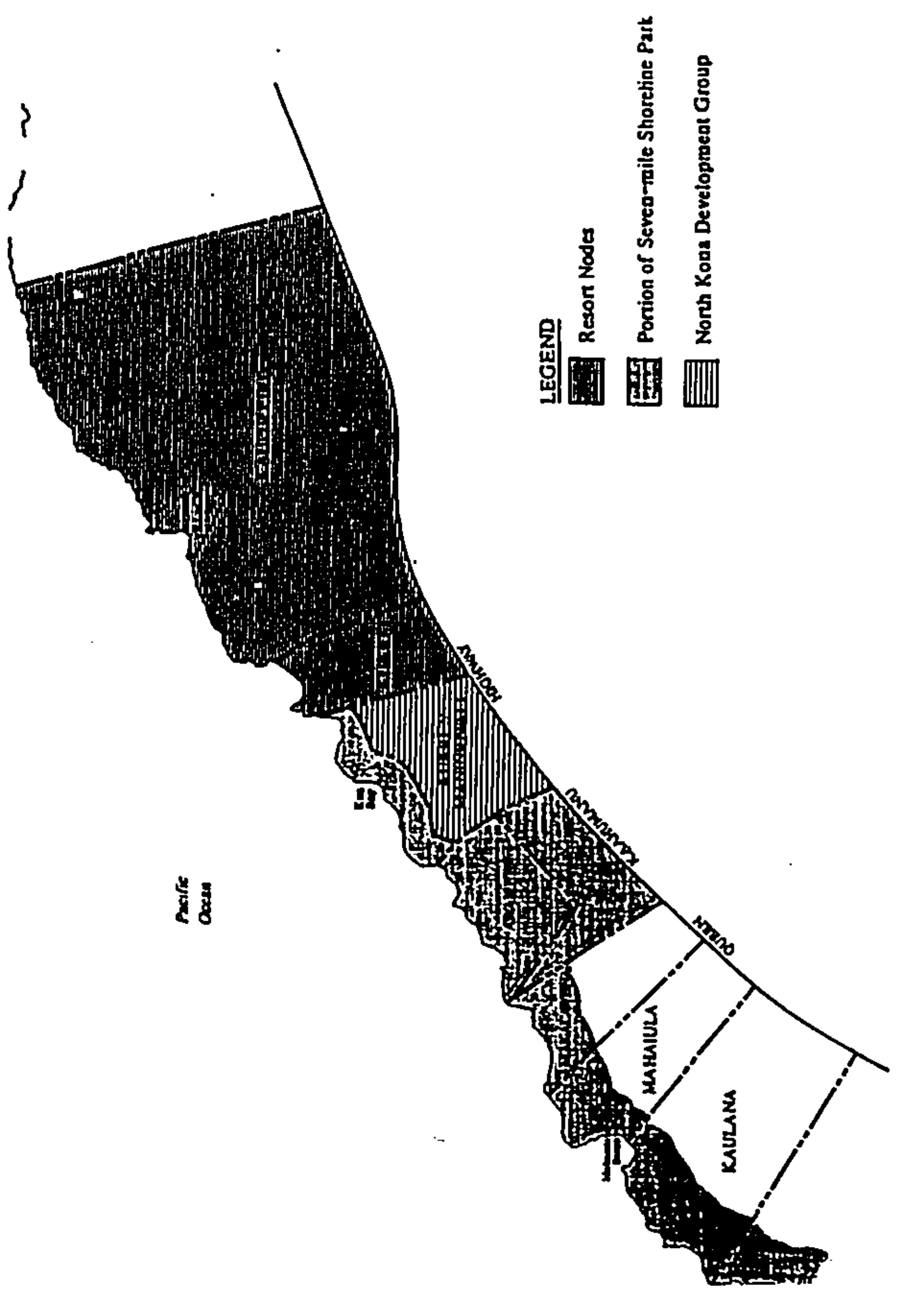
Surrounding land uses are as follows: To the east Queen Ka'ahumanu Highway and mauka of the highway, vacant land owned by the State of Hawaii. To the south is the Awake'e ahupua'a currently vacant and owned by the State of Hawaii, future plans for the parcel are to incorporate it into a regional shoreline wilderness park. To the west is a 1,000 foot coastal strip owned by the State of Hawaii and 9 acres of land presently owned by private owners which will be incorporated into the regional wilderness park. To the west beyond the 1,000 foot strip is the Pacific Ocean. To the north is the Kukio 1 (Huehue Ranch) planned resort development. Further north is the Kona Village and Kaupulehu resort developments.

C. Proposed Land Use

The NKDG proposes to develop a residential golf community consisting of approximately 1,000 residential units on approximately 134 acres of the 388 acre parcel. The remainder of the site will be used for golf course, golf clubhouse, amenities both recreational and commercial, infrastructure, and open space.



Hawaii Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY
MAP 1



Regional Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY

MAP 2

D. Purpose of this Report

The NKDG has retained John Zapotocky, Consultant to prepare a market assessment for the proposed project. The purpose of the report is to satisfy the requirements of Chapter 343 (EIS requirements). In addition, the report will be used for the Land Use Commission Application as well as the County General Plan amendment application.

II. PROJECT DESCRIPTION DEVELOPMENT CONCEPT AND MARKET OBJECTIVES

The Manini'owali residential development is intended to support State and County development goals for West Hawaii and more specifically the North Kona area of the County of Hawaii. The master planned Manini'owali project will be supportive of the resort and residential development identified as critical to the economic improvement of West Hawaii. The specifics of the plan call for the development of 1,000 residential units, an 18 hole championship golf course, and various recreational and commercial amenities as well as open space.

A. Description of Proposed Development

1. Golf Course

The centerpiece of the development will be an 18 hole, 7,000 yard championship golf course. The course will include a clubhouse, cart-barn, maintenance facility, comfort stations and a driving range. The clubhouse will contain approximately 15,000 to 25,000 square feet of space and may contain a restaurnnt. The clubhouse will provide community residents wit' ral point for socializing and recreating as well as fun ually providing a location for the operation of the golf amenity. However, the most unique feature of the Manini'owali golf course will not be its physical character, but its operational character. The Manini'owali course will be the only course in West Hawaii makai of Queen Ka'ahumanu Highway whose first priority will be providing golf services to residents of the Manini'owali community. This is a departure from the practice of giving golf starting times priority to hotel guests over residents.

2. Residential Product

a) Single Family Golf Course Residential Units: (approximately 700 units)

Golf Course units have proven to be a popular product at other locations proximate to destination resort properties throughout the Hawaiian Islands. Given the attractiveness of golf front residential units at

other destination resorts and the variety of these units available, Manini'owali planners have offered a spectrum of golf front single family residential product.

1) Attached Single Family (approximately 550 units)

A total of 550 units low density attached single family golf front units are planned at Manini'owali. These units could potentially range in size from two bedrooms, three bedrooms, and even four bedrooms, however, given the upscale nature of the project and the current market's preference for larger units at this level of quality, the bulk of the product is expected to consist of three bedroom units averaging 2,300 square feet. This product type is unique in Hawaiian resort properties, as the sizes suggest, these are units designed for year round living rather than temporary residences. While similar product could be offered at competing South Kohala and North Kona resorts, the primarily residential character of Manini'owali and priority golf course access should provide these units with a unique advantage in attracting buyers for residentially oriented product.

2) Detached Single Family: (approximately 150 units)

Manini'owali proposes 150 detached single family units. Incorporation of the single family product would result in reduced unit counts. Single family product may be developed at densities of three to five units to the acre. At the present time only house and lot packages incorporating an average 3,000 square foot house (range 2,500 sq. ft. to 4,500 sq. ft.) are being considered for development.

b) Multi-Family Golf Course Residential Units: (approximately 300 units)

Manini'owali planners also propose to offer approximately 300 stacked flats to buyers desiring lower priced and smaller units. These units would be similar to other product which has been successfully offered in the Hawaiian resort residential market and in the North Kona and South Kohala resort residential markets. At the present time, there are few units being offered of the average 1,750 square feet being proposed for the Manini'owali development.

c) Summary of Product to be Offered

The Manini'owali Residential Community plans to offer product which is differentiated from that which is currently being offered at other Kona and Kohala Coast developments and other Resort Residential Communities throughout the state. Manini'owali's concept is to provide it's residents with larger residential units and greater access to communities golf amenities, than is being provided by other competing communities. Specifically Manini'owali offers a makai orientation, truly residential accommodations, the highest priority golf access, while at the same time being proximate to both resort, commercial, employment and service centers.

B. Marketing Concept

The proposed Manini'owali development intends to tap the residential, second home and retirement markets which eventually cluster around maturing resort communities. Manini'owali also anticipates targeting a broader spectrum of the market for residential, second home and retirement markets than the resort developments planned in the Kukio Kaupulehu Development Node.

At the present time no planned resort community in the County of Hawaii or in the State of Hawaii is offering single-family homes or attached single family homes in any price range. A number of West Hawaii resorts, including Mauna Kea, Mauna Lani and Keauhou have offered single family lots, which when developed, with a typical house are valued in excess of a million dollars. A number of proposed resorts including Kukio (Huehue) and Kaupulehu intend to offer single family lots. While marketing of these lots are still some time in the future, the concept is currently to offer very exclusive golf frontage lots similar to those being offered at

Mauna Lani and Mauna Kea, a million dollar price for these lots has often been mentioned as a benchmark. The concept of offering single family lots in connection with Hawaiian resort properties has been well received at other destination resorts in the State including Wailea, Kaanapali and Kapalua on Maui. Kapalua, came the closest to offering single family homes at its Pineapple Hill development, where, lot buyers were allowed to choose only from a limited number of exterior home designs.

Given the success of the Pineapple Hill development, the concept of offering predesigned single-family dwellings within the context of a planned community appears to be an idea whose time has come.

The following market segments, within overall residential demand, would find the residential projects within the Manini'owali development especially attractive:

1. Primary Homes

These units will be especially attractive to Kona's primary home buyers. The proposed units are in the North Kona area, an area which has proved attractive as a residential environment to past and current homebuyers. Manini'owali is located on Queen Kaahumanu Highway, the primary transportation corridor. North Kona is a major employment center which currently includes the Keauhou and Alii Drive Resort properties, Kona commercial areas and the Old Airport and Koloko Industrial Parks. Future employment sources include the Kukio Development Node, the Kealakehe to Kona Planned Development area, and the major commercial growth projected for Kona Town. Additional employment opportunities exist at the South Kohala Resorts which are all within a 20 minute commute.

While the number of executives and professionals within the region is likely to be limited, the Manini'owali Residential community is likely to be within an easy commute of their likely location of work. In addition to executives and professionals, there are a number of small business owners, including those operating food service and retail businesses supporting the West Hawaii resort developments.

Given these attributes and the lack of a truly direct competitor, demand for the proposed product is likely to be strong.

2. Second Home Market

As indicated earlier in the text of this report, there were approximately 7,600 units statewide identified in 1989 as being second homes, units held for occasional personal use by Hawaii or out-of-state residents and not for sale or rent.

Neighbor Island destination resorts have a track record of attracting a large percentage of second home buyers. Waikiki and the Kahala areas also have a higher than average number of second home buyers, particularly from out-of-state. This attraction is twofold: first, destination resort areas cater to second home buyers offering pleasant surroundings and a high degree of amenity availability, as well as a high level of maintenance services; second, these same features, due to their cost or simply their location (not necessarily convenient to major employment locations or residential shopping or community amenities), may make them unattractive to local residents.

At Manini'owali the attractions are present, however, the discouragement to local residents is less, due to the development's location on Queen Kaahumanu Highway which brings Kona Town within an easy commute (15 to 20 minutes), and the job generating resorts of South Kohala equally near.

3. Retirement Homes

The Manini'owali project may have special appeal to the retirement market. This portion of the overall residential demand consists of persons in the 55-year and older category who are retired or soon to be retired. They are generally earning their peak incomes or have started to receive their retirement incomes and have an average family size of less than two.

Conventional wisdom is, that this is only a small local market in Hawaii, due to the ethnic tradition of extended family and the relative high cost of living which discourages immigration of retirees. It is the Consultant's belief that the societal reality and the ethnic stereotype may, in this case, have changed significantly with the nuclear family becoming more dominant as time passes within the ethnic communities. The fact i that many long time Honolulu residents find themselves living in residences which have appreciated to the point where many have $500,000 plus in equity indicates that there is a relatively large population of retirees with the resources to purchase a Manini'owali residence.

The Manini'owali Development offers a number of attractions to the retiree, including aesthetics, security, recreational opportunities, commercial and public infrastructure and superior climate.

C. Market Objectives

One of the primary objectives of the Manini'owali marketing plan is to target the ultimate buyer of prim y housing, second homes and retirement homes directly, thus accelerating absorption and profitability to the developer. If the developer is successful in the marketing objectives, the investor/speculator that has had a primary role in the absorption of product at destination resorts and associated developments throughout the State will have a secondary role at Manini'owali.

Traditionally, residential lots and condominiums associated with resort development have been sold primarily to investors. The investors serve a useful function by allowing new projects to get off the ground before the ultimate buyers recognize the potential of the product being offered. Single family product, in particular in resort residential communities such as Wailea on Maui which was initially marketed as single family lots was absorbed primarily by investors. A number of investors developed spec homes for resale or held the lots for resale. Experience has shown that over time the investor component has decreased as houses and lots are resold to primary and second home buyers. An example of this phenomenon can be seen at the 102 lot Wailea Kai Subdivision at Wailea Resort on Maui. According to the sales staff, most of the lots were bought by investors when the subdivision was developed in 1980. As homes were built, the units were sold primarily to permanent residents. With almost all of the lots now built on

It has been estimated that 80% to 90% of the homes are occupied by permanent Maui residents. A similar transition has been in progress at the Wailea Kialoa subdivision a four-year old 100 lot residential subdivision at Wailea Resort. According to the sales staff, as many as 40% of the homes may now be occupied by permanent residents with the remainder being second home owners and investors.

Developing complete units allows the developer to target the ultimate user directly rather than going through the investor/speculator.

III. RESIDENTIAL DEMAND

A. Methodology

Numerous studies relating to the housing needs of the Big Island have been undertaken particularly in the Kona area. Government planning agencies, housing and social agencies, as well as private interests, have undertaken or commissioned studies to define the quality, quantity, location and need for additional housing. Similarly, volumes have been gathered regarding the population of Hawaii and its characteristics. The analysis contained here draws upon the significant findings of recognized authorities and studies on the subject matter and presents this material as it relates to the demand for units in the Manini'owali Residential Community.

B. The Need For Housing - Island Of Hawaii

The need for housing is a composite of many factors. In its simplest form, the need for housing (need for shelter) is a function of the number of people (the population versus the number of housing units available, the shortfall being the need for housing). However, beyond basic shelter, the need for housing is a function of the location, type and character of housing, namely, owner vs. renter occupancies, vacancy factor, single-family vs. townhouse or multi-family use, fee simple vs. leasehold, cost to the owner, quality of the housing inventory, condition of community facilities, schools, parks, commercial facilities, and transportation. It is also a function of lifestyles, social mores, government policies and many other factors.

This analysis will correlate the key factors to forecast future housing needs for the Island of Hawaii, the North Kona area and the Manini'owali residential development in particular. Further, this analysis will describe how the proposed project fits into Hawaii's forecasted growth pattern, thus demonstrating that there is both a need and a market for the Manini'owali residential development.

C. Historical Population Trends - Hawaii 1970 To 1990

Historical population trends provide one indication of future housing needs. The de facto population has increased significantly since Statehood (1959), an event generally recognized as a major turning point in the growth of post World War II Hawaii. Between 1970 and 1980, the de facto population of the Island of Hawaii grew from 66,600 to 99,500 persons for an average increase of 3,290 per year. As of July, 1989, the Island of Hawaii de facto population was estimated at 138,000 which represents a net increase of 71,400, a 107% percent increase since 1970. (See Exhibit III-1.) Such rapid growth indicates that in-migration has been a major factor in the growth of population. Based on the projected continuation of growth over the next twenty years this pattern of rapid growth fueled by in-migrants will continue.

Exhibit III-1[1]

DE FACTO POPULATION, BY COUNTIES: 1970 TO 1989

[Includes all persons physically present in area, regardless of military status or usual place of residence. Includes visitors present but excludes residents temporarily absent, both calculated as averages for 12-month periods centered on estimate date.]

Date	State Total	County of Hawaii
1970: April 1	796,500	65,700
1970: July 1	798,600	66,600
1971: July 1	833,100	70,600
1972: July 1	869,800	74,500
1973: July 1	901,300	78,200
1974: July 1	923,700	79,500
1975: July 1	943,500	83,300
1976: July 1	970,300	86,800
1977: July 1	992,300	89,300
1978: July 1	1,014,300	93,400
1979: July 1	1,042,700	96,700
1980: April 1	1,052,700	98,700
1970: July 1	1,055,800	99,500
1981: July 1	1,064,500	102,600
1982: July 1	1,088,200	105,700
1983: July 1	1,115,000	110,400
1984: July 1	1,138,300	113,100
1985: July 1	1,148,100	116,000
1986: July 1	1,179,400	119,500
1987: July 1	1,200,500	123,400
1988: July 1	1,218,800	126,300
1989: July 1	1,263,000	138,000

[1] - Department of Business and Economic Development, "State of Hawaii Data Book 1990" Nov. 1990 Revised Table, *De Facto Population, By Counties 1970 to 1989* Table 7, p.18

1: Analysis of Resident Population Trends

As shown in Exhibit III-2, the resident population of the Island of Hawaii increased from 63,648 to 92,053 from 1970 to 1980, an increase of 45 percent in the ten-year period. During the same period, population in the North Kona District increased from 4,832 to 13,748, or 184.5 percent the highest growth rate of any district in the State of Hawaii. From April, 1980 to July, 1989, the resident population of the Island of Hawaii increased from 92,053 to 122,300, or 32.8 percent; during the same period, the population of North Kona increased from 13,748 to 23,000, or 67.4 percent.

The North Kona District has had the greatest growth rate in population for the last two decades of any area on the Island of Hawaii and second only in growth to the District of Hanalei on the Island of Kauai, which started off with a population base one third the size of North Kona.

This trend is likely to continue as new housing units are completed by developers and new commercial developments in the North Kona area are completed. Growth within the North Kona area is also likely to accelerate with the adoption of the County of Hawaii's Keahole to Kailua Plan (K to K Plan) which targets long-range population growth for West Hawaii within the K to K area of the North Kona District. The K to K planning area includes the State's Housing Finance and Develop Corporation Kealekehe Planned Community.

Table III-2[2]
RESIDENT POPULATION OF COUNTIES AND DISTRICTS: 1970,1980, AND 1989

COUNTY AND DISTRICT	April 1, 1970	April 1, 1980	July 1, 1989	Change 1970 to 1980	Change 1980 to 1989
State Total	769,913	964,691	1,112,100	25.3%	15.3%
Hawaii County	63,468	92,053	122,300	45.0%	32.8%
Puna	5,154	11,751	21,000	128.0%	78.6%
South Hilo	33,915	42,278	45,700	24.7%	8.1%
North Hilo	1,881	1,679	1,400	-10.7%	-13.8%
Hamakua	4,648	5,128	5,400	10.3%	5.0%
North Kohala	3,326	3,249	3,900	-2.3%	19.3%
South Kohala	2,310	4,607	9,000	99.4%	95.0%
North Kona	4,832	13,748	23,000	184.5%	67.4%
South Kona	4,004	5,914	7,900	47.7%	33.0%
Ka'u	3,398	3,699	5,000	8.9%	35.8%
Maui County	46,156	70,991	97,200	53.8%	37.0%
Hana	969	1,423	1,900	46.9%	32.4%
Makawao	9,979	19,005	26,900	90.4%	41.5%
Wailuku	22,219	32,111	45,000	44.5%	40.1%
Lahaina	5,524	10,284	14,400	86.2%	39.6%
Lanai	2,204	2,119	2,200	-3.9%	6.1%
Molokai	5,089	5,905	6,700	16.0%	14.1%
Kalawao	172	144	127	-16.3%	-11.8%
City & Co. of Honolulu	630,528	762,565	841,600	20.9%	10.4%
Honolulu	324,871	365,048	376,700	12.4%	3.2%
Koolaupoko	92,219	109,373	118,700	18.6%	8.6%
Koolauloa	10,562	14,195	17,200	34.9%	20.8%
Waialua	9,171	9,849	11,500	7.4%	17.3%
Wahiawa	37,329	41,562	45,800	11.3%	10.2%
Waianae	24,077	31,487	35,800	30.8%	13.6%
Ewa	132,299	191,051	235,900	44.4%	23.5%

[2] - Source: Hawaii State Department of Business and Economic Development, *State of Hawaii Data Book 1990*, Nov. 1990, Table 9, p. 20.

Table III-2 (continued)
RESIDENT POPULATION OF COUNTIES AND DISTRICTS: 1970,1980, AND 1989

COUNTY AND DISTRICT	April 1, 1970	April 1, 1980	July 1, 1989	Change 1970 to 1980	Change 1980 to 1989
Kauai County	29,761	39,082	51,000	31.3%	30.4%
Hanalei	1,182	2,668	5,700	125.7%	114.7%
Kawaihau	7,393	10,497	14,300	42.0%	35.8%
Lihue	6,766	8,590	10,500	27.0%	21.7%
Koloa	6,851	8,734	11,900	27.5%	36.5%
Waimea	7,569	8,593	8,600	13.5%	0.0%

2. Forecasted Population Trends - County of Hawaii 1970 - 2010

The Department of Business and Economic Development, State of Hawaii, uses the M-K Series projections as the official population projections for the State and the County of Hawaii. As shown in Exhibit III-3, the projected de facto population for the Island of Hawaii for the year 2010 is approximately 243,000.

Table III-3[3]

Population Projections: 1990-2010
[in thousands]

Type of Population and Year	State Total	Island of Hawaii
Resident Population		
1970	771.6	63.8
1975	886.2	77.4
1980	968.9	93.0
1985	1,051.5	109.5
1990	1,137.2	124.6
1995	1,225.2	142.5
2000	1,285.1	160.4
2005	1,350.8	180.8
2010	1,435.5	206.1
De Facto Population		
1970	798.6	66.6
1975	943.5	83.3
1980	1,055.8	99.5
1985	1,149.6	116.1
1990	1,269.1	134.4
1995	1,382.3	158.6
2000	1,468.6	183.0
2005	1,560.3	211.0
2010	1,674.2	243.0

During the early 1980's, growth in the North Kona District slowed considerably. This is understandable when one considers the condition of the national and local economy. The impact on tourism to the Island of Hawaii was particularly acute because of the escalating air fares in 1978 and 1979 combined with the loss of the "Common Fare" in 1979 resulted in lower tourist traffic. Since 1981, the low

[3] - Department of Business and Economic Development. *Population and Economic Projections for the State of Hawaii to 2010*, November, 1988 and Department of Planning and Economic Development. Intercensal Population Estimates for Hawaii, 1940 - 1980, February 1, 1983, table 3 & table 10 (Data Book pages 10 & 18)

point in visitor arrivals, tourism has continued to increase with major boosts coming from the initiation of direct flights to Keahole airport by United Airlines in late 1983 and the opening of the Hyatt Waikoloa in October 1988. Through 1986, the recession devastated the real estate, construction and development industries. Interest rates soared, the rate of new construction dropped precipitously, and foreclosures hit levels never before experienced in Hawaii.

The years of 1983 and 1984 reflected national and local economic recovery. Housing and construction followed, but at a modest pace. The year 1984 ended with a relatively high level of consumer confidence, and interest rates were trending down. According to figures compiled by Bank of Hawaii, Construction in Hawaii 1991, 1984 showed the lowest growth in housing inventory recorded in the Big Island for the years 1970 to 1990. In fact, during the years 1983 to 1988 only once, in 1987, did housing inventory increase at a pace greater than the 1970 to 1990 average. In 1985, interest rates declined and acted as a stimulus to home sales. In 1986, interest rates declined to the 10% range, depending on the type of mortgage. This further stimulated sales. The 1987-1990 time period has been one of explosive growth for the housing industry on the Island of Hawaii. Stable interest rates in the 10% range, strong growth of employment and construction industry labor peace have resulted in strong demand for housing, however, past approval policies and lack of infrastructure have resulted in a lack of developable land of all types leading to rapid escalation in prices. The boom in real estate sales in the South Kohala and North Kona Districts demonstrates the market acceptability of the area.

It is therefore reasonable to conclude that the 1980-1986 lag in the development in the North Kona District was a function of short term economic conditions and not a change or reversal of a long term trend. The growth to North Kona is likely to continue because of the overall shortage of housing, the high price of housing proximate to the employment centers of North Kona and South Kohala, and "supply pull" based on availability in North Kona.

Further, numerous new job opportunities will be created in the North Kona and South Kohala District as major resort developments commence or expand.

D. Housing Inventory - Island Of Hawaii

1. Current Housing Inventory

The total housing stock on the Island of Hawaii has increased from 18,972 dwelling units in 1970 to 50,019 in 1990. The net increase over this period was 31,047 dwelling units, or an average of approximately 1,552 per year.[4]

The West Hawaii area has had a continual housing shortage for at least the past decade, even during times when housing was relatively plentiful and inexpensive in East Hawaii. A 1984 DPED report ["Economic Development on the Island of Hawaii: Issues and Options" Department of Planning and Economic Development August 1984] described the long standing problem of the lack of affordable housing in the North Kona and South Kohala districts in 1984.

2. Housing Authorizations

Exhibit III-4 shows Building Permit Trends for the Island of Hawaii for the period 1961 through 1990. According to this Exhibit, over the thirty year period (1961-1990), 74 percent of the units authorized were single-family dwellings, while 26 percent were multi-family. Thus indicating a demand for a mix of single and multi-family development.

3. Demolitions and Substandard Housing

Exhibit III-5 is the historic summary of Demolition Authorizations. The 11 year average for the period 1979 through 1989 was 50 units per year.

Historically, demolitions have occurred most frequently in areas of substandard housing for reasons of highway construction and/or urban renewal. Demolitions in the

[4] - Census Data 1960, 1970, 1980

County of Hawaii are most likely to be due to the replacement of substandard housing due to the lack urban centers outside of the Hilo area. Elimination of plantation housing is expected to continue as sugar employment declines. Demolitions are likely to remain small relative to the overall housing supply as the rapid growth in housing has resulted in a large portion of the housing inventory being relatively new.

Exhibit III-4[5]
BUILDING PERMIT TRENDS FOR HAWAII
1971 - 1990

YEAR	HOUSING INVENTORY AT APRIL 1	SINGLE FAMILY UNITS	VALUE (In Thousands)	MULTI-FAMILY UNITS	VALUE (In Thousands)
1961	18,119	291	3,542	28	172
1962	18,182	363	4,652	71	396
1963	18,248	422	5,481	26	331
1964	18,323	420	5,182	17	81
1965	18,392	431	5,782	94	552
1966	18,479	453	6,484	73	431
1967	18,585	393	6,133	22	84
1968	18,663	493	7,897	370	3,786
1969	18,778	652	11,924	406	4,952
1970	18,972	784	15,403	395	5,736
1971	20,061	1,015	20,560	858	12,741
1972	21,648	1,152	25,123	854	13,055
1973	23,578	1,143	26,492	479	8,597
1974	25,282	839	21,554	994	25,104
1975	26,694	826	21,832	507	13,695
1976	28,131	821	23,013	129	2,043
1977	29,453	1,070	31,825	133	3,430
1978	30,579	1,382	44,787	334	11,935
1979	32,283	1,429	51,085	734	34,865
1980	34,215	1,192	44,765	739	56,325
1981	36,180	1,033	40,407	285	26,942
1982	37,738	809	29,920	245	27,141
1983	38,702	880	37,186	96	13,629
1984	39,763	91[illegible]	42,260	181	16,441
1985	40,820	988	51,935	190	25,342
1986	41,944	1,129	61,633	39	1,971
1987	43,756	1,367	78,857	361	15,916
1988	44,700	1,715	108,010	474	17,172
1989	47,035	2,562	162,735	455	44,978
1990	50,019	2,024	165,475	627	87,499
Total Percent		28,988		10,216	
		74%		26%	

[5] - Bank of Hawaii, Construction in Hawaii, 1991, City and County of Honolulu Building Department

Exhibit III-5[6]

Private Residential Demolition Authorized By Permit County of Hawaii 1979-1989

Year	Demolition Permits Authorized Units Demolished:
1979	60
1980	63
1981	21
1982	34
1983	54
1984	50
1985	38
1986	43
1987	40
1988	57
1989	96
TOTAL	556
11 Year Average	50 per year

4. Condition of Housing Inventory

Many of the older units in the residential housing inventory do not provide the standard of living, in terms of ease of ownership and maintenance, amenities, demanded by today's market.

Older, good homes have appreciated in price to the point where young persons cannot generally afford to purchase them. Older homes which are in poor condition do not meet mortgage lender criteria for low down payment, high loan to value ratio, and long-term mortgages. A mere

[6] - State of Hawaii, *Data Book* and predecessor publications, 1990 (Table 612, page 520)

count of the housing inventory is therefore only a partial measure of the ability to meet the housing needs and desires of the community.

There are a large number of substandard housing units scattered throughout the County of Hawaii. Substandard is defined as units with more than 1.1 persons per room e.g. overcrowding, and/or those units lacking complete plumbing.[7]

In 1980, the number of substandard units, due to overcrowding, amounted to approximately 3,800 units or 13 percent of the inventory while approximately 2,000 units or 7% of inventory lacked complete plumbing. By 1989, only 500 units had been demolished.[8] Not all units demolished were necessarily substandard.

Thus the bulk of the 1980 estimate of substandard units remained in the 1990 housing inventory. A number of additional units become dilapidated each year and should be added to the total to be replaced. On the other hand, some units were no doubt upgraded.

The number of housing units needed statewide to replace dilapidated units and to eliminate overcrowding was estimated by Daly and Associates at over 56,000 units for the period 1981 through 1988, or an average of 7,000 units per year.[9]

5. Correlation of Authorizations and Net Inventory

Exhibit III-4 demonstrates that an average of approximately 1,306 units has been authorized each year between 1961 and 1990, and Exhibit III-5 demonstrates that about 50 demolitions per year are authorized. It should be noted that the time frames for the two averages are different. The figures suggest that the net authorized addition to the housing inventory is roughly 1,256 units per year. Building permit authorizations are not a totally accurate indication of the increase in housing stock. Permit data tends to overestimate actual net growth. For example, between 1961 and 1990, the official records of

[7] - Daly and Associates *Affordable Housing Paper*, 1981

[8] - See Exhibit VI 5

[9] - Daly and Associates *Affordable Housing Paper*, 1981

government agencies show an authorized net increase of 1,256 per year, while the actual growth was approximately 85 percent of actual net authorizations, a net increase of about 1,063 units per year.

A partial explanation for the variance between authorizations and starts is:

(1) Failure to finalize financing is the single largest reason for not starting construction.

(2) Changing market conditions, which frequently cause projects to be postponed. This occurs typically when an economic cycle has peaked, before the project is marketed.

(3) Selectivity of the marketplace, i.e. the project's location, design, amenities or pricing may be such that despite the overall housing shortage, the market will not absorb "any product at any price," a lesson learned by lenders and developers in the early 1980's.

6. Condominiums Major Portion of the Inventory

Exhibit III-6 is a breakdown of the State of Hawaii condominium inventory, by type, for the period 1962 through 1982. Exhibit III-7 shows new multi-family authorizations for the State and County of Hawaii for the period 1962 through 1990.

The tables demonstrate that in the 20-year period from 1962 to 1982, approximately 98,000 condominiums were added statewide. Approximately 89 percent were new authorizations and 11 percent were conversions.

Exhibit III-6 in particular demonstrates a high level of market acceptance of condominiums (medium and high density) during this period; 54 percent were high-rise units, 25 percent were low-rise, and 20 percent were townhouses.

Between 1970 and 1980, the statewide condominium inventory increased from 15,320 units to 80,432 units. The total increase in condominium units over this ten-year

period was 65,112, reflecting an average of 6,511 units per year.

Exhibit III-7 indicates that new multi-family authorizations have averaged 4,965 per year statewide 1971-1990)'. and an annual average of 435 for the County of Hawaii during the same 20-year period.

Exhibit III-6[10]
Condominium Inventory - State Of Hawaii
1962- 1982
Annual Additions

Year	Highrise	Lowrise	Townhouse	Single-Family & Duplex	Cumulative Total	Inventory
1962	174	8			182	182
1963	41				41	223
1964	1,271	258	28	--	1,557	1,780
1965	626	245	147	73	1,091	2,871
1966	1,412	366	216	67	2,061	4,871
1967	1,261	284			1,545	6,477
1968	1,918	74	150	39	2,181	8,658
1969	1,117	453	152	32	1,754	10,412
1970	3,089	874	939	6	4,908	15,320
1971	2,874	382	1,062		4,318	19,638
1972	1,139	914	770	12	2,835	22,473
1973	3,490	1,619	1,596	36	6,741	29,214
1974	5,153	2,112	1,775	235	9,275	38,489
1975	6,048	2,922	1,760	68	10,798	49,287
1976	6,330	260	655	112	7,357	56,664
1977	1,456	883	942	40	3,321	59,965
1978	1,792	810	604	4	3,210	63,175
1979	4,116	1,447	1,156	97	6,816	69,991
1980	4,551	2,553	3,263	74	10,441	80,432
1981	2,067	4,825	2,745	67	9,704	90,136
1982	2,752	3,544	1,298	201	7,795	97,931
Totals	52,677	24,833	19,258	1,163	97,931	

a Includes new and converted units. Conversions from 1963 thru 1981 totaled 10,347 units

[10] Bank of Hawaii, Construction in Hawaii, 1983. Compiled from data in the Hawaii Condominium Guide, Pacific Business News and Monitor.

EXHIBIT III-7[11]
NEW MULTI-FAMILY AUTHORIZATIONS
State of Hawaii and County of Hawaii
1962 - 1990

Year	State	Hawaii
1971	5,788	858
1972	9,356	854
1973	12,374	479
1974	15,474	994
1975	7,269	507
1976	3,560	129
1977	3,193	133
1978	4,657	334
1979	4,989	734
1980	6,758	739
1981	3,321	285
1982	3,070	245
1983	1,479	96
1984	1,280	181
1985	2,633	190
1986	2,735	39
1987	1,879	361
1988	3,225	474
1989	3,018	455
1990	3,225	627
Totals	99,313	8714
Average/Year (20 Years)	4,965	435

It should be noted that not all condominium units are owner-occupied. A substantial number of condominiums were owned by investors and either offered as long-term rentals or transient accommodations. Many were not suited to long-term/primary-home occupancy, because of design, size, facilities and/or location.

The Bank of Hawaii reported that units classified as "transient" dropped in 1988, down 17.3 percent from

11. Bank of Hawaii, *Construction in Hawaii*, 1991 and previous issues

1987, and concludes that the drop is an indication of the severity of the housing shortage on Oahu. Results of the Hawaii Visitor Bureau's 1989 and 1990 surveys of visitor plant inventory indicate that neighbor island transient units have maintained a relatively stable upward trend. In the future, a substantial share of the housing inventory, including condominium/multi-family units, will not available to residents for either sale or rent.

Another observation from the tables is that housing unit authorizations and completions follow the cyclical nature of the economy. For instance, the declines during the recessions of 1961-62, 1973-75, and 1979-82 are clear from the statistics. Other effects, such as the enactment and pre-implementation of the City's new Comprehensive Zoning Code in 1969 brought about a surge of apartment building to "beat" the new and more restrictive zoning regulations.

Between 1980 and 1985, there was an oversupply of condominium units in areas where units were built for speculation rather than for primary housing, or to meet specific second home (vacation home) or resort demand. In Construction in Hawaii, 1989, the Bank of Hawaii notes that multi-family units may be falling into disfavor, with preference by the homebuyer going to single-family dwellings; however, future population increases, decrease in family size, and subsequent increase in households could affect this preference, especially if total housing inventory and prices remain as they have in past decades.

A number of new planned communities proposed for the North Kona and South Kohala area include major elements of multi-family condominiums. A number of these units are targeted at the affordable markets.

7. Government Housing

There are currently 1,224 housing units owned or operated by government agencies, in the County of Hawaii. Exhibit III-8 provides an inventory of housing (other than barracks) owned by the various branches of the federal government. Federal government housing accounts for 48 units in the County of Hawaii and this minimum presence is not expected to change.

Exhibit III-9 provides an inventory of housing owned by various State and County agencies.

At the present time, government inventory of housing units appears account for a negligible portion of the total housing inventory (approximately 2%). These figures, however, understate the impact of State and County sponsored housing programs. To date, much of the State and County activity has been targeted at the gap group. This market demands "for sale" housing which does not show up in government housing inventory. Further, government rental assistance and mortgage programs subsidize a large number of rental and mortgage transactions. In addition, both the State and County have announced aggressive new housing programs at Kealakehe and Waikoloa respectively. Both of which are located in the West Hawaii area, which will undoubtedly contribute a significant portion of the affordable inventory in West Hawaii for the foreseeable future.

Exhibit III-8[12]
Inventory Of Federal Government Housing
(Hawaii County)
April 1, 1990

Armed Forces	15
Oahu Consol. Family Hsg. Office	
Coast Guard	12
Navy	
Civilian Agencies	33
East-West Center	
Fish & Wildlife Service	
National Park Service	33
National Weather Service	
Total Federal Government Housing	48

[12] - Hawaii State Department of Business and Economic Development, Housing Unit Estimates for Hawaii, 1980-1990 (Statistical Report 217, August 1990, p.11)

EXHIBIT III-9[13]

Inventory Of Local Agency
Owned/Operated Housing (Hawaii County)
April 1, 1990

State Government	1,126
Education	
Hawaii Housing Authority:	
Rental	1,058
Teachers' Housing	37
Health	16
Land and Natural Resources	9
Transportation	
University of Hawaii	6
County Government	50
State and County Government	1,176

E. Housing Trends And Characteristics

This section deals with the observed and statistically quantified trends in housing characteristics. It is important to understand the unique market in Hawaii, in which real estate has often continued to be in demand even though raw statistics would seem to contradict actual market conditions.

1. Increase in the Number of Households and Decrease in Household Size

The number of households has increased because of a variety of socio-demographic factors. These include changes in lifestyle, the decline in family size, extended life expectancies, increase in divorce rates, formation of non-conventional households, foreign immigration, undoubling and a variety of other reasons.

The Wall Street Journal has noted that household size (nationally) has declined steadily for as long as statistics have been kept. The first census in 1790 put the average at 5.9 person per household; in 1980, the figure was 2.76.

[13] Hawaii State Department of Business and Economic Development Housing Unit Estimates for Hawaii.

A recent study shows that household size plummeted 0.38 persons during the 1970s and has dropped/further 0.14 in the 1980's. Projections for the year 2000 are that it may be down to as low as 2.48 persons per household.[14]

During the 1970s and early 1980's, the percent increase in the number of households in Hawaii was greater than the percentage increase in the total population. The average number of persons per dwelling unit dropped from 3.15 in 1980 to 2.99 in 1988 for a new low in the State's history. The household size in the County of Hawaii fell from 3.61 in 1970 to 3.09 in 1980. Thus the County of Hawaii appears to be following the national and statewide trends.[15]

As the declining household size trend continues, more dwelling units will needed even if there were to be little or no net increase in population.

2. Change in Age Composition

In 1980, 7.3 percent of the State's population was 65 years of age and over; 9.9 percent of Hawaii County's population was in that age group. Lower birth rates and a longer life expectancy, among other factors, will result in "an aging of the population" in the future.

According to the Department of Business and Economic Development, The median age will rise from 30.5 in 1985 to 37 in the year 2010. Projections further indicate that the population under 15 years of age will fall from 22.9 percent of the total to 19.6 percent. During the same period, persons 65 years and over are projected to rise from 9.4 percent of the total to 13.1 percent.[16]

Elderly households typically consist of two-person families, widows and widowers. These trends have served to further increase the demand for new housing units, particularly, as the young "undouble" from parental house-

1980-1990 (Statistical Report 217, August 1990, p.11)

14 -*Investor's Daily*, dated December 7, 1989

15 -Department of Business and Economic Development, *Housing Unit Estimates for Hawaii, 1970-1989*, October, 1989 and State of Hawaii, Data Book, 1988

16 -DBED, Population and Economic Projections for the State of Hawaii to 2010, November, 1988 and State of Hawaii, Data Book, 1988

holds and establish new households and the elderly live longer.

3. Consumer Preferences

Many of the trends are also indicative of a change in consumer preference. For example, as more women seek employment outside of the home, either as the result of the need for additional family income or the desire to pursue a career, the efficient lifestyle afforded by apartment living becomes extremely attractive.

The elderly frequently choose a less vigorous life than maintaining a single-family dwelling.

At the same time the single-family dwelling retains its status as the "most desirable" type of housing for the majority of the population.

4. Increased Land Costs

Land costs have increased rapidly over the last 30 years, reflecting over and above inflation, a shortage of developable land with proper land use and zoning designation.

In the past, one of the most significant factors affecting housing supply has been the highly restrictive governmental regulation brought on by mandates to preserve agricultural land and the effort of groups to curb environmental abuses. The Department of Business and Economic Development concludes, in its October 1989 Housing Unit Estimates for Hawaii 1970-1989, that "the increase in housing units available to Hawaii residents is continuing to lag behind household formation," and that "it seems clear that residential construction has failed to keep pace.

5. Residential Movement Pattern

The residential movement pattern in the County of Hawaii has been dictated, in part, by the location of the jobs created in the visitor industry in the South Kohala and North Kona area and the availability of housing within driving distance from those locations. Thus growth in residential units on the Big Island has been concentrated in the North Kona and South Kohala areas. The low vacancy rate indicates not only a shortage of available housing units, but also a lack of adequate choice of location and type of housing.

6. Agreement of Sale Financing

Owner financing (Agreement of Sale) was once used extensively in Hawaii during the 1960's and 1970's. This technique made it possible for families who were not qualified for an institutional mortgage to purchase a home. The term of an Agreement of Sale was typically three years to five years, depending upon the strength of the market. Purchasers were able to refinance at the end of the term. Even if the purchasers could not qualify for a-new loan at the end of the Agreement of Sale, they were usually able to sell at a price above cost. In either event, they were in a stronger position to compete for housing.

During the 1980's, this form of financing fell out of favor due primarily to the inclusion and enforcement of "due on sale" clauses. According to the Bank of Hawaii's Construction in Hawaii 1991, Agreements of Sale continue to decline in value and in comparison with the number of mortgages written. By the year 1990, the total value in Agreements was equal to only about 1.8 percent of the mortgages written. In the period 1979 to 1981, on the other hand, Agreements of Sale exceeded $1 billion for each of those years (45.6 percent of the value of mortgages written in 1981).[17]

7. Ground Leases

Until the mid-1970s, leasehold home values were generally less than comparable fee-simple homes and allowed many people to enter the market at a reasonably high standard of living with relatively lower housing expenses. Approximately 17 percent of the owner-occupied homes in the State in 1990 were on leasehold land. In the County of Hawaii only 5.8 percent of the owner-occupied homes were on leased land.[18]

[17] -Bank of Hawaii, *Construction in Hawaii*, 1991

[18] -Bank of Hawaii, *Construction in Hawaii*, 1991 p. 10 and County of Hawaii Department of Research & Development "...a Book 1990" Table 258 p. 205

This worked to an advantage, in the past, in the development of moderate or at least reasonably priced housing in a land-short environment. More recently, however, leasehold premiums and higher leasehold rents have tended to negate this advantage.

An increasing proportion of owner-occupied housing units are now owned in fee-simple, reflecting the provisions of the State Land Reform Act. Leasehold units declined significantly statewide between 1978 and 1990 (from 28% to 17% of owner-occupied housing stock).[19]

8. Substandard Housing

Demolition and subsequent redevelopment of areas containing a substantial number of substandard and/or dilapidated houses has been thwarted by local resistance to change. This resistance can be attributed to a number of factors: many people living in substandard homes do not have the economic wherewithal to compete for adequate housing in the open market; albeit that some people maintain the lifestyle by preference.

To others, the suggestion of leaving a substandard neighborhood is charged with emotion. Some of the issues range from freedom of choice to a breakdown in their mini-society of friends, acquaintances, living patterns and employment opportunity.

9. Owner/Renter Ratio

Recent data indicates there were 167,567 owner-occupied, units in the State as of April 1, 1990. The remaining 235,077 units were either renter-occupied or vacant, including units owned, controlled or leased by government agencies, and condominium units occupied by nonresidents.

Owner-occupied housing units accounted for just 41.6 percent of total housing stock in 1990. This was a slight increase over the 41.1 percent in 1980. (Hawaii had the second lowest rate of homeownership in the nation at that time.)

[19] -Department of Business and Economic Development, *Housing Unit Estimates for Hawaii, 1970 1989*, October 1989

Analysts predict no immediate improvement in the near future. With a national average of close to 60 percent homeownership, a ratio of 60 percent owner-occupied to 40 percent renter-occupied should be a community goal. To achieve this, the relative cost of housing must be stabilized, or reduced through increased supply.

10. Rents County of Hawaii Renter-Occupied Dwelling Units

Rents in the County of Hawaii rental market are difficult to determine with any degree of certainty, due to the wide variety of conditions throughout the Island and the large number of resort units. The clearest indication of the level of rents which is available is the 1980 Census data. In a comparison of information regarding the percentage of income used to purchase rental housing, in the County of Hawaii approximately 31% of the renters paid in excess of 35% of their income to purchase rental housing. In 1980, this was the highest percentage of household paying in excess of 35% compared with the other counties. Discussions with Realtors and other real estate industry officials indicates that there continues to be a significant shortage of affordable rental units in the County of Hawaii particularly in the North Kona area.

11. Vacancy Factor

National housing studies have cited vacancy rates of three to five percent in dwellings for sale and five to eight percent in dwellings for rent as the level necessary to permit households an adequate choice of housing. This would allow sufficient mobility in order to take advantage of job opportunities, promote price competition, and provide a choice of unit type and location without creating hardship on landlords and developers.

County of Hawaii vacancy rates in both public and private housing have been traditionally been statistically adequate, however, this adequacy has been misleading. High vacancy rates during the past twenty years in the Hilo area have masked extremely low vacancy rates in the rapidly growing West Hawaii area in general and in the North Kona area in particular. West Hawaii vacancies have been inadequate and well below standards according to Realtors and others knowledgeable in housing. Unfor-

tunately, there has been a lack of statistical data developed to demonstrate this. In most instances, survey data, including census data has not focused on the nature of the vacancies surveyed to determine the actual residential vacancy. Health department surveys conducted on the neighbor islands are considered to small to provide meaningful vacancy rates outside of an aggregate number for all neighbor islands.[20]

Exhibit III-10 is a ten year summary of housing vacancy rates on the neighbor islands. Analysis of the data indicates that there as been a shortage of residential units on the island for most of the last decade and that this condition persists. HUD estimates of vacancies in West Hawaii based on an 1987 study of approximately 1%, well below acceptable levels.

[20] As reported in DBED *Data Book*, 1990

Exhibit III-10[21]
Housing Vacancy Surveys Of Neighbor Islands: 1980-1989

Year	Hawaii, Maui and Kauai Units Sampled	Percent Vacant
1970	2,890	3.0
1971	2,877	5.1
1972	1,754	5.4
1973	1,279	5.0
1974	1,319	4.7
1975	1,272	6.9
1976	623	5.6
1977	2,373	5.1
1978	2,588	4.5
1979	2,417	4.4
1980	2,886	5.0
1981	2,979	5.8
1982	3,041	5.4
1983	2,992	5.8
1984	3,411	6.5
1985	3,613	5.7
1986	3,490	4.5
1987	3,703	6.1
1988	3,705	3.7
1989	3,945	4.0

12. Economic Cycles

Since statehood (1959), Hawaii has gone through three separate economic cycles. Each has had a slightly different set of characteristics. Three major housing "boom" cycles occurred during this time frame. Housing was produced at an extremely high rate during each "boom" period, i.e. approximately 1-1/2 times the 1963 through 1982 average. The offsetting decline which followed the boom period resulted in production rates well below the average. Overall, even with housing "boom" the quantity of housing has not increased to a satisfactory level to meet

21 -State of Hawaii, Data Book, 1990, Table 629, p 543.

the needs of population growth and its changing characteristics.

13. Use of Housing Units For Other Purposes

It was previously noted that some multi-family housing units are located in areas which permit them to be used as visitor facilities, either on an all-year or on a part-time basis. The latter, in part accounts for the large number of units being held for rental but not available as primary residences. In addition, some units classified as residential apartments are used as office space due to their proximity to business and commercial centers. Most real estate analysts believe the impact of these uses on residential inventory has been underestimated.

14. Financing

One of the most dramatic trends in housing during the last real estate cycle (since 1979) was the change in the fundamental structure of mortgage financing for single-family homes and condominiums. Many mortgages were shorter in term and/or had adjustable interest rates. Assumability of a mortgage was a major consideration. Historically, purchasers were able to obtain 30-year fixed rate mortgages which had the effect of stabilizing the homeowner's cost of occupancy. Fixed rate mortgages all but disappeared for a period, but are now readily available. Mortgage rates have remained stable for approximately five years and have been relatively available for primary, second home and investment real estate purchases in Hawaii.

15. Inflation

Investment in real estate has historically been one of the best methods of hedging against inflation. To a large degree, the buildup in condominium units in the 1960s and 1970s was the result of hedging and, to some degree, accounts for the lopsided construction of multi-family units and the owner/renter ratio.

This was good for the construction industry in the short-run, but did not make as great a contribution to solving the housing problem as it might have, had design, price and location of the units been more appropriate. As an investment vehicle, purchasers were willing to sustain negative cash flows for extended periods of time in order to realize capital gains at the time of sale. However, in 1982, inflation began to stabilize. Annual inflation amounted to approximately 2 percent, according to the Consumer Price Index between 1985 and 1986. Under these conditions, real estate was less desirable investment.

Inflation between 1986 and 1990 has been in the 4 to 5% range. According to First Hawaiian Bank's Construction Index, construction costs have risen only modestly since 1986. Unfortunately, speculation in housing throughout the state of Hawaii has continued for reasons other than the underlying construction cost increases.

16. Foreclosures

Hawaii had historically, prior to 1980, maintained one of the lowest foreclosure records in the nation; however, commencing with the real estate downturn in 1980, Hawaii experienced an unprecedented rate of foreclosure. This activity has been directly related to the decline in the economy and the inability of highly leveraged purchasers to maintain their payment schedules, or, in the alternative, to sell the property to another purchaser even at/or below cost. This was, in part, due to the inability to find suitable financing, a lack of consumer confidence, and an inability to qualify as credit underwriting criteria became more restrictive. The foreclosures, to a large degree, had focused on investment condominiums. Lenders and vendors under Agreements of Sale placed these units back on the market creating a moderate increase in availability from 1982 to 1986. In many cases, these units were not designed or located to serve as primary homes. Foreclosures were less than $1 million in 1980. They rose steadily, reaching an all-time State high of $139.7 million in 1986. A decline in interest rates and increased economic activity in 1987 resulted in a drastic decline in the foreclosure rate as well, which dropped to $51.3 million. This decline has continued and it would appear that Hawaii is back to its pre-1980 order of magnitude rate of foreclosures.

17. Price of Housing

In 1980, the average value of a single family dwelling unit in Hawaii County was $79,000.

The average cost for new and used single-family dwellings available for purchase had increased to over $150,000 in 1990. The average sales price for condominiums available for purchase was in excess of $127,000.[22]

18. Ohana Dwellings

The Ohana concept was mandated by the State Legislature in 1981 and adopted by Hawaii County ordinance in 1982. Ohana zoning permits a second dwelling on a residential lot when infrastructure, e.g. water, sewers, and road, are adequate to accommodate the increase in density.

According to a 1988 Legislative Reference Bureau Study, Ohana zoning has fared best in the County of Hawaii. However according to the study applications for only 557 units were received during the first five years of the program and of those 88%, or 492, were approved. Thus the program has accounted for approximately 100 units per year. Ohana units are not expected to account for large increases in housing inventory in the future. In addition, the Counties were given more flexibility by the State Legislature in designating communities "Ohana-Eligible" in 1989. It is likely that the impact will be to withdraw areas from eligibility and thus reduce the potential number of new Ohana units.

For the long-term, therefore, it is unlikely that Ohana will continue to have any more than a minor impact on the housing inventory of the county of Hawaii.

19. Second Homes/Vacation Homes and Other Vacant Units

According to 1980 Census Data, the Hawaii County rental vacancy rate was 14.1% while the homeowner vacancy rate was 2.5%. According to the 1987 HUD study, the

[22] Locations, Inc. MLS sources January 1991

rental vacancy rate had declined to 6% while the home-owner vacancy rate remained at 2.5%.

Unfortunately these are estimates based on assumptions of units usage and are difficult to verify. In the County of Hawaii, based on self-reporting of the visitor industry, approximately 4% to 5% of the County's housing stock is occupied by non-resident or visitor populations.[23] Real estate professionals generally agree that the numbers of units classified as non-resident use are substantially underreported. This figure does not include a growing number of second homes which tend to increase as the affluence of the buyers tend to increase. Vacancies estimated by the census included units which were characterized as vacant year-round, units rented or sold but not occupied, units held for occasional use, and units occupied entirely by persons with their place of residence elsewhere.

April 1, 1990 the Department of Business and Economic Development reported that condominium units intended for tourists totaled 22,160 statewide. This was an increase of 10,523 units, or 90.4 percent, since 1980. (Resident housing, on the other hand, increased by only 18 percent during the same time period.) Hawaii Visitors Bureau 1990 survey data indicated that 2,115 condominium units on the Island of Hawaii alone are intended for transient occupancy.[24]

Given Hawaii's popularity as a vacation destination and increased interest from out-of-state investors, this trend toward unoccupied units and units occupied only a portion of the year by non-residents is likely to continue. It is especially significant in light of the increases in resident population and faster increases in the number of households during the period 1980 to 1990.

As the Hawaiian resort industry continues to upscale, it is likely to result in more second homes and resort units used exclusively for personal use.

23 - HVB 1990 *Visitor Plant Inventories* Jan. 1991.

24 - Department of Business and Economic Development, *Housing Unit Estimates for Hawaii, 1980-1990*, August 1990, Statistical report 217

F. Factors Affecting Future Demand

1. Existing Shortages

According to The Hawaii State Plan - Housing (Draft) 1988, 45,000 families within the State currently reside in overcrowded units (overcrowded defined as units with more than one person per room) and 6,500 families are living in substandard units (substandard defined as lacking basic plumbing facilities). While there is undoubtedly some overlap between overcrowded and substandard units, the total number of families falling into either category is likely to be at least 50,000.

According to Housing Finance and Development Corporation's (HFDC) calculations the housing shortfall statewide between 1980 and 1986 was 20,222 units (HFDC document titled Statewide Housing Demand - Chart 4 provided by HFDC Staff). The shortfall existing prior to 1980 was not addressed.

According to a the "Comprehensive Housing Market Analysis Hawaii County Housing Market Area" (as of July 1, 1987) by the San Francisco Housing and Urban Development Office, the Big Island as a whole generally had an adequate housing supply, the West Hawaii Area and the employment centers of North Kona and South Kohala specifically had a housing shortage. While this study is four years old, it reconfirms earlier observations contained in "Economic Development on the Island of Hawaii - Issues and Options" DPED August 1984 which indicated that the housing supply in North Kona and South Kohala was inadequate to meet the existing and future needs of the expanding resort areas. The recently completed (September 1990) "Kealakehe Planned Community Final EIS" Belt Collins and Associates p. V1 - V3 indicates that as of late 1989 the housing shortage in the West Hawaii area had deteriorated significantly between 1980 and 1989. According to the social impact section of the EIS terms such as "critical", "severe" and "drastic" were used to describe the housing situation in West Hawaii. In more analytical terms, the "Market Assessment - Kealakehe Planned Community" by Peat Marwick June 1990 outlines a very tight West Hawaii market.

2. Future Demand for Housing

Future demand for housing in West Hawaii will result from four primary factors: population growth; household size; desired vacancy rate; and affordability.

a) Population

The anticipated growth in the population is the first parameter in the equation. It determines the number of persons which will require the basic shelter function of housing. The population used in this analysis is that projected by the Department of Business and Economic Development (DBED) for the year 2010. The final report for series M-K projections was issued in November 1988 and projects an County of Hawaii resident population for 2010 at 206,100 persons.

b) Household Size

The number of persons housed in each unit determines the number of units required per given population. The following excerpt from the State Housing Functional Plan Technical Reference Document (Draft) August 1, 1987, p. 27 illustrates the importance of the social and demographic factors and their resultant impact on household size.

"Housing stock increase is meaningful only with regard to changes in the population to be housed. The relationship between increases in the housing stock and the rate of increase in the households since 1970 exhibits the following patterns:

1) Between 1960 and 1970, households grew at a rate of 2.8 percent a year compared to 2.6 percent for the housing inventory.

2) During the 1970s, housing growth exceeded household growth, growing by 4.4 percent a year compared to 3.8 percent for households.

3) In the 1980's, however, housing growth has slowed down to 1.7 percent a year while households have grown at 2.3 percent or roughly 35 percent faster than housing stock.

Greater increases in the number of households has been attributed to a reduction in household sizes. Household sizes have declined from 4.46 in 1940, to 3.87 in 1960, to 3.59 in 1970, and to 3.15 in 1980.[25] This trend reflects the sharply reduced birth rates, fewer families with several generations sharing the same living quarters and the replacement of larger single-family homes by smaller homes or apartments, caused by the inability of most buyers and renters to pay for more spacious housing.

Smaller household sizes are also influenced by cultural and social developments including greater numbers of single-member households, both among the young and elderly; higher ages at marriage; delayed child-bearing and lower birth rates; higher incidence of divorce and single-parent households; and the general aging of the population.

Between 1970 and 1980, persons living alone in Hawaii increased from 26,532 to 50,304, or over 89 percent.[26] Additionally, in 1980, 32 percent of those living alone (16,375) were over 60 years of age; this represented 14.4 percent of all older persons 60 years and over.[27]"

According to the Statistical Abstract of the United States 1990 published by the Bureau of the Census, the average household size in the United States declined from 3.14 persons in 1970 to 2.76 in 1980 to an estimated 2.60 persons in 1990. The Census Bureau study Projections of the Numbers of Household and Families : 1986 to 2000 released in May of 1986 indicated that household size in the United States could decline to 2.32 by the year 2000 although using more conservative assumptions would result in a national household size of 2.49 in 2000. The aging of the population is primarily responsible for this shrinking of the household size and it is expected continue based on the DBED M-K projections which

25 -State of Hawaii, Department of Planning and Economic Development, *Hawaii State Plan: Socio Cultural Advancement*, December 1984, p 22.

26 -State of Hawaii, Department of Planning and Economic Development, *Hawaii State Plan: Socio Cultural Advancement*, December 1984, p.23.

27 -Ibid.

indicate that the median age in Hawaii in 2010 would be 37 vs. the median age in 1990 of 32.

For the purpose of this analysis the household size for the County of Hawaii by the year 2010 has been estimated by the consultant to be 2.61 persons per household.

The average household size, while an important determinant in projecting the demand for household units over time, must be adjusted for persons who are not in households. These individuals in Hawaii are primarily military personnel living in barracks or on shipboard. However, the lack of major military installation in the County of Hawaii means that the bulk of persons not in households are made up of the following: persons incarcerated; living in long term hospitals or nursing homes; students in dormitories; and others in group living environments. In 1980 1.8% of the population on in the County of Hawaii was not in households.

c) Desirable Vacancy

Information provided in the "Comprehensive Housing Market Analysis Hawaii County Housing Market Area" HUD July 1, 1987 indicates that the West Hawaii area had a vacancy rate of approximately 1% when adjusted for units held as second homes and for short term rentals. Interviews with various Realtors and business people indicates that they believe there has been little change in vacancy rates for long term primary housing. This compares with much higher vacancy rates in Hilo and an island wide vacancy rate of 6%.

The low vacancy rates contrast sharply with what is considered to be a healthy vacancy rate of approximately 5%. The low inventory of available rental units has caused a shortage of rental units and high rental rates. A survey of Kona Realtors reported in the July 1, 1989 issue of "Hawaii Realtor Journal" page 1 indicated, that the inventory of rental units in the West Hawaii area had decreased by as much as 95% in some areas in the three years between 1986 and 1989. Obviously if the figure from the 1987 HUD

study of 1% vacancy was accurate, then by 1989, the vacancy rate in the West Hawaii area would be practically zero.

According to the same Realtor Journal article the decrease in supply between 1986 and 1989 was reflected in rental rates which were estimated to have risen approximately 40% across the board.

A more normal vacancy rate would be 5% and would allow for more mobility among West Hawaii homeowners and renters as well as mitigation in the upward spiral of rents and home prices. To achieve this end additional growth in the housing stock should be accommodated and encouraged.

Note: this analysis assumes that an increase in the vacancy rate will provide Hawaii residents with additional housing opportunities although others may argue that increased vacancies will encourage immigration to the State, particularly in light of the current tight job market.

d) Affordability

The last key element in the equation of housing demand is affordability. Without the presence of this element the demand for housing would be destined to go unsatisfied. In an administrative memo dated May 18, 1988, Mr. Joseph Conant, Executive Director of the Housing Finance and Development Corporation (HFDC), defined for HFDC's purposes the term affordable housing and established the target groups for affordable rentals and affordable homes for sale. The following is an excerpt from the text of the report regarding the affordability of for sale housing.

...the purchase price of homes would be as follows in order to be "affordable" by families in the "gap group" range in the County of Hawaii

$62,700 to $82,700 (depending on interest rates and expense assumptions) for a family of four earning 80% of median, or $26,480 per year; $109,200 to $140,400 for a family of four earning 120% of median, or $39,720 per year and; $132,600 to

$167,700 for a family of four earning 140% of median, or $46,340 per year:

Note: The price ranges shown above reflect unit price estimates developed by HFDC (5/14/91) with alternate interest rates ranging form 8.75% to 10.5%.

The proposed Manini'owali project is committed to participating in meeting this important need.

There are of substantial waiting lists for "affordable" units whenever they become available. Unfortunately the cost structure for developing affordable units is such that they tend to be developed only when subsidies from market units are available. The most recent example of this phenomenon is the County of Hawaii's affordable housing project at Waikoloa. This project was made possible by a contribution of land and offsite development costs by Waikoloa Land Company as part of its affordable housing contribution, while units in the first phase, are actually being developed by James Schuler and Associates. Nansay as its contribution to its affordable housing requirement in the West Hawaii area is providing the remainder of the units within the County Waikoloa development.

According to the Peat Marwick Market Assessment for the Kealakehe Master Planned community only 7,000 of the planned 21,000 housing units in the West Hawaii area are to be priced in the affordable range.

For the purposes of this analysis it is assumed that housing units can be developed within the price ranges described with government entities concentrating on the lower end of the spectrum and private entities concentrating on the mid and high ranges.

It should be emphasized that in order to insure affordability of housing units an adequate supply is an absolute necessity. Providing units only at "affordable" prices while ignoring the demand for market units forces market unit buyers to raid "affordable" inventory to redevelop as market units thus increasing the price of the affordable housing stock.

While the Manini'owali planned community proposes to develop market units, it contributes in three ways to the development of affordable units in West Hawaii as follows: first, by increasing the overall inventory of housing units, escalation in housing costs are held in check by providing an ample supply; second, by providing market units targeted at the upper middle and upper income residential, second home, retirement and investor markets, these buyers are less likely to convert existing residential housing for these uses (as has happened in the Kahala area on Oahu); and lastly by contributing directly to affordable housing development in cooperation with state and county departments (in this manner, affordable housing resources can be coordinated and concentrated in the areas of greatest need).

G. Government Policies Effect on Supply (Developable Units) and Demand

In order to assist government agencies in their efforts to plan for growth, two major studies have been conducted in the West Hawaii area to outline the demand for residential and resort growth in the area. "The West Hawaii Regional Plan" Office of State Planning, November 1989, and the "Keahole to Kailua Development Plan" R. M. Towill Corporation, November 1990.

While both studies provide broad guidance as to preferred growth scenarios, each recognize it is difficult to predict with certainty long range development of specific locations particularly those controlled by private interests and are closely tied to market and economic conditions.

1. Factors Likely to Reduce Supply

a) Developer Financial Problems

The development business is cyclical and periodically developers like other businesses are forced to operate under unfavorable conditions. Often a single developer may control many projects in a number of areas. A major financial reversal at one of the projects may affect the developers ability to perform at other projects. In some cases, development is simply slowed until the developer can improve his financial situation. In more serious cases, a project is halted and may come under bankruptcy court supervision. Such a situation may result in long delays in development.

b) Social and Political Awareness

In recent years citizens groups have taken a more aggressive posture in their opposition to development in general and specific projects in particular. To various degrees they have stopped, slowed, increased the number of conditions placed on development or reduced the unit count. In general their actions, disregarding the merits of their motives or results, have increased the uncertainties of projects. Oahu tends to have seen more of this activity because of its highly publicized development plan processing procedures and the large number of projects. Perhaps the most highly publicized of these citizens actions was the Save Sandy Beach Initiative. In 1988, a group of concerned citizens opposed to the development of residential units across from the Sandy Beach recreational area met, the requirements to have the issue placed on the ballot via the initiative process. Their efforts were successful and the initiative opposed to the development was passed by a two to one margin. The City Council took action to down zone the property in accordance with the wishes of the public.

The neighbor islands including the Island of Hawaii have experienced these actions. Noteworthy examples include, the Nukolii (Kauai) initiative, the Hapuna Beach (Hawaii) initiative, and the Kalaka Rock (Molokai) hearings, one can see that the public will play an increasingly important role in future development decisions.

The discussion above is not intended to be judgmental or to comment ... any of the issues raised in any of the cases. The purpose of the discussion is to present the uncertainty of future land supply for development.

c) Long Range Projects

According to the West Hawaii Regional Plan the bulk of the resort residential development is contained in four development nodes and in planned communities controlled by eight major developers. To date only four of these planned communities have delivered product.

The same is true for the bulk of the residential product planned in the West Hawaii area and judging by the Kealakehe to Kailua (K to K) plan this concentration of developable resort residential and residential land supply is likely to continue well into the future.

While this concentration of land control has merits from a governmental control standpoint it does subject a large amount of the developable land to the financial well-being and long range development goals of a relative few.

d) Second Home/Tourist Use of Residential Units

Not all of the residential units constructed will ultimately be used to provide primary housing for West Hawaii's population. A number of these units will be used as second homes. The recent well-publicized purchases of Kahala homes and luxury Waikiki condominiums by wealthy foreigners is a reminder of an alternate use for primary residential property.

As the attractiveness of placing a unit into a resort rental pool increases, buildings in tourist areas devoted primarily to residential use would be under pressure to convert to resort use because of the high potential income. Restrictive zoning could be changed or ignored.

2. Factors Likely To Increase Supply

a) Impact of Land Use Commission Decisions on Supply

In recent years the State Land Use Commission has acted to approve a number of projects within the West Hawaii areas. The following is a discussion of the impact of these decisions on the supply of residential properties.

The Land Use Commission (LUC) has approved a total of 8,900 to 10,300 residential units in the North Kona area in recent years. (See Schedule III-11)

While the optimistic 10,339 unit figure represents a large increase, only 27% of the units will be in the affordable range. This compares favorably with composition of the overall inventory of residential units planned for West Hawaii of 33% identified in the Peat Marwick study for Kealakehe which included all government sponsored projects.

It must be remembered that the Urban designation by the Land Use Commission does not permit any specific development within the designated area. The designation represents a grant by the State to the County (in this case the County of Hawaii) to determine the uses within the area designated Urban. Thus while the Urban designation permits the County of Hawaii to allow residential, industrial or other Urban uses within the Urban district there is no requirement for the County to do so.

Actual development of residential property requires that a series of governmental and private actions all be accomplished in order for the development to take place. In the case of residential development, the LUC must give its Urban designation, the county must provide a residential designation and appropriate zoning, and the developer must then develop the property for residential use. Any of the participants, LUC, County Council, or developer may

Exhibit III-11
Manini'owali Market Assessment
Recent LUC Approvals - North Kona
Market and Affordable Units
July 1991

Project	Market Units		Affordable Units		Total Units	
	Low	High	Low	High	Low	High
Keauhou Investment Co.	279	279	31	31	310	310
Huehue Ranch (Condos)	720	1,800	80	200	800	2,000
Huehue Ranch (Lots)	720	720	80	80	800	800
Kona Beach Dev.	1,035	1,035	115	115	1,150	1,150
Kaupulehu Development ✓	315	540	35	60	350	600
Y-O Limited Partnership ✓	983	983	110	110	1,093	1,093
Y-O Limited Partnership ✓	306	306	34	34	340	340
Gamlon Corp.	193	193	22	22	215	215
Gamlon Corp.	256	256	29	29	285	285
Pualani Development Co.	153	153	230	230	383	383
Haseko (Hawaii), Inc.	191	191	288	288	479	479
Villages of La'i'opua I	1,071	1,071	1,608	1,608	2,679	2,679
	6,222	7,527	2,662	2,807	8,884	10,334

Affordable Housing Percentage	Low Range	25.8%
	High Range	27.2%

prevent the property from being developed, but all working together are required to allow the development to be accomplished. Thus, in the opinion of the Consultants, if the goal is to assure that adequate residential development is to occur the bias should be in favor of providing additional land rather than providing just the right amount.

At the present time a number of West Hawaii developments are pending before the land use commission and if approved they could substantially increase the potential residential inventory in the area.

b) Affordable Housing Legislation

Special legislation adopted in 1988 permits Housing Finance and Development Corporation to develop units without County approval. In effect, this allows units at affordable projects under the auspices of the Housing Finance and Development Corp. to undertake "affordable housing projects" without regard to county zoning limitations. In actual practice HFDC's freedom to proceed is subject to constraints of both political and practical considerations.

H. Demand For Housing Units In West Hawaii

Although the product proposed for Manini'owali consists exclusively of residential housing units, it is expected that the primary competition for Manini'owali buyers will come from planned communities located makai of Queen Kaahumanu and Kuakini Highways in North Kona and South Kohala which generally contain a mix of resort and residential units. The following exhibits show the projected demand for housing units as forecast by various sources through the year 2005.

1. West Hawaii Demand for Housing Units

a) Unit Demand

Exhibit III-12 shows a range of demand for residential units for the West Hawaii area for the 1996-2005 from various sources. Exhibit III-13 indicates the actual growth in housing units for the time periods (1970-1980) and (1980-1990) based on Census

information from the 1970, 1980 and 1990 surveys. Exhibit III-14 contains a computation of the number of housing units absorbed in the County of Hawaii and West Hawaii and their relation to population growth.

Based on the information contained in the foregoing exhibit, the total demand for housing units in West Hawaii is expected to average approximately 1,439 units per year in the 1996 to 2005 time frame.

b) Affordable vs. Market Demand

Based on schedule III-12 affordable demand is 46% of total housing unit demand.

c) Market Demand for Housing units in Excess of $500,000.

Exhibits III-15 A and B show the percent of total resales of condominiums and single family homes in the $500,000 and up price range for Oahu, Maui and Hawaii Counties based on Multiple Listing Service (MLS) Data.

d) Market Demand for Housing Units in Excess of $500,000 within Makai Planned Communities

In addition, Exhibit III-16 indicates the location of the $500,000 plus resales West Hawaii Makai Planned Communities. Exhibit III-17 shows the condominium "notice of owner occupant publications" in 1990 and provides the breakdown of affordable units, market units and market units over $500,000.

Exhibit III-12
Manini'owali Market Assessment
Average Annual Demand
West Hawaii Housing Units
Thru Year 2005
Based on Recent Projections
August 1991

Housing Unit Demand	Additional 1996-2005	Affordable Units	Annual Units Total	Annual Units Affordable
West Hawaii Regional Plan (Consultant Allocation)(1)	14,400	5,964	1,440	596
(Draft) County Estimates Long Range Highway Plan 1991 (See Schedule III-12-a)	13,534	0	1,354	N/A
Consultant Estimate 1991 Assumes Population Housing Unit Ratio 1980-1990 Census Maintained (See Schedule III-12-b)	14,680	0	1,468	N/A
Consultant Estimate 1991 (Draft Affordable Housing Study) (See Schedule III-12-c)	14,126	7,645	1,413	765
Average Residential Demand			1,439	680

(1) Housing Unit Estimate is for a 17 year timeframe for Hawaii County Eighty Percent Allocated to West Hawaii.

Exhibit III-12-a
Manini'owali Market Assessment
Hawaii County
Projected Inventory of Housing Units
Hawaii County Planning Department
1987 - 2010

District	1987	1990	1995	2000	2005	2010	
West Hawaii	16,990	20,103	25,291	30,480	38,852	47,188	30,198
West Hawaii Increase		3,113	5,188	5,189	8,372	8,336	30,198
West Hawaii Annual				1,038	1,671		

Estimated Change in Inventory 1995 - 2005 = 13,532

Estimated Annual Demand 1995 - 2005 = 1,353

Source: Extrapolated by Consultant from Hawaii County Planning Department, January 1991 Prepared for DOT Master Plan

Exhibit III-12-b
Manini'owali Market Assessment
Hawaii County Population Growth
Hawaii County/West Hawaii Housing Unit Growth
August 1990

POPULATION (000)	1990	1995	2000	2005	2010
County of Hawaii	120.3	142.5	160.4	180.8	206.1
Change		22.2	17.9	20.4	25.3
HOUSING UNITS (000)					
County of Hawaii	48.2	59.2	68.1	78.2	90.8
West Hawaii	18.7	25.9	33.1	40.6	50.0
West Hawaii %	38.8%	43.7%	48.6%	51.9%	55.1%
West Hawaii Increase Housing Units		7.2	7.2	7.5	9.5
Cummulative		7.2	14.4	21.9	31.3
Per Year		1,436	1,445	1,492	1,892

Annual Average Demand (1995 to 2005)= 1,468

Source: Ratio of Housing Units to Population Growth between 1980 and 1990 Census Applied to Series M-K Projections for County of Hawaii

Exhibit III-12-c
Manini'owali Market Assessment
Average Annual Demand
Housing Unit Demand
1995-2010

	1995	2000	2005	2010
Residential Population	142,500	160,400	180,800	206,100
Percent in Households	98%	98%	98%	98%
Persons in Households	139,650	157,192	177,184	201,978
Persons per Household	2.73	2.68	2.64	2.61
Units Required Based on Households	51,279	58,797	67,280	77,576
Desirable Vacancy Rate	5%	5%	5%	5%
Vacant Units	2,564	2,940	3,364	3,879
Grand Total Demand	53,843	61,737	70,643	81,455

Increase in Units 1995-2005	16,800
West Hawaii Allocation	62%
West Hawaii Units (1)	10,416
Other Housing Unit Demand (2)	3,710
	14,123

(1) Source: "Affordable Housing Analysis of Office of State Planning Boundary Review" (DRAFT) John Zapotocky, January 1991

(2) Estimated by Consultant Based on DBED Series M-K Data and County Planning Allocations

Exhibit III-13

Manini'owali Market Assessment

HOUSING COUNTS BY CENSUS 1990, 1980 & 1970- By Tract

COUNTY OF HAWAII

Tract Number	Location	Housing Units 1990	80-70	Housing Units 1980	80-70	Housing Units 1970
201	South Hilo	1,795	141	1,654	143	1,511
202	South Hilo	609	92	517	(41)	558
		2,404	233	2,171	102	2,069
203	Hilo (South)	1,797	(89)	1,886	841	1,045
204	Hilo (South)	1,523	117	1,406	412	994
205	Hilo (South)	2,223	294	1,929	648	1,281
206	Hilo (South)	1,583	348	1,235	502	733
207	Hilo (South)	3,077	736	2,341	925	1,416
208	Hilo (South)	2,694	557	2,137	805	1,332
209	Hilo (South)	1,179	338	841	436	405
		14,076	2,301	11,775	4,569	7,206
210	Puna	5,875	3,012	2,863	1,562	1,301
211	Puna	2,722	1,010	1,712	1,184	528
		8,597	4,022	4,575	2,746	1,829
212	Ka'u	1,958	591	1,367	373	994
213	South Kona	1,925	648	1,277	808	469
214	South Kona	1,003	202	801	131	670
		2,928	850	2,078	939	1,139
215	North Kona	5,511	2,042	3,469	2,519	950
216	North Kona	4,479	1,025	3,454	2,422	1,032
		9,990	3,067	6,923	4,941	1,982
217	South Kohala	4,235	2,269	1,966	1,168	798
218	North Kohala	1,540	416	1,124	183	941
219	Hamakua	1,312	197	1,115	235	880
220	Hamakua	646	79	567	24	543
		1,958	276	1,682	259	1,423
221	North Hilo	567	13	554	(37)	591
	Totals •	48,253	14,038	34,215	15,243	18,972
	Annual Average		1,404		1,524	
	West Hawaii Total	18,693	6,602	12,091	7,231	4,860
	Annual Average		660		723	

• Housing unit count in 1990 census not comparable to 1980 and 1970 figures. State statistition estimates that amount may be understated by significant amount (4%).

Exhibit III-14

Manini'owali Market Assessment

Unit Demands vs Population Growth

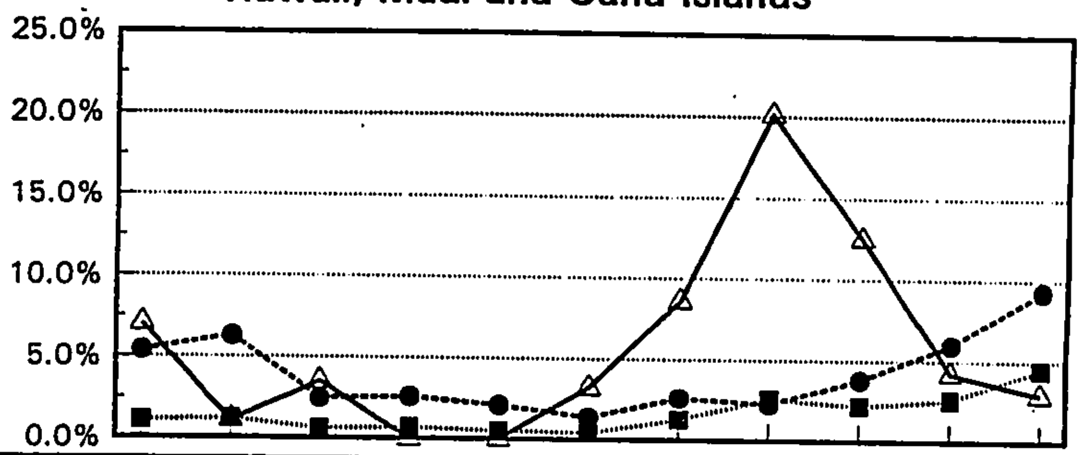
1970-1990

	1980 to 1990 Units per Chg Pop	1970 to 1980 Units per Chg Pop
Hawaii County	0.496 *	0.532
West Hawaii Total	0.416 *	0.554

Due to a change in counting procedures in the 1990 census, end the number of units are not comparable to units counts in the 1970 and 1990 census. The number of resort units included in the count is believed to be substantially less than in previous census counts. Therefore, it is possible that the ratios of units to population increase may be equal to or greater than those shown in the 1970-1980 time frame.

Exhibit III-15 a

Comparison Condominium Sales Percentages
Hawaii, Maui and Oahu Islands



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Hawaii —	7.0%	1.1	3.5	0.0	0.0	3.2	8.6	20.1	12.5	4.2	2.9
Maui —·	5.4%	6.3	2.5	2.6	2.1	1.4	2.6	2.3	3.8	6.0	9.3
Oahu ···	1.1%	1.2	0.6	0.7	0.5	0.4	1.3	2.6	2.2	2.6	4.5

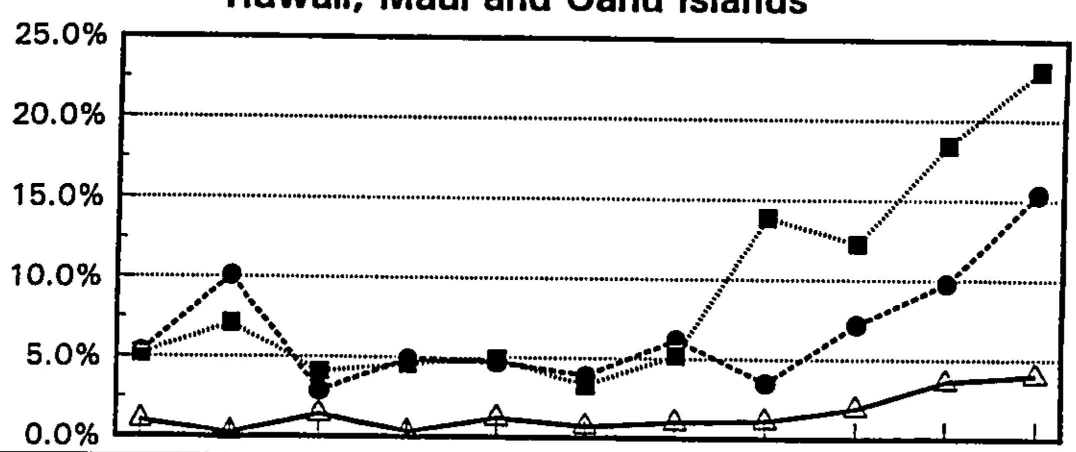
MLS > $500,000 ($1990) versus Total Sales

Source: Locations, Inc. Run 7/91

Maniniowali Market Assessment

Exhibit III-15 b

Comparison Single Family Sales Percentages
Hawaii, Maui and Oahu Islands



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Hawaii —	1.0%	0.2	1.4	0.3	1.2	0.7	1.0	1.1	1.9	3.6	4.0
Maui —·	5.3%	10.1	2.9	4.9	4.7	3.9	6.2	3.5	7.2	9.8	15.4
Oahu ···	5.2%	7.1	4.1	4.6	4.9	3.3	5.2	13.9	12.3	18.4	23.1

MLS > $500,000 ($1990) versus Total Sales

Source: Locations, Inc. Run 7/91

Maniniowali Market Assessment

Exhibit III-16
Hawaii County
Condo Sales
Over $500,000
1990

Project Name	Sales Over $500,000	% Over $500,000
WAIKOLOA		
Shores at Waikoloa	8	40%
MAUNA LANI		
Mauna Lani Terrace	4	
Mauna Lani Point	6	
	10	50%
KEAUHOU		
Hale Kehau	2	10%
Totals	20	100%

Exhibit III-17
Manini'owali Market Assessment
Published Owner Occupant Offerings
Hawaii-County

	Unit Count	Units in Makai Planned Communities	Price Range Low		Price Range High	Affordable Number of Units Below $153,000	Number of Units Over $500,000	Range of Price Per Square Foot Units > $500,000 Low	Range of Price Per Square Foot Units > $500,000 High
Halau O Malani	45		$335,000	-	$990,000		5	$272	$316
Islands at Mauna Lani	46	46	$1,275,000	-	$1,750,000		46	$450	$540
Kona Coast Villas	34		$250,000	-	$575,000		4		$267
Kaulana - Phase I	44	44	$247,000	-	$510,000		2		$226
Kalani Maiai 46-A-5	2		$250,000	-	$250,000				
Kalani Makai 3	2		$150,000	-	$150,000	2			
Wailea Beach Parcel 26	2		$4,500,000	-	$4,500,000		2		
Wailea Beach Parcel 27	2		$3,500,000	-	$3,500,000		2		
Kinohou Estates Lot 4	2		$175,000	-	$175,000				
Kinohou Estates Lot 5	2		$175,000	-	$175,000				
Kinohou Estates Lot 8	2		$175,000	-	$175,000				
Vista Waikoloa	122	122	$510,000	-	$625,000		122	$300	$360
The Grove at Mauna Lani	5	5	$6,400,000	-	$6,500,000		5	$925	$950
The Greens at Waikoloa	35		$218,000	-	$303,000				
Hano Hou Cottages	3		$120,000	-	$266,000	1			
Haina Cottages	2		$288,000	-	$288,000				
The Bay Club	172	172	$360,000	-	$840,000		106	$350	$450
Waikoloa Palms	110	110	$475,000	-	$1,350,000		97	$330	$450
Fairway Terrace	199		$98,000	-	$148,000	199			
Kamalani	224	224	$480,000	-	$3,500,000		210	$300	$600
	1,055	723				202	601	$272	$950

Analysis: Percent of Affordable Units 19.1%
Percent of Total Units > $500 57.0%
Percent of Units in Makai Planned Communities 83.1%

1990 Median Income $32,000
Maximum Cost of Home (140% Median) $153,000

Based on the information contained in the exhibits, the percentage of resales of single family and condominium sales in the $500,000 and over price range for the counties of Oahu, Maui and Hawaii are as follows:

County	Oahu		Maui		Hawaii	
	1980	1990	1980	1990	1980	1990
Residential	5%	23%	5%	15%	1%	4%
Condominium	1%	5%	5%	9%	1%	3%

Source: Locations, Inc. Special Run 7/8/91

Further research indicates that all of the condominium resales in the County of Hawaii in excess of $500,000 occurred in West Hawaii Makai Planned Communities of Mauna Lani, Waikoloa, and Keauhou. Of the residential resales in excess of $500,000, 95% were in West Hawaii. No residential resales in 1990 were reported in Mauna Lani (only one house has been completed in Mauna Lani) or Mauna Kea (less than twenty homes are complete in Mauna Kea), no single family homes exist in the Waikoloa Makai Area and only three sales over $500,000 reported in Keauhou.

It is the consultant's view that as the resort industry grows within the County of Hawaii the market for $500,000 and higher product will equal or surpass levels achieved on Oahu and on Maui. The reason for this assumption is that a far higher portion of the housing units offered in West Hawaii will be located in Planned Destination Areas. Planned Destination areas such as Mauna Lani, Wailea, Kapalua are known to command extremely high premiums (often two to three times comparable properties outside of these communities).

The fact that West Hawaii accounted for all of the over $500,000 sales of condominiums and almost all of the single family product and yet contained only 39% of the county's inventory of housing units indicates that within the West Hawaii area, product in

excess of $500,000 currently accounts for approximately 10% of the resale market.

This view is further reinforced by Exhibit 17 which shows of the 1,055 condominium units offered for sale in 1990 in the County of Hawaii, all were located in West Hawaii and, 601 units or 56% of the units were priced in excess of $500,000. If the units were further broken down into units within North Kona or South Kohala Makai Planned Communities, then the total units offered would be 718 and the number priced in excess of $500,000 would be 588 or 82%.

To date, new single family residential product has not been offered for sale within North Kona or South Kohala Makai Planned Communities. With the exception of custom homes offered individually, new single family product in the County of Hawaii has typically been priced below $300,000. The very high offering prices for houselots within Mauna Kea and Mauna Lani as well as those projected for Waikoloa, South Kohala Resort, Kaupulehu, Kukio, and the recent resales of lots at Keauhou ranging from $250,000 to $450,000, suggest that virtually all of the house and lot product within West Hawaii Makai Planned Communities will be offered at prices in excess of $500,000.

e) Summary Demand In Excess of $500,000

Assuming 80% of the condominiums offered within Makai Planned Communities in West Hawaii and 100% of the house and lot product offered at West Hawaii Makai Planned Communities are priced in excess of $500,000 would result in approximately 90% of the Makai Planned Communities product offered in the $500,000 and over range. Assuming that demand in Makai Planned Communities will make up one-third (1/3) of total residential demand in West Hawaii results in a demand for approximately 430 $500,000 plus units annually.

Assuming further that 10% of the remaining demand is for $500,000 plus units results in an additional 100 units per year or a total of 530 units per year.

2. Manini'owali - Absorption

The developer has estimated an annual absorption of 100 units per year commencing in 1996. This figure, however, may be relatively conservative, given the proposed variety of product and its uniqueness. The consultant believes that the demand for Manini'owali residential units exists now and that by 1996 that demand could expand significantly depending on the progress of the Kaupulehu and Kukio Planned Communities. The following rationale suggests that a much faster overall absorption is possible and even likely due to the broad array of product and existing pent up demand.

a) Broad Array of Product

The Kukio/Kaupulehu development node is one of largest new planned development areas in North Kona. As discussed previously, the developers have identified various upscale product categories, within which a variety of product could be offered. The scope of the projects allow the developers to respond to the many facets which make up the total demand within the upscale market.

b) Pent Up Demand

The Kukio/Kaupalehu development node has been in the approval process for many years. Most island residents and particularly the population involved in real estate have been hearing about these projects for a considerable time. Many homebuyers and investors have been waiting to see what type of product is to be offered. Further, the Kona Village Resort has been serving a small but financially capable clientele for many years, thus introducing literally thousands of potential buyers to the attributes of the development node. For these reasons, strong interest and demand for various product types offered is expected. The Manini'owali project location allows it to benefit from the activities occurring within the Kukio Kaupalehu development node.

c) Concept Uniqueness

The Manini'owali Planned Community is unique in concept. It provides residential units adjacent to upscale resort facilities yet separate and apart. At the same time the Manini'owali Residential community offers a golf course dedicated primarily to serving the needs of the resident community . No other planned community makai of Queen Kaahumanu Highway, in North Kona or South Kohala has offered residential property owners first priority on golf facilities within the community. None of the new developments makai of Queen Kaahumanu Highway have proposed to offer such an amenity in the future.

d) Product Acceptability

During the past twenty years there have been a number of opportunities for homebuyers or investors to purchase new fee simple and leasehold real estate within South Kohala and North Kona Makai Planned Communities . New residential product in North Kohala and Waimea has been successfully offered from time to time. Low density golf front condominium developments offered at Mauna Lani Waikoloa and Keauhou have been well received. Single family lots with golf course frontage offered at Mauna Lani and Keauhou have also sold well. While a number of new communities will offer golf course oriented product, none has the unique combination of location and amenities contained in the Manini'owali planned community.

e) Land Absorption vs. Unit Deliveries

One aspect of the absorption which must also be considered is the land absorption vs. that of the unit absorption. The land must be available for development at least one to two years prior to deliveries in order that the necessary planning and permitting be accomplished. The Manini'owali developer plans to undertake all of the residential construction. Even with this assumption, however, design development as well as financing and condominium approvals often require a year's time. Final permitting and construction may require between 18 and 24 months.

3. Manini'owali Absorption by Year and Unit Type

As indicated earlier in the text, Manini'owali residential product is expected to enjoy a special window to the market.

The Manini'owali planned community is expected to consist of a number of unique villages within an integrated whole. These independent developments are expected to have their own identity, their own homeowner/condominium associations and their own architectural themes. The villages would range in size from fifty to one hundred fifty units although a particularly unique location might be developed as a small project with ten to twenty homes or attached units.

To maximize the number of sales in any given year a variety of product must be offered. To minimize developer risk and not oversupply what are essentially several niche markets, the various villages may be developed on an incremental basis, limiting the size of the increment to thirty to fifty units. Depending on market conditions, development of the increments could be accelerated or curtailed.

While closely associated with the Kuklo/Kaupulehu development node, from a marketing standpoint, Manini'owali should be considered an independent housing project, similar to other independent developments located within the North Kona and South Kohala planning areas.

Planned communities within the two districts, each emphasizing particular market segments or niches, are in competition with each other for a portion of the total housing market. In most cases the various planned communities achieve their market share by serving a relatively broad spectrum of the market. Thus in the short run, total demand notwithstanding, units at Keauhou compete with units at Waikoloa, while units at Mauna Kea compete with units at Mauna Lani. Units in existing planned communities are in competition with future planned communities. In addition, units in planned communities are in competition with units not in planned communities.

Recognition of the Manini'owali development as a competitor within the North Kona and South Kohala housing

market, suggests that the development will obtain a share of the projected housing demand.

Assuming projections of makai planned demand outlined above of 480 units per year between 1996 - 2005 and assuming that the Manini'owali's development projection is met, Manini'owali would account for approximately 20% of the market between 1996 and 2005. While such a projection appears aggressive it must be viewed in the context of a changing resort residential market at destination resorts throughout the State.

During the past two years, with the existence of a strong market for housing units product in the North Kona and South Kohala market areas, the majority of the product developed or proposed within Makai Planned Communities, approximately 900 units has been at the Waikoloa resort. This has been accomplished despite the existence of three other housing developments with approved Makai Planned Communities components which could have offered substantial competition: Mauna Kea; Mauna Lani; and Keauhou.

In the case of the Mauna Kea Node, management opted to pursue the development of the South Kohala Resort's hotel and infrastructure rather than the development of condominiums, single family homes, or residential lots at its existing Mauna Kea Resort. Thus the Mauna Kea Node is expected to develop no new for sale product through 1992. Based on Mauna Kea's track record in development, it is anticipated that new product to be marketed will be of the highest quality and priced to retain Mauna Kea's reputation for high quality, exclusive and premium priced product.

The Mauna Lani Node has moved aggressively during the last two years to position itself as the premier destination resort in the State. Real estate professionals and visitor industry observers, generally agree that this effort has been successful with competition limited to Kapalua on Maui and the neighboring Mauna Kea Resort. Addition of the Ritz Carlton Hotel, the second golf course, additional recreational and shopping amenities and the likelihood that Mauna Lani will be the first Big Island Destination resort with its own marina, appears to have positioned it as the premier resort for the foreseeable feature. Based on the offerings of residential product at Mauna Lani during the recent past, its original commitment to the top of the market has been reinforced and upgraded. Few resales of condominium product have occurred in the past 18 months within Mauna Lani of less than $500,000 and those which did occur were typically for one bedroom product in Mauna Lani Terrace the project's first condominium project. In fact, recent offering of condominium or cluster product have been in the multi-million dollar price range. Sales of vacant fee simple lots have been in the $500,000 to $6,000,000 price range meaning completed single family residential product, when available, is likely to be in the $1,500,000 to $10,000,000 price range. This concentration on the upper end of the market has come at the price of absorption. Since 1984 Mauna Lani has averaged only 35 units of condominium product per year and since 1989 (first lot offering has averaged only 20 lots per year).

Keauhou on the other hand has the reputation of a planned community containing many moderately priced units. Appreciation of product at Keauhou has been in line with appreciation at other Makai Planned Communities but starting from a much lower base. Further, a number of the development parcels at Keauhou are outside of the control of the Kamehameha Investment Company, (Kamehameha Schools/Bishop Estate), the master developer. Development and performance standards in some instances are outdated. The Keauhou Planned Community, does not have the centralized control exerted by the South Kohala Makai Planned Communities. On the other hand single family lot subdivisions being developed by the master developer have had success in attracting a more upscale buyer and the master developer has had some success in upgrading the overall community standards. A number of condominium projects have been undertaken by various developers during the recent strong market.

Activity at Waikoloa has been at a fever pitch since the opening of the Hyatt Waikoloa in 1988. The combination a tremendous surge in demand for condominium product, opening of the Hyatt, opening of the Kings Course and the aggressive marketing of development parcels by an experienced management, backed by well financed owners, has resulted in a tremendous surge in activity.

Exhibit III 18 illustrates the potential competition for the Makai Planned Community residential market assuming competition is restricted to developments contained in the West Hawaii Regional Plan's 2005 planning scenario. While Exhibit III-18a illustrates total competitive inventory.

Exhibit III-18
Manini'owali Market Assessment
Estimated Absorption Potential
West Hawaii Makai Planned Communities
1996-2005

	Potential Annual Average Annual Unit Deliveries	Annual Average
Mauna Kea Node		
Mauna Kea*	25	
South Kohala Resort*	45	
		70
Mauna Lani Node		
Mauna Lani*	55	
Waikoloa**	150	
		205
Kaupulehu/Kukio Node		
Kaupulehu*	50	
Kukio*	50	
Manini'owali	100	
		200
Keahole/Keauhou Node		
Ooma II	60	
Kohanaiki	95	
Kailua Kona**	20	
Keauhou**	100	
		275
Total Supply Per Year		750

* Assumed targeted at $1,000,000 plus price range
Note: Consultant estimate based on past performance, anticipated target market and competitive environment.
**A strong market and aggressive development on the part of these developers could result in a depletion of certain types of inventory for these particular developers due to lack of competition during the 1990 to 1995 time frame.

Exhibit III-18 a
Manini'owali Market Assessment
Inventory of Housing Units

Competitive Supply	Existing	Proposed
Mauna Kea Node		
Mauna Kea Beach		250
South Kohala Resort		450
Mauna Lani Node		
Mauna Lani	89	1,948
Waikoloa	117	2,863
Kaupulehu-Kukio Node		
Kaupulaehu		600
Kukio		1,958
Keahole-Keauhou Node		
O'oma II		600
Kohanaiki		950
Kailua-Kona	1,511	200
Keauhou	448	2,703
Total Existing/Proposed	**2,167**	**12,522**

Source: West Hawaii Region Plan, 1989

Assuming that makai residential development is restricted to the development nodes identified in the West Hawaii Plan "2005 Planning Scenario" it is feasible for the Manini'owali project to capture one fifth of the market or 100 units per year during the 1996-2005 time frame.

Summary of Potential Demand

Obviously, the absorption scenario presented depends on a number of factors, including tourism and economic growth as forecast by the Department of Business and Economic development, hotel unit construction as forecast and development activities by other developers as envisioned by the scenario. Given the past performance of new planned communities it is far more likely that financing problems, approval delays or other factors will result in fewer suppliers, than a scenario which envisions all projects producing units.

A number of factors, however, could improve the prospects for the West Hawaii Development community in general and the Manini'owali Residential community in particular. First, visitor projections for the state and West Hawaii could be exceeded, a not unheard of occurrence. (This is especially likely if the recently funded Keahole Airport expansion attracts direct overseas flights.) Second, hotel development moratoriums on Maui and Kauai and a moratorium on new development in Waikiki could be extended, providing West Hawaii with an opportunity to increase its statewide share of the market. Third, there has been a trend towards upscaling of product throughout the resort industry. This is particularly true of the Kukio Kaupulehu node which is likely to have far fewer units than envisioned in the West Hawaii Regional Plan. This has been the case at numerous other upscale Resort Communities throughout the State including Mauna Lani, Wailea, and Kapalua, where densities have been reduced resulting in fewer units. Based on the above, the absorption schedule shown in Exhibit III appears reasonable.

Exhibit III-19
Manini'owali Market Assessment
Absorption Schedule Manini'owali Residential Community
1996-2005

	Single Family	Attached Single Family	Stacked Flats	Total
1996	15	55	30	100
1997	15	55	30	100
1998	15	55	30	100
1999	15	55	30	100
2000	15	55	30	100
2001	15	55	30	100
2002	15	55	30	100
2003	15	55	30	100
2004	15	55	30	100
2005	15	55	30	100
Total	150	550	300	1,000

4. Other Housing Needs Met by the Manini'owali Development

As identified previously, the Kealakehe Market Assessment identified a potential for 21,000 units in the West Hawaii area, but only 30% of those units were identified as affordable. In addition, a review of approved supply (by the LUC) for the North Kona area as of 6/20/91 shown in Exhibit III-11 reveals that less than 30% of the units approved in North Kona are required to be provided in the affordable range.

Given the fact that major developments such as Mauna Lani have already met their affordable housing commitment and given the recent experience that in order to fund the proposed government projects, i.e., the County's Waikoloa housing program, the contributions of Waikoloa and Nansay were necessary.

- Manini'owali could provide additional support of affordable housing projects and would also serve to meet an existing and future housing need.

I. Special Attributes of the MANINI'OWALI Development

According to North Kona Development Corporation, Manini'owali is the premier planned residential community proposed for the Kona Coast during the next 15 years. Among its attributes are the following:

1. Ocean orientation - Only planned purely residential community in North Kona or South Kohala located Makai of Queen Kaahumanu Highway and with no intervening development between it and the ocean.

2. Strong economic potential

   - Adjacent to Kukio Development Node
   - Resorts units within 20 mile radius forecast to increase by 17,000 during the next twenty years
   - Within Five Miles of the K to K Planning area, designated to accommodate the bulk of the growth in the North Kona area for the next twenty years
   - Located in the center of the fastest growing resort area in the State of Hawaii (North Kona/South Kohala - County of Hawaii) Forecast growth 168% from 1990 to 2010 vs. 108% for Kauai, 97% for Maui and 34% for Oahu.

3. Unique aesthetic and amenity package, including:

   - Proximity and access to Kua Bay one of a very few white sand swimming beaches located on the Kona Coast
   - Fifteen minute drive to small boat harbor at Honokahao
   - Golf course dedicated primarily to the use of community residents

   - Tennis
   - Leading Edge Design - Unit design from Davidson Communities, winner of numerous awards for single family and attached housing, winner Pacific Coast Builders Conference Attached home award 1991
   - Commercial convenience center providing for day to day needs without driving to major shopping facilities in Kona area
   - High maintenance standards throughout the community
   - Security

4. Capable development team

   - Davidson Communities, Inc. award winning developer
   - Track record of in excess of 1,000 units during the past ten years developed for upper middle and upper income residential buyer

IV. Golf Demand Analysis

The Manini'owali Golf Course is an integral part of the Manini'owali residential community. The following analysis, however, seeks to demonstrate the absorption of the course within the West Hawaii golf environment.

A. Golf - Demand

1. Background

According to the State Data Book as of January 1990, there were 61 golf courses in operation in the State of Hawaii (*Exhibit IV-1*). These courses are further broken down by type: seven municipal; nine military and forty-five privately owned, including Resort Courses. By the end of 1990, three additional courses had opened--one municipal and two privately owned--bringing the total to 64 courses. During the past ten years almost all of the golf course development has taken place as an integral part of land development projects. This situation closely follows the national experience.

Exhibit IV-1
GOLF COURSES, BY NUMBER OF HOLES, OWNERSHIP, AND ISLANDS: JANUARY 1990

Island	Ownership	Number of Golf Courses				Number of Holes
		Total	9-hole	18-hole	27-hole	
State Total		61	11	48	2	1,017
Hawaii		12	2	9	1	207
	Municipal	1	-	1	-	18
	Private	11	2	8	1	189
Maui		10	1	9	-	171
	Municipal	1	-	1	-	18
	Private	9	1	8	-	153
Lanai		1	1	-	-	9
	Private	1	1	-	-	9
Molokai		2	1	1	-	27
	Private	2	1	1	-	27
Oahu		29	5	24	-	477
	Military	9	3	6	-	135
	Municipal	4	1	3	-	63
	Private	16	1	15	-	279
Kauai		7	1	5	1	126
	Municipal	1	-	1	-	18
	Private	6	1	4	1	108

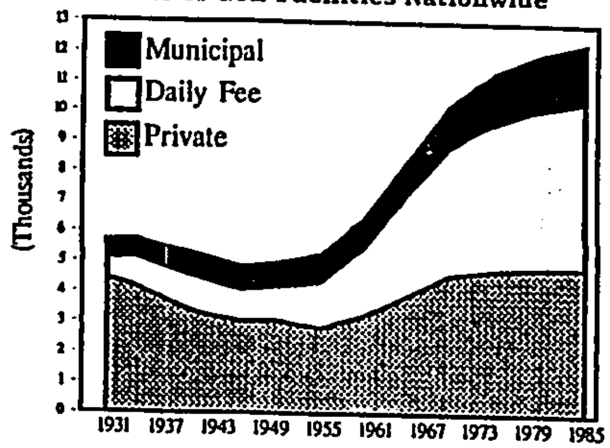
Source: Compiled by Hawaii State Department of Business and Economic Development from county departments of parks and recreation.

The county of Hawaii currently has 11 Golf courses. There are 35.5 18-hole golf courses are either under construction or proposed. Twenty-six are within the Kona Region. (See *Appendix I*)

2. National Golf Trends

Statistics provided in the National Golf Foundation's (NGF), publication Golf Facilities in the United States, 1985, attest to the growth of golf in the United States over the past 30 years. Between 1955 and 1985 the number of golf facilities in the country grew from 5,218 to 12,346, a 136% increase. At the same time, population grew from 164 million to 237 million, a gain of only 44%. From 1985 to 1989 an additional 274 facilities have been added. While the overall trend in course development is positive, the number of private facilities has decreased from approximately 54% to 39%. This decrease indicates a broadening of the participation in the sport to include a wider spectrum of the American population (*Exhibit IV-2*).

Exhibit IV-2
Growth in Facilities
Number of Golf Facilities Nationwide



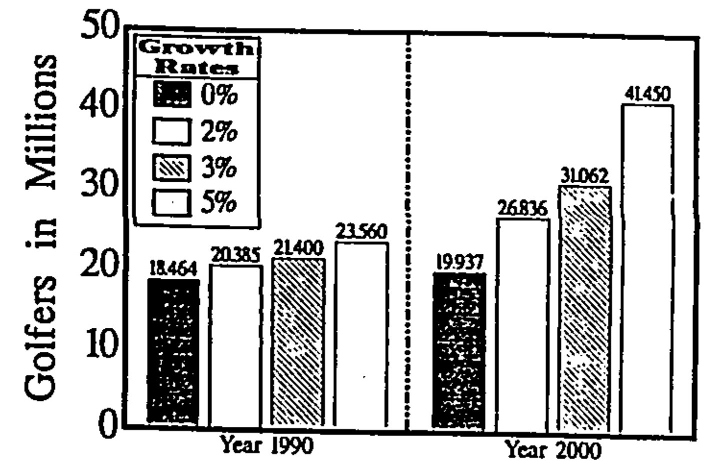
Source: National Golf Foundation *Golf Facilities in the United States*
Graphics by John Zapotocky

At a 1986 symposium sponsored by the National Golf Foundation, Dr. John F. Rooney of Oklahoma State University presented a paper on the Demand for Golf in the Year 2000. The paper presented historical data on the growth of golf in the United States and those factors which would be predictive of future growth. Dr. Rooney estimated that in 1986 there were 17.5 million golfers being accommodated by 12,500 golf facilities. A ratio of one course for every 1,400 golfers.

Rooney said that golf participation nationwide is expected to increase due to the following growth generators: higher

incomes; an aging of the population; early retirement; more leisure time, flex time, residential mobility and a trend towards exercise. Using alternate growth rates for golf participation ranging from 0% to 5% and including only the known demographic changes in the population, Rooney estimated that there would be a range of between 20 to 41 million golfers by the year 2000 (*Exhibit IV-3*). Thus in the short time, between now and the year 2000, golf demand nationally could rise between 10% and 100%+.

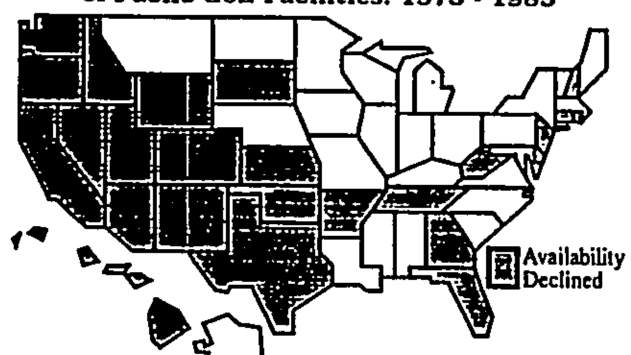
Exhibit IV-3
Potential Growth in Golf Participation



Source: National Golf Foundation *Golf Projections 2000: Golf Summit '88 Research Presentation*
Graphics by John Zapotocky

At the same symposium in a paper titled The Crisis in Public Golf Course Development, Dr. Robert Adams of the University of New Hampshire attempted to quantify the demand for new golf facilities. Dr. Adams' research indicated that golf facilities nationwide are in tight supply (thus frustrating the desire for golf among the "wider spectrum" of golfers identified previously) and that the availability of public golf facilities declined in 23 of 50 states (including Hawaii) during the time of his research (*Exhibit IV-4*). Dr. Adams, using the same alternate scenarios cited in Dr. Rooney's paper, but eliminating the 5% scenario, developed projected increases in golf facilities to maintain present levels of course availability. The results of his analysis showed the need for a range of between 1,400 to 7,900 new courses by the year 2000 if growth rates of 0% and 3% were assumed, respectively (See *Exhibit IV-5*). Annualized, these projections would result in an increased golf course inventory of 100 to 560 courses per year. Need for additional facilities is expected to be the greatest in the south and the west, where population growth has outstripped new golf facilities in recent years.

Exhibit IV-4
States that Declines In Availability of Public Golf Facilities: 1975 - 1985



Source: U.S. Bureau of the Census and NGF
Graphics created by John Zayotocky

Exhibit IV-5
COURSE DEVELOPMENT REQUIRED TO MEET POTENTIAL GROWTH

Year:	Today	2000	2000	2000
% Growth in Golf Population	-	@ 0% Growth	@ 2% Growth	@ 3% Growth
Number of Golfers	17,500,000	19,900,000	26,800,000	31,100,000
Number of Courses[28] That must be added to Maintain Current Availability[29]	0	1,399	5,420	7,926
Required Average Yearly Increase in Number of Courses to 2000[30]	--	100/year	387/year	566/year

SOURCE: Market Facts, Inc. and NGF

A research summary published by the National Golf Foundation in May 1990 indicated both participation and the number of rounds increased between 1986 and 1989. Participation increased by 7% annually and rounds by 4% annually. This report was one of the first opportunities to measure the validity of the initial growth projections contained in the two aforementioned studies. It appears, however, that growth in golf is tracking the upper end of the projected ranges.

Similar projections have been made by others. The following quote from an article in the January 1987 issue of Urban Land Magazine illustrates the point.

"Golf will be a major beneficiary of the aging of the population. A disinterested baby boom generation slowed golf play growth considerably in the 1970s. However, as this generation moves into the 35- to 54-year-old age bracket group with the highest golf participation rate _ and as growth accelerates in the 65-and-over population _ the group exhibiting the highest per capita play _ golf will benefit greatly. Today there are approximately 6 million golfers in the 35- to 54-year-old age bracket. By 1990, there will be approximately 7.2 million, and by

28. Course = 18-Hole Equivalents
29. Current Availability = 58 Courses/100,000 Golfers
30. Average Yearly Growth 1983-1985 = 116 Courses/Year (Not 18 Hole Equivalents)

2000, golfers in that age group will swell to over 9 million, a 50 percent increase in 15 years. In addition, golf is becoming increasingly popular with women."

Thus, the number of golfers is expected to increase significantly by 1995 (*Exhibit IV-6*). And, because of the aging population, golf demand (number of rounds) will rise at an even faster rate. Moreover, with a growing retirement population, golf demand during mid-week periods should accelerate, a major factor in improving the profitability of golf course operations.

Exhibit IV-6
GROWTH IN GOLF PLAY

Year	Number (Millions)	Percent Increase	Number of Rounds (Millions)	Percent Increase
1985	18.1	--	440	--
1990	19.1	5.5	466	5.9
1995	19.9	4.2	491	5.4

Source: Economics Research Associates

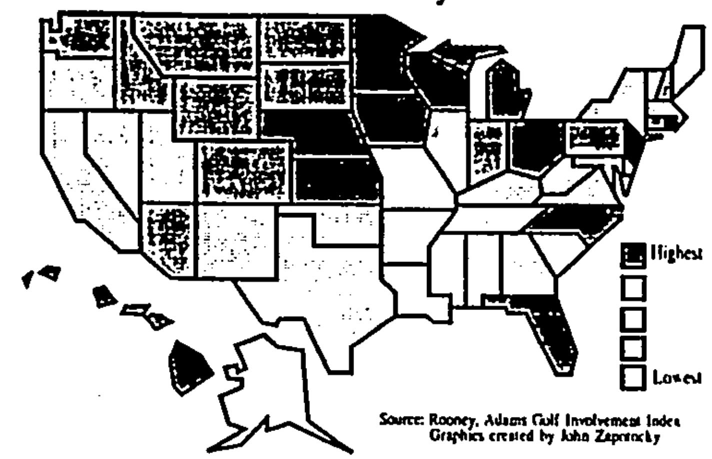
The awareness of golf has grown, in part, due to its prime time weekend television exposure supported by major sponsors who target their message at the middle income and affluent market. Awareness has also increased due to expanded coverage of preliminary rounds by cable channels such as ESPN. Further, the development of a strong seniors and women's has also brought golf into the public's awareness. Golf awareness has also grown due to an increase in junior golf programs and the emergence of golfers as sports heroes.

3. Golf Trends In The State Of Hawaii

Golf in the State of Hawaii has also exhibited strong growth for many of the same reasons identified as golf generators nationally. Hawaii has been identified as one of the states in the nation with a high golf intensity (*Exhibit IV-7*). The most explosive growth in golf in Hawaii during the past 20 years has been in the development of the planned resort community and the resort golf industry. This trend is expected to con-

tinue with more rounds per individual per annum also being a driving factor in golf growth within the State.

Exhibit IV-7
Golf Intensity



Source: Rooney, Adams Golf Involvement Index
Graphics created by John Zaprocky

a) Resident Golf

State wide resident golfers play the majority of the rounds played. Although specific figures are unavailable for the county of Hawaii, it is estimated that Hawaii county residents play the same percentage of golf as do other neighbor island residents, 35%. This percentage converts to 2.23 rounds per capita. Demand for golf by residents is expected to grow at, at least, the same rate as national trends. Based on the State Department of Business and Economic Development's M-K Series projections, the median age of Hawaii's population is expected to increase from 30.5 in 1985 to 35.3 in the year 2010 with the 35-54 year old population group increasing by 52% and the over 65 population group by 90%. This aging of the population also follows national trends. As the population ages, people have a much higher propensity to participate in the sport of golf. This is due to a number of factors including: the search for less demanding forms of exercise; the ability to set aside large blocks of time for recreation; increased disposable income; and increased attraction of the State of Hawaii as a retirement community.

b) Resort Golf

Although it is not anticipated that the resort vacationers will be a major segment of the golf market at Manini'owali, it is anticipated that they will be one of the contributing factors to it's success.

Demand for golf by tourists is expected to continue to increase with the growth of the visitor industry and may accelerate as the mix of Hawaii's visitors shift towards the up-scale market.

The growth in golf as a leisure time activity has translated into the growth of golf as an activity for tourists. In 1955, none of the golf courses in the State of Hawaii could be classified as being resort courses; in 1965 only the Mauna Kea (Hawaii County) and the Kaanapali Golf (Maui County) Facilities could be classified as resort courses; by 1985 there were 20 golf courses in the state classified as resort golf courses. Today, this number continues to grow, increasing the State's popularity as a golf vacation destination.

An examination of golf courses by island indicated that resort courses have developed on the neighbor islands to a greater degree than on Oahu when measured against average visitor census or visitor expenditures by county (*Exhibits IV-8* and *IV-9*). This can probably be explained by the fact that growth of the neighbor island visitor industry has taken place more recently and, to a large degree has focused around destination resorts. Proposed additions to Hawaii's visitor plant such as Regent/Huehue Ranch and Waikoloa include golf facilities as prominent features of the proposed resort development plans. A study[31] commissioned by the State Legislature stated that Hawaii attracted approximately 200,000 golfers in 1985 and that they expended $30,000,000 at the state's resort golf courses.

31 . Coopers & Lybrand, *A Master Plan for the Continued Development of Hawaii as a Sports Center*, February 1987.

Exhibit IV-8
AVERAGE VISITOR CENSUS,
BY COUNTIES AND ISLANDS: 1986 TO 1989

[Before 1989, all eastbound and northbound visitor-days were allocated to Oahu]

County or Island	1986	1987	1988	Total	West-bound	Other[32]
State total	132,910	134,270	141,410	169,670	135,480	34,190
Oahu	73,870	74,660	80,450	88,750	61,480	27,270
Hawaii County	9,870	10,210	10,690	17,760	15,560	2,200
Kauai County	14,840	15,510	16,400	19,140	18,090	1,050
Maui County	34,330	33,890	33,870	44,020	40,350	3,670
Lanai	(NA)	(NA)	(NA)	240	210	30
Maui	(NA)	(NA)	(NA)	42,690	39,240	3,450
Molokai	(NA)	(NA)	(NA)	1,090	900	190

NA Not available.

Source: Hawaii Visitors Bureau, Westbound Visitors to Hawaii (annual), release data March 1989, and records.

The development of destination resorts in Hawaii, starting with the development of Kaanapali on Maui over 25 years ago, have followed a more or less standard formula for success. In general, resorts have been sited in coastal areas with prevailing good weather and provided a variety of self-contained recreational amenities, including ocean activities, golf course(s), tennis facilities, shopping and various other amenities. In the early years golf and other recreational facilities were considered to be necessary cost centers for the resort development. Development costs for these amenities were generally allocated to parcels for sale or lease and were recovered by sales of developable land within the resort. The basic reason for this assumption was that golf course fees and demand was relatively low in comparison to golf course development, operating and capital costs. During the past five years there has been an unprecedented increase in the level of demand, and fees have been increased to allocate scarce playing times on an economic basis. Golf course operations have become self-supporting and, in most cases, become profitable. One of

32 . Eastbound and northbound. Distribution by island based on data for fourth quarter.

the reasons this change in demand at Hawaiian resort courses occurred, is the result of maturation of the Hawaiian destination resort industry.

Exhibit IV-9
ESTIMATED EXPENDITURES BY VISITORS TO HAWAII, BY COUNTIES: 1970 TO 1989

[Millions of dollars. Interisland air fares have been distributed on a prorata basis. Before 1989, all expenditures by eastbound visitors were included with the City and County of Honolulu. Excludes expenditures by Hawaii residents]

Year	State Total	City and County of Honolulu	Other Counties Total	Hawaii	Kauai	Maui
1970	595	442.0	153.0	53.4	45.1	54.5
1971	705	507.0	198.0	67.7	56.1	74.2
1972	840	609.0	231.0	77.0	61.9	92.1
1973	1,020	777.0	243.0	81.9	63.2	97.9
1974	1,225	927.5	297.5	99.3	73.9	124.3
1975	1,360	1,004.1	355.9	114.6	87.2	154.1
1976	1,640	1,212.8	427.2	126.8	101.8	198.6
1977	1,845	1,376.5	468.5	131.2	109.9	227.4
1978	2,146	1,569.0	577.0	152.9	137.9	286.9
1979	2,537	1,867.2	669.[illegible]	162.0	159.1	348.7
1980	2,875	2,097.5	777.5	187.6	189.3	400.6
1981	3,200	2,394.1	805.9	179.2	197.3	429.4
1982	3,700	2,748.2	951.8	200.9	210.6	540.3
1983	3,974	2,653.1	1,320.9	277.2	250.[illegible]	[illegible]
1984	4,582	2,895.4	1,686.6	248.9	[illegible]	1,078.3
1985	4,881	3,084.5	1,799.5	285.9	407.9	1,105.7
[illegible]	5,500	3,443.8	2,056.2	343.8	516.9	1,195.5
1987	6,600	4,370.4	2,229.6	381.8	580.1	1,267.7
1988	9,200	6,552.7	2,647.3	464.2	712.1	1,471.0
1989 [33]	10,907	6,635.6	4,271.0	1,004.8	952.3	2,313.9

Source: Hawaii Visitors Bureau, *Neighbor Island Statistics*, tabular releases dated May 1989 and 1990.

As destination resorts have matured, the number of resort accommodations providing potential golf users has increased. An upscaling of accommodations generally at

33 . Data reflect improved allocation of eastbound visitor expenditures, previously included with Oahu, and thus are not comparable to estimates for earlier years.

planned resorts has resulted in a reduction in densities tending to attract groups which traditionally exhibit higher rates of golf participation. These factors have also encouraged the growth of the visitors who play golf.

Another factor encouraging the expansion of the golf playing visitor market has been the expansion, availability and marketing of resort golf facilities. The islands of Hawaii and Maui have led the state in the expansion of golf facilities. Twenty-five years ago on Maui, there was a single golf facility at the then "infant" Kaanapali Resort. Today there are seven resort golf courses with a number of new facilities under construction and in the planning stages. Unlike a tennis court or a ball field, each golf course has it's own character and distinctiveness. Every golf course is designed differently, in many cases when a course is designed by a "famous name" golf course architect it will increase the marketability of the course because of the unique experience that a particular architect has demonstrated on other courses he has designed. Avid golfers seek opportunities for experiencing a number of championship facilities, thus encouraging them to return year-after year especially if there is a variety of golf in the area. This has also resulted in word of mouth advertising upon their return home. Maui has marketed its golf on a national (U.S.) basis under the heading "Maui Golf Coast". The Mauna Lani Resort has also helped identify Hawaii as a major golf-vacation destination with it's televised golf tournaments.

Future prospects for growth in demand for Hawaiian resort golf look extremely bright for the following reasons: i) Continued maturation of the Hawaii destination resort industry; ii) Favorable demographic trends of golf in the United States (primary source of the Hawaiian visitor market).

While golf course play at selected resorts shown in *Exhibit IV-10* shows a [illegible]ing of play with resources, it does not take into accou[illegible] that, with the exception of Kaanapali, the resort developments shown have reached less than 50% of their ultimate size in terms of total units.

Further, Wailea and Kaanapali benefit from the availability of neighboring courses such as Makena and Kapalua, respectively, where development of visitor accommodations (hotels and condos) is, at a very early stage, comprising only 20 to 30% of ultimate development. It should be noted that all of the resort facilities shown in *Exhibit IV-10* are planning additional golf courses.

EXHIBIT IV-10

RESORT AND NUMBER OF GOLF COURSES	ACTUAL ROUNDS FY 1989	DESIRED MAXIMUM ROUNDS[34]	TWO TIERED PRICING [35]	ROUNDS RESERVED FOR HOTELS[36]	%ROUNDS FROM RESORT COMPLEXES	COMMENTS
Kaanapali 2 Courses	107,000	108,000	No	No	60%	Additional course is under consideration for North Beach Expansion
Wailea 2 Courses	105,000	110,000	$105/$60	90	70%	Additional course is under construction
Mauna Lani 1 Course	44,000	44,000	$130/$60	No	66%	Additional course is under construction
Waikoloa 2 Courses	10,000	50,000	90/45	No	75%	4 additional courses are planned

SOURCE: John Zapotocky, Consultant

As the population ages, people have a much higher propensity to golf. This is due to a number of factors including: the search for less demanding forms of exercise; the ability to set aside large blocks of time for recreation; and, increased disposable income.

Maintaining the quality of resort play has been stressed time and again by resort management and development executives. Review of desirable annual levels of play and desirable daily levels of play indicate a wide discrepancy between a desirable annual level of play versus the theoretical annual level of play at the stated desired daily level. The reason for this situation is that demand for resort golf

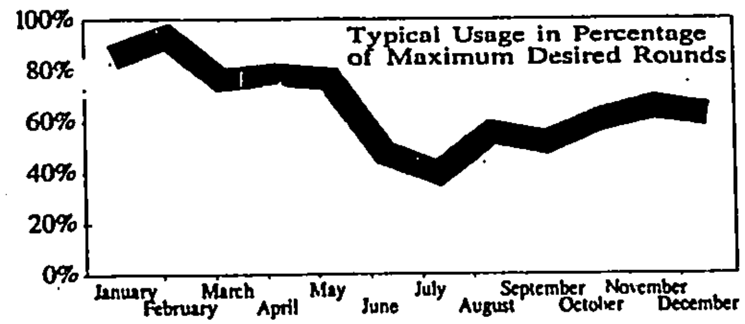
34 - Desired Maximum Rounds refers to rounds which the operator feels are achievable under current conditions due to seasonality of play. Theoretical maximum capacity is approximately 70,000 rounds per course

35 - Two tiered Pricing refers to a policy of pricing which discriminates in favor of complex (resort) guests. Resorts have priority reservations policies which give priority to hotels in making reservations for golf play. Operators have seasonal pricing policies. Rates shown are for high season. Kaanapali has not offered low season rates since 1987.

36 - Wailea and Princeville have guaranteed availability for hotel guests. Kaanapali provides no guarantee but gives reservation priority. Mauna Lani owns both resort and hotel. In 1989, Shinwa (Wailea Resort Owner) acquired the Stouffer Wailea Beach Hotel.

is seasonal in nature (See *Exhibit IV-11*). In fact, it is not unusual at Hawaiian resort developments for January through March to account for in excess of 35% of total annual rounds played. Note: The percentage of rounds played during the high season understates the demand during that time due to the fact that many requests for starting times go unsatisfied during that period. This seasonality has been recognized by resort managers for many years. The competition for high season starting times at many resorts has led to the allocation of these starting times. Many courses have supplemented existing priority of reservation schedules with high and low season rates as well as pricing policies designed to give favorable treatment to guests of the complex. As the marketing strategies have become more sophisticated for the high season times, low season times have been getting extra attention, benefitting local players with lower rates and an increased availability of starting times. Resort managers have become increasingly aware of the large number of starting times which go unused during the low season and have been attempting to attract both tourist and local play to tap this unused resource.

Exhibit IV-11
Typical Utilization of Mature Hawaiian Resort Golf Facilities



Source & Graphics: John Zapotocky

c) Number of Rounds Available Per Golf Course

Golf course capacity itself is the product of a number of physical and aesthetic considerations. Resort courses in Hawaii have in general limited play to a maximum of between 175 and 215 rounds per day. At this level of play, golfers can enjoy the game at a leisurely pace with only a minimum of waiting and with minimum interaction with others playing on the course. Assuming an average of 200 rounds per day and 365 playing days per year, the capacity of resort courses should be at 73,000 rounds annually. Experience has shown that demand for golf from resort guests is strongest during the winter months. (*Exhibit IV-11*) It should be noted that available starting times decline during the winter months due to shorter days and the increased likelihood of rain-outs. In addition, demand for golf is also skewed in favor of morning times. Therefore, resort courses are generally operated below capacity during the majority of the year. A yearly average of 50,000 rounds to 70,000 rounds per year is considered achievable and desirable by resort golf operators.

B. Supply and Demand of Golf Courses in West Hawaii

The Island of Hawaii is twice the size of all the other Hawaiian Islands combined, therefore it is inappropriate to examine the entire island as a single market. It is more logical to analyze the West Hawaii market area (North and South Kohala and North and South Kona) as a separate entity, as driving distances actually indicate separate markets. Presently the West Hawaii area contains approximately 33% (Exhibit IV-12) of the county's residential population and 83% (Exhibit IV-13) of its visitor units. These percentages are expected to increase to 43% and 96% respectively by the year 2010. The following analysis uses golf rounds played at West Hawaii's golf courses in 1988 to estimate the demand for golf between 1989 and 2010. The year 1988 was selected as a base year because it represented a relatively stable time for West Hawaii golf. In 1989, the demand for golf was destabalized by the first full year of operations of the Hyatt Regency Waikoloa. In 1990, the supply of golf was destabalized by the opening of Waikoloa's Kings Course.

1. Golf Survey

A 1988 survey of West Hawaii golf courses indicated approximately 290,000 rounds played with residents accounting for 30% of the play while visitor play accounted for the remaining 70%. A review of *Exhibit IV-14* shows that visitor play predominates on courses within Resort nodes while the local play predominates at the Waikoloa Village course.

Exhibit IV-12
Manini'owali Market Assessment
Comparison of 1970, 1980 & 1990 – Population for the County of Hawaii

Tract Number	Location	Population Count 1970	Population Count 1980	Population Count 1990	Increase in Population 1970–1980	Increase in Population 1970–1990	Increase in Population 1980–1990	Percentage Over the Last Per Year 10 Years	Percentage Over the Last Per Year 20 Years
201	South Hilo	5,503	5,261	5,102	(242)	(401)	(159)	-3.02%	-7.29%
202	South Hilo	2,059	1,748	1,871	(311)	(188)	123	7.04%	-9.13%
		7,562	7,009	6,973	(553)	(589)	(36)	-0.51%	-7.79%
203	Hilo (South)	3,435	4,292	3,723	857	288	(569)	-13.26%	8.38%
204	Hilo (South)	3,531	4,003	3,612	472	81	(391)	-9.77%	2.29%
205	Hilo (South)	4,604	5,672	5,576	1,068	972	(96)	-1.69%	21.11%
206	Hilo (South)	2,989	3,702	3,902	713	913	200	5.40%	30.55%
207	Hilo (South)	5,231	7,690	9,092	2,459	3,861	1,402	18.23%	73.81%
208	Hilo (South)	4,865	7,017	8,143	2,152	3,278	1,126	16.05%	67.38%
209	Hilo (South)	1,615	2,868	3,618	1,253	2,003	750	26.15%	124.02%
		26,270	35,244	37,666	8,974	11,396	2,422	6.87%	43.38%
210	Puna	3,802	7,055	14,079	3,253	10,277	7,024	99.56%	270.31%
211	Puna	1,352	4,696	6,702	3,344	5,350	2,006	42.72%	395.71%
		5,154	11,751	20,781	6,597	15,627	9,030	76.84%	303.20%
212	Ka'u	3,398	3,699	4,438	301	1,040	739	19.98%	30.61%
213	South Kona	1,563	3,560	4,998	1,997	3,435	1,438	40.39%	219.77%
214	South Kona	2,441	2,354	2,660	(87)	219	306	13.00%	8.97%
		4,004	5,914	7,658	1,910	3,654	1,744	29.49%	91.26%
215	North Kona	2,589	7,610	12,623	5,021	10,034	5,013	65.87%	387.56%
216	North Kona	2,243	6,138	9,661	3,895	7,418	3,523	57.40%	330.72%
		4,832	13,748	22,284	8,916	17,452	8,536	62.09%	361.18%
217	South Kohala	2,310	4,607	9,140	2,297	6,830	4,533	98.39%	295.67%
218	North Kohala	3,326	3,249	4,291	(77)	965	1,042	32.07%	29.01%
219	Hamakua	2,829	3,287	3,681	458	852	394	11.99%	30.12%
220	Hamakua	1,819	1,841	1,864	22	45	23	1.25%	2.47%
		4,648	5,128	5,545	480	897	417	8.13%	19.30%
221	North Hilo	1,881	1,679	1,541	(202)	(340)	(138)	-8.22%	-18.08%
	TOTALS	63,385	92,028	120,317	28,643	56,932	28,289	30.74%	89.82%

Source: 1970, 1980, 1990 Census Data

Exhibit IV-13
Manini'owali Market Assessment
Analysis of the Units Available in the County of Hawaii

	Hilo Honokaa	Naalehu Kau	Volcano	Kona	Waimea Kawaihae Kohala	Total Units
B & B	5	2	28	10	10	55
Condo	196	28		1,535	256	2,015
Condo/Hotel	100				12	112
Hotel	1,027	13	38	2,543	3,019	6,670
Other	83		9	8		100
Totals	1,411	43	75	4,096	3,297	8,952
Percentage	15.76%	0.48%	0.84%	45.76%	36.83%	100.00%

Amount on the Kona Coast: 83%

Exhibit IV-14

Manini'owali Market Assessment

Survey of Number of Rounds per Golf Course 1988

	Course Name	Location	Type of Course	Number of Holes	Yearly Rounds Per Site	Avgerage Rounds Per Week	Local Rounds %	Local Rounds Yearly	Tourist Rounds %	Tourist Rounds Yearly
1	Waikoloa Village	So Kohala-Waikola	Resort	18	48,000	923	60.0%	28,800	40.0%	19,200
2	Wail-. - Beach Resort	So Kohala-Waikola	Semi-Private	18	52,000	1,000	25.0%	13,000	75.0%	39,000
3	Waikoloa Kings Resort (1)	So Kohala-Waikola	Semi-Private							
4	Mauna Lani-Francis I'i Brown	South Kohala	Resort	18	44,000	846	5.0%	2,200	95.0%	41,800
5	Mauna Kea	Ouli-Lalamilo	Resort	18	54,000	1,038	10.0%	5,400	90.0%	48,600
6	Kona Country Club Ocean &	Kona-Keauhou	Resort	27	93,400	1,796	40.0%	37,360	60.0%	56,040
	OVERALL TOTAL			99	291,400	5,604		86,760		204,640
	OVERALL AVERAGE			5.5	52,982	1,019	32.8%	17,352	77.2%	40,928

(1) The Waikola Kings Course opened in April of 1990, therefore no information is currently available.

2. Estimate of Number of Rounds Played per Visitor and per Resident

The estimates indicated that in 1988 there were 2.23 rounds played by the average resident while the average visitor played 22.60 rounds. (see *Exhibit IV-15*) Note: The average rounds figure is based on average daily visitor population and not actual visitors.

Exhibit IV-15
West Hawaii Golf Courses:
Visitor / Resident Rounds
1988

Population Group	Total Population Kona Coast Region	Total # of Rounds	Rounds Per Groups
Residents	38,990	86,760	2.23
Visitors	9,055	204,640	22.60
Total	48,045	291,400	

3. Estimate of Golf Course Demand thru Year 2010

The consultant has developed a demand projection thru the year 2''10 using alternate rates of growth. Resident and visitor population estimates developed by the State of Hawaii, Department of Business and Economic Development in the *Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)* dated November 1988 serve as the base assumptions for these projections. The increased populations were multiplied by the number of golf rounds for each category to come up with a projected increase in demand for golf as shown in *Exhibit IV-16*. The increased population was then divided by the average number of rounds played on West Hawaii courses in 1988 to determine future demand. The projections show an anticipated need for an additional 14 courses by the year 2010 assuming no growth in the popularity of golf. If the popularity of golf increases at the rate of 2% annually, there will be a demand for an additional 25 courses (see *Exhibit IV-17*). Assuming a 5% increase there will be a need for 50 new golf courses (see *Exhibit IV-18*). Note these projections are in addition to the existing courses.

Although this later projection may seem high, if the Kona Coast achieves the status of a golf destination area similar to other U.S. golf destinations the demand could be greater. Thus a comparison with areas such as Murtle Beach, South Carolina; Pinehurst, North Carolina; Hilton Head Island, South Carolina; Palm Beach, Florida or the Monterey Peninsula in California is appropriate. For example at Hilton Head Island there is a room count of approximately 9,200 with 324 holes of golf for 18, 18-hole golf courses or a ratio of one golf course for every 511 visitor units. West Hawaii could need 76 18-hole golf courses using the West Hawaii Regional Plan's maximum buildout scenario to provide this ratio. Using the more conservative 2005 planning scenario, 49 courses would be required to service only the resort demand in West Hawaii.

Assuming that the County and State planning officials would like to maintain the Kona Coast's current level of availability, the projected demand would be as follows.

Based on information provided in the West Hawaii Regional Plan, Existing and Proposed Hotel and Resort Residential Units Maximum Buildout Scenario there is a potential for a total of 39,053 resort units to be developed. According to the plan 7,429 visitor units existed in 1988 supported by 5.5 18-hole golf courses, therefore a ratio of 1 course is for every 1,368 resort units can be derived. It then stands to reason that if all other factors remained constant, West Hawaii would need 28 more 18-hole golf courses to fulfill the demand projected in the Plan.

4. Existing Shortfall of Golf Courses on the Kona Coast

A number of factors argue strongly that there is an existing shortfall of golf facilities on the island of Hawaii including the following: 1) Existing golf courses operating at maximum capacity; 2) Escalating golf fees; 3) Projected increase in retirement population; and 4) The flurry of activity among

Exhibit IV-16

Manini'owali Market Assessment

County of Hawaii Golf courses Estimated Demand from 1990 thru 2010

Assuming an Annual Growth Factor of 0%

	Estimated Population			Estimated Visitor Count			Total Estimated Demand for Rounds							
Year	Hawaii Resident	% living in Kona	Kona Resident	Hawaii Visitor	% of lodging in Kona	Visitor	Avg Rnd	Resident	Avg Rnd	Visitor	Total Estimated Rounds	Estimated Increase In Rounds	Growth Need (3)	Cummulative Demand
	(1)	(2)		(1)	(2)									
1988	117,440	33.20%	38,990	10,910	83.00%	9,055								
1989	121,020	33.87%	40,989	11,155	83.00%	9,259	2.23	91,209	22.60	209,235	300,445			
1990	124,600	34.54%	43,037	11,400	89.40%	10,192	2.23	95,765	22.60	230,319	326,084	25,639	0.48	0.48
1991	128,180	35.21%	45,132	12,700	89.96%	11,425	2.23	100,427	22.60	258,191	358,618	32,534	0.61	1.10
1992	131,760	35.88%	47,275	14,000	90.52%	12,673	2.23	105,197	22.60	286,392	391,588	32,970	0.62	1.72
1993	135,340	36.55%	49,467	15,300	91.08%	13,935	2.23	110,073	22.60	314,921	424,994	33,406	0.63	2.35
1994	138,920	37.22%	51,706	16,600	91.64%	15,212	2.23	115,055	22.60	343,780	458,835	33,842	0.64	2.99
1995	142,500	37.89%	53,993	17,900	92.20%	16,504	2.23	120,145	22.60	372,968	493,113	34,277	0.65	3.64
1996	146,080	38.56%	56,328	19,260	92.76%	17,866	2.23	125,341	22.60	403,743	529,084	35,971	0.68	4.32
1997	149,660	39.23%	58,712	20,620	93.32%	19,243	2.23	130,644	22.60	434,862	565,506	36,422	0.69	5.00
1998	153,240	39.90%	61,143	21,980	93.88%	20,635	2.23	136,054	22.60	466,325	602,378	36,873	0.70	5.70
1999	156,820	40.57%	63,622	23,340	94.44%	22,042	2.23	141,570	22.60	498,132	639,702	37,324	0.70	6.40
2000	160,400	39.90%	64,000	24,700	95.00%	23,465	2.23	142,411	22.60	530,284	672,694	32,992	0.62	7.03
2001	164,480	40.26%	66,220	26,280	95.15%	25,005	2.23	147,351	22.60	565,095	712,446	39,752	0.75	7.78
2002	168,560	40.62%	68,469	27,860	95.30%	26,551	2.23	152,356	22.60	600,014	752,371	39,924	0.75	8.53
2003	172,640	40.98%	70,748	29,440	95.45%	28,100	2.23	157,427	22.60	635,040	792,467	40,097	0.76	9.29
2004	176,720	41.34%	73,056	31,020	95.60%	29,655	2.23	162,563	22.60	670,174	832,737	40,269	0.76	10.05
2005	180,800	41.70%	75,394	32,600	95.75%	31,214	2.23	167,764	22.60	705,414	873,178	40,442	0.76	10.81
2006	185,860	42.06%	78,173	34,000	95.90%	32,606	2.23	173,948	22.60	736,860	910,809	37,630	0.71	11.52
2007	190,920	42.42%	80,988	35,400	96.05%	34,002	2.23	180,214	22.60	768,402	948,615	37,806	0.71	12.23
2008	195,980	42.78%	83,840	36,800	96.20%	35,402	2.23	186,560	22.60	800,038	986,598	37,982	0.72	12.95
2009	201,040	43.14%	86,729	38,200	96.35%	36,806	2.23	192,987	22.60	831,769	1,024,756	38,158	0.72	13.67
2010	206,100	43.50%	89,654	39,600	96.50%	38,214	2.23	199,495	22.60	863,595	1,063,090	38,334	0.72	14.39

(1) Source: Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)
(2) Source: County of Hawaii - Summary of Projections by Judicial District.
(3) Assumes the average daily rounds as shown in Exhibit IV-14

Exhibit IV-17

Manini'owali Market Assessment

County of Hawaii Golf courses Estimated Demand from 1990 thru 2010
Assuming an Annual Growth Factor of 2%

Year	Estimated Population: Hawaii Resident (1)	% living in Kona (2)	Kona Resident	Estimated Visitor Count: Hawaii Visitor (1)	% of lodging in Kona (2)	Visitor	Total Estimated Demand for Rounds: Avg Rnd 2.00%	Resident	Avg Rnd 2.00%	Visitor	Total Estimated Rounds	Estimated Increase in Rounds	Growth Need	Cummulative Demand
1989	121,020	33.87%	40,989	11,155	83.00%	9,259	2.23	91,209	22.60	209,235	300,445			
1990	124,600	34.54%	43,037	11,400	89.40%	10,192	2.27	97 680	23.05	234,926	332,606	32,161	0.61	0.61
1991	128,180	35.21%	45,132	12,700	89.96%	11,425	2.32	104,485	23.51	268,622	373,106	40,501	0.76	1.37
1992	131,760	35.88%	47,275	14,000	90.52%	12,673	2.36	111,635	23.98	303,921	415,556	42,450	0.80	2.17
1993	135,340	36.55%	49,467	15,300	91.08%	13,935	2.41	119,146	24.46	340,881	460,027	44,471	0.84	3.01
1994	138,920	37.22%	51,706	16,600	91.64%	15,212	2.46	127,030	24.95	379,561	506,591	46,564	0.88	3.89
1995	142,500	37.89%	53,993	17,900	92.20%	16,504	2.51	135,303	25.45	420,023	555,325	48,734	0.92	4.81
1996	146,080	38.56%	56,328	19,260	92.76%	17,866	2.56	143,977	25.96	463,773	607,751	52,426	0.99	5.80
1997	149,660	39.23%	58,712	20,620	93.32%	19,243	2.61	153,070	26.48	509,510	662,580	54,829	1.03	6.84
1998	153,240	39.90%	61,143	21,980	93.88%	20,635	2.66	162,597	27.01	557,301	719,898	57,318	1.08	7.92
1999	156,820	40.57%	63,622	23,340	94.44%	22,042	2.71	172,573	27.55	607,220	779,794	59,895	1.13	9.05
2000	160,400	39.90%	64,000	24,700	95.00%	23,465	2.77	177,070	28.10	659,341	836,411	56,617	1.07	10.12
2001	164,480	40.26%	66,220	26,280	95.15%	25,005	2.82	186,876	28.66	716,678	903,554	67,143	1.27	11.38
2002	168,560	40.62%	68,469	27,860	95.30%	26,551	2.88	197,089	29.23	776,183	973,272	69,717	1.32	12.70
2003	172,640	40.98%	70,748	29,440	95.45%	28,100	2.94	207,721	29.82	837,922	1,045,644	72,372	1.37	14.07
2004	176,720	41.34%	73,056	31,020	95.60%	29,655	2.99	218,788	30.42	901,966	1,120,754	75,110	1.42	15.48
2005	180,800	41.70%	75,394	32,600	95.75%	31,214	3.05	230,305	31.02	968,382	1,198,687	77,933	1.47	16.95
2006	185,860	42.06%	78,173	34,000	95.90%	32,606	3.12	243,570	31.64	1,031,782	1,275,352	76,665	1.45	18.40
2007	190,920	42.42%	80,988	35,400	96.05%	34,002	3.18	257,389	32.28	1,097,467	1,354,856	79,504	1.50	19.90
2008	195,980	42.78%	83,840	36,800	96.20%	35,402	3.24	271,782	32.92	1,165,504	1,437,287	82,430	1.56	21.46
2009	201,040	43.14%	86,729	38,200	96.35%	36,806	3.31	286,769	33.58	1,235,965	1,522,734	85,447	1.61	23.07
2010	206,100	43.50%	89,654	39,600	96.50%	38,214	3.37	302,368	34.25	1,308,922	1,611,290	88,557	1.67	24.74

(1) Source: Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)
(2) Source: County of Hawaii - Summary of Projections by Judicial District.
(3) Assumes the average daily rounds as sh[illegible] n Exhibit IV-14

Manini'owali Market Assessment

Exhibit IV-18

Manini'owali Market Assessment

County of Hawaii Golf courses Estimated Demand from 1990 thru 2010
Assuming an Annual Growth Factor of 5%

Year	Estimated Population: Hawaii Resident (1)	% living in Kona (2)	Kona Resident	Estimated Visitor Count: Hawaii Visitor (1)	% of lodging in Kona (2)	Visitor	Total Estimated Demand for Rounds: Avg Rnd 5.00%	Resident	Avg Rnd 5.00%	Visitor	Total Estimated Rounds	Estimated Increase in Rounds	Growth Need	Cummulative Demand
1989	121,020	33.87%	40,989	11,155	83.00%	9,259	2.23	91,209	22.60	209,235	300,445			
1990	124,600	34.54%	43,037	11,400	89.40%	10,192	2.34	100,553	23.73	241,835	342,388	41,944	0.79	0.79
1991	128,180	35.21%	45,132	12,700	89.96%	11,425	2.45	110,721	24.92	284,655	395,376	52,988	1.00	1.79
1992	131,760	35.88%	47,275	14,000	90.52%	12,673	2.58	121,778	26.16	331,534	453,312	57,936	1.09	2.89
1993	135,340	36.55%	49,467	15,300	91.08%	13,935	2.70	133,794	27.47	382,789	516,583	63,271	1.19	4.08
1994	138,920	37.22%	51,706	16,600	91.64%	15,212	2.84	146,843	28.84	438,760	585,603	69,021	1.30	5.38
1995	142,500	37.89%	53,993	17,900	92.20%	16,504	2.98	161,005	30.28	499,813	660,818	75,215	1.42	6.80
1996	146,080	38.56%	56,328	19,260	92.76%	17,866	3.13	176,367	31.80	568,107	744,474	83,656	1.58	8.38
1997	149,660	39.23%	58,712	20,620	93.32%	19,243	3.29	193,021	33.39	642,489	835,509	91,035	1.72	10.10
1998	153,240	39.90%	61,143	21,980	93.88%	20,635	3.45	211,064	35.06	723,423	934,487	98,977	1.87	11.97
1999	156,820	40.57%	63,622	23,340	94.44%	22,042	3.62	230,603	36.81	811,405	1,042,008	107,521	2.03	14.00
2000	160,400	39.90%	64,000	24,700	95.[illegible]%	23,465	3.81	243,571	38.65	906,965	1,150,536	108,528	2.05	16.04
2001	164,480	40.26%	66,220	26,280	[illegible]%	25,005	4.00	264,621	40.58	1,014,830	1,279,451	128,915	2.43	18.48
2002	168,560	40.62%	68,469	27,860	95.30%	26,551	4.20	287,290	42.61	1,131,417	1,418,707	139,256	2.63	21.11
2003	172,640	40.98%	70,748	29,440	95.45%	28,100	4.41	311,694	44.74	1,257,337	1,569,031	150,324	2.84	23.94
2004	176,720	41.34%	73,056	31,020	95.60%	29,655	4.63	337,957	46.98	1,393,243	1,731,200	162,169	3.06	27.00
2005	180,800	41.70%	75,394	32,600	95.75%	31,214	4.86	366,209	49.33	1,539,830	1,906,039	174,839	3.30	30.30
2006	185,860	42.06%	78,173	34,000	95.90%	32,606	5.10	398,693	51.80	1,688,897	2,087,591	181,552	3.43	33.73
2007	190,920	42.42%	80,988	35,400	96.05%	34,002	5.36	433,705	54.39	1,849,250	2,282,956	195,365	3.69	37.42
2008	195,980	42.78%	83,840	36,800	96.20%	35,402	5.62	471,427	57.11	2,021,656	2,493,083	210,127	3.97	41.38
2009	201,040	43.14%	86,729	38,200	96.35%	36,806	5.90	512,052	59.96	2,206,931	2,718,983	225,900	4.26	45.65
2010	206,100	43.50%	89,654	39,600	96.50%	38,214	6.20	555,786	62.96	2,405,944	2,961,730	242,747	4.58	50.23

(1) Source: Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)
(2) Source: County of Hawaii - Summary of Projections by Judicial District.
(3) Assumes the average daily rounds as shown in Exhibit IV-14

Exhibit IV-17

Manini'owali Market Assessment

County of Hawaii Golf courses Estimated Demand from 1990 thru 2010
Assuming an Annual Growth Factor of 2%

Year	Estimated Population: Hawaii Resident (1)	% living in Kona (2)	Kona Resident	Estimated Visitor Count: Hawaii Visitor (1)	% of lodging in Kona (2)	Visitor	Total Estimated Demand for Rounds: Avg Rnd 2.00%	Resident	Avg Rnd 2.00%	Visitor	Total Estimated Rounds	Estimated Increase In Rounds	Growth Need	Commulative Demand
1989	121,020	33.87%	40,989	11,155	83.00%	9,259	2.23	91,209	22.60	209,235	300,445			
1990	124,600	34.54%	43,027	11,400	89.40%	10,192	2.27	97,680	23.05	234,926	332,606	32,161	0.61	0.61
1991	128,180	35.21%	45,132	12,700	89.96%	11,425	2.32	104,485	23.51	268,622	373,106	40,501	0.76	1.37
1992	131,760	35.88%	47,275	14,000	90.52%	12,673	2.36	111,635	23.98	303,921	415,556	42,450	0.80	2.17
1993	135,340	36.55%	49,467	15,300	91.08%	13,935	2.41	119,146	24.46	340,881	460,027	44,471	0.84	3.01
1994	138,920	37.22%	51,706	16,600	91.64%	15,212	2.46	127,030	24.95	379,561	506,591	46,564	0.88	3.89
1995	142,500	37.89%	53,993	17,900	92.20%	16,504	2.51	135,303	25.45	420,023	555,325	48,734	0.92	4.81
1996	146,080	38.56%	56,328	19,260	92.76%	17,866	2.56	143,977	25.96	463,773	607,751	52,426	0.99	5.80
1997	149,660	39.23%	58,712	20,620	93.32%	19,243	2.61	153,070	26.48	509,510	662,580	54,829	1.03	6.84
1998	153,240	39.90%	61,143	21,980	93.88%	20,635	2.66	162,597	27.01	557,301	719,898	57,318	1.08	7.92
1999	156,820	40.57%	63,622	23,340	94.44%	22,042	2.71	172,573	27.55	607,220	779,794	59,895	1.13	9.05
2000	160,400	39.90%	64,000	24,700	95.00%	23,465	2.77	177,070	28.10	659,341	836,411	56,617	1.07	10.12
2001	164,480	40.26%	66,220	26,280	95.15%	25,005	2.82	186,876	28.66	716,678	903,554	67,143	1.27	11.38
2002	168,560	40.62%	68,469	27,860	95.30%	26,551	2.88	197,089	29.23	776,183	973,272	69,717	1.32	12.70
2003	172,640	40.98%	70,748	29,440	95.45%	28,100	2.94	207,721	29.82	837,922	1,045,644	72,372	1.37	14.07
2004	176,720	41.34%	73,056	31,020	95.60%	29,655	2.99	218,788	30.42	901,966	1,120,754	75,110	1.42	15.48
2005	180,800	41.70%	75,394	32,600	95.75%	31,214	3.05	230,305	31.02	968,382	1,198,687	77,933	1.47	16.95
2006	185,860	42.06%	78,173	34,000	95.90%	32,606	3.12	243,570	31.64	1,031,782	1,275,352	76,665	1.45	18.40
2007	190,920	42.42%	80,988	35,400	96.05%	34,002	3.18	257,389	32.28	1,097,467	1,354,856	79,504	1.50	19.90
2008	195,980	42.78%	83,840	36,800	96.20%	35,402	3.24	271,782	32.92	1,165,504	1,437,287	82,430	1.56	21.46
2009	201,040	43.14%	86,729	38,200	96.35%	36,806	3.31	286,769	33.58	1,235,965	1,522,734	85,447	1.61	23.07
2010	206,100	43.50%	89,654	39,600	96.50%	38,214	3.37	302,368	34.25	1,308,922	1,611,290	88,557	1.67	24.74

(1) Source: Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)
(2) Source: County of Hawaii - Summary of Projections by Judicial District.
(3) Assumes the average daily rounds as sh[illegible] n Exhibit IV-14

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Exhibit IV-18

Manini'owali Market Assessment

County of Hawaii Golf courses Estimated Demand from 1990 thru 2010
Assuming an Annual Growth Factor of 5%

Year	Estimated Population: Hawaii Resident (1)	% living in Kona (2)	Kona Resident	Estimated Visitor Count: Hawaii Visitor (1)	% of lodging in Kona (2)	Visitor	Total Estimated Demand for Rounds: Avg Rnd 5.00%	Resident	Avg Rnd 5.00%	Visitor	Total Estimated Rounds	Estimated Increase In Rounds	Growth Need	Commulative Demand
1989	121,020	33.87%	40,989	11,155	83.00%	9,259	2.23	91,209	22.60	209,235	300,445			
1990	124,600	34.54%	43,037	11,400	89.40%	10,192	2.34	100,553	23.73	241,835	342,388	41,944	0.79	0.79
1991	128,180	35.21%	45,132	12,700	89.96%	11,425	2.45	110,721	24.92	284,655	395,376	52,988	1.00	1.79
1992	131,760	35.88%	47,275	14,000	90.52%	12,673	2.58	121,778	26.16	331,534	453,312	57,936	1.09	2.89
1993	135,340	36.55%	49,467	15,300	91.08%	13,935	2.70	133,794	27.47	382,789	516,583	63,271	1.19	4.08
1994	138,920	37.22%	51,706	16,600	91.64%	15,212	2.84	146,843	28.84	438,760	585,603	69,021	1.30	5.38
1995	142,500	37.89%	53,993	17,900	92.20%	16,504	2.98	161,005	30.28	499,813	660,818	75,215	1.42	6.80
1996	146,080	38.56%	56,328	19,260	92.76%	17,866	3.13	176,367	31.80	568,107	744,474	83,656	1.58	8.38
1997	149,660	39.23%	58,712	20,620	93.32%	19,243	3.29	193,021	33.39	642,489	835,509	91,035	1.72	10.10
1998	153,240	39.90%	61,143	21,980	93.88%	20,635	3.45	211,064	35.06	723,423	934,487	98,977	1.87	11.97
1999	156,820	40.57%	63,622	23,340	94.44%	22,042	3.62	230,603	36.81	811,405	1,042,008	107,521	2.03	14.00
2000	160,400	39.90%	64,000	24,700	95.00%	23,465	3.81	243,571	38.65	906,965	1,150,536	108,528	2.05	16.04
2001	164,480	40.26%	66,220	26,280	95.15%	25,005	4.00	264,621	40.58	1,014,830	1,279,451	128,915	2.43	18.48
2002	168,560	40.62%	68,469	27,860	95.30%	26,551	4.20	287,290	42.61	1,131,417	1,418,707	139,256	2.63	21.11
2003	172,640	40.98%	70,748	29,440	95.45%	28,100	4.41	311,694	44.74	1,257,337	1,569,031	150,324	2.84	23.94
2004	176,720	41.34%	73,056	31,020	95.60%	29,655	4.63	337,957	46.98	1,393,243	1,731,200	162,169	3.06	27.00
2005	180,800	41.70%	75,394	32,600	95.75%	31,214	4.86	366,209	49.33	1,539,830	1,906,039	174,839	3.30	30.30
2006	185,860	42.06%	78,173	34,000	95.90%	32,606	5.10	398,693	51.80	1,688,897	2,087,591	181,552	3.43	33.73
2007	190,920	42.42%	80,988	35,400	96.05%	34,002	5.36	433,705	54.39	1,849,250	2,282,956	195,365	3.69	37.42
2008	195,980	42.78%	83,840	36,800	96.20%	35,402	5.62	471,427	57.11	2,021,656	2,493,083	210,127	3.97	41.38
2009	201,040	43.14%	86,729	38,200	96.35%	36,806	5.90	512,052	59.96	2,206,931	2,718,983	225,900	4.26	45.65
2010	206,100	43.50%	89,654	39,600	96.50%	38,214	6.20	555,786	62.96	2,405,944	2,961,730	242,747	4.58	50.23

(1) Source: Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)
(2) Source: County of Hawaii - Summary of Projections by Judicial District.
(3) Assumes the average daily rounds as shown in Exhibit IV-14

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Manini'owali Market Assessment

land owners and developers to develop new golf course properties.

a) Courses Operating Levels

Presently Mauna Kea, Kona Country Club and Mauna Lani Courses are operating at or near capacity. In fact, the Mauna Lani Course is having to accommodate additional golfers due to the completion of the Ritz Carlton hotel, while the second Mauna Lani Course is not yet ready for play.

The three Waikoloa Courses are operated below capacity primarily due to the opening of the King Course in April of 1990 and the impact of the Persian Gulf War on tourism during the first half of 1991. The golf play at Waikoloa is expected to reach capacity as tourism recovers, condominiums under construction are completed and occupied and a new emphasis is placed on golf by the Hyatt Waikoloa's marketing staff. The new King Course designed by Weiskoff & Moorish has quickly gained an exceptional reputation and should become a major Waikola amenity.

b) Escalating Green Fees

A survey comparing the cost per round of golf in 1986 and the cost per round in 1991 established that the average cost per round increased from $27 to a cost of $71, see Exhibit IV-19. One of the factors contributing to this increase in cost is the fact that Hawaii golf courses have generally experienced a tremendous demand for starting times. According to the National Golf Foundation the average US golf course did 49,000 rounds annually in 1988 compared to the average Kona Course which supported an average demand for 53,000 rounds during the same year.

Exhibit IV-19
Mànini'owali Market Assessment
Comparison of the 1986 and 1991
Golf Fees

	1986	1991	Percentage Increase
Mauna Kea			
Resort Guest	27	57	211%
Non-Guest	32	107	334%
Mauna Lani			
Resort Guest	24	50	208%
Non-Guest	34	130	382%
Waikoloa Beach Course			
Resort Guest	28	60	214%
Non-Guest	31	95	306%
Waikoloa Village			
Resort Guest	20	28	140%
Non-Guest	29	52	179%
Kona County Club			
Resort Guest	21	60	286%
Non-Guest	27	70	259%
Average	27.3	70.9	260%

c) Comparison with Maui and Oahu Play

The following table shows the results of surveys under taken by the consultant:

Rounds Per Resident

Oahu	1.81
Maui	2.79
Hawaii	2.23

Rounds Per Visitor Year

Oahu	3.58
Maui	12.06
Hawaii	22.60

Relatively clear evidence that availability (supply) has a major impact on demand.

d) Activity Among Developers

Appendix I lists sites where golf courses are currently proposed or mentioned as possible sites for golf facilities. The fact that so much interest exists is testimony to the existing shortfall of these types of facilities.

e) Projected increase in the retirement population.

The Department of Business, Economic Development and Tourism projects that the percentage of the population who is age 65 and older is expected to increase from an estimate of 11.02% in 1990 to 16.53 by the year 2010. This ageing of the population should increase the demand for golf since retired individuals tend to have more time available for recreation. Further golf is a less strenuous form of exercise.

5. Future Supply of Golf Courses in West Hawaii

While the potential supply of 35.5 new courses (26 in West Hawaii (Appendix II) may look overwhelming in light of the number of existing courses it must be viewed in terms of the likelihood of development and the future long term demand for golf along the Kona Coast.

A number of factors suggests that not all golf courses proposed will be built including the following:

a) Approval Requirements

Since the golf courses must be approved through the county and state's planning process, it is realistic to assume that some of the courses originally proposed will not be approved.

This has been particularly true on other islands. Both Maui and Oahu have recently put in place moratoriums to prohibit the development of golf courses until each respective county has had a chance to create a policy governing the future development of golf courses.

b) Lifestyle Issues

The recent increase in golf course proposals, particularly in rural areas has raised the public consciousness about golf courses. Community groups have been formed to protest the development of golf courses where adverse lifestyle changes are foreseen. The conclusion is that the availability of golf rounds is one factor in estimating the demand for golf courses. If people perceive that they will have difficulties in booking starting times they are less likely to try and even less likely to vacation in that specific area.

c) Environmental Concerns

Increased public concerns relating to the fragility of the environment and recent publicity relating to concerns over Hawaii's aquifers have led to concerns about land uses which might potentially impact the island's aquifers in terms of usage and/or pollution. In addition, recent publicity relating to endangered species and pollution from runoff has led the public and government agencies to express concern for land uses such as golf courses which utilize fertilizers, herbicides and pesticides which might have far ranging impacts.

d) Infrastructure Requirements

While golf courses are a relatively low intensity land use, they do require a minimum amount of infrastructure development. Particularly in rural areas, even the low intensity use may create traffic problems or negatively impact sewer and potable water systems already at capacity.

e) Resource Allocation

While the area of land use was addressed earlier, the question of water usage and how it impacts other development is an issue relating to golf course development. State and County water allocation authorities already prohibit the use of potable water for golf course irrigation. There is however a question of allocating scarce non potable water resources for golf course usage.

f) Economic Viability

While the existing shortfall of golf courses is obvious and the economic viability of new courses reasonably assured, each new course which is developed helps to meet the existing and future demand. In addition, the increase in land values generated by demand for golf course, increased costs to mitigate pollution concerns, as well as other approval concerns tend to lower the economic viability on proposed projects.

Based on the above, the Consultant believe that only half of the courses currently proposed or under consideration as golf course sites will actually be developed prior to 2010.

C. Demand and Supply of Golf at Manini'owali

Demand for golf at Manini'owali is expected to be very strong. There are three primary reasons for this conclusion. First, as indicated previously in the market assessment the Kona Coast is expected to be the beneficiary of most of the Islandwide golf demand because of the strong resort and residential population growth planned for the area. Second, the Manini'owali residential community is targeted at individuals likely to possess many of the same qualities which also identify likely golf participants, i.e., relatively more affluent, well educated, older than the general population and with more flexible schedules. Third, the Manini'owali Golf Course is adjacent to the Kaupulehu-Kukio resort development node. This development node could contain

4,958 units under a maximum buildout scenario. Although it is not forecasted that this will be a major component of the overall market demand at Manini'owali it is expected to be contributing factor.

1. Manini'owali Golf Course Residential Demand

According to *Golf Participation in the United States 1988 Edition* by the National Golf Foundation, in 1987, the United States had an estimated population of 243,934,000. Of this population a total of 21,700,000 golfers played an estimated 434,000,000 rounds of golf (approximately 1.8 rounds per resident). A study of the demographic characteristics of golfers indicates that income, age, education and occupation are strong predictors of whether a person will be a golfer or not. However, in determining whether or not an individual will be a frequent golfer (a frequent golfer plays more than 26 rounds annually, the average frequent golfer plays 65 rounds annually) the most important criteria is age.

This is not surprising given the life cycle of the typical working and personal life of a United States resident. Persons in their twenties and thirties are often preoccupied with their careers or raising a family or a combination of both. Persons forty years and older tend to have established themselves, having reached mid level or senior positions in their careers. In their personal lives, persons in their forties, tend to have children in their teens which allows them more independence. Both the career and personal lives of persons forty years and older tend to allow them more freedom to engage in activities which require greater commitments of time, i.e., travel, golf, club activities, volunteer work and hobbies. This age differentiation is important because frequent golfers who make up approximately 22% of all golfers play 73% of the golf rounds. Statistics demonstrate that persons over 40 years of age are 1.75 times more likely to be frequent golfers than the average golfer.

a) Demand Attributable to Manini'owali Residential Community

In the case of the Manini'owali Residential Community, the target market for the residential product is the upper income, highly educated, management or professional household. Primary emphasis will also on the buyer who is trading up. Thus, by definition, the target market is an older market. In the consultant's opinion, the target market for the residential product at Manini'owali will be almost exclusively in the forty and older head of household age category.

Approximately 36% of the Hawaii population in 1990 was 40 years or older. If one assumes a household size at Manini'owali of 2.23 and the buyer and spouse are 40 years or older, then 89.6% of the persons in Manini'owali will be 40 years or older. This translates into a Manini'owali population with 1.9 times more forty or older persons than are in the general population.

It is further assumed that the availability of a golf facility within the Manini'owali planned community will attract twice as many frequent golfers as would normally be found. Further if it is assumed that the ratio of medium and low frequency play will be equal to the ratio found in the general population, then the total number of rounds demanded by Manini'owali residents can be estimated as shown on *Exhibit IV-20*.

b) Other Residential Demand

Although most of the play is projected to be generated from within the development approximately 13% will come from West Hawaii residents who enjoy experiencing the different courses located within a reasonable driving distance. Residences of the Kona Coast play currently 86,760 rounds annually. This would mean that to meet the projections listed the Manini'owali Golf Course would have to capture only 4% of the current resident play.

Exhibit IV-20
Manini'owali Market Assessment
Projected Demand for Golf
of Residents

	Averages	
	Permanent Resident	Second Home Resident
Planned number of units	750	250
Estimated Household Size	2.23	2.23
Estimated Population	1,673	558
Projected number of Rounds per resident		
Estimated Frequent Golfers	2.23	22.60
Adjustment for age group	189.70%	189.70%
Adjustment of the attractiveness a golf communit[illegible] a golfer	150%	150%
Adjustment for oc[illegible]pancy	100%	40%
Adjusted Frequency of projected number of rounds per resident	9.69	39.28
Projected Number of Rounds	16,212	21,907
		38,119

2. Estimated Visitor Demand

As mentioned earlier in this report The West Hawaii Regional Plan breaks down the existing and proposed development area into what it calls "development nodes". Manini'owali will abut the southern edge or the boundaries of the KAUPULEHU-KUKIO NODE. The Plan shows that within a 10-mile radius the State Land Use Commission has approved a total of 7,429 visitor units and a total of 20,804 resort residential units. If the reader assumes an increase in the popularity of golf or in the Kona Coast's ability to attract more avid golfers, the number will be even greater. At full development the Manini'owali Residential Community Golf Course will have to attract an insignificant portion of the visitor industry golf to meet the projections outlined on exhibit 25.

3. Summary of Manini'owali Golf Course Demand

The demand for the Manini'owali Golf Course is expected to be generated from a number different components. The full-time residents are projected to demand 38% of the annual rounds or 16,212 rounds annually after full development. Part time (second home) residents are expected to generate the largest number of rounds annually which is projected to be 21,907 or 50% of the total number of rounds played. The balance is expected to be evenly distributed between the Visitor and Kamaaina populations, each is expected to generate approximately 7,000 rounds annually or 13%.

4. Absorption of Manini'owali Golf Course

The total demand described above indicates the ultimate demand for golf at the Manini'owali Golf Course. Demand for golf using the above scenario will have to take into account the projected development time table at the Manini'owali Residential Community, the Kaupulehu Resort, Kukio (Huehue Ranch) and the general growth of the Kona Coast area of Hawaii County.

Exhibit IV-21
Manini'owali Market Assessment
Absorption for Manini'owali Golf Course
1996 thru 2005

Year	Rounds	Manini'owali Permanent Residents	Manini'owali Second Home Residents	Kaamaaina	Vistor	Utilization
1996	27,812	6%	8%	43%	43%	53.36%
1997	30,624	11%	14%	38%	38%	58.76%
1998	33,436	15%	20%	33%	33%	64.15%
1999	36,248	18%	24%	29%	29%	69.55%
2000	39,060	21%	28%	26%	26%	74.94%
2001	41,871	23%	31%	23%	23%	80.34%
2002	44,683	25%	34%	20%	20%	85.73%
2003	47,495	27%	37%	18%	18%	91.13%
2004	50,307	29%	39%	16%	16%	96.52%
2005	52,119	31%	42%	13%	13%	100.00%

	Rounds	Manini'owali Permanent Residents	Manini'owali Second Home Residents	Kaamaaina	Vistor	Utilization
1996	27,812	1,621	2,191	12,000	12,000	53.36%
1997	30,624	3,242	4,381	11,500	11,500	58.76%
1998	33,436	4,864	6,572	11,000	11,000	64.15%
1999	36,248	6,485	8,763	10,500	10,500	69.55%
2000	39,060	8,106	10,954	10,000	10,000	74.94%
2001	41,871	9,727	13,144	9,500	9,500	80.34%
2002	44,683	11,348	15,335	9,000	9,000	85.73%
2003	47,495	12,970	17,526	8,500	8,500	91.13%
2004	50,307	14,591	19,716	8,000	8,000	96.52%
2005	52,119	16,212	21,907	7,000	7,000	100.00%

The Manini'owali Residential community would require approximately ten years to develop from the date of commencement. It is projected that the full time residents of Manini'owali will use approximately 31% of the courses projected 53,000 annual rounds. In addition the second home owners of the development are projected to utilize 41% of the annual rounds.

The golf course is also forecasted to attract other residents and visitors located in West Hawaii. According to projections developed by the consultant it is likely that these groups will each utilize for another 26% (13% Kamaaina & 13% Visitor).

D. Advantages of Golf Course Development at Manini'owali

The golf course proposed for development at Manini'owali has a number of advantages over other golf courses being proposed along the Kona Coast.

1. Proximity to Residential

Manini'owali Residential Community as its name implies, is focused on the residential market. Residents whether or not fronting the golf course will have golf course privileges. Resident play will have priority.

2. Proximity to the Kaupulehu-Kukio Resort Destination Node

Since golf is a sport where variety of courses can be a major factor in the enjoyment of the sport, it is important to analysis the adjoining area when looking at the need for a golf course. Manini'owali abuts the Kaupulehu-Kukio development node along it's southern border. It is also located within an easy drive to the other Kona and Kohala resorts.

3. Visibility and Access

The Manini'owali is located along the Queen Kaahumanu Highway and will therefore, be highly visible and accessible to both the resident, and visitor golfers.

4. Topography

The site is a continuous gentle slope towards the ocean. Many of the tees, greens and fairways will provide the golfers with ocean views.

5. Open Space

Land makai of the Queen Kaahumanu Highway commands premium prices. This pricing structure has traditionally encouraged high density resort oriented developments. Manini'owali will create an opportunity to preserve open spaces through incorporation of a golf course into a low to medium density residential community of less than 3 units to the acre on the entire project and less than 9 units per acre on the residential development sites. Manini'owali Resident Community presents a development concept whose time has come.

E. Conclusion

Incorporation of a golf course into the proposed Manini'owali Planned Community is justified based from a marketing standpoint.

The golf course will enhance the marketability of the community by providing additional recreational opportunities as well as enhanced aesthetics of the residential lands surrounding the golf course.

At the same time, the proposed course would enhance the recreational opportunities available to West Hawaii visitors and to the County of Hawaii's golfers.

Appendix 1
Summary of Existing Golf Courses

	Course Name	Location	Type of Course	Status	Number of Courses	Number of Holes
1	Naniloa CC (Hilo Municipal)	Hilo	Municipal	open to public	1	18
2	Volcano Country Club	Ka'u	Private	open to public	1	18
3	Sea Mountain	Punaluu	Private	open to public	1	18
4	Discovery Bay	Ka'u	Private	open to public	1	18
5	Kona Country Club Ocean	Keauhou	Resort	open to public	1	18
6	Waikoloa Beach Resort	Waikoloa/South Kohala	Resort	open to public	1.5	27
7	Waikoloa King's Course	Waikoloa/South Kohala	Resort	open to public	1	18
8	Waikoloa Village	Waikoloa/South Kohala	Resort	open to public	1	18
9	Mauna Lani - Brown	Kalahuipuaa	Resort	open to public	1	18
10	Mauna Kea	Ouli-Lalamilo	Resort	open to public	1	18
11	Honokaa Country Club	Honokaa	Private	Members Only	0.5	9
					11	

Appendix 1 (continued)
Summary of Golf Courses Under Construction

	Course Name	Location	Type of Course	Status	Number of Courses	Number of Holes	Owner
1	Kohala Ranch	Kahua-Waika	Resort	Grading	1	18	Kaloko Joint Venture
2	Mauna Lani (2nd)	Kalahuipuaa	Resort	Construction	1	18	Mauna Lani Resort
3	Waikoloa Highlands	Waikoloa Mauka	Proposed	Grading	1	18	Waikoloa Development
4	Kaupulehu Resort #1	Kaupulehu	Resort	Grading	1	18	Potomac Investment
5	Kona Country Club	Keauhou	Resort	Construction	0.5	9	Otaka, Inc.
5	Ataka Kohala Ranch	North Kohala	Private	Grading	1	18	Kohala Joint Venture
6	Huehue Ranch	North Kona	Private	Grading	1	18	Regent Beach
7	Oneloa at Pohoiki	Puna	Private	Grading Pending	2	36	A & O International
8	South Kohala Resort	South Kohala	Resort		1	18	Maunakea Properties
					9.5		

Appendix 1
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1	Nanaloa CC (Hilo Municipal)	Hilo	Municipal	open to public	1	18
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6	Waikoloa Beach Resort	Waikoloa/South Kohala	Resort	open to public	1	18
7	Waikoloa King's Course	Waikoloa/South Kohala	Resort	open to public	1	18
8	Waikoloa Village	Waikoloa/South Kohala	Resort	open to public	1	18
9	Mauna Lani - Brown	Kalahuipuaa	Resort	open to public	1	18
10	Mauna Kea	Ouli-Lalamilo	Resort	open to public	1	18
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6	Huehue Ranch	North Kona	Private	Grading	1	18	Regent Beach
7	Oneloa at Pohoiki	Puna	Private	Grading Pending	2	36	A & O International
8	South Kohala Resort	South Kohala	Resort		1	18	Maunakea Properties
					9.5		

Appendix 1 (continued)
Summary of Proposed Golf Courses

	Course Name	Location	Type of Course	Status	Number of Courses	Number of Holes	Owner
1	Manini'owali	Kukio	Private	Conceptual	1	18	North Kona Development Group
2	Ouli Signal Properties	Waikoloa, S Kohala	Private	In SLU	2	36	Nansay Hawaii, Inc.
3	Royal Vista Estates	Puuanahulu	Private	Use permit	1.5	27	Premier Resort Development/Marufuju of America
4	Kaupulehu Resort #2	Kaupulehu	Resort	SMA Approved	1	18	Potomac Investment
5	Regent Beach #1	Kukio	Resort	SMA Approved	1	18	Regent Beach & Kona Coast
6	Regent Beach #2	Kukio	Resort	SMA Approved	1	18	Regent Beach & Kona Coast
7	Kohanaiki	Kohanaiki	Resort	SMA Approved	1	18	Nansay Hawaii, Inc.
8	Hawaiian Riviera Resort	Kahuku	Resort	SLU Pending	3	54	Hawaii Ka'u Aina & Palace Development
9	Royal Vista Golf & C C	Puuanahulu	Private	Use approved	1.5	27	Marufuju of America/Premier Resort Development.
10	Kaloko	Kaloko	Private	Use approved	1	18	TSA International
11	Komohana	Hilo	Private	Use permit	1	18	KTA Consulting Group
12	Mauna Kea (2nd)	Ouli-Lalamilo	Resort		1	18	Maunakea Properties
13	Waikoloa Resort (Unnamed)	Waikoloa	Private	Conceptual	1	18	Trancontinental Development
14	Kohanaiki Resort (Kona Iki)	Kohanaiki	Private		0		
15	Kona Municipal	Kealakehe	Municipal	Conceptual	1	18	County of Hawaii
16	O'oma II	North Kona	Private	Conceptual	1	18	Unkown
17	Puako	South Kohala	Private		6	108	Nansay hawaii
18	O'oma Resort	South Kona	Private		1	18	
19	Kealakekua Bay Golf Club	South Kona	Private		1	18	Unkown
					27		

APPENDIX B

ENGINEERING REPORT

FOR

MANINI'OWALI RESIDENTIAL COMMUNITY

TAX MAP KEY: 7-2-04, portion 3

At MANINI'OWALI, NORTH KONA, HAWAII

Prepared by:
Park Engineering
Kawaiahao Plaza, Hale Mauka
567 South King Street, Suite 300
Honolulu, Hawaii 96813

October 30, 1991

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MANINI'OWALI RESIDENTIAL COMMUNITY

SECTION 1
GENERAL INFORMATION

1.1 General Description of Project: The proposed project will result in the development of approximately 388 acres for a residential/golf course development. Included is 1,000 residential housing units, an 18 hole golf course, a golf maintenance facility and clubhouse, driving range, tennis center, park and sewage treatment facility.

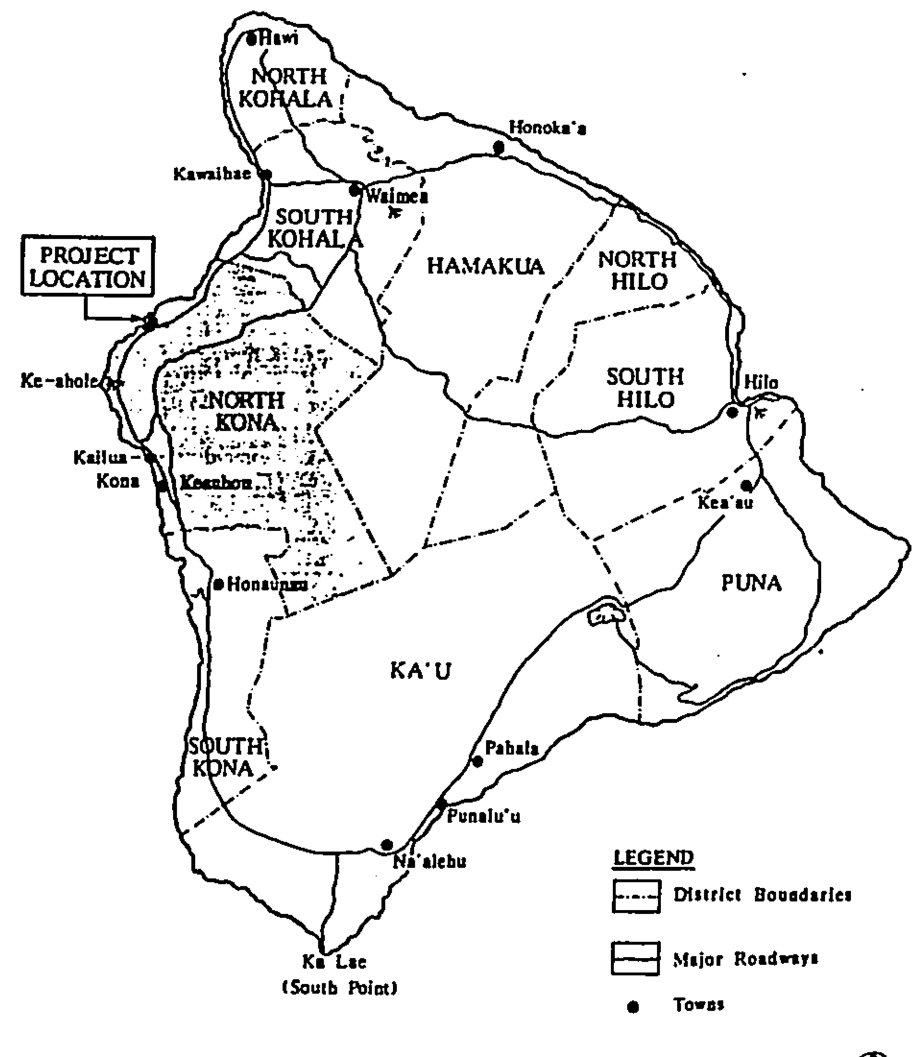
The objective of this report is to present preliminary engineering information for the proposed development. Specifically, this report will include:

1. Physical and Hydrological Characteristics of the Area
2. Water Supply
3. Wastewater
4. Stormwater Drainage
5. Roadways
6. Other Utilities
7. Grading/Clearing/Excavation/Earthwork
8. Order of Magnitude Cost

1.2 Location: The project is located in the northwestern portion of Manini'owali in the North Kona district of the island of Hawaii (Tax Map Key 7-2-04, portion 3). The Manini'owali parcel is bounded to the east by the Queen Ka'ahumanu Highway, to the south by Awake'e, and to the west by Kakapa Bay, Papiha Point and Kua Bay. A project location map is shown in Figure 1-1.

1.3 Name of Owner or Official Custodian: The project is being developed by The North Kona Development Group (NKDG). Regulation and control of the groundwater resources is under the jurisdiction of the State of Hawaii, Department of Land and Natural Resources.

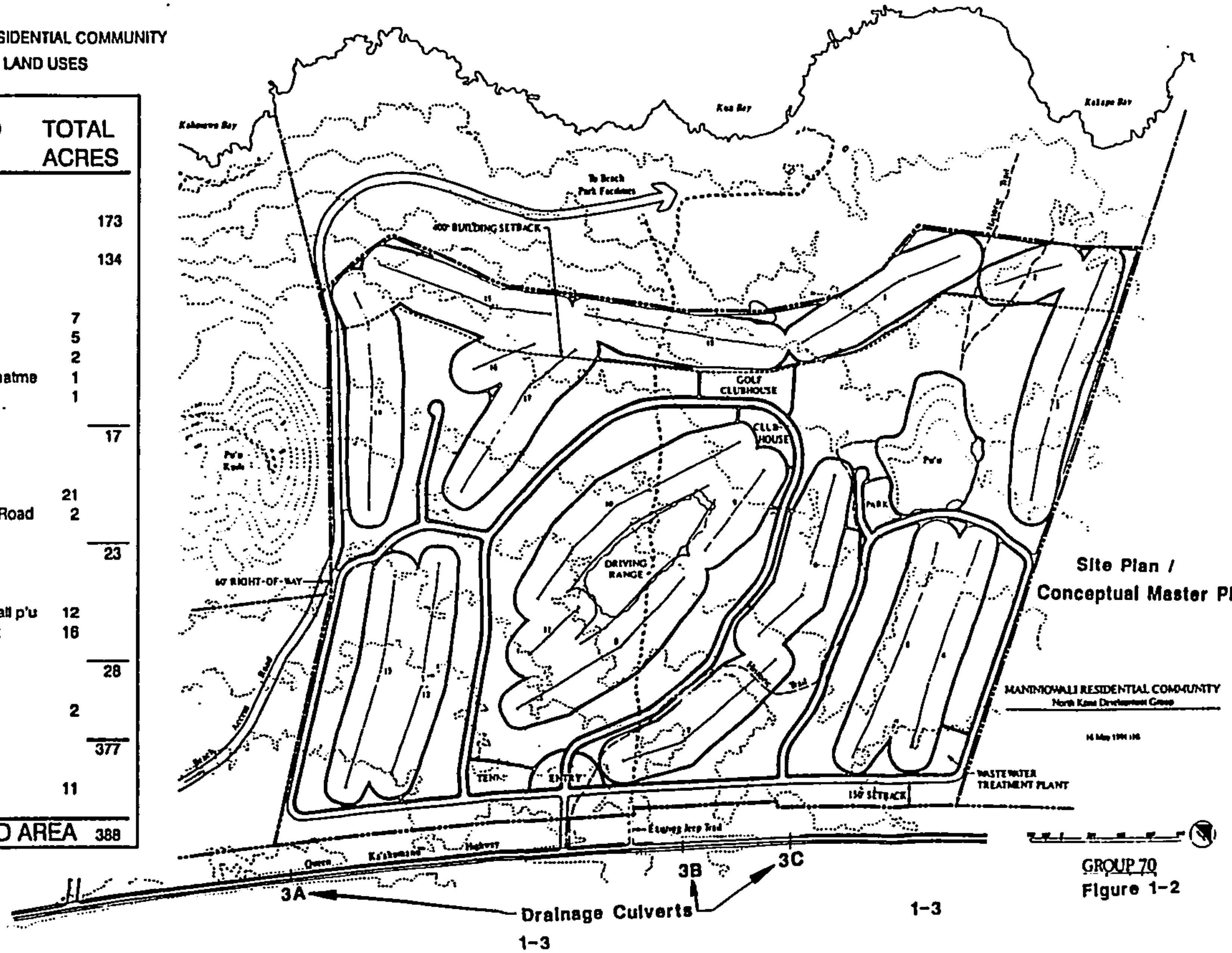
1.4 Site Plan: The site plan is presented in Figure 1-2.



Hawaii Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY
FIGURE 1-1

MANINI'OWALI RESIDENTIAL COMMUNITY
PROPOSED LAND USES

PROPOSED LAND USE		TOTAL ACRES
Golf Course		173
Residential		134
Facilities		
Driving Range	7	
Clubhouse	5	
Tennis Center	2	
Wastewater Treatme	1	
Park	1	
		17
Roads		
40' Internal Road	21	
60' Park Access Road	2	
		23
Constraints		
Cinder cone (small p'u	12	
Highway setback	16	
		28
Entrance	2	
Subtotal		377
Open land	11	
TOTAL LAND AREA		388



Site Plan /
Conceptual Master Plan

MANINI'OWALI RESIDENTIAL COMMUNITY

GROUP 70
Figure 1-2

SECTION 2
PHYSICAL AND HYDROLOGICAL CHARACTERISTICS OF THE AREA

2.1 Topographic Features: The project site lies within the northwest rift zone of Hualalai volcano. The lava slopes are comprised mainly of basaltic lava flows, intrusive rocks and pyroclastic materials, and are largely undissected by streams except for a few shallow water courses. The lavas contain numerous cinder cones and dikes which cut the lava flows along the rift zone (Davis and Yamanaga, 1968). The site has both A'a and Pahoehoe lavas which are highly porous and contain numerous lava tubes, cracks and loose clinker zones.

The land slopes gently seaward from an elevation of 185 to 260 feet from the site's east border, which parallels the Queen Ka'ahumanu Highway, to 50 to 125 feet along the project's western boundary. Average slopes range between five and seven percent. The topographic relief is a result of layering and buckling of successive lava flows.

2.2 Climate: Manini'owali lies on the leeward side of the island and is sheltered from northeast trade wind rainfall by Mauna Loa and Mauna Kea. Much of the rainfall in the North Kona area is the result of convective-type showers on the west slopes of Mauna Loa and Hualalai (Taliaferro, 1958), with higher precipitation on the upper slopes. Mean annual rainfall in the project area is between 10 to 20 inches (Giambelluca, 1986). Monthly mean rainfall varies from a high of 2.5 inches in January to 0.5 inches in June, July and August. Average annual temperature is 78 degrees F, with relatively small daily and seasonal fluctuations. The relative humidity ranges between 71 to 77 percent year round.

2.3 Volcanic and Earthquake Considerations: The project site is located in Seismic Zone III of the Uniform Building Code (UBC). Although Hualalai has been dormant for 185 years, underground movement of magma toward it's core has produced numerous earthquakes over the years. The closest large earthquake to the site occurred on October 6, 1929, and was centered under Hualalai Volcano with a magnitude of 6.5. Assuming a distance of 10 to 15 miles from the center of the 1929 earthquake, Modified Mercalli intensities of VII to VIII at the site would have resulted. This corresponds to ground motion causing damage ranging from negligible to slight in well-built structures and slight to considerable damage in ordinary substantial buildings.

Although there appears to be no immediately predictable danger from lava flows, earthquake activity can be expected. Historic data on the frequency of seismic activity shows that earthquakes of a level of 6.4 Richter Scale magnitude occur on the average of every 62 years (Kona Regional Plan, 1982).

2.4 Groundwater Conditions: The extrusive basalts of the Hualalai Volcanic Series are extremely permeable and, like most flank flows of the major volcanoes of the Hawaii island, are comprised of aquifers of exceptional hydraulic characteristics. A thin Ghyben-Herzberg lens underlies Manini'owali (about 125 feet) and much of the coastal region of western Hawaii.

Recently drilled wells near Muheenui by Huehue Ranch have confirmed the presence of this thin basal lens with brackish water found at the top of the water table. The water table stands at about 2 feet above sea level with a probable seasonal range of 1.5 to 2.5 feet. Measurements of diurnal water level fluctuations indicate a tide influence of about 0.2 feet (Waimea Water Services [WWS], 1991).

Surface water tends to percolate downward to the water table except when deflected temporarily by layers of dense rock, buried soil or volcanic ash layers. Brackish water saturates the lavas at or near sea level. Because of lower densities, the brackish water floats on top of the salt water. Groundwater under land lower than the 1,000 foot elevation is expected to contain chlorides greater than 200 milligrams per liter. This brackish basal water is unsuitable for a potable water supply because of high salinity, but might be acceptable for some irrigation purposes, or desalinization to meet potable standards. The Kona Village Resort uses wells at about the 500 foot elevation which produce water containing chlorides from 360 to 600 mg/l.

The groundwater gradient under the lower slopes of Hualalai is estimated to be approximately 1 foot per mile, using the water levels found at Muheenui. This gradient would appear to result in a groundwater flow of 2 to 4 mgd per mile of aquifer width (WWS, 1991).

2.5 Tsunami and Flooding: The project site is located on land designated Zone X, an area outside of the 500-year flood plain according to the Federal Emergency Management Agency (FEMA) Flood Insurance Map for Hawaii County. A portion of the adjacent shoreline area makai of the property boundary is within zone "VE" which means the shoreline area is subject to 100 year coastal floods with wave action. The base flood elevation of this area is 9 feet above mean sea level.

2.6 Special Geology-related Considerations: Natural lava tubes and cavities should not be considered for use as collectors and drainage pits for subsurface storm drainage. If retention ponds and settling basins are utilized, precautions should be taken to assess the subsurface conditions including the occurence of natural lava tubes so as to minimize the effects on down-slope areas.

Studies associated with any construction project generally help determine bearing loads and structural requirements for buildings, roads, and other improvements. In addition, site specific geotechnical surveys required for detailed design and engineering studies, necessary borings and acoustical methods should be used to locate holes, voids, channels lava tubes and any collapsible features on the site which pose hazards to construction workers and resort visitors and residents. The plans should contain appropriate provisions to ensure the presence of tubes, channels or bores do not directly or indirectly effect near-shore water quality.

SECTION 3
WATER SUPPLY

3.1 Estimated Maximum Sustainable Capacity: The sustainable yield or capacity of an aquifer represents the amount of water available in the aquifer. More specifically, it is the rate of total pumpage which could be continually withdrawn from an aquifer without affecting the quality or quantity of the output. Based on an estimate done by Waimea Water Services in October 1991, the sustainable capacity of the aquifer which could supply the Manini'owali project is about 14 million gallons per day (MGD). The table below shows the existing and approved water demands for developments in the Kaupulehu/Kona Village/Kukio Resort node, adjacent to the Manini'owali project total to about 5.41 MGD, or about 39 percent of the estimated sustainable capacity. The demand on the aquifer inclusive of the Manini'owali project totals to 6.50 MGD, or about 46 percent of the estimated sustainable capacity.

PROJECTED POTABLE AND NON-POTABLE WATER DEMAND FOR KAUPULEHU/KONA VILLAGE/KUKIO RESORT NODE

DEVELOPMENT	POTABLE	NON-POTABLE	TOTAL	STATUS
	gallons per day (gpd)			
Hu'ehu'e Ranch (housing, golf)	530,000	0	530,000	Approved
Regent Kona Coast (hotel,housing,golf)	1,430,000	1,000,000	2,430,000	Approved
Kaupulehu	350,000	1,800,000	2,150,000	Approved
Kona Village	100,000	200,000	300,000	Existing
Node Total	2,410,000	3,000,000	5,410,000	
Estimated Sustainable Capacity			14,000,000	
Percentage of Estimated Sustainable Capacity			39%	
Manini'owali	861,200*	225,600	1,086,800	Proposed
Total Including Manini'owali	3,271,200	3,225,600	6,496,800	
Percentage of Estimated Sustainable Capacity			46%	

*861,200 gpd of brackish feed water will yield 430,600 gpd of potable water and 430,600 gpd of by-product water.

3.2 Dual Water System: To deal with the significant amounts of water used for irrigation purposes at the golf course and community landscaped areas, and at the same time address potable water restrictions of the Kona Coast, a dual water system consisting of separate potable and brackish water systems should be considered for this project. The potable and non-potable water systems should be kept separate to eliminate the possibility of cross-connecting the two systems. Potable water would be supplied inside the residential units, the golf clubhouse, maintenance buildings and the sewage treatment plant. Non-potable water would be supplied outside buildings for irrigation, with spigots clearly labelled to prevent inadvertent consumption of non-potable water.

All consequences of a dual water system need to be evaluated before implementation of such a system. In addition to the design considerations, legal liability and marketability of homes with common landscaped areas served by a brackish irrigation system needs to be taken into account.

3.3 Projected Water Demand: The projected demands for potable and non-potable water, are based on the Department of Water Supply's (DWS) Water System Standards, County of Hawaii and information gathered by Waimea Water Services (WWS).

Table 3-1 shows the projected average daily demand is approximately 430,600 GPD for potable water and 947,400 GPD for non-potable water. Nearly half of the non-potable water will be used for the 93 acres of golf course and driving range turf and landscaping.

If a Reverse Osmosis (R.O.) plant is used, approximately 861,200 GPD of water will need to be drawn from the aquifer to meet the 430,600 GPD demand [based on a 50 percent R.O. feedwater to product water recovery ratio (Aqua Design inc., May 1991)]. The by-product water from the R.O. plant can be used to offset the non-potable water demand by 430,600 GPD. If recycled wastewater is permitted for non-potable applications, the total non-potable water demand can be reduced by another 291,200 GPD.

Table 3-2 shows the proposed proportion of average daily water allotted for potable and non-potable applications for both a conventional and a dual water system.

Table 3-1
PROJECTED WATER DEMAND
BASED ON HAWAII COUNTY STANDARDS & WWS ESTIMATES

POTABLE WATER USE	AVERAGE DAILY DEMAND (gpd/unit)	AVERAGE DAILY DEMAND (gpd)	(1) MAXIMUM DAILY DEMAND (gpd/unit)	(1) MAXIMUM DAILY DEMAND (gpd)
1,000 Housing Units	400	400,000	600	600,000
1 Golf Club House and Tennis center		20,000		30,000
1 Golf Maintenance Bldg.		10,000		15,000
1 Sewage Treatment Bldg.		600		900
TOTAL POTABLE WATER DEMAND		430,600		645,900
AMOUNT OF BRACKISH WATER TO PRODUCE 430,600 gpd POTABLE WATER		861,200		
NON-POTABLE WATER USE	**AVERAGE DAILY DEMAND (gpd/unit)**	**AVERAGE DAILY DEMAND (gpd)**	**(1) MAXIMUM DAILY DEMAND (gpd/unit)**	**(1) MAXIMUM DAILY DEMAND (gpd)**
1,000 Housing Units	300	300,000	450	450,000
Golf Course (86 acres turf) and Driving Range (7 acres)	4,800	446,400	7,200	669,600
Landscaping (40 acres)	4,800	192,000	7,200	288,000
3 Water Features	1,200	3,600	1,800	5,400
1 Sewage Treatment Bldg.	5,400	5,400	8,100	8,100
TOTAL NON-POTABLE WATER DEMAND		947,400		1,421,100
TREATED EFFLUENT		(291,200)		
R.O. BY-PRODUCT (RECYCLED DESALINIZATION WATER)		(430,600)		
ADJUSTED TOTAL NON-POTABLE WATER DEMAND		225,600		2,067,000
TOTAL DEMAND TO PRODUCE POTABLE & ADJUSTED NON-POTABLE WATER DEMAND		1,086,800		

(1) MAXIMUM DAILY DEMAND = Average Daily Demand x 1.5 (R.O. by-product water and recycled wastewater effluent is not factored into the Maximum Daily Demand figures.

Table 3-2
Summary of Water System Design Criteria

LAND USE	UNIT	Average Water Use CONVENTIONAL SYSTEM Potable (%)	Non-Potable (%)	Total	Average Day Demand DUAL WATER SYSTEM Potable	Non-Potable	Total
Residential units	GPD/unit	360 (57%)	270 (43%)	630	400	300	700
Golf Club House & Tennis Center	GPD/unit	20,000 (100%)	* 0	20,000	20,000	* 0	20,000
Golf Maintenance Bldg.	GPD/unit	10,000 (100%)	* 0	10,000	10,000	* 0	10,000
Sewage Treatment Bld	GPD/unit	500 (10%)	4,500 (90%)	5,000	600	5,400	6,000
Golf Course	GPD/acre	0	4,000 (100%)	4,000	0	4,800	4,800
Landscaping	GPD/acre	0	4,000 (100%)	4,000	0	4,800	4,800
Water Features	GPD/unit	0	1,000 (100%)	1,000	0	1,200	1,200

PIPELINE, STORAGE, AND WELL PUMP SIZING CRITERIA

1. Demand Factors
   a. AVERAGE WATER USE figures are the project's estimated potable and non-potable water demands for a conventional water system.

   b. AVERAGE DAY DEMAND. To allow for the uncertainty of water use estimates, a factor is applied to the average use rates to obtain the average day demand for a dual water system.

   c. MAXIMUM DAY DEMAND = (1.5) x AVERAGE DAY DEMAND

   d. PEAK HOUR RATE = (5.0) x AVERAGE DAY DEMAND

2. FIRE PROTECTION can be met in either the potable or non-potable system subject to meeting all present fire protection standards.

3. Reservoir Size
   a. The potable reservoir volume shall be equivalent to the MAXIMUM DAY DEMAND.

   b. The non-potable reservoir volume is dependent on the storage capacity of the golf course pond(s).

4. Potable and non-potable pipelines shall be sized for PEAK HOUR flowrates with a minimum residual pressure of 40 psi and maximum velocity in the main of 6 feet per second. Hydraulic analyses will utilize tank spillway elevations as the initial hydraulic grade line elevations. Pipelines providing fire protection shall be sized for the MAXIMUM DAY flow plus fire flow with a residual of 20 psi at the critical fire hydrant. Hydraulic analyses shall use three-quarters full tank water surface elevations as initial hydraulic grade line elevations.

5. Well pumps for potable and non-potable systems shall provide MAXIMUM DAY in an operating time of 24 hours.

* Non-potable water figures for golf course club house, tennis center and maintenance building are included in the golf course water demand figures.

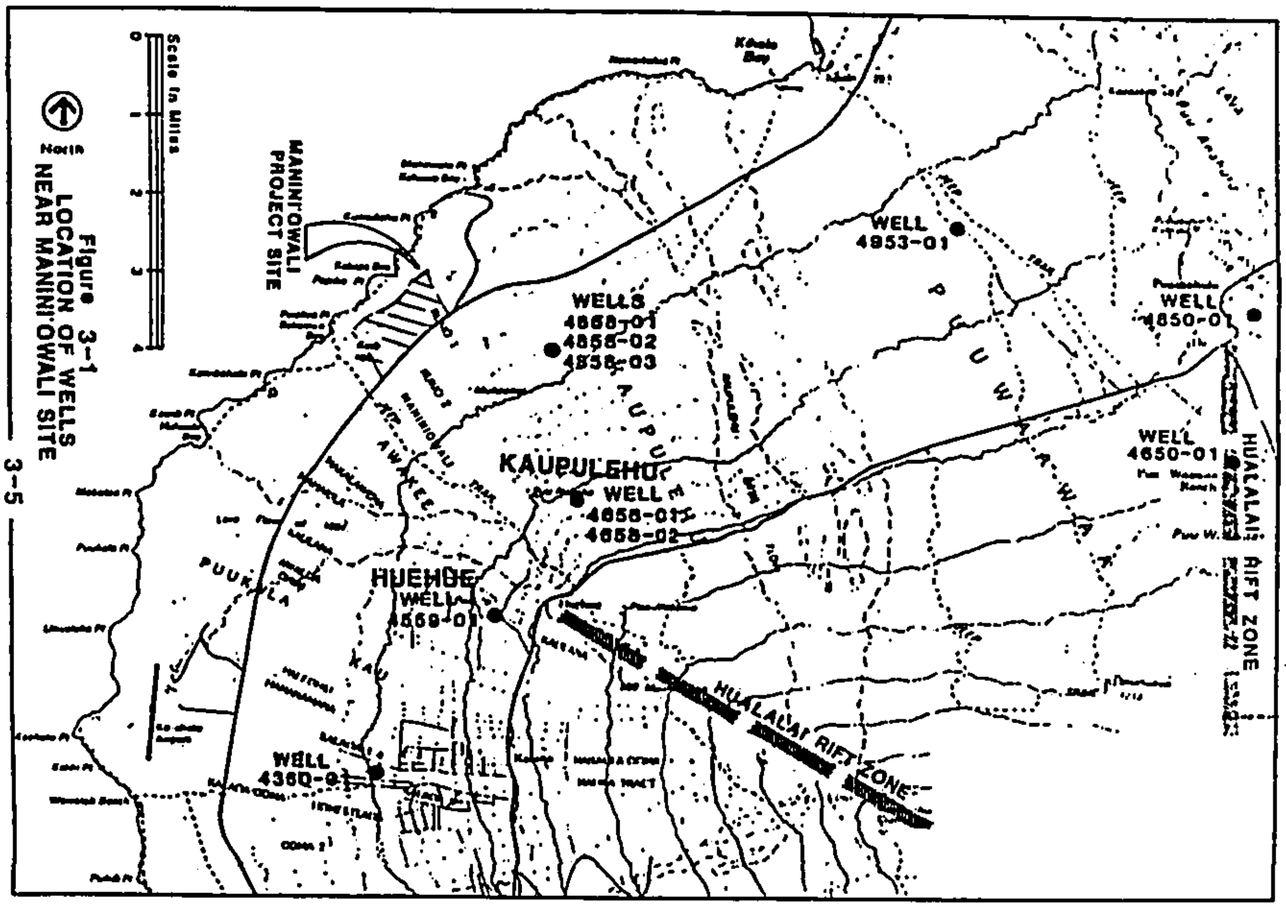


Figure 3-1
LOCATION OF WELLS
NEAR MANINI'OWALI SITE

3-5

SUMMARY OF WELLS IN VICINITY OF MANINI'OWALI

NAME OF WELL

POTABLE WATER ALTERNATIVE	Huehue Ranch "A"	Kaupulehu (Puu Nahaha) "B"	Kaupulehu "B"	Kalaoa	Puu Waawaa	Puu Anahulu	Kona Village	Kona Village	Kona Village	Kiholo
WELL NUMBER	4559-01	4658-01	4658-02	4360-01	4650-01	4850-01	4858-01	4858-02	4858-03	4953-01
YEAR DRILLED	1985	1981	1986	1968	1978	1979	1960	1968	1973	1972
DISTANCE FROM SHORELINE (miles)	4.5	3.6	3.6	3.0	7.3	6.3	2.1	2.1	2.1	2.7
DISTANCE FROM MANINI'OWALI (miles)	1.3	1.1	1.1	5.2	10.4	10.6	1.8	1.8	1.8	6.9
GROUND ELEVATION (feet)	1579	1344	1350	680	2550	2317	501	503	500	932
CASING DIAMETER (inches)	10	12	—	10	6	7	4	8	10	12
TOTAL WELL DEPTH (feet)	1655	1412	1465	702	4898	5,000	528	523	534	971
SOLID CASING LENGTH (feet)	1579	1362	1350	682	2593	2,500	517	503	514	926
LOUVERED CASING LENGTH (feet)	30	50*	80	20	0	100	11	20	20	40
OPEN HOLE LENGTH (feet)	46	0*	35	0	2303	2,400	0	0	0	5
ELEVATION AT BOTTOM OF WELL (ft., msl)	-76	-68*	-115	-22	-2348	-2,683	-27	-20	-34	-39
STATIC WATER LEVEL (feet)	+3.2	6.9*	12.6**	+3.2	+245	+18	+1.8	+1.8	+1.8	+2.6
PUMPING RATE (gpm)	150	500	575	150	35	35	25	90	100	700
DRAWDOWN (feet)	17	30	18.5	0.6	Not Known	Not Known	Not Known	Not Known	10.5	0.8
CHLORIDE CONTENT (mg/l)	90	40	38	740	28	30	360	430	600	345
CURRENT USE	Unused	Unused	Unused	Unused	Domestic	Domestic	Unused	Domestic	Domestic	Irrigation

SOURCE: BELT COLLINS AND ASSOCIATES, KAUPULEHU RESORT FINAL EIS, 1986.
* Data reported in "Kaupulehu Water Lands Source at Kaupulehu, North Kona, Hawaii" by Fukunaga and Associates, Inc., July 1981
North Kona, Hawaii" by Fukunaga & Associates, Inc., July 1981
** Water level as presented in Water Resources International, Inc., Report to the State Division of Water & Land Development

3-6 ATTACHMENT TO FIGURE 3-1

3.4 Water Source Alternatives: Several alternatives for a dual water system are considered. The locations of wells near the Manini'owali site are shown in Figure 3-1.

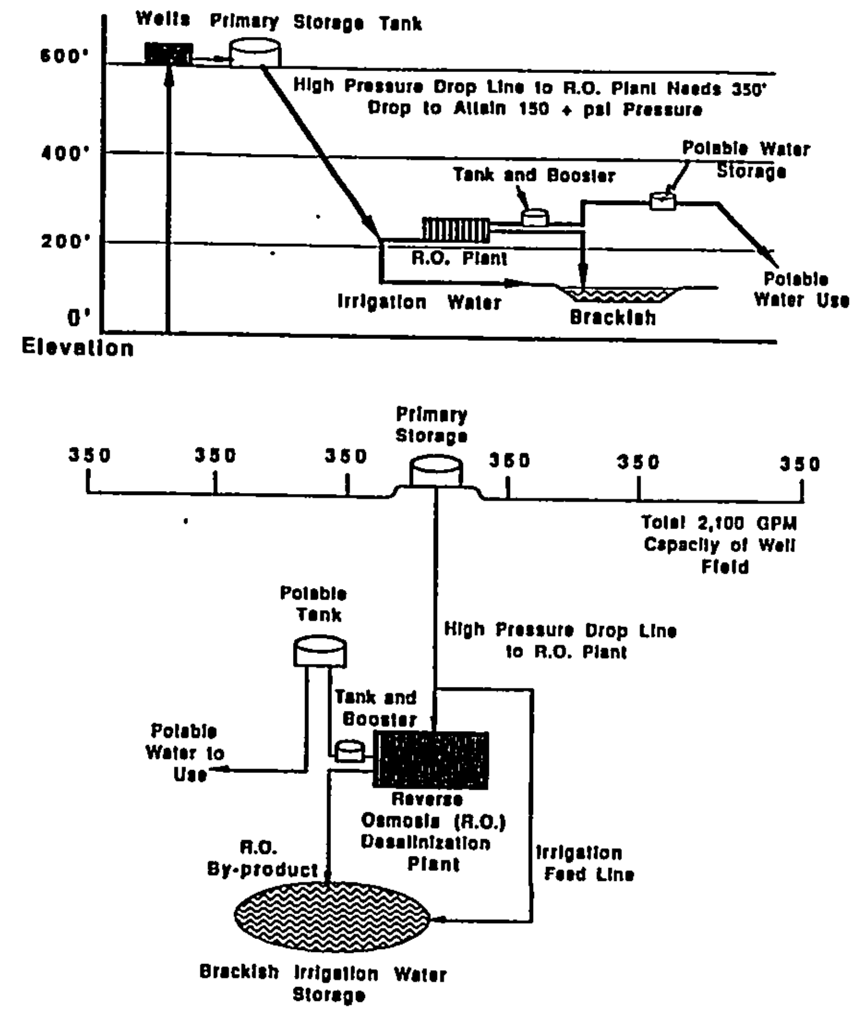
3.4.1 Alternative A - Non-potable Water Well, with Desalinization Plant: Desalinization of brackish water could produce a sufficient quantity of potable water. This alternative involves development of a well and desalinization plant as well as installation of a dual water system with separate storage reservoirs. NKDG will pursue developing non-potable water wells and a desalinization plant because it would have the lowest system cost and would enable control of their own water supply.

Off-site Desalinization Plant: The State lands mauka of the Queen Ka'ahumanu Highway, in the Manini'owali ahupua'a are being considered as a site to develop a non-potable water well, storage facility and desalinizion plant. Water pumped from beneath this land, at approximately 600 feet above mean sea level, is expected to have a salinity of approximately 1,000 mg/l and could either be stored in the non-potable water reservoir and/or delivered by transmission lines to the Reverse Osmosis (R.O.) plant. The water produced by the desalinization plant will first be used for irrigation purposes. After a demonstrated period of reliability and proper testing, the plant could then be approved as a potable water source by the State Department of Health.

Prevention of Groundwater Contamination: In order to prevent the possible occurrence of groundwater contamination by seepage around the well, the drilled wells would be cased into the aquifer and the annular spacing surrounding the casing would be grouted to just above the groundwater table.

On-site desalinization plant: If an agreement with the State cannot be reached for an off-site, upland location for well sites, an on-site well would be considered. However, an on-site plant would be more costly to develop and operate because the high chloride levels expected from any wells drilled on the property (1,500 to 2,500 mg/l) would necessitate treatment of all the water extracted from the well, whether for potable or non-potable use.

The desalting process most commonly used worldwide is Reverse Osmosis (R.O.). This process has been approved by the Environmental Protection Agency (EPA). Projects and municipalities in Florida, California and the Caribbean use R.O. Figure 3-2 shows a diagram of the proposed desalinization process.



Schematic Layout of Proposed Water System

MANINI'OWALI RESIDENTIAL COMMUNITY

Figure 3-2

3.4.2 Alternative B: Cost-sharing with Neighboring Private Water Supplies: This alternative involves entering into a cost-sharing agreement with the neighboring developers of Kaupulehu and Kukio in the development of potable and non-potable water wells, and the installation of the transmission system and storage tank. Operation and maintenance costs could also be cost-shared between the developers of the Kaupulehu/Kona Village/Kukio Resort node. Based upon water resource studies by Island Resources Ltd., off-site fresh water wells north of Kona must be located between the elevations of 1,500 to 1,800 feet to be practical (WWS, October 1991). It is very important that well locations be properly oriented to the County water system and neighboring private water systems for future cross connections.

3.4.2.1 Cost-sharing with Kaupulehu Development. According to the final Environmental Impact Statement (EIS) for Kaupulehu in 1986, the projected average daily potable water supply is about 0.31 MGD for the first five years, and 0.53 MGD to meet the project demand after 10 years. The first well (no. 4658-01) drilled in 1981, was satisfactorily tested with a demonstrated pumping rate of 500 GPM to satisfy the first five year water demand. In 1986, the second well (no. 4658-02) was drilled nearby with a similar demonstrated reliability, water quality and pumping rate of 575 GPM.

POTABLE WATER. The wells drilled for Kaupulehu were designed to meet the potable water demands of the project, as well as the Hawaii County Standard pump capacity criteria. The three wells will also meet the maximum daily demand of the project, with some reserve capacity. However, to meet the combined demands of both the Manini'owali and Kaupulehu projects, a fourth well would have to be developed.

NON-POTABLE WATER. Two 18-hole golf courses planned for Kaupulehu will require an average irrigation demand of 1.5 MGD, and as much as 2.0 MGD during the drier months. Brackish wells will be developed for this use.

To meet the water demands for Manini'owali's proposed golf course, community landscaped areas and other non-potable water needs, approximately .95 MGD would be required (see Table 3-1). The location and elevation of the non-potable well sites affect the salinity of the water and ultimately, the choice of grass turf for the golf course and the landscaping plants.

Regardless of which water alternative is chosen, careful consideration of salt-tolerant grass and plants will minimize the amount of non-potable water used. Indigenous plants and especially endemic plants of Hawaii should be extensively used in all landscaping efforts, especially for the golf course.

3.4.2.2 Cost-sharing with Kukio Resort (Huehue Ranch). The well drilled for this development is at an elevation of 1,579 feet on the upper slopes of Hualalai. Pump tests have demonstrated the reliability and water quality of this source. The projected water demands for this project at maximum development is 1.96 MGD of potable water and 1.52 MGD for non-potable water from brackish water wells or other non-potable sources. If this alternative is accepted, Manini'owali could participate with Huehue Ranch in the water system improvements, including the transmission system from the source to the project and the storage tank.

3.5 Underground Injection Control (UIC) Safe Drinking Water Permit: Potable groundwater sources will be protected from potential waste water disposal and irrigation practices by complying with the Department of Health's Underground Injection Control and Safe Drinking Water Permit. Compliance with these permit requirements should also protect coastal water quality since groundwater seepage is the primary pathway for pollutants in the area. The Department of Health is especially concerned about any extraction of water for potable water use from the Manini'owali project site, which is below the Underground Injection Control line.

3.6 Wastewater Treated Effluent for Irrigation: Treated wastewater effluent would be incorporated into all of the non-potable water supply alternatives being considered to conserve the potable water supply. Treated effluent could be pumped from the wastewater treatment facility to a pond (lined to prevent infiltration) located within the golf course, where it could be blended with non-potable water for irrigation. An on-site wastewater treatment facility will generate approximately 291,200 GPD of effluent.

3.7 Dual Water System Design Criteria:

3.7.1 Average Water Use figures are the estimated potable and non-potable water demand in gallons per day needed for the project for a conventional all-potable water system. These demand figures were derived from the Board of Water Supply (BWS) Water System Standards and Waimea Water Services estimates.

3.7.2 Average Day Demand: To allow for the uncertainty of water use estimates, a factor is applied to the average water use rates to obtain the average day demand for a dual water system. A factor of 1.11 is used for residential units and 1.2 for all other land uses.

3.7.3 Maximum Day Demand = Average Day Demand x 1.5

3.7.4 Peak Hour Rate = Average Day Demand x 5.0

3.8 Fire Protection Systems: The required fire flows for this project are listed in Table 16 of the BWS Water System Standards. For residential areas, required fire flow depends on the character and congestion of housing units. For the golf club house, maintenance building and sewage treatment plant the required fire flows depend on bulk, congestion, fire resistance and contents of the buildings.

3.9 Reservoir Capacity:

3.9.1 **POTABLE RESERVOIR VOLUME** = Maximum Day Demand (Table 3-1)

645,900 gallons, therefore provide a 0.75 MG reservoir

3.9.2 **NON-POTABLE RESERVOIR VOLUME:**

A 100,000 gallon non-potable reservoir is assumed, based on the assumption that the storage capacity of the golf course pond(s) will handle most of the non-potable water demands of the project.

3.10 Pipelines Sizes: Potable water pipelines shall be sized for PEAK HOUR FLOWRATES with a minimum residual pressure of 40 pounds per square inch (psi), and maximum velocity in the main of 6 feet per second. Non-potable water pipelines shall be sized for MAXIMUM DAY FLOWRATES. Pipelines providing fire protection shall be sized for the MAXIMUM DAY FLOW plus fire flow with a residual pressure of 20 psi at the critical fire hydrant. Hydraulic analyses shall use three-quarters full tank water surface elevations as initial hydraulic grade line elevations.

3.11 Pump Capacity: The sizing of pumps for potable and non-potable systems in a dual system is based on the MAXIMUM DAY DEMAND with an operating time of 24 hours.

WELL PUMPS: MAXIMUM DAILY DEMAND of 2.07 mgd or 1,435 gpm (Table 3-1)

therefore provide 4- 575 gpm pumps, including 1 for standby

SECTION 4
WASTEWATER

4.1 Existing Wastewater Facilities in the Area: Manini'owali is not within reasonable range of an existing public sewer system. The closest public sewer system in the area is a small package treatment plant maintained by the State of Hawaii at Keahole Airport to serve airport operations.

A new wastewater treatment facility with a design capacity of 2.8 MGD is currently being designed for a site near Honokohau Harbor. The plant is intended to replace the Kailua-Kona Treatment Plant which services the Kailua-Kona area and parts of Alii Drive.

Some of the Kona Village Resort units are tied to a sewer system using a secondary treatment plant of capacity 30,000 gallons. The remainder of the units are cavittetes.

Like other resort systems along the West Hawaii coast, Manini'owali will have to either develop an independent sewage treatment and disposal facility, or enter into a cost-sharing agreement with the neighboring Kaupulehu or Huehue developments.

4.2 Wastewater Quantities: Assuming a per capita flow of wastewater of 80 gallons per day and dwelling unit densities shown below, the amount of wastewater generated by residences will be approximately 291,200 GPD.

TYPE OF DWELLING UNIT (D.U.)	NO. OF D.U.	DENSITY (persons/ D.U.)	AVERAGE FLOW Gallons per Capita-Day(GPCD)
Multi-family	300	2.8	67,200
Single-family (low density)	150	4.0	48,000
Single-family (medium density)	550	4.0	176,000
TOTAL	1,000		291,200

4.3 <u>Wastewater Treatment and Disposal Alternatives:</u>

4.3.1 <u>Alternative A - On-site Wastewater Treatment Facility:</u> The favored alternative for this project is to develop a wastewater collection, treatment and disposal system with a central wastewater treatment facility on the property. A one acre site on the northeastern corner of the property is the proposed location for the treatment facility.

For ease of construction and maintenance, gravity sewers and force mains shall be located along the proposed roadway system to the extent that the terrain and site layout will allow.

4.3.2 <u>Alternative B - Cost-sharing with a Neighboring Private Wastewater Facility:</u> The Huehue (Kukio) and Kaupulehu resort developments located to the north of Manini'owali plan to develop private wastewater facilities to serve their resort needs. This alternative involves entering into a cost-sharing agreement with one of these developers for an off-site wastewater treatment and disposal facility.

In the Kaupulehu development, processed effluent will be transmitted back to the project site for golf course irrigation and other landscaped areas, or blended with brackish water, or disposed of in deep wells on Kaupulehu lands.

In the Huehue development a similar, self-contained sewage treatment plant is planned. Properly treated effluent will be used for irrigation of the golf course and other open landscaped areas. The projected wastewater generation upon completion of this project, with 100% occupancy is 1.17 MGD.

4.4 <u>Land Treatment Effluent Disposal:</u> The proposed method for disposal of treated effluent is irrigation for the golf course, park and other landscaped areas. The recovery and reuse of treated wastewater and its nutrient resources has a proven record of reliably meeting water quality goals throughout the world while helping to conserve the valuable potable water supply. Land treatment also minimizes the risk of adverse effects when compared to other disposal methods (ocean discharge, disposal wells, leaching fields). The combined effects of nearshore water currents, diurnal tidal flushing and the continuous downslope movement of groundwater will prevent any significant deterioration of nearshore water quality. While it is recognized that acceptance is not universal, the utilization of land treatment systems has the potential for significant cost savings when compared to conventional disposal alternatives.

4.5 <u>Treated Effluent Quality Requirements:</u> Generally, any wastewater applied to land must receive secondary treatment. The specific effluent quality requirements, including bacteriological limitations shall be established on a case-specific basis by a joint review among the Department of Health (DOH), the Counties where applicable, other regulatory agencies. Based on the DOH, Hawaii Administrative Rules For Wastewater Systems (Chapter 62), treated effluent shall meet the following requirements:

- Five-day Biochemical Oxygen Demand (BOD_5) in the effluent from a treatment unit shall not exceed 30 milligrams per liter based on the arithmetic average of the results of the analyses of composite samples. In no case shall any grab sample exceed 60 milligrams per liter of BOD_5.
- Suspended Solids (SS) in the effluent from a treatment unit shall not exceed 30 milligrams per liter based on the arithmetic average of the results of the anlayses of composite samples. In no case shall any grab sample exceed 60 milligrams per liter of SS.

In addition, treatment works using effluent irrigation systems shall meet the following requirements.

- Total Coliform Organisms in the effluent for five grab samples during a 30-day period from a treatment unit shall not exceed a median of 23/100-millimeters, unless otherwise specified by the director on the basis of restrictions to public accessibility and public health considerations. In no case shall any grab sample exceed 240/100 millimeters of total coliform. The sampling for total coliform analyses shall be taken at the effluent weir of the treatment unit.

4.6 <u>Public Health Concerns:</u> Public health concerns generally associated with the use of wastewater effluent for irrigation are:

- The effects of aerosals generated during irrigation,
- The impact of the effluent on water resources.

In the city of St. Petersburg, Florida, approximately 6,500 homes are irrigated with reclaimed water. A study to address public health concerns found no evidence linking reclaimed wastewater treated by coagulation, filtration and disinfection with increased enteric diseases. No evidence of significant risks of transmission of viral or microbial diseases was found as a result of exposure to effluent aerosols from spray irrigation with reclaimed water.

In locations as varied as Ada, Oklahoma, where chlorinated secondary effluent is used for sprinkler irrigation, or agricultural settlements in Israel where reclaimed water is also used for sprinkler irrigation, the safety of the process has been demonstrated with no apparent growth in overall enteric disease incidence (Engineering Concepts, "Wastewater Management Plan For The proposed Lihi Lani Recreational Community").

Studies of recycling of sewage effluent by irrigation in Mililani, Oahu have shown that Bermuda grass and other plants with thickly matted surface root systems are excellent users of sewage nutrients, including nitrogen. They are also very effective in removing BOD_5, Total Organic Carbon (TOC), phosphorous, potassium, boron, coliforms, and viruses and at the same time preserving the groundwater quality (University of Hawaii - Water Resources Research Center, "Recycling of Sewage Effluent By Irrigation: A Field Study On Oahu - Final Progress Report For August 1971 to June 1975", (July, 1975).

SECTION 5
STORMWATER DRAINAGE

5.1 Existing Drainage Conditions: The project site is comprised mainly of the highly permeable rocks of the Hualalai Volcanic Series. Due to low rainfall amounts and intensities, sparse soil cover, and rocks which lack definitive drainage patterns, there is virtually no surface runoff. What little surface runoff that occurs during storm events is predominately carried as sheet flow before percolating to the groundwater table.

5.2 Drainage Structures Near the Site: In preparation for construction of the Queen Ka'ahumanu Highway, a hydrology study was conducted to determine what types of drainage structures were needed along the highway alignment. A 50 year storm recurrence interval was used, with a 6-hour storm duration to design for the highest runoff rate. The areas mauka of the highway and above the Manini'owali parcel were designated drainage basins 3A, 3B and 3C, with runoff volumes of 80 cfs, 210 cfs and 50 cfs, respectively. Based on this analysis, three pipe culverts were installed under the highway, mauka of Manini'owali to accommodate storm runoff (R.M. Towill, Hydrology Study, 1971). Approximate locations of these culverts are shown on Figure 1-2 and are listed below.

Highway Station	Length	Peak Flow (CFS)	Drainage Culvert
490+00	90 L.F.	80	"3A", 48" diameter 2-2/3" x 1/2" corrugated metal pipe w/CRM Inlet & Outlet Structures
518+00	100 L.F.	210	"3B", 72" diameter 3" x 1" corrugated metal pipe w/CRM Inlet & Outlet Structures
524+30	134 L.F.	50	"3C", 42" diameter 2-2/3" x 1/2" corrugated metal pipe w/CRM Inlet & Outlet Structures

5.2 Surface Water and Drainage: Development of this project will increase surface water runoff. The extent of runoff will depend on the nature of the fill used for the golf course, the increase of paving and other impermeable surfaces within the project site and the final configuration of the storm drainage system.

5.3 Lava Tubes and Subsurface Cavities: Lava tubes and subsurface cavities should not be used as natural collectors and drainage pits for subsurface storm drainage. If retention ponds and settling basins are used, precautions should be taken to assess the subsurface conditions including the presence of lava tubes, so as to minimize the effects on down slope areas.

5.4 Proposed Drainage System: The capacity of the stormwater drainage system will be designed to handle flows of a ten-year storm as required by Hawaii County ordinance. The overall design intent of the drainage system will be to maintain nearshore water quality by limiting stormwater runoff to the shoreline. This will be accomplished by handling the runoff on-site.

Stormwater flows will be directed to the golf course and other open spaces of the project for their percolation capacity, to preclude runoff from reaching the shoreline. Options include directing stormwater flows to a golf course water feature with some retention capacity and/or to dry well sumps to collect runoff for percolation and filtration. An Underground Injection Control permit must be obtained by the applicant for the operation of any rainfall drainage drywells.

5.5 Effects of Proposed Drainage System on Nearshore Water Quality: The integrated stormwater drainage collection system described above should minimize the impact on marine life and coastal water quality due to groundwater contaminated with nutrients and pesticides during periods of heavy stormwater runoff.

5.6 Non-point Source Pollution Management: The Coastal Zone Management Act of 1990 requires states with approved Coastal Zone Management (CZM) programs to incorporate non-point source pollution management into the program.

SECTION 6
ROADWAYS

6.1 Roadway Policies: The Kona Regional Plan (1982) defines general plan goals, policies and standards for roadways in the region. The plan also provides an overview of traffic conditions and volumes. The plan states " The further development of the area north of Kailua will require additional roads to serve these developments. The roadways should be laid out to interconnect the respective developments, provide access within the area without utilizing the Queen Ka'ahumanu Highway or Palani Road for internal circulation."

6.2 Existing Roadway: The Queen Ka'ahumanu Highway is the major roadway providing access to Manini'owali. It is a two lane, Class I, limited access state highway designed for a 70 mile per hour vehicle speed and a two-way capacity of 2,000 vehicles per hour. The road is designed with a 24 foot pavement width within a 300 foot right-of-way.

Access to the Manini'owali parcel is currently available through a road across the lava field starting from the Queen Ka'ahumanu Highway. The Department of Land and Natural Resources (DLNR) currently has a legal access point from the Queen Ka'ahumanu Highway at Manini'owali.

6.3 Right-of-way: The right-of-way and alignment of all streets shall be considered in their relation to topographical conditions and to public convenience and safety, and in their appropriate relation to the proposed uses.

6.4 Dimensions: The internal roadways shall have a minimum right-of-way width of 40 feet, and a minimum pavement width of 24 feet. The park access road shall have a minimum right-of-way width of 60 feet and a minimum pavement width of 44 feet.

6.5 Materials: Pavement, shoulder, swale and sidewalk materials and appropriate thicknesses shall be as specified by the engineer. Refer to the Standard Details for Public Works Construction, sheet R-34, for typical Road Pavement and Shoulder detail for Hawaii County.

All suitable materials removed from excavation on the site shall be used as much as practicable in the construction of embankments, shoulders, sidewalk areas, slopes, in backfill for structures, and at other places, as directed by the engineer.

6.6 Roadway Grading and Excavation: All work related to excavating and grading of the road prism (section of road between right-of-way lines and including cut or fill slope sections outside of the normal right-of-way lines) shall conform to the requirements of Section 12 of the Standard Specifications for Public Works Construction (September, 1986).

SECTION 7
OTHER UTILITIES

7.1 Electrical Supply: The project's estimated electrical load is 4,215 Kilovolt-amps (KVA) [see table below]. This load consists of residential lighting, general power, residential utility loads, and non-residential loads such as sewage pumps, water pumps, irrigation pumps and golf course water feature pumps.

In an effort to conserve energy, design efforts will be made to use energy efficient light sources, daylighting design and energy efficient pumps. Scheduling of industrial loads will be during off-peak hours as much as possible.

PRELIMINARY LOAD ESTIMATE

1,000 residential units	3,000 KVA
Sewage Pump Station	100 KVA
Waste water treament plant	400 KVA
Golf Course	
Clubhouse/Maintenance	200 KVA
Irrigation pump	200 KVA
Water Feature	50 KVA
Desalinization plant	265 KVA
TOTAL ESTIMATED LOAD	4,215 KVA

7.2 Provisions for Telephone: Telephone facilities are not presently available at the site. Hawaiian Telephone (HTCO) has estimated that after 1993, HTCO facilities will be available at adjacent projects and can be routed via underground ductlines to the Manini'owali project site.

SECTION 8
GRADING/CLEARING/EXCAVATION/EARTHWORK

8.1 Soil Types at the Project Site: According to the U.S. Department of Agriculture, Soil Conservation Service (1972) the project site contains: Cinder land (rCL), Rock land (rRO) and A'a lava flows (rLV). Pahoehoe lava flows (rLW) are found along the northeast boundary of the site. See Figure 8-1.

8.1.1 A'a is the more viscous form of lava. The molten mass moves so slowly that a rough, jagged clinker layer forms on it's surface. It has a dense interior sandwiched between layers of volcanic clinker. It has been demonstrated that the A'a surface can be easily moved and crushed by bulldozers into a relatively smooth surface of 1 inch to 4 inch cobbles.

8.1.2 Rock land (rRo): The Rock land type consists mainly of Pahoehoe lava bedrock covered in places by a thin layer of soil material. The average depth of the soil material is 6 to 8 inches, although in some places the material extends into the cracks of the lava. Pahoehoe lava flows rapidly and forms a relatively smooth surface characterized by low domes and ridges. The "ropy" surface texture of the Pahoehoe may conceal cavities, blisters or lava tubes. Individual flows tend to be a few feet thick, but several flows from the same eruption may rest above each other to form a relatively thick flow unit. Rough grading for the golf course, building pads, roadways and landscaped areas will be more difficult on the Pahoehoe lava than on the A'a lava. In some locations the Pahoehoe will resist blading or ripping and may require blasting of lava formations.

Extreme care must be exercised while working on the basalt, as lava tubes and cavities can collapse under the weight of construction equipment.

8.2 Existing Vegetation: The majority of the Manini'owali parcel is covered by grassland composed of fountain grass with scattered Kiawe trees. The mauka portion is largely barren A'a and Pahoehoe lava flows. A cinder cone composed of reddish-brown, cinder-ash-pumice material is found near the large A'a lava flow along the Kukio boundary.

8.3 Fill and Borrow: Cinder is suitable borrow material and can be used for grading of the golf course and backfill purposes to reduce importation requirements. Cinder is not a suitable source for road fill because of it's low density when compacted. A'a lava is good in the fragmental surface layer for road fill. Rocks excavated at the site can be acceptable borrow material if maximum fragment size and gradation is appropriate. No soil for the golf course and other landscaped areas is available on-site and will have to be imported from existing or future borrow pits on other parts of the island. Preliminary estimates indicate a total of approximately 250,000 to 300,000 cubic yards of topsoil will be needed for the project site. Detailed site planning and grading plans will be developed at a later stage in the review process.

6.7 Proposed Highway Improvements:

6.7.1 Improvements to Accommodate the Year 2006 Highway Deficiencies Without the Project: Based upon evaluation criteria for highway deficiencies established in the State Department of Transportation (DOT) Long Range Highway Plan, the Queen Ka'ahumanu Highway will eventually require widening to four lanes. Until the proposed interchange and frontage road system is constructed, at-grade access should be provided at channelized intersections under traffic signal control. See Figure 6-1.

6.7.2 Site Access Improvements: The proposed access road intersection for Manini'owali should provide for exclusive left turn lanes (northbound), a right turn deceleration lane (southbound), and a right turn acceleration lane (southbound) on Queen Ka'ahumanu Highway. Traffic signals should be installed at this channelized intersection. These improvements should be implemented on an interim basis, with the undestanding that at-grade access on Queen Ka'ahumanu Highway would eventually be eliminated and replaced with a system of frontage roads leading to the proposed interchanges.

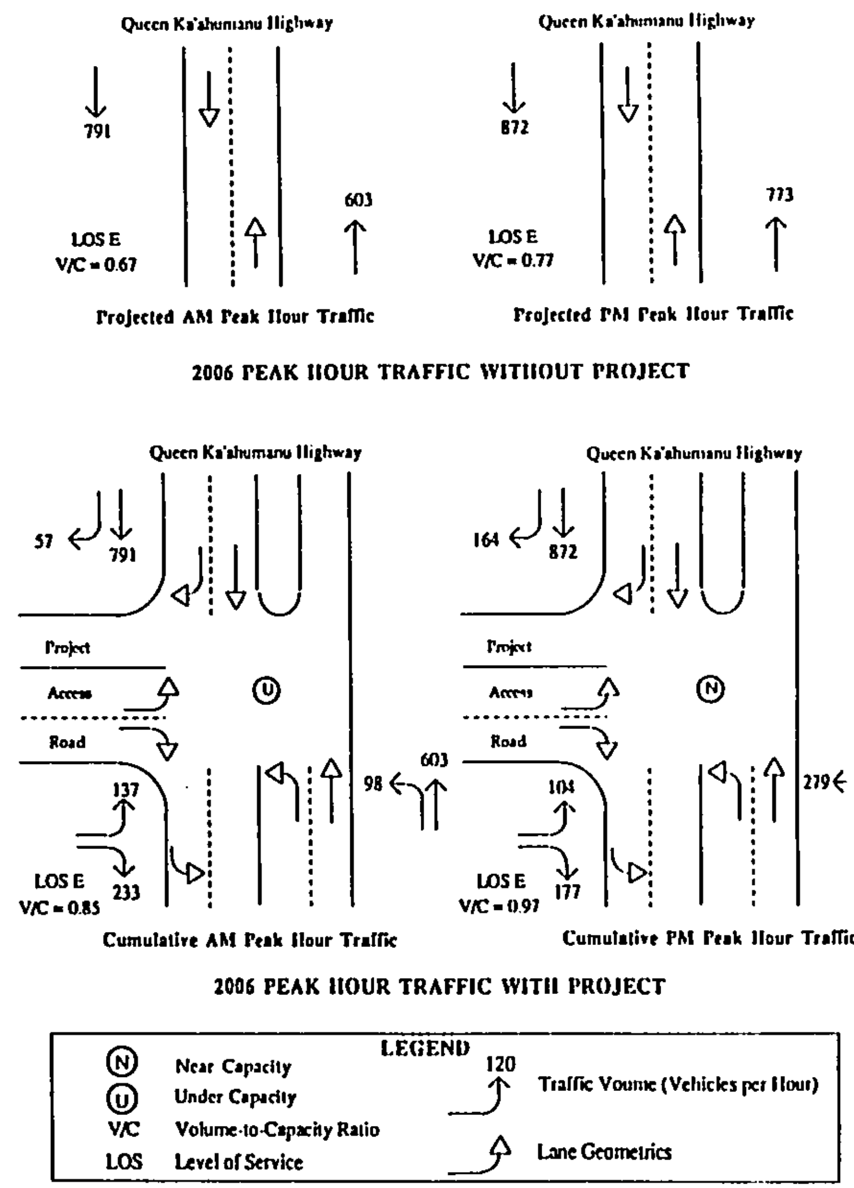
6.8 Traffic Impact Analysis:

6.8.1 A.M. Peak Hour Traffic With Project: During the A.M. peak hour with the site-generated traffic, the project access road intersection on Queen Ka'ahumanu Highway would operate "under capacity" under signalized conditions. The Queen Ka'ahumanu Highway, south of the project access road, would operate at Level of Service (LOS) "E" whose upper limit is the capacity of the highway. Operation in this zone is unstable, speeds and flow rates fluctuate and there is little independence of speed selection or manuever. The Volume to Capacity Ratio (V/C) is 0.85.

6.8.2 P.M. Peak Hour Traffic With Project: The project access road intersection on the Queen Ka'ahumanu Highway would operate "near capacity" under signalized conditions, during the P.M. peak hour with the site-generated traffic. The Queen Ka'ahumanu Highway, south of the project access road, would operate at LOS "E" and a V/C ratio of 0.97.

6.8.3 Estimated Construction Traffic: Based on previous projects (Mauna Lani Resort, Kaupulehu) it is estimated that 70% of the construction employees will be Hawaii island residents with the remaining construction workers from the other islands. Contractors in South Kohala report that approximately two-thirds of off-island construction workers obtain housing in the short-term rental market in the Kona area, with 10% to 11% staying in the Waimea and Waikoloa areas.

Preliminary estimates for borrow material required to be hauled to the project site range from 250,000 to 300,000 cubic yards. Traffic in the area will be affected by the movement of heavy trucks to and from the borrow site(s). Based on an average truck load of 30 cubic yards, more than 8,000 trips from the borrow site(s) will be required. The impact of hauling activities on traffic can be minimized by proper construction planning.



2006 Peak Hour Traffic With and Without Project Traffic

MANINI'OWALI RESIDENTIAL COMMUNITY **Figure 6-1**

8.4 Siltation and Dust Drift: The potential for siltation and dust drift will be minimal with construction practices to be in compliance with the County of Hawaii Grading Standards and the State Department of Health Regulations.

8.5 National Pollutant Discharge Elimination System (NPDES) Permit: The Department of Health's Regulations 122, 123 and 124 require that those proposing construction activities that result in the disturbance of more than five acres of total land area, must apply for a NPDES Permit.

SECTION 9
ORDER OF MAGNITUDE COST

I.	**POTABLE WATER SYSTEM**		
	A. Control Building & Site Improvements	400,000	
	B. Electrical	700,000	
	C. 0.75 MG Concrete Reservoir	730,000	
	D. Salt water Reverse Osmosis Desalinization Plant (650,000 GPD)	1,600,000	
	E. Water Mains and Appurtenances	1,900,000	
			$5,330,000
II.	**NON-POTABLE WATER SYSTEM**		
	A. Development of One Well		
	1. Drilling and Casing	350,000	
	2. Pump	70,000	
		420,000	
	6 wells @ $420,000/each		$2,520,000
	B. Control Building and Site Improvements	400,000	
	C. Electrical	700,000	
	D. 0.1 MG Concrete Reservoir	200,000	
	E. Water Mains and Appurtenances	1,900,000	
			$3,700,000
III.	**WASTEWATER**		
	A. Sewage Treatment Plant	$2,910,000	
	B. Materials and Appurtenances	1,045,000	
			$3,955,000
IV.	**STORMWATER DRAINAGE**		
	A. Pipes and Appurtenances	195,000	
	B. Dry Wells	1,458,000	
			$1,653,000

V. GRADING/CLEARING/EXCAVATION/EARTHWORK		
A. Clearing and grubbing	1,127,000	
B. Lot Grading	2,184,000	
C. Trench Excavtion, Water	490,000	
D. Trench Excavtion, Drain	302,000	
E. Trench Excavtion, Sewer	770,000	
F. Borrow Material, Topsoil	4,316,000	
		$9,189,000
VI. ROADWAYS		
A. Major Roads	5,280,000	
B. Park Access Road	1,824,000	
		$7,104,000
VII. OFF-SITE ELECTRICAL		
A. Electrical Substation	750,000	
B. Electrical 12 KV Distribution	80,000	
C. Telephone Feeder	120,000	
		$950,000
VIII. ELECTRICAL ON-SITE (MAJOR ROADWAYS/INFRASTRUCTURE)		
A. Major Roadway	2,550,000	
B. Sewer Pump Station, Electrical Service	190,000	
C. Sewer Pump Station, Distribution/Controls	250,000	
D. Wastewater Treatment Plant, ELectrical Service	30,000	
E. Wastewater Treatment Plant, Distribution/Controls	400,000	
F. Utility Charge	2,016,000	
		$5,436,000
SUBTOTAL		$39,337,000
CONTINGENCY		$7,868,000
TOTAL COSTS		$47,205,000

REFERENCES

- Waimea Water Services (1991). Evaluation of Manini'owali Water Supply Alternatives-Draft Feb. 7, 1991.
- Commission on Water Resource Management, Department of Land and Natural Resources, State of Hawaii (1989). Hawaii County Water Use and Development Plan.
- Phillips Brandt Reddick & Assoc. (Hawaii), Inc. (1986). Final Kukio Beach Resort Environmental Impact Statement.
- Belt Collins & Associates. (1986). Final Environmental Impact Statement Kaupulehu Resort.
- Dan A. Davis and George Yamanaga (U.S. Geological Survey) (1968). Preliminary Report on the Water Resources of the Kona Area, Hawaii.
- Group 70 Limited (1990). Environmental Assessment for Awake'e/Manini'owali Land Exchange - A Land Exchange Involving State Lands.
- R.M. Towill Corporation (1971). Hydrology Study for Kailua-Kawaihae Road Section III Keahole to Hapuna Districts of North Kona, South Kohala Island of Hawaii.
- Belt Collins and Associates (1987). Ewa Water Master Plan.
- U.S. Environmental Protection Agency (1977). Process Design Manual for Land Treatment of Municipal Wastewater.
- University of Hawaii - Water Resources Research Center (1975). Recycling of Sewage Effluent By Irrigation: A Field Study On Oahu Final Progress Report For August 1971 to June 1975.

APPENDIX C

ENVIRONMENTAL ASPECTS OF STORM WATER RUNOFF

Maniniowali Residential Community
North Kona, Hawaii

June, 1991

by

Gordon L. Dugan, Ph.D.
Environmental Consultant

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INTRODUCTION

The proposed Manlniowali Residential Community Project, Located in the North Kona District of the Island of Hawaii, as shown in Figure 1, consists of a residential development, an 18 hole golf course, driving range, club house, tennis center, park wastewater treatment facility, and roadways. An outline of the proposed project is shown on Figure 2 and the corresponding acreage for each separate land-use is presented in Table 1. The total indicated development area of 388 acres, listed in Table 1, also includes areas that will not be developed, but rather will remain in their natural state. Most notable is that only approximately 100 acres of the golf course, out of 173.3 acres listed, will be cultured in grass, with the remainder being undeveloped and non-maintained. The other undeveloped areas are the 25.1 acres under the Constraints heading, more specifically the Archeological/Burial Sites, Small Puu, and Highway setback, and the 17.3 acres of open land. Thus, out of the gross area of 388 acres only approximately 272 acres will actually be developed. Only the portion of the beach access road within the project boundaries are included in Table 1. The remaining portion of the beach access road is expected to be developed by the County of Hawaii.

Physically, as can be noted in Figure 2, the proposed project is situated approximately between Kaholawa Bay and Kakapa Bay, with an ocean setback varying from 600 to 1400 ft on the makai side, while the mauka boundary is about 200 ft from Queen Kaahumanu Highway. The Keahole Airport is situated approximately 5mi away in the southwesterly direction. The elevation inside the property boundaries, ranging from about 35 to 275 ft, slopes in a diagonal direction across the property in a northern direction toward the ocean.

The proposed property is situated in one of the driest areas of the island, as can be noted in Figure 1. Based on the isohyets of Figure 1 it appears that the property receives a median annual rainfall of approximately 430 mm or 17 in. This quantity of rainfall is essentially the same (16.5 in) as that measured at the Natural Energy Laboratory at Keahole Point, 6.5 mi to the southwest, as reported by State of Hawaii Department of Land and Natural Resources (DLNR)*. The mean annual pan evaporation rate at the project site is estimated to range from 80 to

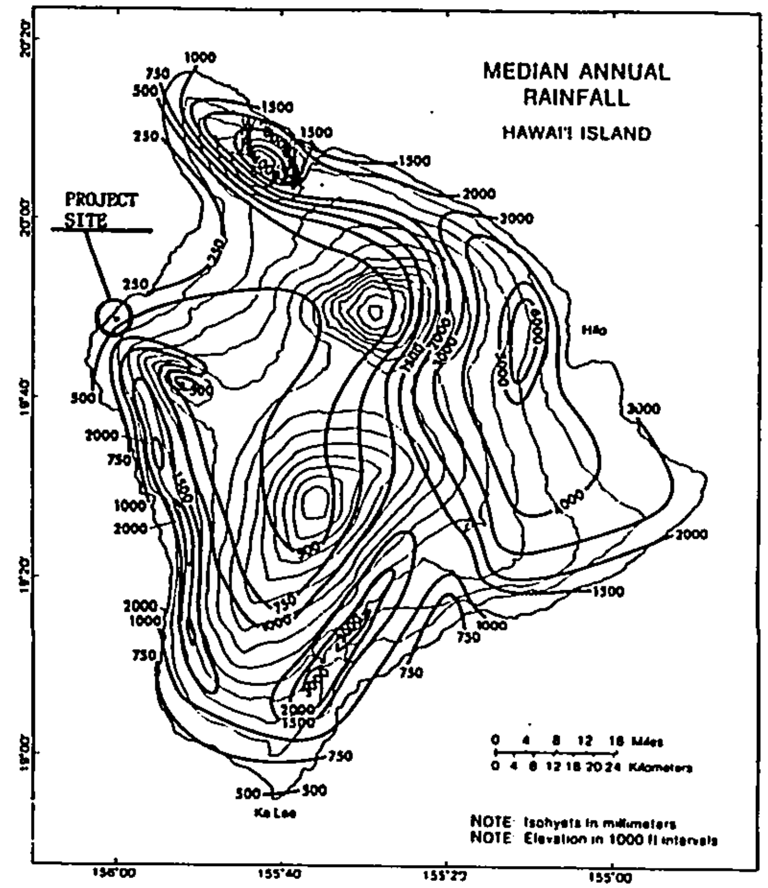


Figure 1. Median Annual Rainfall and Topographic Characteristics, Island of Hawaii

Source: Reference, Giambelluca, Nullet, and Schroeder

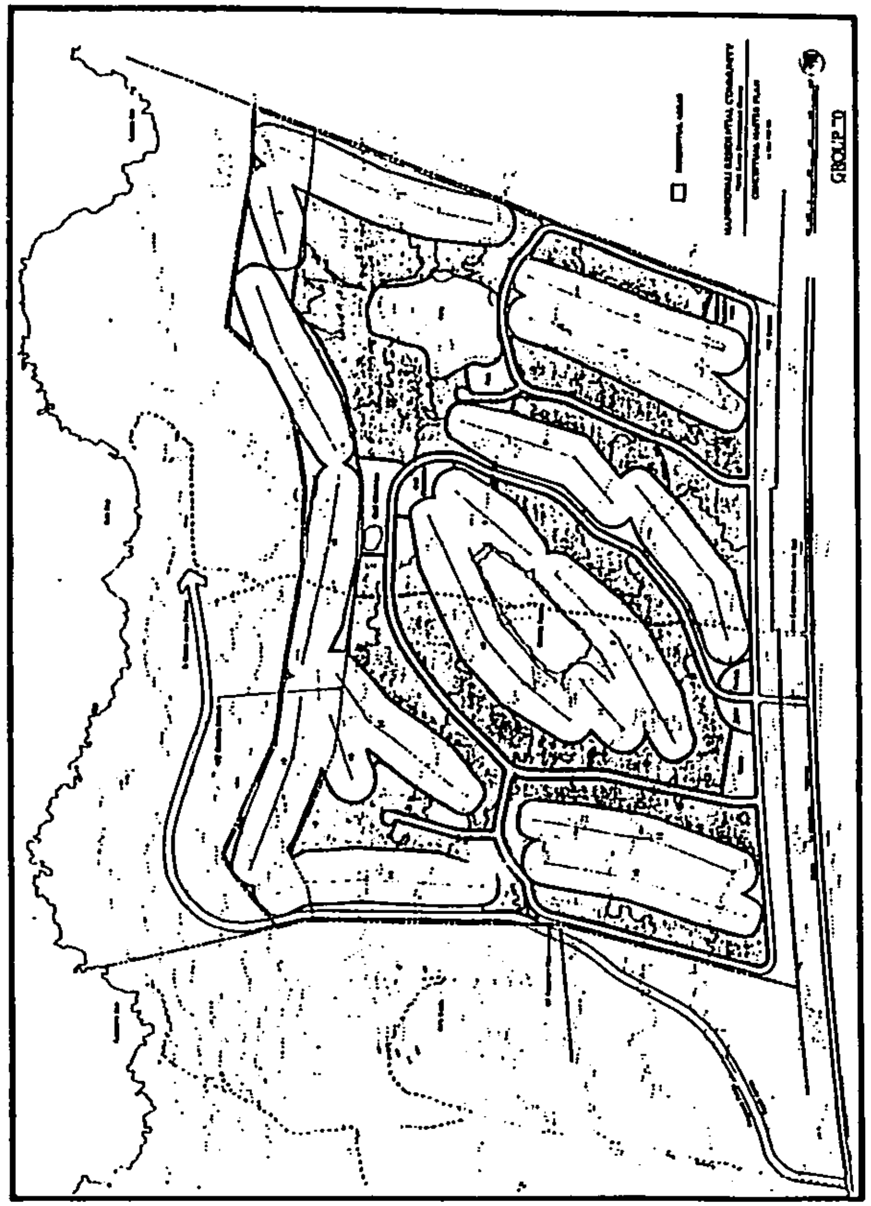


Figure 2. Maniniowali Residential Community, North Kona, Hawaii

TABLE 1

MANINIOWALI RESIDENTIAL COMMUNITY
PRELIMINARY MASTER PLAN AREAS - ALTERNATIVE II

May 15, 1991

LAND USE	APPROXIMATE AREAS (acres)* ALT. II	
RESIDENTIAL	132.3	
GOLF COURSE	173.3 [1]	
FACILITIES	14.7	
Driving Range		(6.8)
Clubhouse		(2.8)
Tennis Center		(1.9)
Wastewater Treatment		(1.6)
Park		(1.6)
ROADS	21.7	
40' Internal Road R.O.W.		(19.2)
60' Park Access Road R.O.W.		(2.5) [2]
CONSTRAINTS	25.1	
Archaeological/Burial Sites		(0.9)
Small Pu'u		(9.7)
Highway Setback		(14.5)
ENTRANCE	3.6	
SUBTOTAL	370.7	
OPEN LAND	17.3	
TOTAL	388	

* Estimated areas derived from digitizing of preliminary sketch drawings
[1] It is estimated that only 100 acres of this total will be developed, with the remaining acreage staying in its natural state
[2] Includes only the portion inside the proposed project boundaries

Table prepared by Group 70 Ltd., Honolulu, Hawaii

90 in, which is in the order of five times higher than the site's median annual rainfall (Ekern and Chang, 1985).

The project has a parched/arid type appearance, with the bedrock material consisting of prehistoric lava flows from the Hualalai Volcanic series, as shown in Figure 3. The lava flows on the project site are quite evident. Three soil series within the project boundaries, Rock Land, Lava Flow (Aa), and Cinder Land, as presented in Figure 4, cover approximately 50, 47, and 3% of the property respectively. The classification preceded by "r" for the three soil series indicates a reconnaissance survey, in comparison to the progressively more complete surveys labeled low-intensity and high-intensity. The soil series Rock Land (rRO) primarily consists of Pahoehoe lava covered in places by a thin layer of soil material; Lava Flows (rLV) are Aa lava typically with no soil covering or vegetation; and Cinder Land (rCL), which is a miscellaneous land type, consists of bedded cinders, pumice and ash (Sato, et al., 1973). The small Puu (knoll), shown in Figure 2 and listed in Table 1, which will not be developed, covers the majority of the Cinder Land area. All three of these soil types are highly permeable, with the result that, coupled with only a thin soil layer in some areas, very little surface water runoff actually reaches the ocean, except in limited quantities by way of access road and trails. The presence of lavas flows without vegetation takes up approximately one-half of the project site, with the other one-half covered with clumps of Fountain Grass and a scattering of Kiawe Trees.

The groundwater underlying the proposed project has been long known as consisting of a thin basal lens of brackish water, as can be ascertained in Figure 5, which was reproduced from a publication by Stearns and Macdonald (1946). Groundwater becomes fresher as the distance from the ocean increases. Although there are no wells within the project site, wells in other nearby areas have lead investigators to estimate that the chloride (essentially salinity) content would not be expected to be less than 1000 mg/l, with a likely concentration range of 1500 to 3000 mg/l (Bowles and Stubbart,1990). The upper desirable chloride limit for drinking water is 250 mg/l (U.S. Environmental Protection Agency), 1979).

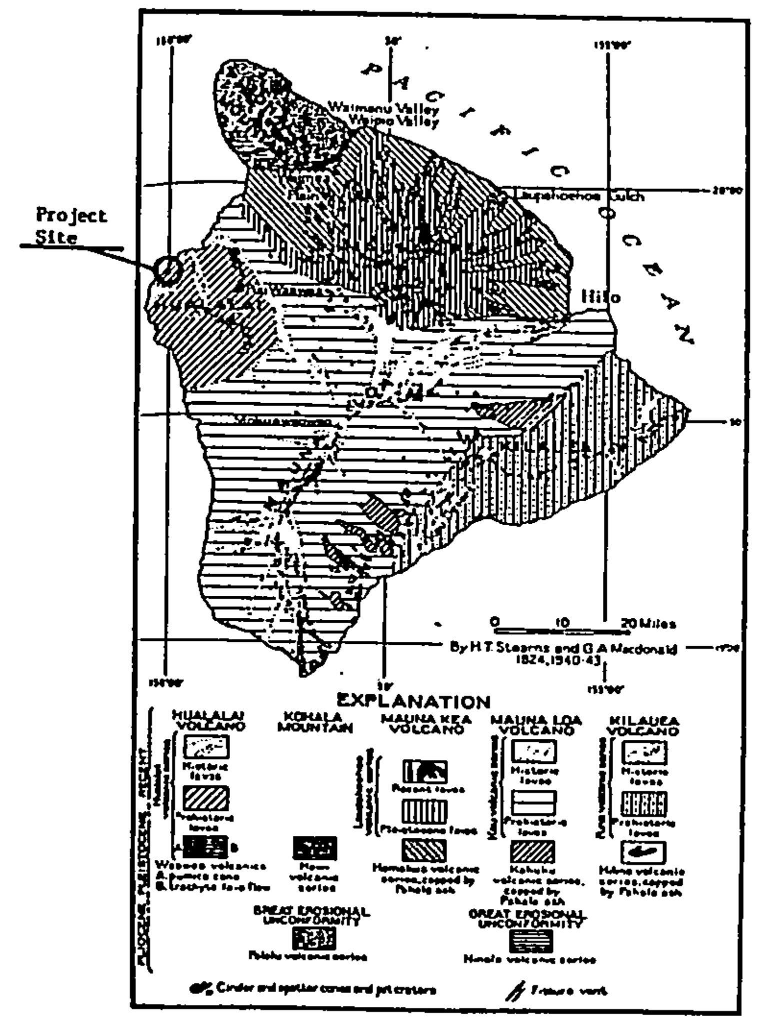
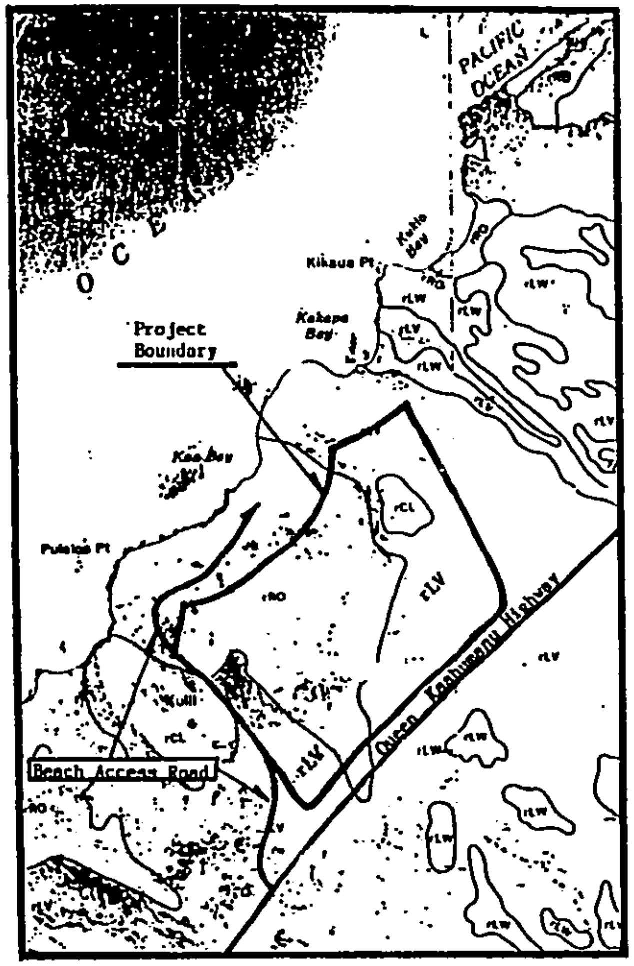


Figure 3. Geologic Characteristics of Island of Hawaii

Source: Reference, Stearns and Macdonald, 1946



Legend:
rLV - Lava Flows
rCL - Cinder Land
rRO - Rock Land

Figure 4. Soil Series Within Maniniowali Residential Community Boundaries, North Kona, Hawaii

Source: Reference, Sato, et al., 1973

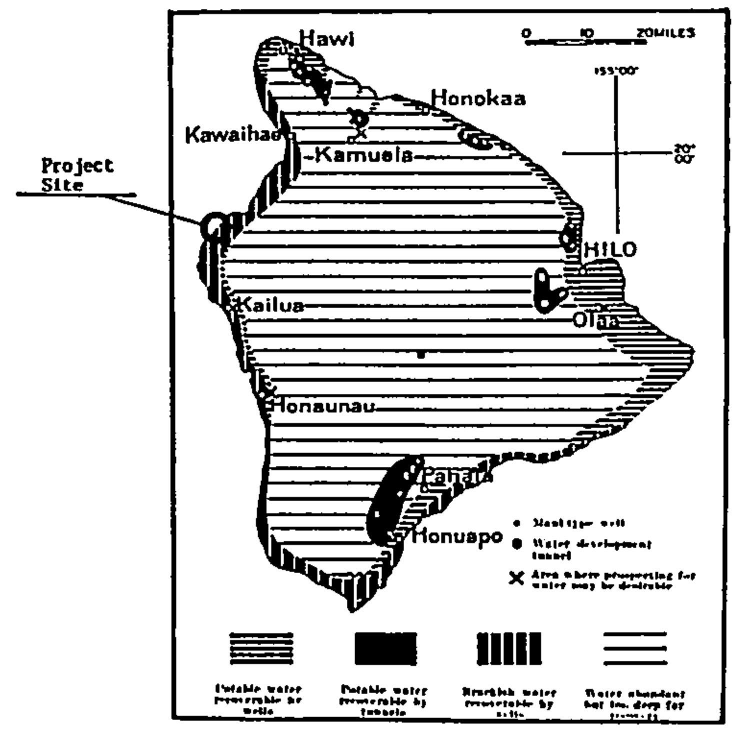


Figure 5. Generalized Potable and Brackish Groundwater for Island of Hawaii

Source: Reference, Stearns and Macdonald, 1946

A development project such as the one being herein proposed generally produce alterations in surface water runoff as a result of modifying existing ground conditions. Interest in these runoff changes is generally a result of concern over two factors: one, public safety, and two, environmental impact. The first factor requires the identification of changes in peak discharge rates, the magnitudes of which are necessary for designing adequate drainage structures to prevent flooding, while the second concern requires identification of changes in total runoff volume, as well as sediment, nutrient, and other constituent loads, and the effects these will have on the ecosystem of the natural resource serving as the "sink." It is this second concern, environmental impact resulting from increased runoff volume and sediment and nutrient loads, and its probable effect on subsequent receiving waters (groundwater and nearshore ocean waters) that is under study in the present investigation as herein reported.

PURPOSE AND SCOPE

The purpose of this study is to evaluate the environmental impact of the proposed Maniniowali Residential Community as it relates to surface water runoff. From an assemblage of baseline hydrologic and water quality data, an estimate of the existing and projected volume and quality characteristics of surface water runoff will be made, along with an assessment of the environmental impact resulting from this runoff, in the form of written comments.

METHODOLOGY

The methodology used in this study consisted of assembling, analyzing, and interpreting existing data from federal, state, and county agencies, as well as from on-site surveys of field conditions.

Inasmuch as the scope of work consisted of estimating the alterations in volume and quality of surface water runoff resulting from the proposed project, it was necessary to identify those factors that affect runoff generation and runoff quality for both present and full development conditions.

Methods currently available to estimate the surface water runoff volume from a specific storm event requires the determination of reasonable rainfall-runoff coefficients for varying magnitude and duration storms, and for different land management, vegetation, soil, and soil moisture conditions, to name but a few hydrologic factors. In most practical situations, it is not considered feasible, due to the numerous influencing factors, to determine varying rainfall-runoff coefficients; rather, it is more practical for design and evaluation purposes to use a single coefficient for a particular land use over a given rainfall intensity range. However, in order to circumvent a major portion of the unavoidable error created by using a constant rainfall-runoff coefficient, methods developed by the Hawaii Environmental Simulation Laboratory (HESL) of the University of Hawaii at Manoa (Lopez, 1974; Lopez and Dugan, 1978), and the U.S. Soil Conservation Service (SCS)(1986), were utilized to determine representative storm water volumes under varying conditions.

The HESL/SCS methods are based on the use of soil maps (Sato et al., 1973) and the incorporation of curve numbers from the U.S. SCS which were obtained from empirical data, including precipitation, soil and changing soil moisture conditions, and vegetative cover information from the classification of thousands of soils throughout the nation. These soils were classified into four groups, labeled A, B, C, and D, with Class A having the highest water intake rates and Class D soils the lowest (U.S. Soil Conservation Service, 1986).

As previously indicated the three soil series on the project site, Rock Land, Lava Flows (Aa), and Cinder Land are highly permeable, with the

result that very little storm water runoff actually exists for any significant distance, except possibly along the access roads and trail or pathways. Under these natural conditions only a limited quantity of storm water runoff, if any, even under heavy storm conditions, would actually reach the ocean from the setback (600 to 1400ft to the ocean) proposed project site. Rather the storm water that is not subjected to evaporation and/or transpiration will reach the ocean by way of groundwater discharge in a narrow band in the intertidal zone (Lau, 1980).

The actual construction practices to be used for the proposed project development over the lava and rock land terrain are not known at this time. However, because of the expense involved in crushing the existing rock surfaces it is presumed that the fill material necessary for vegetation surfaces (golf course, lawns, shrubbery) and general filling over and above the excess material excavated on site will consist of material from an unspecified, easily accessible cinder cone area. The cinder cone materials include bedded cinders, pumice, and ash (Sato, 1973). For the areas that will receive a vegetative surface it is presumed that the cinder cone material will be overlayed by a finer textured soil.

Under the present natural conditions of high permeability the present soils would undoubtably be classified under Class A (highest water intake rates), even though this type of surface apparently has not been officially designated as such by the U.S. Soil Conservation Service listing of Hawaiian Soils (Lopez and Dugan, 1978). Although various finer textured soil condition scenarios (type and thickness) could be advanced, considering the high permeability of the existing soil rock material and the expected coverage of high permeable cinder cone material (or on-site crushed materials) in the areas needing additional fill it is assumed that the overall result would be a ground surface that would represent Class A conditions.

In any event no storm water drainage facilities to the ocean are planned for the proposed project. Storm water runoff is expected to remain on-site and be disposed of by means of specially constructed seepage areas located throughout the project site. Thus, even though the overall developed soil conditions prove to have a lower water intake rate than Class A the excess storm water runoff will still be directed to the groundwater.

The land enclosed by the proposed project boundaries can be segregated into four general categories, which have similar storm water runoff characteristics according to their land use. The four categories, which include all the separate land uses shown in Table 1, are: Residential, Golf Course, Roadways, and undeveloped land (open space). Referring to Table 1 the Residential land-use includes the residential, clubhouse, tennis center, wastewater treatment, park, and entrance, for a total of 143.8 acres. The Golf Course land-use consists of 100 acres out of the 173.3 acres (73.3 acres are not scheduled to be developed) and the Driving Range, for a total of 106.8 acres. The Roadway land-use is mainly the internal roads plus 2.5 acres of Park Access Road that is within the project's boundaries, for a total of 21.7 acres. Undeveloped land within the project site, the undeveloped portion of the Golf Course, Archaeological/Burial Sites, Small Puu, Highway setback, and Open Land totals 115.7 acres. Thus, the developed portion of the land within the project boundaries is approximately 272 acres out of the 388 acres listed in Table 1.

The rainfall recurrence interval storms chosen for evaluation purposes, 1, 5, 10, 25, 50, and 100 yr, with 1 and 24 hr durations, were obtained from a rainfall-frequency atlas for the Hawaiian Islands (Weather Bureau, 1962).

Once the increase in surface water runoff volume has been established, it is necessary to determine the runoff quality for present and full development conditions.

The quality parameters of storm water runoff considered the most representative to identify potential changes under different land management practices (i.e. present and full development conditions) are: total nitrogen; total phosphorus; and suspended solids (sediments). Unfortunately, there are no water quality data from the project site or even nearby areas, primarily because of the low rainfall and high permeability conditions encountered.

To circumvent the problem of determining representative nitrogen and phosphorus values in surface water runoff, for comparative purposes, nitrogen and phosphorus values of 2.0 and 0.2 lb/acre-yr, respectively, were selected to represent the present (1991) conditions at the proposed project site area. These values were derived from a compilation of data

relating to nutrient outputs from rural and agricultural lands throughout the nation that were reported by Loehr (1972) and adjusted downward because of the thin and sparse soil and vegetative conditions on the project site. To convert the output loads to concentration values, nitrogen and phosphorus values of 2.0 and 0.2 lb/acre-yr, respectively, were calculated with the median annual rainfall of 17 in., and a rainfall-runoff coefficient of 0.20, which results in average (rounded-off) concentration values of 2.60 and 0.26 mg/L, respectively, for the present development conditions.

Representative suspended solids values in storm water runoff from the present (1991) conditions at the project site area are again difficult to determine, inasmuch as it is commonly presumed, by mainly indirect methods, that the majority of the annual suspended solids load is carried by heavy storm water runoff events which tend to occur on an infrequent basis. However, for the unusual storm water runoff conditions encountered at the project site, because of the high percolation rate of the rough surfaces of Rock Land, Aa Lava Flows, and Cinder Land the actual storm water runoff on the ground surface would be limited over most of the site. Some channeling of storm water runoff from significant storms may occur along the access road and trail or pathways, but the quantity actually flowing for any distance along these routes in comparison to the area of the entire project site would be negligible.

The concentration of sediment (suspended solids) may be relatively high under heavy storm conditions because the median and coarse rocks/sand and the thin soil on the site are not well stabilized by vegetation as would be the case in other areas of higher rainfall and thicker fine grain organic soil conditions. High sediment loads in storm water may move only a short distance before being impeded by the rough surface terrain and filtered out before reaching the groundwater surface by percolation. Based on the foregoing the concentration of suspended solids for the present study was assumed to be 500 mg/l for comparative purposes, which is below the 800 to 1200 mg/l concentration range typically found for composite measured and estimated suspended solids loads per unit area from other locations in Hawaii.

Quality data for storm water runoff from developed areas are sparse, both locally and nationally. Loehr (1974) compiled urban storm water runoff quality data collected from throughout the United States, as well as from a few international locations. As expected, the data are diverse. Locally, Fujwara (1973) reported urban water quality data collected from storm drains in different land use drainage areas of Honolulu (residential, commercial, and industrial). The quality values of storm water runoff draining residential areas are shown in Table 2. These values compare favorably with similar situations from the continental U.S.

When evaluating projected storm water quality constituent concentrations it must be borne in mind that the values of concern are for surface water runoff, in comparison to values contained in percolated water. For example while certain forms of nitrogen (organic and ammonia) and nearly all the phosphorus are effectively removed from waters percolating through most Hawaiian soils those contained in surface water are not necessarily subjected to this sorption process. Constituents leached and/or introduced to surface water runoff (principally storm water) from vegetative sources, human and animal activity, and even fertilizers (if significant rainfall occurs shortly after application) can be carried and solubilized in the storm water runoff without being subjected to the sorption process in the soil column.

The storm water runoff situation, however, for the herein reported proposed project is somewhat unique in comparison to land-use alterations from most development projects in the State of Hawaii. The difference is that the storm water runoff will not be directly rou[illegible] to a surface water body, but rather will flow to on-site seepage areas, which will recharge the groundwater table beneath the site before it flows into the fronting ocean. If the seepage areas contains organic soil material it would be expected that most of the organic and ammonia nitrogen and phosphorus will be removed from the storm water before reaching the groundwater table. The oxidizable forms of nitrogen (nitrite and nitrate) are, with few exceptions, only found in the soluble form. Thus, nitrites and nitrates, including the portion oxidized from organic and ammonia nitrogen compounds, that are not taken up by vegetative roots and/or subject to the denitrification process can reach the groundwater table.

TABLE 2

Representative Storm Water Quality Data for a Honolulu Residential Area a/*

All units in mg/l:

CONSTITUENT	CONCENTRATION
Total Solids	511
Suspended Solids	252
COD	142
BOD	10
Disolved Oxygen	7.1
NO_3 - N	0.211
TKN	0.381
Total P	0.57
Ortho P	0.27
Iron	0.377
Lead	0.407
Chromium	0.013
Zinc	0.512
Copper	0.036

a/ Storm water samples collected on Aupuni Street near Nuhelewai Stream.
* Values obtained from Fujwara (1973).

Prudent application of nitrogen fertilizers can help control the potential for nitrogen being introduced into the storm water runoff.

For the present study, the quality results of storm waters from the Honolulu residential area of Table 2 for nitrogen, phosphorus, and suspended solids of 0.60, 0.57, and 250 mg/L, respectively, were used for the proposed project's full development conditions, including the roadways, since they are, in this situation, positioned to be an integral part of development. The residential quality storm water runoff values were used for the golf course inasmuch as fertilization is applied under professional supervision with attention given to the application rate as well as abstaining from fertilization during periods of probable heavy rainfall, for economic as well as environmental reasons. Attention is likewise drawn to the heavy metal content of residential storm water runoff.

The aforementioned storm water runoff constituent concentrations for nitrogen, phosphorus, and suspended solids for the present (1991) conditions and full development conditions can then be applied to the present and full development runoff volumes to determine the projected sediment and nutrient loads from the project site.

SURFACE WATER RUNOFF ALTERATIONS

Quantity

The estimated storm water runoff and constituent changes due to the proposed 272 acre alterations out of the 388 acres (Table 1) within the boundaries of the Maniniowali Residential Community development are shown in Table 3. The values presented, it must be emphasized, are only for comparative purposes, and are not intended to be representative of the accuracy implied by the practice of reporting results to one/two decimal places. This was done primarily for convenience of calculations and balancing. No attempt was made to compare these changes with contributions from its surrounding or parent watershed area, which would tend to negate apparent changes caused by the land use alterations within the project site.

As can be observed in Table 3, the storm water runoff for all 1-hr duration storms and the 24-hr duration, 1-yr recurrence interval storm indicated no runoff under existing (1991) natural conditions. The remaining higher level storms showed a calculated increase of up to 13.8 acre-ft for the highest level storm considered, the 24-hr, 100-yr event. This quantity of runoff is relatively minor when considering the 272 acres of land alterations involved, and that the existing soil/rock natural conditions could have a higher infiltration rate than indicated in the assumed Class A soil designation. Presuming that the repositioned and imported/crushed soil surface will remain under the Class A designation, as previously discussed the incremental quantity of calculated storm water runoff (over existing conditions) increases from 1.5 acre-ft for the 1-hr, 1-yr storm up to 53.4 acre-ft for the 24-hr, 100-yr storm event. Thus, under the given assumed conditions of Class A soil conditions the project would require a calculated 53.4 acre-ft of storage for the 24-hr, 100-yr storm to equal the same (1991) storm runoff conditions for a 24-hr storm event that is a statistical expected on once every 100 years.

If the readjusted soil conditions for the finished development proved to be a higher class soil (less infiltration) then the on-site storage capacity would have to be increased accordingly for the 24-hr,100-yr storm in order to maintain the goal of no additional storm water runoff from the finished development project. Nevertheless, a higher

TABLE 3
Estimated Storm Water Runoff and Constituent Changes due to the proposed Maninlowali Residential Community, North Kona, Hawaii

Storm			Storm Water Runoff											
Duration	Recurrence Interval	Quantity	Hydraulic			Nitrogen			Phosphorus			Suspended Solids		
			Development		Δ	Development		Δ	Development		Δ	Development		
			1991 AF event	Full AF event	AF event	1991 lb event	Full lb event	lb event	1991 lb event	Full lb event	lb event	1991 ton event	Full ton event	ton event
hr	yr	in.												
1	1	1.00	0.0	1.5	1.5	0.0	2.4	2.4	0.0	2.3	2.3	0.00	0.49	0.49
1	5	1.50	0.0	3.2	3.2	0.0	5.2	5.2	0.0	4.9	4.9	0.00	1.08	1.08
1	10	1.75	0.0	4.4	4.4	0.0	7.2	7.2	0.0	6.8	6.8	0.00	1.49	1.49
1	25	2.00	0.0	5.8	5.8	0.0	9.5	9.5	0.0	9.0	9.0	0.00	1.97	1.97
1	50	2.25	0.0	7.4	7.4	0.0	12.1	12.1	0.0	11.5	11.5	0.00	2.52	2.52
1	100	2.50	0.0	9.1	9.1	0.0	14.9	14.9	0.0	14.2	14.2	0.00	3.11	3.11
24	1	2.75	0.0	11.0	11.0	0.0	18.0	18.0	0.0	17.1	17.1	0.00	3.75	3.75
24	5	4.00	0.1	22.4	22.3	0.6	36.5	35.9	0.1	34.7	34.6	0.06	7.61	7.55
24	10	5.00	1.9	33.8	31.9	13.3	55.2	41.9	1.3	52.5	51.2	1.28	11.51	10.23
24	25	6.00	5.7	46.9	41.2	40.3	76.5	36.2	4.0	72.7	68.7	3.87	15.94	12.07
24	50	6.75	9.7	57.5	47.8	68.5	93.8	25.3	6.9	89.1	82.2	6.59	19.55	12.96
24	100	7.40	13.8	67.2	53.4	97.9	109.6	11.7	9.8	104.1	94.3	9.41	22.84	13.43

a) From "Rainfall-Frequency Atlas for the Hawaiian Islands (Weather Bureau, 1962)

b) Based on a nitrogen value of 2.60 mg/l for 1991 conditions, and 0.60 mg/l for "Full" development.

c) Based on a phosphor[illegible]lue of 0.26 mg/l for 1991 conditions, and 0.57 mg/l for "Full" development.

d) Based on a suspended solids value of 500 mg/l for 1991 conditions, and 250 mg/l for "Full" development.

Note: Constituent load results are based on hydraulic loads prior to rounding-off to one/two decimal points.
Table values based on Group 70's May 16, 1991 conceptual Master Plan map.

percentage of the storm water would infiltrate essentially in-place for higher infiltrative soil conditions, or the storm water runoff would be intercepted on-site by additional capacity engineered means for forced seepage if the finished soil surface had a lower infiltrative capacity than assumed for calculation purposes.

These runoff values (acre-ft/event) represent a volume of water and should not be confused with peak discharge rates which represent the maximum volume of storm water runoff discharge per unit of time (e.g., cfs or mgd). Peak discharge rates are required for engineering design of proposed drainage facilities and ascertaining the capacity of existing facilities, while total runoff volume provides a more realistic estimate of impact on water quality.

Quality

Besides the changes in volume of storm water runoff, the quality of the various constituents being transported is of equal, if not, sometimes, of more importance. However, estimates of water quality constituents resulting from significant storm water runoff that occurs at the most only a few times a year is very perplexing, especially since information on this subject essentially only become available at both the local and national levels in the 1970's.

The summation of nitrogen, phosphorus, and suspended solids loads from both the present (1991) and projected (full) development for storms of 1 and 24-hr duration at recurrence intervals of 1, 5, 10, 25, 50, and 100 -yr are shown in Table 3, along with the correspondingly previously discussed storm water volumes for specific storms.

The calculated incremental storm water runoff changes per storm event for the present and projected development conditions for the various duration and recurrence interval storms indicate that from the least to the greatest amount of rainfall: the nitrogen load increases for the first nine storm events and then decreases for the remaining three; and phosphorus and suspended solids (sediments) increases for all storms. As was indicated in the discussion concerning storm water runoff volume, the interspersion of on-site engineered seepage facilities throughout the proposed project, if provided with sufficient organic content soil, will restrict constituent loads to the property, except for the previously discussed oxidized forms of nitrogen (nitrite and nitrate which are with few exception only found in the soluble form). Nitrogen oxidized to nitrite or nitrate, or applied to that form that escapes the vegetative root zone (and is not denitrified) could percolate to the brackish groundwater lens below the project site, during significant rainfall events and/or during times of excess irrigation. The latter is only expected to be required at infrequent times to control salt build-up in the soil, since Class A soils have high infiltrative capacities anyway. Nevertheless, the calculated highest quantity of incremental nitrogen load under full development conditions for Class A soils was only approximately 42 lb (24-hr/10-yr event - Table 3) which is relatively small for a 272 acre land-use alteration project. A lower infiltrative soil would potentially increase the nitrogen load in surface water runoff and prudent fertilization practices could decrease the load.

The hydrologic and water quality aspects of the surface water runoff were only considered for the present and projected full development conditions. However, increases in constituent loads could result from construction activities, especially if a significant storm occurs during the interim period between earth moving operations or exposed soil conditions and soil stabilization completion. The impact of construction activities can be minimized by adhering to strict erosion control measures.

Other water quality constituents of general concern include biocides and heavy metals. Typically, the biocides in general use tend to break down more readily in comparison to the more long lasting types used in previous years. This aspect will be presented in another report concerning the proposed project.

Heavy metals, on the other hand, do apparently increase somewhat as a result of urbanization, however, for a comparison basis, although it is not directly applicable for storm water runoff, only lead and iron (by a slight margin), according to the values in Table 2, actually exceed the primary (Department of Health, 1981) and secondary (U.S. Environmental Protection Agency, 1979) drinking water standards, respectively. Inasmuch as essentially all new automobiles have switched over to unleaded gasolines since the mid-1970's and a stricter control of lead in consumer products, the concentration of lead in residential storm water runoff appears to be steadily decreasing. The concern with iron

concentrations in drinking water is due to its potential for staining fixtures and producing tastes.

SUMMARY AND CONCLUSIONS

The proposed Maniniowali Residential Community, located in the North Kona District, Island of Hawaii, consists of a residential development, an 18 hole golf course and associated appurtenances. Although there are 388 acres within the project boundaries only 272 acres are being planned to be developed, with the remaining acreage staying in its present natural state. The project is positioned 600 to 1400 ft from the ocean shoreline, while the mauka portion of the property is about 200 ft from Queen Kaahumanu Highway. The project is situated about 5 mi in the northeasterly direction from Keahole Airport.

Median annual rainfall at the project site is approximately 17 in. while annual pan evaporation rates range from 80 to 90 in. Three soil series, Rock Land, Lava Flows (Aa), and Cinder Land, all highly permeable, cover the project site. The relationship of the soils to storm water runoff is discussed in the text of the report. A thin soil mat, covering about one-half the site, supports clumps of Fountain Grass and a scattering of Kiawe trees. The low rainfall, restricted soil coverage, and high infiltrative soils give the appearance of an arid environment.

The purpose of this study is to evaluate the environmental impact of the proposed 272 acre land alterations, within the project boundaries as it relates to surface water runoff. To this end the study identified changes in total runoff volume, as well as sediment, nutrient, and other constituent loads. The study does not directly relate itself to peak discharge rates resulting from storms, which are required for designing adequate drainage structures to prevent flooding and other excess storm water runoff related aspects. However, incremental storm water runoff over and above natural runoff conditions are planned to be retained on-site for discharge through engineered seepage facilities located throughout the project site.

The methodology utilized in the evaluation of the environmental impact of storm water runoff from the project site consisted of the incorporation of methods reported by the Hawaii Environmental Simulation Laboratory of the University of Hawaii at Manoa and the U.S. Soil Conservation Service, soil maps, a rainfall frequency atlas, and derived storm water quality constituent values. The rainfall reacurrence

interval storms chosen for evaluation purposes were 1, 5, 10, 25, 50, and 100-yr, with 1 and 24-hr durations.

The results of the storm water runoff volume calculations indicated that no storm water runoff would be generated for all the 1-hr duration storms, and the 24-hr duration, 1-yr recurrence interval storm for existing (1991) natural conditions. The incremental quantity of calculated storm water runoff (over existing conditions) increases from 1.5 acre-ft for 1-hr, 1-yr storm up to 53.4 acre-ft for the 24-hr, 100-yr storm event. Thus under the given assumptions concerning the importation and/or crushing of on-site rock material a calculated 53.4 acre-ft of storage for the 24-hr/100-yr storm would be required in order to maintain the goal of no additional storm water runoff from the finished development project.

Besides the changes in the volume of storm water runoff, the quality of the various constituents being transported is of equal, if not, sometimes,of more importance. The incremental load changes per storm event for the present (1991) and full development project conditions for the various duration and recurrence interval storms indicate that from the least to the greatest amount of rainfall: the nitrogen load increases slightly for the first nine storm events and then decreases for the remaining three; while phosphorus and suspended solids (sediment) increases for all storms evaluated. The interspersion of engineered seepage facilities throughout the project site is intended not only to contain calculated runoff volume but also to consequently retain the constituent loads within the property, with the exception of excess nitrogen that is oxidized (nitrite and nitrate) and escapes the root zone and is not denitrified before reaching the underlying brackish groundwater lens. This aspect is particularly true for phosphorus which is readily adsorbed by contact with most Hawaiian soils. The seepage areas, if they contain organic soil material should strip the remaining major eutrophication nutrients and sediment from the storm water runoff generated from significant storm events.

The foregoing hydrologic and water quality aspects were only considered for the present and projected full developed conditions. However, increases in constituent loads could result from construction activities, especially if a significant storm occurs during the interim period between exposed and stabilized soil conditions. Thus, to limit these potential increases it is imperative that strict erosion control measures be adhered to. However, with the existing high infiltrative soil/rock conditions of the project site this is of lower concern than with most project developments in higher rainfall areas that have tighter soil conditions (lower infiltration - more runoff) throughout the State of Hawaii.

Other water quality constituents of general concern include biocides and heavy metals. Typically, the biocides in general use tend to breakdown more readily in comparison to the more long lasting types used in past years. This aspect will be presented in another report concerning the proposed project.

Heavy metals, on the other hand, do apparently increase somewhat as a result of urbanization, however, for a comparison basis only lead and iron (by a slight margin) are actually reported to exceed the primary and secondary drinking water standards, respectively. With essentially all new automobiles switching over to unleaded gasolines since the mid-1970's and a stricter control of lead in consumer products the concentration of lead appears to be decreasing with time. The concern with iron concentrations in drinking water is due to its potential for staining fixtures and producing tastes.

REFERENCES

Bowles, s., and Stubbart, J. 1990 "Evaluation of Maninlowali Valley Water Supply Alternatives." Waimea Water Services, P.O. Box 326, Kamuela, Hawaii 96743.

Department of Health, 1981. "Potable Water Systems." Chapter 20 of Title 11, Administrative Rules, State of Hawaii.

Ekern, P.C. and Chang, J., 1985. "Pan Evaporation: State of Hawaii, 1894 - 1983. Report R74. Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii.

Fujiwara, T.D., 1973. "Characterization of Urban Stormwater Discharge from Separate Sewers." M.S. Thesis, Department of Civil Engineering, University of Hawaii at Manoa, Honolulu.

Giambelluca, T.W., Nullet, M.A., and Schroeder, T.A., 1986. "Rainfall Atlas of Hawaii." Report R76, Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii, Honolulu.

Lau, L.S.,1980. "Proposed Prototype Testing Program, Land Disposal by Injection Wells of Ocean Water Effluent at Seacoast Test Facility, Keahole Point, Hawaii Island." unpublished report.

Loehr, R.C., 1972. "Agricultural Runoff." ASCE Journal Sanitary Engineering Division, Vol. 98, SA6, pp. 909-925.

Loehr, R.C., 1974. "Characteristics and Comparative Magnitude of Non-Point Sources." Journal Water Pollution Control Federation, Vol. 46, No. 8, pp. 1849-1892.

Lopez, N.C., 1974. "Estimating the Effects of Urbanization on Small Watershed Peak Discharges." Working Paper WP 73-001, Hawaii Environmental Simulation Laboratory, University of Hawaii at Manoa, Honolulu.

Lopez, N.C., and Dugan, G.L., 1978. "Estimating Peak Discharge in Small Urban Hawaiian Watersheds for Selected Rainfall Frequencies." Technical Memorandum Report No. 58, Water Resources Research Center, University of Hawaii at Manoa, Honolulu.

Sato, H.H., Ikeda, W, Paeth, R. Smythe, R., Takehiro, M. Jr., 1973. "Soil Survey of Island of Hawaii, U.S. Department of Agriculture, Soil Conservation Service.

Stearns, H.T., and Macdonald, G.A., 1946. "Geology and Ground-water Resources of the Island of Hawaii." Bulletin 9, Hawaiian Division of Hydrography. Prepared in cooperation with Geological Survey, United States Department of the Interior.

U.S. Environmental Protection Agency, 1979. "National Secondary Drinking Water Regulations." EPA-570/9-76-000, Office of Drinking Water, Washington, D.C., 20460.

U.S. Soil Conservation Services, 1986. "Urban Hydrology of Small Watersheds." Technical Release 55, Second Edition U.S. Department of Agriculture, P.O. Box 2890, Washington, D.C. 20013.

Weather Bureau, 1962. "Rainfall-Frequency Atlas of the Hawaiian Islands." Technical Paper 43, U.S. Department of Commerce, Washington, D.C.

APPENDIX D

ENVIRONMENTAL ASSESSMENT

OF

FERTILIZER, HERBICIDE AND PESTICIDE USE

ON THE PROPOSED

MANINIOWALI GOLF COURSE

A REPORT TO

Group 70, Ltd.

March 30, 1991

PREPARED BY

Charles L. Murdoch, Ph. D

Richard E. Green, Ph. D.

I. INTRODUCTION

This report addresses the potential environmental impact of fertilizer and pesticide application on the Maniniowali Golf Course. The 18-hole golf course will require application of fertilizers to supply essential nutrients to turfgrasses and ornamental plants, and pesticides to control their associated weed, disease, and insect pests. The term pesticide, used in its generic sense in this report, includes herbicides, fungicides and insecticides. The assessment provided in the report focuses principally on the potential for applied chemicals to move in surface runoff and to groundwater. Additionally, the potential for pesticide transport in the air and potential for negative impact on birds in the area are addressed briefly in the appendices. The toxicity and environmental behavior of pesticides which are likely to be used are considered in the analysis, as are soil, topographic and climatic factors which may impact on fertilizer and pesticide movement.

II. APPROACH

Key elements of the analysis are (1) calculation of quantities of applied chemicals (pesticides and fertilizer nutrients) which are likely to be used throughout the year, (2) compilation of soil, geologic and climatic information which will aid in the assessment of chemical movement, (3) estimation of water balance from rainfall, irrigation and evapotranspiration, (4) compilation of pesticide properties which may be of environmental significance, and (5) computation of the Attenuation Factor for pesticides used on golf courses, using properties of the chemicals and soil properties, in order to estimate the likelihood of chemical movement to groundwater.

A location map of the Maniniowali Golf Course project site was provided by Group 70, Ltd. Soil maps and associated soil survey publications provided information required for an assessment of infiltration and runoff potentials. Published rainfall and evaporation data in the area provided an estimate of groundwater recharge with turf cover. Anticipated use of chemicals in golf course management is based on our own recommendations, and pesticide properties were obtained from published reports.

III. ANALYSIS OF FACTORS IMPACTING ON CHEMICAL MOVEMENT

A. Site Factors

1. Topography, geology and soils

The project site is located in the North Kona District, between a boundary 1000 feet inland from the coastline and Queen Kaahumanu Highway (State Highway 19) on the mauka side, and between Makalawena and Kaupulehu on the coast. The topography is sloping downward from the highway (elevation about 200 feet) to the shoreline, with the slope varying from about 4 to 7 percent. Geographic reference points on the shoree line are Puialoa Point near the southwest boundary and Papiha Point near the northwest boundary, with Kua Bay between the two Points.

The land area is characterized by relatively unweathered A'a lava and cinders, and rock land which has minimal soil development over pahoehoe lava (Sato et al., 1973; see appendix soil map).

2. Climate and hydrology

Mean annual rainfall in the vicinity of the project site is approximately 10 to 20 inches (Giambelluca, et al., 1986). Monthly mean rainfall varies from a high of approximately 2.5 inches in January to approximately 0.5 inch in June, July and August (Fig. 1). Mean pan evaporation is approximately 80 to 90 inches annually (Ekern and Chang, 1985). There are no data for monthly pan evaporation, therefore the water balance can only be calculated on an annual basis. There is an evaporation deficit of approximately 60 to 80 inches annually. Evaporation greatly exceeds rainfall for all months of the year. Thus with careful irrigation, recharge of groundwater will be minimal.

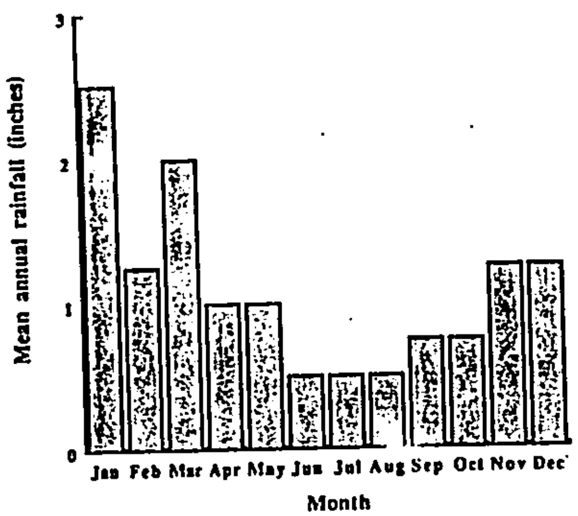


Figure 1. Mean monthly rainfall for the Maniniowali Golf Course area (Giambelluca et al., 1986).

The nature of the groundwater aquifer in the vicinity of the Maniniowali site can be deduced from the analysis of Kanehiro and Peterson (1977) and Lau (1980). The former study included an area immediately north of Maniniowali, the southern boundary of the area being at Kiholo Bay. The assessment by Lau (1980) focused on the Keahole area to the south of Mininiowali. Lau states: "A thin Gyben-Herzberg lens underlies the coastal region of western Hawaii from Keahole Northward to beyond Keauhou. In the Keahole vicinity, the lens is brackish and probably less than 125 feet thick and discharges freely along the coast in a narrow band a few feet wide in the intertidal zone." "Observations .... show that an unconfined Gyben-Herzberg lens containing brackish water underlies the area to at least five miles north of Keahole, at least three miles east, and more than five miles to the south. Evidently no structural or lithologic barriers interfere with hydraulic continuity throughout this region. The hydraulics of groundwater flow can therefore be described in terms of a highly permeable basaltic aquifer carrying a continuous thin basal lens of brackish water underlain by salt water". The average outflow of brackish water from the lens at the shoreline was calculated with a water budget method by Kanehiro and Peterson (1977) to be 6.38 million gallons per day per mile of coastline. This outflow is likely sustained by infiltrated rainfall on the slopes of Hualalai. The outflow of lens water on a gradient of about one foot per mile (Kanehiro and Peterson, 1977) is moderated by ocean tides, which may affect the groundwater table within 600 feet of the shoreline (Lau, 1980). Tidal action undoubtedly increases the mixing of salt water and fresh water in the relatively thin lens. Lau (1980) notes that the basal lens is brackish and does not meet the U. S. Drinking Water Standards, even at the top of the lens and at a distance of three miles from the shoreline.

B. Management Factors

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in each of these types of turf for a 18-hole golf course are estimated in the discussion below.

Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about 4 times as much N as P.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to soil clays and moves little if any from the site of application. Phosphorus, therefore will not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high nitrogen use rates by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss by surface runoff or by leaching below the root zone. Thus nitrogen movement can be mitigated by applying a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied (Brown, et al., 1977) or by applying small amounts of soluble N through the irrigation system and irrigating only to replace soil moisture used by evapotranspiration (Snyder, et al., 1984).

Fertilizer use rates for the different golf course areas are shown in Table 1. Complete fertilizers (ones containing N, P, and K) are usually applied. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 1. Approximate fertilizer use rates for different areas of a typical 18-hole golf course in Hawaii.

Type of turf	Area (acres)	Fertilizer amount (lb. N/1000 sq. ft.)	Application frequency	Total annual application (tons N)
Greens	3	0.5	2 weeks	0.85
Tees	3	1.0	3 weeks	1.15
Fairways	50	1.5	8 weeks	10.00
Roughs	30	1.0	3 months	2.60
Total	86			14.60

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii which sometimes require application of chemical pesticides. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides other than herbicides are applied in a regularly scheduled, preventative program. A typical pesticide program for golf courses in Hawaii is given in Table 2 below. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 2, as well as those of most chemicals used in turf in Hawaii, are given in Appendix Table A-1.

Table 2. A typical pesticide program for a 18-hole golf course in Hawaii.

Turfgrass area	Area (acres)	Chemical	Frequency	Rate/application	Annual total
I. Herbicides					
A. Greens	3	MSMA	6 times/year	2 lb. ai†/acre	36 lb. ai.†
		bensulide	2 times/year	12 lb ai/acre	72 lb. ai
B. Tees	3	MSMA	6 times/year	2 lb. ai./acre	36 lb. ai
		Trimec®	3 times/year	1 pint/acre	9 pints
		bensulide	2 times/year	12 lb. ai./acre	72 lb ai
C. Fairways	50	MSMA	6 times/year	2 lb. ai./acre	600 lb. ai
		Trimec®	3 times/year	1 pint/acre	19 gallons
		metribuzin	2 times/year	0.75 lb. ai./acre	75 lb. ai.
D. Roughs	36	MSMA	2 times/year	2 lb. ai./acre	144 lb. ai
		metribuzin	1 time/year	0.5 lb. ai./acre	18 lb. ai.
II. Insecticides					
A. Greens	3	chlorpyrifos	As needed	1 lb. ai./acre	18 lb. ai.§
B. Tees	3	chlorpyrifos	As needed	1 lb. ai. acre	18 lb. ai.§
C. Fairways	Spot treatments	chlorpyrifos	As needed	1 lb. ai./acre	50 lb. ai.§
III. Fungicides					
A. Greens	3	metalaxyl	As needed	1.3 lb. ai./acre	25 lb. ai.§
		chlorothalonil	As needed	8 lb. ai./acre	72 lb. ai.§
B. Tees	3	metalaxyl	As needed	1.3 lb. ai./acre	25 lb. ai.§
		chlorothalonil	As needed	8 lb. ai./acre	72 lb. ai.§
C. Fairways	Spot treatments	chlorothalonil	As needed	8 lb. ai./acre	250 lb ai.§

† ai. = active ingredient

§ = Estimated total annual application, since these pesticides are applied on an as needed basis.

3. Irrigation

a. Water requirements of turfgrasses

Because of occasional drought periods in Hawaii, all golf courses are irrigated to supplement rainfall. Golf courses usually have permanent sprinkler irrigation systems with sophisticated control systems. Many are computer controlled, so that each sprinkler head on the golf course can be adjusted to apply a selected amount of water on each cycle.

Irrigation requirements for the Maniniowali Golf Course will be large because of the low annual rainfall (Figure 1) and the high pan evaporation. Brackish irrigation water will likely be used and this will require a leaching fraction (usually approximately 20% greater than the amount of water required by turf) to leach salts from the root zone. With careful irrigation scheduling, however, leaching will be no more than required to leach salts from the soil periodically. Applying a Leaching Fraction of irrigation water should be avoided soon after nitrogen fertilizer applications to reduce nitrate leaching. Use of slow release nitrogen fertilizer sources will further reduce the amount of nitrate present in the soil at a given point in time, thus reducing the possibility of nitrate reaching the brackish groundwater lens and eventually the shoreline.

b. Sewage effluent irrigation

The irrigation water for the golf courses will consist of brackish well water mixed with sewage effluent from an on-site treatment plant. Sewage effluent water contains several materials which may influence turfgrass growth. The most important constituents of sewage effluent with respect to turfgrass irrigation and impacts on groundwater are the nitrogen content and salinity. After full development of the project, sewage effluent will likely make up the largest part of the irrigation water. Total nitrogen content of typical secondary treatment sewage effluent is 10 to 25 ppm. The salinity of undiluted sewage effluent will likely be on the order of 1.0 to 2.0 mmhos/cm (650 to 1300 ppm total dissolved salts). In order to leach the salts contained in the irrigation water from the rootzone, a leaching fraction (an additional amount of water above the water use requirements of the turfgrass) will be required. Irrigation water with 1.0 to 2.0 mmhos/cm will require a leaching fraction of 10 to 20% above the water use requirements of the turf. If turfgrass nitrogen fertilizer rates are reduced to compensate for the additional N added in effluent water, nitrogen leaching will not be increased.

IV. Potential for Chemical Movement to Groundwater and Surface Waters

A. Potential Impact on Surface Water Quality

There are no inland surface waters at this site. The coastal waters are turbulent and therefore well mixed, so that runoff from the golf course would not adversely affect water quality. Runoff quantities during storms will likely be reduced as a result of turf development on pahoehoe areas. Development of golf courses on coastal areas of the South Kohala and North Kona Districts have not evidenced degradation of water quality when normal precautions are taken in chemical and water applications. The setback of 1,000 feet from the shoreline will greatly reduce the likelihood of direct runoff from turf areas into shoreline waters.

B. Potential impact on groundwater quality

1. Nitrogen from treated sewage effluent and fertilizer

Wastewater from the development will be used to irrigate the golf course. Activated sludge secondary treatment, will be utilized. As there is no industrial sewage entering, heavy metal content of the effluent will be low. Secondary treatment wastewaters in Hawaii are within the range acceptable for use in irrigation. Secondary treatment with chlorination removes 98 to more than 99 percent of the bacteria and up to 99 percent of the viruses in sewage effluent (Jacobs,

1977). Total dissolved solids (TDS) of sewage effluents are the soluble organic and inorganic compounds in the wastewater. Treatment usually reduces the organic compounds, however the inorganic salts remain in solution and are the greatest contributors to elevated salinities of sewage effluent. The elevated salt content will require application of a leaching fraction, an amount of water greater than the evapotranspiration (ET) of the turfgrass, to reduce salt levels in the soil. Figure 2 below shows leaching fractions required to maintain different rootzone salinities when irrigating with water with a range of salinities. Irrigation in excess of ET contributes recharge to groundwater, thus water management and the soil behavior of chemicals applied are important in limiting chemical movement. Nitrogen is the only constituent in treated sewage effluent in Hawaii which is likely to have a negative impact on ground water. Typical total N content of secondary sewage effluent in Hawaii is approximately 10 to 20 ppm. This amounts to 8 to 16 pounds of N per one hundred thousand gallons of sewage effluent. Golf course superintendents should reduce total N fertilizer applications by the amount of N applied in sewage effluent. Table 3 below gives the amount of N supplied by sewage effluent containing 15 ppm total N. To illustrate the use of this table, if a superintendent is applying 2 inches of irrigation water per week and treated sewage effluent comprises 50% of the total irrigation water, then the total N monthly application rate should be reduced by 0.32 lb. N/1000 square feet/month. As the recommended N application rate is generally 1.0 to 1.5 lb. N/1000 sq. ft./month, only 0.68 to 1.18 lb. N/1000 sq. ft. would be required from fertilizer.

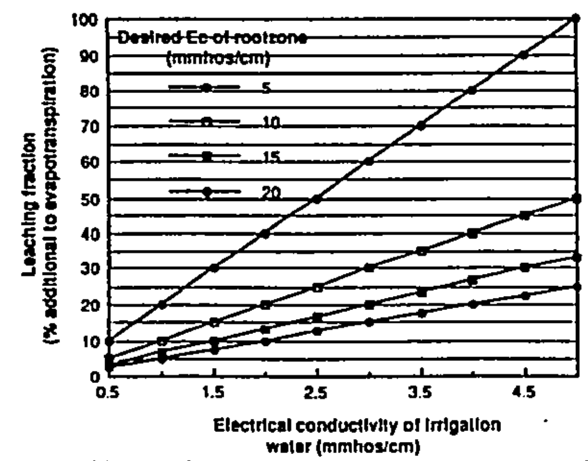


Figure 2. Leaching requirement to maintain various rootzone salinities when irrigating with waters of different salinities.

Table 3. Amount of total N supplied by different amounts of treated sewage effluent irrigation of turfgrasses.

Sewage effluent use (percent of total irrigation water)	Irrigation rate (inches per week) 0.5	1.0	1.5	2.0	2.5	3.0
	Amount of N supplied by sewage effluent (lb./1000 sq. ft./month)†					
5	0.01	0.02	0.02	0.03	0.04	0.05
10	0.02	0.03	0.05	0.06	0.08	0.10
25	0.04	0.08	0.12	0.16	0.20	0.24
50	0.08	0.16	0.24	0.32	0.40	0.48
75	0.12	0.24	0.36	0.48	0.60	0.72
100	0.16	0.32	0.48	0.64	0.80	0.96

† assuming total N content of sewage effluent of 15 ppm

Chang and Young (1977) did an extensive study of the effects of sewage effluent irrigation on groundwater, surface runoff, and air quality at the Kaneohe Marine Corps Air Station (KMCAS) Klipper Golf course in Kaneohe Their conclusions included: .... "6. On the basis of nitrogen, phosphorus, and fecal coliform bacteria, the quality of the percolate from the effluent-irrigated golf course soil does not detrimentally alter the quality of the groundwater. 7. On the basis of total Kjeldahl nitrogen, combined nitrate and nitrite nitrogen, and total phosphorus, the quality of runoff from the KMCAS golf course is not a source of contamination for the adjacent surface waters. ... 9. The reuse of sewage effluent for the spray irrigation of the KMCAS golf course is an effective method of waste water disposal and can be continued, as well as expanded, to other areas of the KMCAS."

These findings are in agreement with those of Dollar and Smith (1988) who found no enrichment of nearshore waters from sewage effluent irrigation of the Waikaloa Golf Course, even though the golf course has a thin layer of highly permeable soil and excessive irrigation water was applied. Dollar and Smith (1988) did find an increased nitrogen content of water in Keauhou Bay. They concluded that this was a result of over irrigation with effluent during establishment of a new 9-hole golf course and the fact that the golf course drains into an enclosed bay where mixing is not as efficient as is the case for the other golf courses studied.

From the above it would appear that treated sewage effluent can be used to irrigate golf courses with no adverse environmental impact. Irrigation of golf courses with treated sewage effluent is considered a desirable method of waste water disposal by many (eg. Chang and Young, 1977). Because sewage effluent contains

relatively high levels of total N, however, caution should be exercised in thinking of the golf course as a place to dispose of unlimited amounts of treated sewage effluent. The likelihood of nitrate leaching to groundwater and being transported to ponds and shoreline water is increased when an excessive amount of sewage effluent water is applied.

2. Pesticides

Because the area treated with pesticides on a golf course is small, the total amount of pesticide applied is relatively small also. Most pesticides used in golf course management are of low toxicity (Appendix Table A-1). Most are either rapidly degraded in soil and/or are sorbed tightly to organic matter or soil colloids and move little from the site of application. The pesticides in Appendix Table A-1 which are most likely to move below the root zone are metribuzin, mecoprop, dicamba, simazine, and trichlorfon. The relative mobility of these chemicals can be quantified by computation of the Attenuation Factor (AF) of each chemical for an appropriate set of conditions. Attenuation of chemical movement by the soil includes both retardation of movement due to sorption on soil organic matter and degradation in the soil by both biological and chemical pathways. The AF numerical index (Rao et al., 1985) is presently being evaluated (Khan and Liang, 1989; Loague et al., 1989) for use in an assessment methodology which the State of Hawaii will use in pesticide regulation. The AF index can have numerical values from AF = 0 (total attenuation) to AF = 1 (no attenuation). By definition, AF is the fraction of chemical remaining in the soil after a single application when the recharge is sufficient to carry the chemical to the bottom of a soil layer of a given depth (for example, 50 cm). For soil and water recharge conditions of practical interest in Hawaii, AF values for the five chemicals which are most likely to move beyond a depth of 50 cm are shown in Table 4. AF values range from 2.1×10^{-6} for simazine (lowest contamination potential) to 7.1×10^{-3} for trichlorfon (highest contamination potential). For comparison, DBCP, which was used for 25 years in pineapple and has contaminated groundwater at many locations, has AF = 4.6×10^{-1}, indicating a much higher likelihood for DBCP movement to groundwater than any of the chemicals listed in Table 4. Also, the total amounts of chemicals in Table 4 which are used on golf courses are relatively small. Trichlorfon is not used in Hawaii to our knowledge, although it is labeled. Mecoprop and dicamba are components of the herbicide Trimec®. Total annual mecoprop and dicamba application for the 18-hole golf courses will be approximately 9.6 and 2.4 pounds pounds, respectively. The total amount of metribuzin applied will be approximately 93 lb. annually. Simazine is used on few golf courses in Hawaii. If used, simazine application would not exceed 100 lb. annually.

Table 4. Attenuation factors (AF) for the most mobile pesticides labeled for use on golf courses.†

Pesticide	AF
Metribuzin	3.5×10^{-6}
Mecoprop	1.3×10^{-3}
Dicamba	7.1×10^{-5}
Simazine	2.1×10^{-6}
Trichlorfon	7.1×10^{-3}

†Based on the following conditions: soil organic carbon content = 1.5%; soil bulk density = 1.2 g/cm^3; soil water content = 35% by volume; water recharge = 0.1 cm/day; depth of penetration = 50 cm.

If a groundwater aquifer is to be used for a potable water supply, the potential for contamination by agricultural chemicals used in turfgrass management requires a more detailed analysis than when the water is likely to be used for irrigation or may not be used at all because of its salinity. A preliminary assessment has indicated that the aquifer beneath the project site is not suitable for human consumption. Hence, concern for groundwater quality is associated principally with the transport of leached chemicals to shoreline water by way of the groundwater. Lava areas with no soil mantle will require importation of soil to support turf growth and to retard movement of applied chemicals to groundwater. The imported soil should have an organic carbon content of about 1% or greater for adequate reduction of pesticide movement. Considering the negligible quantities of pesticides likely to move to groundwater and the potential for control of nitrate leaching by careful management of fertilizer and irrigation scheduling, there will be no significant contamination of shoreline water by chemicals in the groundwater.

The above assessment of the potential for pesticide contamination of groundwater at this site is necessarily qualitative. It is of some interest to note actual groundwater monitoring results for other locations considered vulnerable to groundwater contamination. A study of four golf courses on sandy soils in Cape Cod, Massachusetts by Cohen et al. (1990) revealed only a few occurrences (in sixteen sampling wells observed quarterly over a period of one and a half years) of detection of pesticides that are currently registered for turf. Of the pesticides listed in our Table 2, Cohen et al. found 2, 4-D, dicamba and chlorpyrifos in only one well (different wells for each compound), and chlorothalonil in two wells. In each case the concentrations in the water were less than 0.3 ppb, far below the specified health guidance levels for these chemicals. Thus the Cape Cod results suggest that under conditions where leaching of pesticides is most likely there is little danger of groundwater being contaminated to the extent that it would endanger human life if the water were used as a potable water source. On the other hand the results demonstrate that pesticides applied to golf greens and tees can be leached to shallow groundwater in soils that are vulnerable to leaching.

V. Mitigation of Possible Negative Impacts on Water Quality.

A. Irrigation

Irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in soils. If excessive irrigation water is applied soon after application of soluble nitrogen sources, the likelihood of runoff or leaching of nitrogen below the root zone is increased. Basing irrigation scheduling on water use rates and leaching requirements will result in large savings of water and also reduce the likelihood of chemicals being leached from the rootzone. Determination of water use rates for irrigation scheduling can be accomplished by any of several methods, including the following.

1). U. S. Weather Bureau Class A Evaporation pan data.

A standard Class A evaporation pan should be placed on the golf course in an area representative of environmental conditions and in accordance with instructions for correct placement provided by the U. S. Weather Bureau. Water use of warm season grasses can be calculated as approximately 50% of class A pan evaporation. Additional water will be required to account for inefficiencies in coverage by the irrigation system (no irrigation system provides perfect coverage) and for the required leaching fraction to leach salts from the rootzone. Irrigation should be scheduled when soil water content of the rootzone is approximately one-half the available water storage capacity of a particular soil. The amount of water to apply at a given irrigation is that required to replenish the soil water storage capacity plus additional amounts to compensate for inefficiency of sprinkler coverage and to provide additional water for leaching of salts. One can assume that the depth of the rootzone for turf is approximately one foot.

An example of how Class A pan evaporation data are used to schedule irrigation is given below.

Fairways with a silt loam soil store approximately 2.5 inches of available water per foot of depth.

Greens and tees composed of a mixture dominated by sand hold approximately 0.75 inch of water per foot of depth.

The Coefficient of Uniformity (a measure of the uniformity of sprinkler coverage) of the irrigation system is 85%.

Brackish irrigation water is being used with an electrical conductivity of 1.25 mmhos/cm.

Bermudagrass turf is being used throughout the golf course. Bermudagrasses *are quite salt tolerant, therefore the salinity of the soil solution will be maintained at a salinity level less than 10 mmhos/cm. Leaching fraction required to maintain a given salinity of soil solution = (Salinity of Irrigation water ÷ Desired salinity of the soil solution).*

Water use rate of the bermudagrass turf is approximately 50% of Class A pan evaporation.

a. Fairways should be irrigated when 2.5 inches of water is evaporated from the Class A pan (one-half of the water storage capacity of fairway soils = 1.75 inches/ft. depth; water use rate = 50% of pan evaporation, 1.75 ÷ 0.50 = 2.5 inches).

. The amount of water applied to fairways at each irrigation should be 1.75 + [1.75 X (1.00 - 0.85)]+ [1.75 X (1.25÷10.0)] = 1.75 + 0.26 + 0.22 = 2.23 inches.

b. Greens and tees should be irrigated when 0.75 inch of water has evaporated from the Class A pan (one-half the water storage capacity of greens and tees = 0.375 inches/foot; water use rate = 50% of pan evaporation, 0.375 ÷.50 = 0.75 inch).

The amount of water applied to greens and tees at each irrigation should be 0.75 + [(0.75 X (1.00 - 0.85)] + [(0.75 X (1.25 ÷ 10.0)] = 0.75 + 0.11 + 0.09 = 0.95 inch.

2). State-of-the-art irrigation systems provide the option of environmental sensing instruments which calculate the water use rate of turf from climatic elements such as solar irradiation, temperature, relative humidity and wind speed. This type of equipment therefore eliminates the need to manually determine water use rates. The turfgrass manager will still need to program in the amount of water to be used before water is applied and the amount to be applied at each irrigation.

B. Nitrogen Movement

Fertilizer applications should always be scheduled so that additional water (leaching fraction) is not applied soon after soluble nitrogen fertilizers are applied. Application of soluble nitrogen sources should also be avoided when heavy rainfall is expected. Use of only slow release N sources will ensure minimum N leaching. Petrovic (1990) reviewed the literature on fate of nitrogen applied to turfgrasses. The amount of applied N leached from turfgrass areas ranged from over 50% for soluble N sources to less than 1% for slow release sources. The amount leached was greatest when soluble N sources were applied to coarse textured soils and excessive irrigation or rainfall applied. Nitrogen leached from slow release fertilizers has generally been less than 1% of applied N, even when applied to porous soils and excessive irrigation or rainfall applied. Cohen et al. (1990) reported that nitrate content of leachate beneath golf greens, tees and fairways of golf courses on Cape

Cod, Mass. was usually less than the Health Advisory Level of 15 ppm. Nitrate content of leachate was shown to decrease greatly on a golf course which changed from a soluble N source to a slow release N fertilizer.

C. Pesticide Movement

1. Soil Importation

The lack of a natural soil over most of the site will require soil importation for turf growth and as a barrier to pesticide leaching. Both soil depth and organic carbon content of the soil are important determinatants of pesticide retardation. The Attenuation Factor, presented earlier in this report, provides a numerical measure of the effect of soil depth and organic carbon content on pesticide leaching. The attenuation factors change with thickness of the soil layer and organic carbon content of the soil. This relationship is shown for metribuzin in Table 5.

Table 5. Relationship of soil depth and organic carbon content to the computed Attenuation Factor for metribuzin*.

Soil Depth (meters)	Soil Organic Carbon Content (% by weight) 0.25	0.5	1.0	2.0
0.1	4.2×10^{-1}	3.2×10^{-1}	1.8×10^{-1}	5.8×10^{-2}
0.3	7.5×10^{-2}	3.2×10^{-2}	5.8×10^{-3}	1.9×10^{-4}
0.5	1.3×10^{-2}	3.2×10^{-3}	1.9×10^{-4}	6.4×10^{-7}

*Soil and recharge characteristics not shown in the table are the same as given for calculations in Table 4.

The significance of this table relates to the mitigation of chemical leaching by increasing the thickness of the soil layer through which pesticides must move before entering highly pervious, non-sorptive lava. The data indicate that pesticide movement is attenuated 10-fold more if the soil-layer thickness is increased from 0.1 meter (4 inches) to 0.3 meter (12 inches), if the organic carbon content of the soil is 0.5%. Another 10-fold benefit is achieved with a 0.5 meter soil layer.

The effect of soil organic matter content on pesticide leaching is also shown in Table 5. If the soil material imported to the Maniniowali development has an organic carbon content of 0.25%, metribuzin movement would be 13 times less attenuated in this soil material than in a soil with 1.0% organic carbon. Many natural soils in Hawaii have organic carbon contents of 2% or more and thus are less likely to be subject to serious pesticide leaching than would low-carbon soil material that may be available for man-made soils in the North Kona area. Note that a 0.5 meter-thick soil layer with 2% organic carbon has a very low attenuation factor, indicating negligible leaching. From a management point of view it may not be possible to apply organic amendments, such as peat, in large quantities to large land areas, but it may be feasible to treat smaller areas which are the most intensively managed. Table 6 shows the required tons of organic matter required to achieve various organic carbon contents in soil layers of various thicknesses. For example, a 12-inch layer with 0.25% organic carbon will require 7 tons/acre of added peat to bring the organic carbon content up to 0.5%. The feasibility of doing this on greens and tees, the most intensively managed areas of golf courses, should be explored.

Table 6. Estimated organic matter (tons per acre) in soil layers of various depths and organic carbon content*.

Soil Depth (inches)	Organic Carbon Content (percent by weight)			
	0.25	0.5	1.0	2.0
	(Tons organic matter per acre)			
6	3.5	7.0	14.0	28.0
12	7.0	14.0	28.0	56.0
18	10.5	21.0	42.0	84.0

*Assuming a factor of 1.7 to convert organic carbon to organic matter; soil bulk density = 1.2 gm/cm³.

2. Pesticide selection

Numerous pesticides are available for use on turf, as indicated in Appendix Table A-1. Principal considerations in the choice of which pesticides to use are (1) the efficacy of the chemical in controling the pest of concern, (2) the environmental impact of the chemical, and (3) cost, for chemicals applied in larger amounts. Included in environmental impact is worker safety. An example of a possible alternative which might lessen the likelihood of a negative impact would be the choice of carbaryl rather than chlorpyrifos if a pond containing fish on a golf course were subject to receiving runoff from turf which is treated with the insecticide; carbaryl is less toxic to fish than is chlorpyrifos. In the Maniniowali situation, substantial runoff is not expected, and chlorpyrifos is selected for its superior efficacy and resistance to leaching. The chemicals in Table 2 should have no adverse environmental effects with proper management.

3. IPM approach

Integrated Pest Management is the use of all known pest control tactics in design of a program to manage, not eradicate, pest populations, so that aesthetic or economic damage to turfgrass and harmful side effects to the environment are avoided. The goal of an IPM program is to manage pest populations in such a manner that high quality turfgrass can be produced economically, and in an acceptable and ecologically sound manner.

In an IPM approach, pesticide applications are made only when populations of pests reach predetermined damaging levels. Pesticides with the least detrimental environmental impact are utilized.

VI. SUMMARY AND CONCLUSIONS

The proposed Maniniowali Golf Course is part of a combined residental community-golf course to be located on barren lava land in the North Kona District. The topography is gently sloping toward the ocean. Soil development is minimal. Mean annual rainfall is 10 to 20 inches, varying from about 0.5 inch/month in the summer to about 2 inches/month in January. Mean pan evaporation is 80 to 90 inches per year, giving an evaporation deficit of 60 to 80 inches annually. With careful irrigation of turfed areas, recharge of groundwater will be minimal. A relatively permeable landscape and limited rainfall suggest negligible runoff. A 1000 feet border between the development and the shoreline will also limit direct runoff from the golf course into shoreline waters. Groundwater beneath the site is thought to be brackish and thus would not be used as a potable water source. It is likely that sewage from living units would be treated on-site and the treated effluent would constitute a source of irrigation water for the golf course.

In view of the above considerations, the principal water quality concern to be assessed is the possibility that fertilizer nutrients, nitrogen in the sewage effluent used for irrigation, and pesticides applied to the golf course might leach to groundwater and be transported by groundwater to the shoreline waters. A number of factors suggest that this is not likely to be a problem: 1) Natural recharge at the site is minimal; 2) The continuous flow of groundwater to the ocean and the rapid mixing with turbulent coastal sea water effectively dilutes any contaminants below concentrations of likely environmental significance. Further mitigation of any adverse coastal water quality effect due to applied nutrients and pesticides can be accomplished by 1) well managed irrigation to regulate recharge so that excessive leaching of applied chemicals does not occur; 2) careful accounting of the quantity and quality of sewage effluent applied as irrigation to avoid over-fertilization with nitrogen; 3) use of slow-release nitrogen fertilizers as a supplement to nitrogen in sewage effluent to limit N leaching; 4) importation of sufficient soil to cover turfed areas with about one foot of soil having an organic carbon content of 1% to minimize pesticide leaching; 5) selection of pesticides which are effective but not likely to leach to groundwater; 6) implementation of IPM procedures to minimize pesticide use.

The above conclusions are based on the assumption that sound management practices will be followed carefully. A well qualified Golf Course Superintendent should be given the responsibility of managing the golf course.

VII. LITERATURE CITED

Brown, K. W., R. L. Duble, and J. C. Thomas. 1977. Influence of management and season on fate of N applied to golf greens. Agron. J. 69: 667-671.

Chang, S. Y. K., and R. H. F. Young. 1977. An Investigation into environmental effects of sewage effluent reuse at the Kaneohe Marine Corps Air Station Klipper Golf Course. Tech. Memo. Rep. No. 53. Water Resources Research Center, University of Hawaii. 39pp.

Cohen, S. Z., S. Nickerson, R. Maxey, A. Dupuy, and J. A. Senita. 1990. A ground water monitoring study for pesticides and nitrates associated with golf courses on Cape Cod. Ground Water Monitoring Review. Winter Issue, 1990. p 160-172.

Dollar, S., and S. V. Smith. 1988. The Effects of Golf Course Irrigation and Fertilization on Nearshore Marine Waters off West Hawaii. A Report Prepared for Helber, Hastert Van Horn and Kimura, Planners. 27pp.

Ekern, P. C. and J. Chang. 1985. Pan evaporation: State of Hawaii, 1894-1983. Report R74. Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii. 171 pp.

Giambelluca, T. W., M. A. Nullet, and T. A. Schroeder. 1986. Rainfall Atlas of Hawaii. Report R76. Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii. 276 pp.

Handreck, K. A. and N. D. Black. 1984. Growing Media for Ornamentals and Turf. New South Whales University Press. P. O. Box 1, Kensington NSW, Australia 2033. p. 252.

Hartley, Douglas and Hamish Kidd (Eds.). 1983. The Agrochemicals Handbook. Unwin Brothers, Ltd. Old Working, Surrey, England.

Hofman, Vern, Henry Kucera and Mark Berge. 1986. Spray Equipment and Calibration. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota 58105. 13 AEng-5-3. 31 pp.

Jacobs, L. W. 1977. Utilizing Municipal Sewage Wastewaters and Sludges on Land for Agricultural Production. North Central Regional Extension Publication No. 52., Cooperative Extension Service, Michigan State University, East Lansing MI. 75 pp.

Jarrett, Albert. 1985. Golf Course and Grounds Irrigation and Drainage. Reston Publishing Co. Inc. Reston, VA 22090.

Khan, M. A. and Tung Liang. 1989. Mapping pesticide contamination potential. Environmental Management. 13: 233-242.

Kanehiro, B. Y. and F. L. Peterson. 1977. Groundwater recharge and coastal discharge for the northwest coast of the island of Hawaii: A computerized water budget approach. Tech. Rept. 110, Water Resources Research Center, Univ. Hawaii, Honolulu. 83 pp.

Lau, L. S. 1980. Proposed prototype testing program, land disposal by injection wells of ocean water effluent at seacoast test facility, Keahole Point, Hawaii Island. Unpublished Report.

Loague, K. M., R. S. Yost, R. E. Green and Tony C. Liang. 1989. Uncertainty in a pesticide leaching assessment for Hawaii. J. Contam. Hydrol. 4: 139-161.

Miles, J. R. W., C. M. Tu, and C. R. Harris. 1979. Persistence of eight organophosphorus insecticides in sterile and non-sterile organic and mineral soils. Bull. Environ. Contam. Toxicol. 22: 312-318.

Murabayashi, Edwin T. 1989. Wastewater reuse by irrigation in Hawai'i. Water Resource Research Center Special Report 09:00.88, University of Hawaii. 10 p.

Petrovic, A. M. 1990. The fate of nitrogenous fertilizers applied to turfgrass. J. Environ. Quality. 19:1-14.

Rao, P. S. C., A. G. Hornsby, and R. E. Jessup. 1989. Indices for ranking the potential for pesticide contamination of groundwater. Soil and Crop Sci. Soc. Fla. Proc. 44: 1-8.

Sato, H. H., W. Ikeda, R. Paeth, R. Smythe and M. Takehiro, Jr. 1973. Soil Survey of Island of Hawaii, State of Hawaii. United States Dept. of Agric., Soil Conservation Service.

Sears, M. K., and R. A. Chapman. 1980. Persistence and movement of four insecticides applied to turfgrasses. In: H. D. Niemcyzk and B. G. Joyner (eds.) Advances in Turfgrass Entomology. pp. 57-50.

Snyder, G. H., B. J. Augustin, and J. M. Davidson. 1984. Moisture sensor-controlled irrigation for reducing N leaching in bermudagrass turf. Agron. J. 76. 964-969.

Soil Conservation Service, U. S. D. A. 1976. Soil survey laboratory data and description for some soils of Hawaii. Rept. No. 29. 208 p.

Tashiro, H. 1980. Distribution and persistence of chlorpyrifos and diazinon in soil when applied to turfgrass. In: H. D. Niemcyzk and B. G. Joyner (eds.) Advances in Turfgrass Entomology. pp. 53-56.

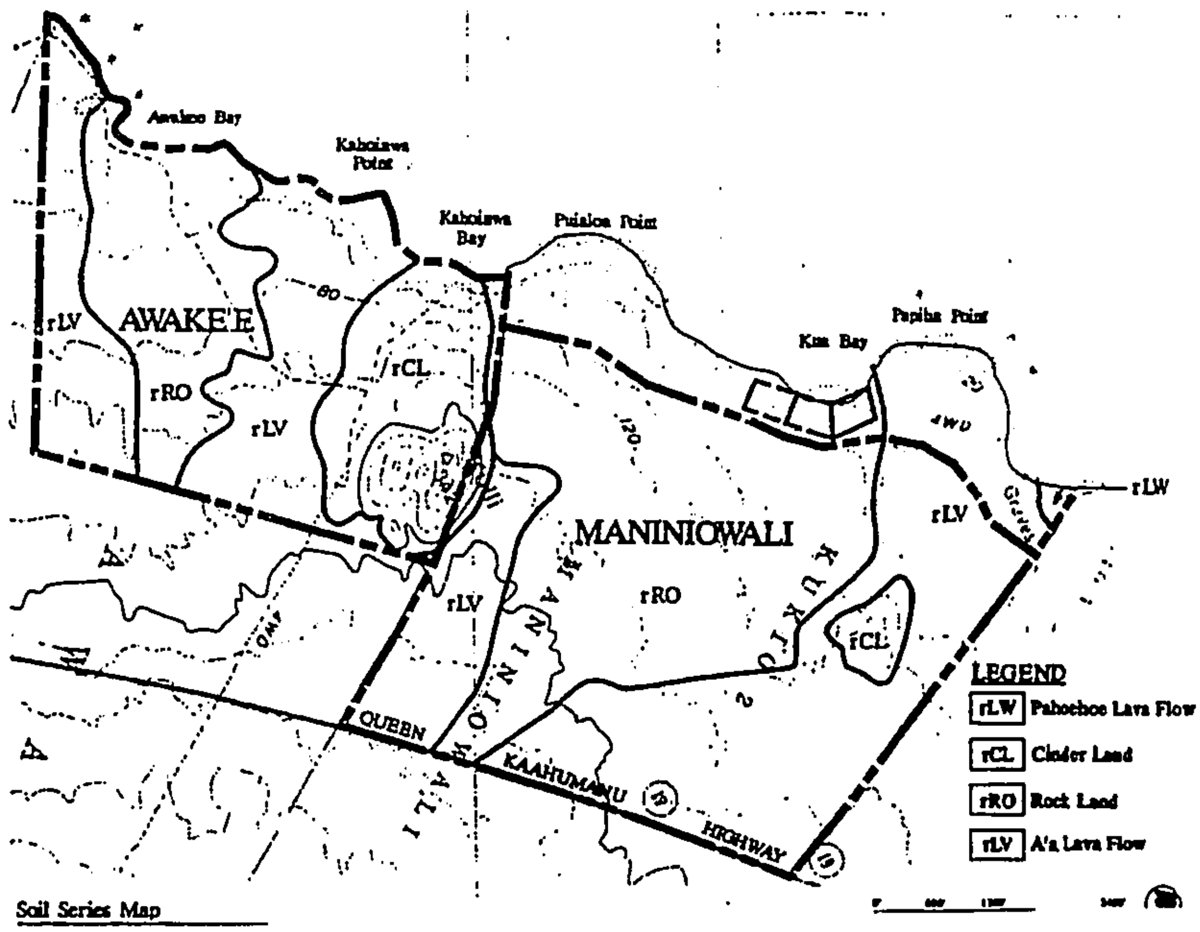
Appendix Table A-1. Properties of pesticides used on turf in Hawaii.

Pesticide common name	Trade name (s)	Oral LD-50 (mg/kg body wt)*	Toxicity to fish and wildlife*	Soil sorption index (Koc)**	Water solubility (mg/l)**	Half-life in soil (days)**	Leaching potential**
I. Herbicides				10000	1000000	100	Small
MSMA	WeedHoe etc	1800	Low	10000	1000000	30	Small
glyphosate	Roundup, Kleenup	150	Mod. to birds, none to fish	41	1220	30	Large
metribuzin	Sencor	2200	Moderate	109	300000	10	Medium
2 4-D	part of mixtures	370-700	High to fish	3	680000	21	Large
mecoprop	ditto	700-1500	Low	2	800000	14	Large
dicamba	ditto	1000-2000	Non toxic to fish	2700	2.5	60	Small
oryzalin	Surflan	10000	Mod. to birds, toxic to fish		0.7		
oxadiazon	Ronstar	8000	Toxic to fish	980	15	30	Small
propyzamide	Kerb	5620-8350	Low	138	3.5	75	Large
simazine	Princep	>5000	Low	5000	0.5	30	Small
chlorthal-dimethyl	Dacthal	>3000	Low	10000	25	60	Small
bensulide	Betasan, Betamec	770	Mod. to fish	100000	1000000	3600	Small
paraquat dichloride	Ortho Paraquat CL	150	Mod. to birds, none to fish	11000	0.1	30	Small
benfluralin	Balan	10000	Low to birds, high to fish				
II. Insecticides				6070	2	30	Small
chlorpyrifos	Dursban	135-163	High				
bendiocarb	Ficam	40-156	High	229	40	7	Small
carbaryl	Sevin	400-850	Moderate	2	154000	27	Large
trichlorfon	Dylox	450-630	Moderate				
III. Fungicides				3000	10	1	Small
anilazine	Dyrene	<2000	Low	2100	2	100	Small
benomyl	Benlate	9980	Low	1300	0.6	20	Small
chlorothalonil	Daconil 2787	>10000	Low to birds, mod. to fish	500	13	20	Small
iprodione	Chipco 26019 FP	3500	Low	1000	0.5	35	Small
mancozeb	Dithane M-45	>8000	Low	1000	0.44	21	Small
quintozene	PCNB, Terrachlor	12000	Non-toxic	383	30	20	Medium
thiram	Tersan	7500	Low	273	260	21	Medium
triadimefon	Bayleton	568	Low	18	7100	7	Medium
metalaxyl	Subdue	669	Non-toxic	1000	3.5	0	Small
thiophanate-methyl	Cleary 3336	7500	Low				

*From: Hartley, Douglas and Hamish Kidd (Eds.) 1983. The Agrochemicals Handbook. Unwin Bros., Ltd. Old Working., Surrey, England.

**From: Wauchope, R. D. 1988. U. S. D. A.-ARS Interim Pesticide Properties Database, Version 1.0. Unpublished

APPENDICES



APPENDIX B: Map of Maniniowali soils (Provided by Group 70)

Appendix Table A-2. Toxicity classes of pesticides.

Class	Description	Warning Statement	Oral LD50
1	Highly Toxic	Poison, Skull & Crossbones	1-50
2	Moderately Toxic	Danger	51-500
3	Low Toxicity	Warning	500-5,000
4	Very Low Toxicity	Caution	>5,000

APPENDIX C

IMPACT ON MIGRATORY BIRDS AND ENDANGERED HAWAIIAN WATERBIRDS.

The fertilizers, herbicides, and fungicides used in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with golf courses. Fertilizers are relatively non-toxic unless ingested in large amounts. All herbicides and fungicides used in golf course maintenance in Hawaii are of low to moderate toxicity (Appendix Table 1). The only chemicals used in golf course maintenance in Hawaii which are highly toxic to birds are the organic phosphate insecticides, especially chlorpyrifos.

Although chlorpyrifos is toxic to birds, it is strongly adsorbed on the thatch layer of turf and moves little from the site of application. One reason for its weakness in controlling soil infesting insects is the inability to get the insecticide through the thatch layer to the depth needed to contact these insects. Recent studies (Sears and Chapman, 1980; Tashiro, 1980) have shown that chlorpyrifos applied to turfgrasses does not penetrate more than 2 to 3 centimeters in the soil. In addition to resistance to movement in the soil, it has been shown that it is rapidly degraded in the soil, both by hydrolysis and microbial action (Miles et al. 1979).

Because of the adsorption of organic phosphate insecticides on organic layers in turf and their rapid break down, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions for application of these pesticides (which turfgrass managers are required by law to follow) specifically prohibit their direct application to streams and ponds.

The likelihood of bird injury by pesticides used in maintenance of the proposed golf course can be reduced by proper application of pesticides with reduced toxicity to birds. Appendix Table 1 shows that carbaryl and trichlorfon are less toxic to birds than chlorpyrifos. In most cases these insecticides may be substituted for chlorpyrifos with little loss of effectiveness.

Golf courses are frequently visited by birds. As far as we are aware, there have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management. Waterfowl and fish appear to thrive in ponds and water hazards on golf courses in Hawaii. Many golf courses cultivate white amur fish in the ponds to control algae. Mosquito fish are generally stocked to prevent mosquito problems. We are aware of no incidents of fish or waterfowl injury from chemicals applied to golf courses.

The labeling of herbicides and pesticides by EPA for particular uses, enforced by the Hawaii Department of Agriculture, is perhaps the best assurance of protection of humans and wildlife from their hazards. All pesticides must be applied in compliance with federal and state laws regulating their use. Hazards to both humans and wildlife are included in the decision to label a pesticide for specific uses, including use on golf courses, and in developing regulations on allowable application procedures of the pesticide for various uses.

APPENDIX D

IMPACT ON AIR QUALITY

Most herbicides and pesticides used on golf courses are of relatively low mammalian toxicity, with LD_{50} values ranging from hundreds to several thousand mg/kg body weight (Appendix Table 1). None of the chemicals listed in Table 2 above are highly volatile. A measure of volatility is the vapor pressure (VP). The compounds used in highest quantity, for which vapor pressure data is readily available, are chlorothalonil (VP=1.3×10^{-5} atm at 25° C) and chlorpyrifos (VP=2.4×10^{-8} atm at 25° C). In comparison, DBPC, which is known to be volatile, has a vapor pressure of 1.2×10^{-3} atm at 21° C, i.e. at least 100 times the vapor pressure of chlorothalonil and 100,000 times the vapor pressure of chlorpyrifos. In addition, pesticides are applied on golf courses in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas. For these reasons there is little likelihood of volatility once the pesticides are applied.

If properly applied, there is also little potential for drift of spray particles from golf course spray equipment. The greatest danger of significant drift of pesticides is from aerial application. Golf course pesticides are applied with ground spray equipment. Boom height of spray equipment is less than one meter. Low spray pressures (20 to 40 psi) and coarse spray droplets further reduce the hazard of airborne fine droplets. Droplets larger than 100 micrometers diameter are not highly subject to drift.

Most of the spray volume from typical flat-fan nozzles used in agricultural spray equipment is from droplets larger than 100 micrometers. Appendix Table D-1 below shows a typical distribution of droplet sizes for a flat-fan nozzle (the type used in most golf course spray equipment). At the low concentrations used in pesticide application, this would not result in significant quantities of pesticides being carried downwind. High wind speed would increase the likelihood of drift of fine spray droplets, however, because high wind speed distorts spray patterns and results in poor coverage; spraying in periods of high wind is not common practice. Appendix Table D-2 below shows the percent of spray application volume deposited at 4 and 8 feet downwind and the distance downwind for the volume to drop to 1% or below for flat-fan nozzles under different conditions. Even under high wind conditions (almost 10 mph) and spraying at 40 psi, the distance downwind at which 1% or less of the total spray volume was deposited was only 17 feet.

Appendix Table D-1. Droplet size range for a typical flat-fan nozzle at 20 and 40 psi. (from Hofman et al., 1986)

Droplet size range (microns)	Percent of spray 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

Appendix Table D-2. Percent of spray volume deposited at 4 and 8 feet downwind and the distance in feet for the volume of spray solution to drop to 1% of the total spray volume (from Hofman et al., 1986).

Nozzle ht.	Pressure (psi)	Wind speed (mph)	Percent deposited 4ft.	8ft.	Distance to drop to 1% of volume
14	40	3.5	3.1	0.6	7.0
27	40	3.5	5.9	1.5	13.0
18	30	5.3	9.3	2.2	14.0
18	25	9.9	10.3	3.1	15.5
18	40	9.9	9.1	3.6	17.0

To facilitate spray operations and to comply with label instructions of some pesticides, spray applications are only made in late afternoon or early morning hours when golfers are not on the golf course. This reduces the risk of exposure of people to airborne spray particles. Sufficient buffer space with tall vegetation between the golf course and housing sites and facilities (such as the clubhouse) which will be used by people will further reduce the chance of exposure to airborne pesticide particles.

The greatest danger of airborne pesticides is to the applicators of pesticides themselves. Mixing of wettable powder formulations and being in close proximity to airborne spray particles, particularly when operating spray equipment in a downwind position, places spray operators in particularly vulnerable positions. EPA and OSHA have strict standards which specify that spray operators wear appropriate protective clothing and breathing apparatuses.

APPENDIX E

WATER RESOURCES AND SUPPLY

FOR THE

MANINI'OWALI RESIDENTIAL COMMUNITY

North Kona District, Island of Hawai'i

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October 1991

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1.0 INTRODUCTION

The North Kona Development Group (NKDG) proposes to develop the Manini'owali Residential Community in North Kona, Hawai'i. The overall goal of this project is to develop a residential community with recreational amenities of a golf course and tennis facility on a 388-acre site located approximately five miles north of the Ke-ahole Airport (Figure 1). The property is approximately approximately 1,000 feet *mauka* of Kua Bay shoreline and directly *makai* of the Queen Ka'ahumanu Highway. The various elements of the Master Plan, as shown in Figure 2, include approximately 1,000 single and multi-family residential units, 18-hole golf course, clubhouse, driving range and tennis facility.

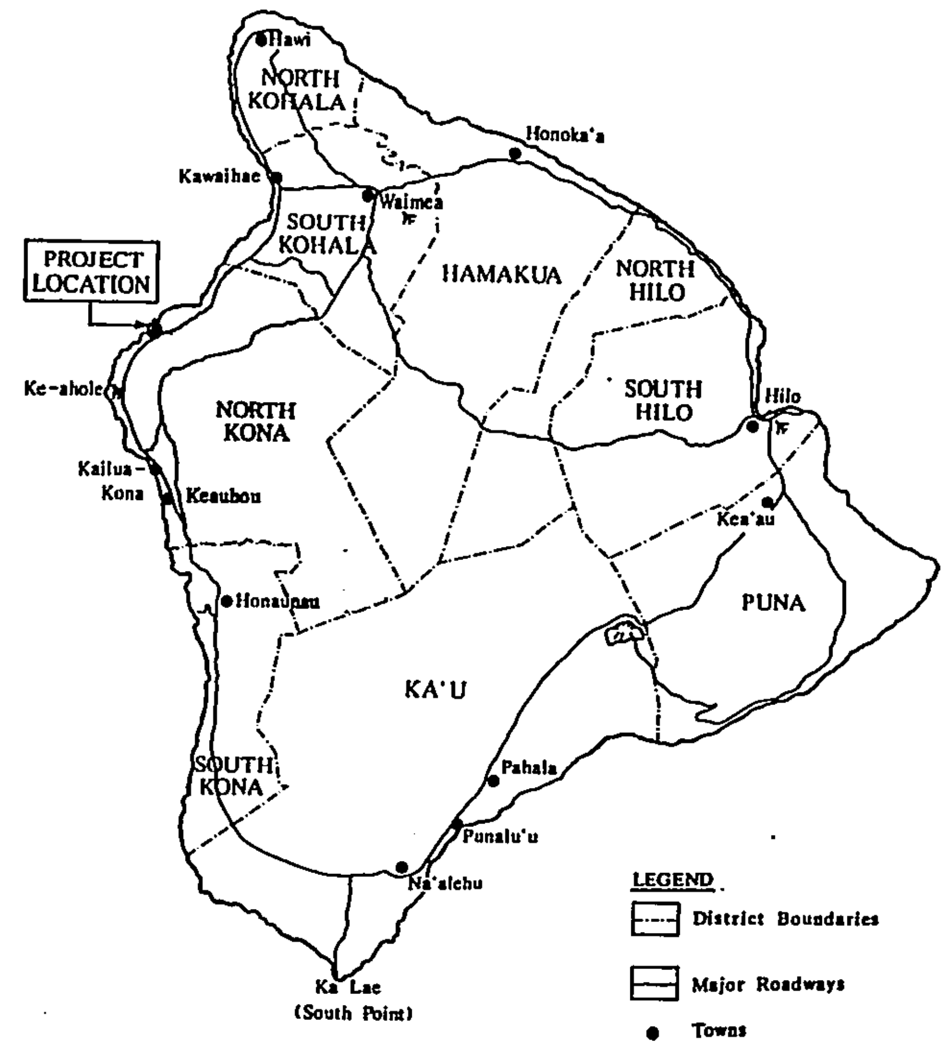
The project will require both potable and brackish water supplies. However, there is no existing water system on-site to serve its water requirements. Other infrastructure facilities to support the development include the access and circulation roadway network, and a wastewater treatment plant. Treated effluent from the wastewater treatment plant blended with brackish water will be used for irrigation of the golf course and and common landscaping. Residential irrigation will utilize brackish water only. Desalinated potable water will be provided for domestic use, as well as fire protection purposes.

The purpose of this study is to describe and evaluate the hydrology, potable and brackish water availability, and potential impact of the project on water resources in the area.

2.0 BACKGROUND

2.1 PHYSICAL ENVIRONMENT

Climate: The project site is located inland from the coastal area of the North Kona coast. The climate is semi-tropical and semi-arid. Average annual precipitation in this area is 17 inches (Figure 3). Average annual temperature is 78 degrees F, with an average high temperature of 83 degrees F and an average low of 67 degrees F. Rainfall increases with elevation from the coastal area, with a high rainfall belt located between the 1,200 and 3,000 feet elevations on the leeward slopes of Hualalai and Mauna Loa.



Hawaii Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY
FIGURE 1

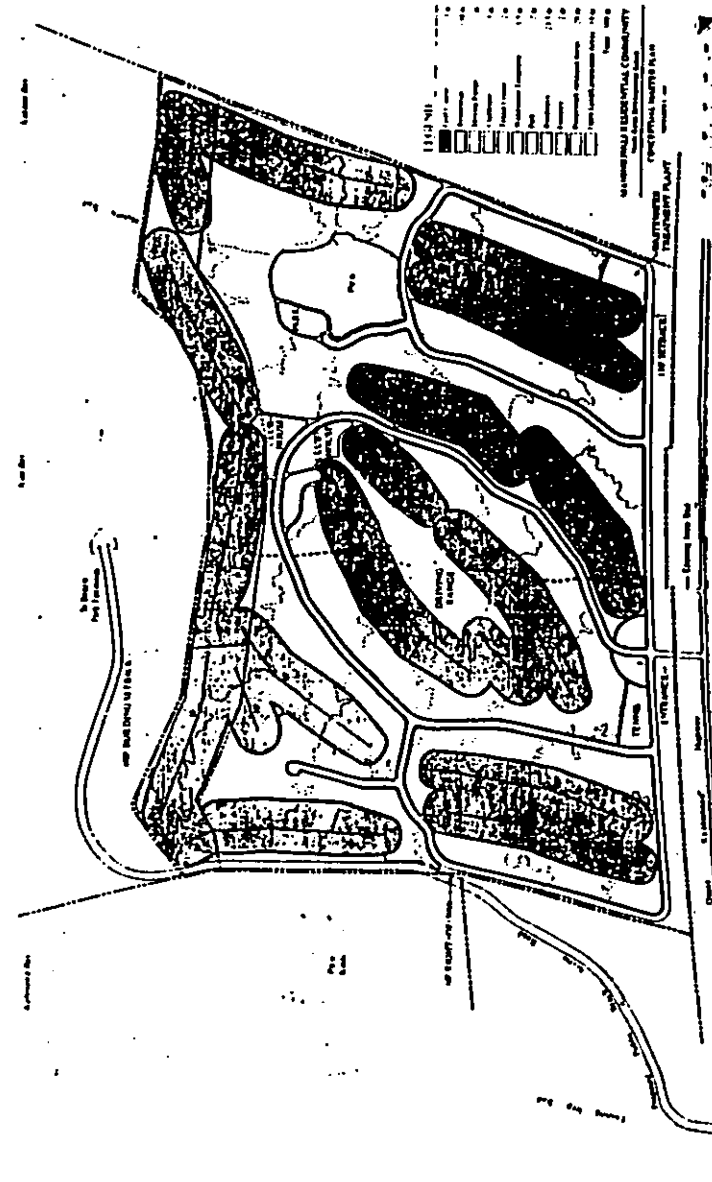
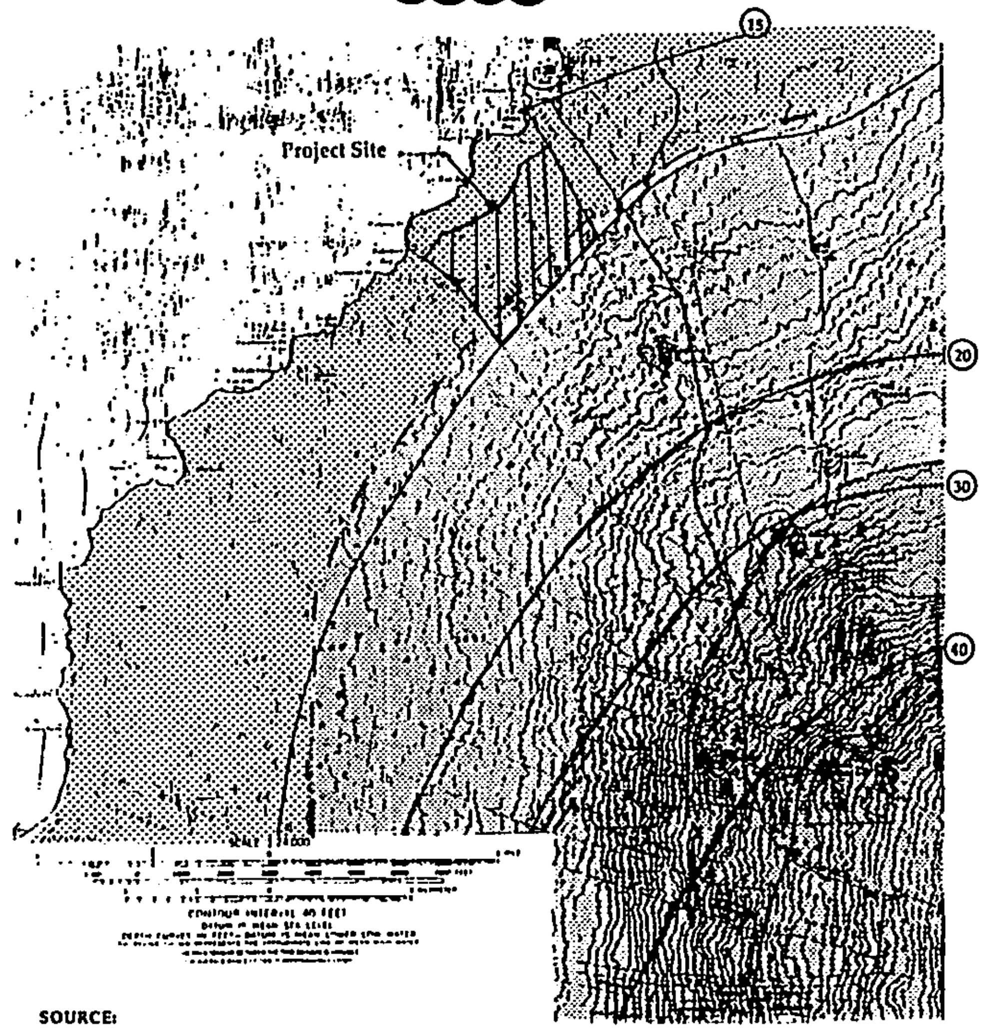


FIGURE 2

waimea water services



SOURCE:
Rainfall Data:
Report R47, USGS
Chloride Data:
Hu'ehu'e Well Report (1985),
S. Bowles

◯ RAINFALL IN INCHES
2,000 + MG/L CHLORIDE
250 - 2,000 MG/L CHLORIDE
UP TO 250 CHLORIDE

Annual Rainfall and Groundwater Chloride Content

MANINI'OWALI RESIDENTIAL COMMUNITY — FIGURE 3

The large land masses of Mauna Loa, Mauna Kea, and Hualalai generally shelter the North Kona coast from the predominant northeasterly trade wind system affecting the Hawaiian Islands. Winds follow a typical pattern of on-shore winds (westerly and southwesterly) in the morning and early afternoon. Cloud banks often form along the higher elevation slopes during the day, and off-shore breezes occur in the late afternoon and evening. Typical wind velocities range from 3 to 14 knots. Relative humidity generally ranges between 71 to 77 percent the year round.

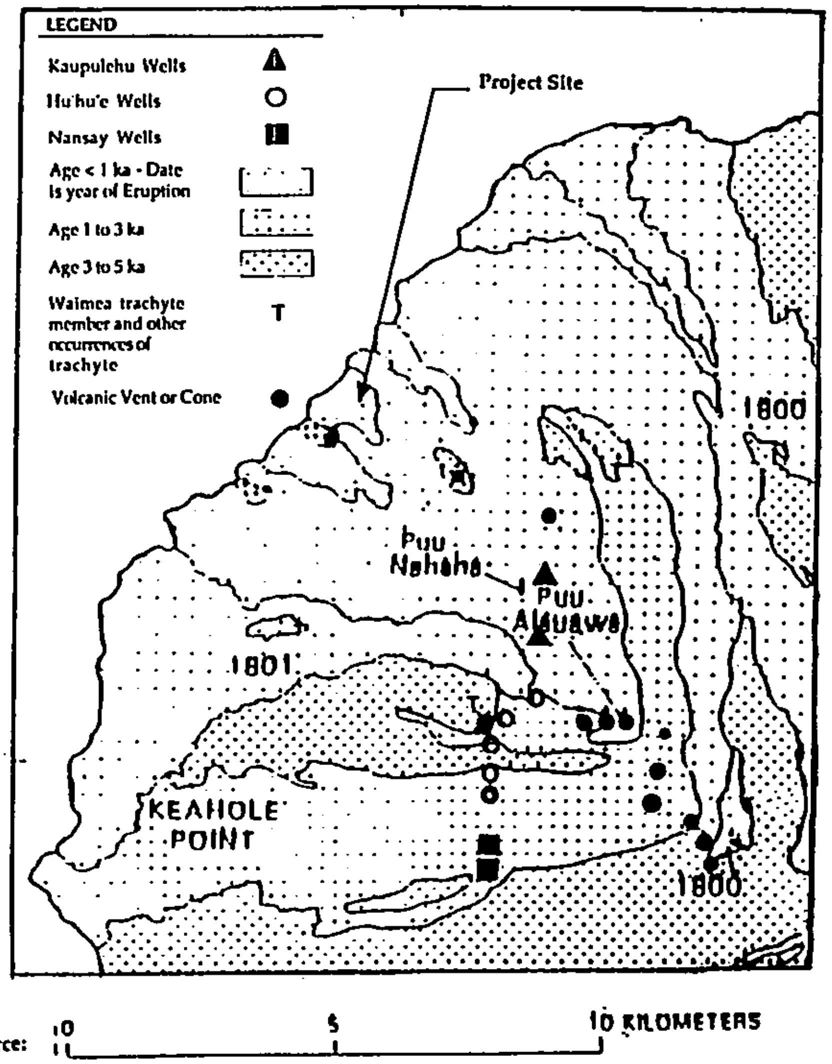
Soils: Four soil types occur on Manini'owali. These include *pahoehoe* lava flows (rLW), cinder land (rCL), rock land (rRO), and *'a'a* lava flows (rLV). The predominant soil types of the land are *'a'a* lava flows and rock land. There are generally few sections of the site which have soil depths exceeding a few inches. These soil areas are able to support a few species of dry land grasses and trees.

Topography and Geology: The parcel is located on the western slope of Hualalai, a dormant shield-type volcano (summit elevation 8,271 feet). The topography of the project site is gently to moderately sloping. The significant topographic feature includes a small *pu'u* or cinder cone, at the northern end of the property. Average slopes at the development site are five to seven percent, with elevations ranging from 60 to 250 feet above mean sea level (msl).

2.2 HYDROGEOLOGY

The area is underlain by lava from the Hualalai volcanic series. A recently published geologic map based on detailed field studies is presented in Figure 4. Generally, the lavas of the upper five hundred feet are best described as thin-bedded *pahoehoe* and *'a'a* flows interspersed with clinkers. These types of lava, when found in the basal aquifer, produce an extremely high permeability.

There are no surface streams or indications of groundwater impounding dikes in the area; however, these may be present below the surface. Groundwater recharge is due primarily to winter storms of high intensity and short duration.



Source: Modified from Moore, R.B. al; 1987, USGS Professional Paper 1350

Hydrogeology

MANINI'OWALI RESIDENTIAL COMMUNITY FIGURE 4

The County of Hawai'i has a water system serving the Ke-ahole Airport which is approximately five miles south of the project site (Figure 5). The *mauka* water is to be extended to the southern boundary of Hu'ehu'e Ranch. Water is not available to be moved to these areas for use by newly zoned areas as current water commitments exceed availability and transmission line sizing.

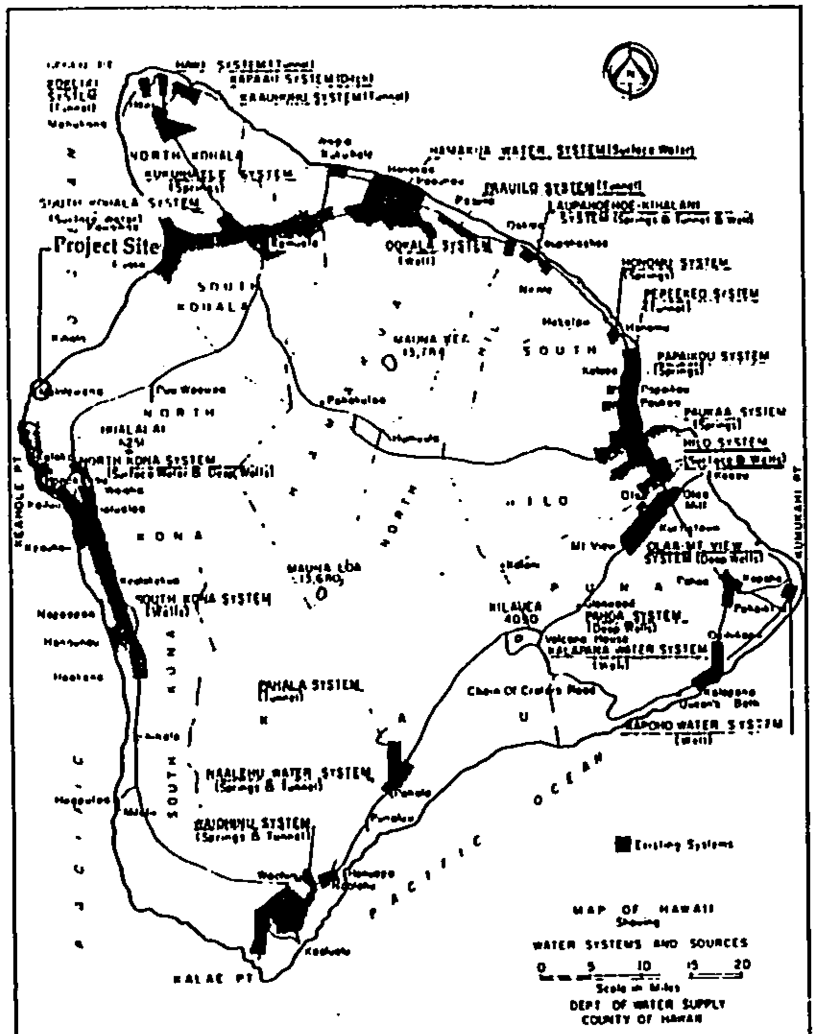
Recently drilled wells near the Manini'owali site (at Muhe'enui, by the Hu'ehu'e Ranch) have confirmed the presence of a thin basal lens, with brackish water found at the top of the water table. The water table stands at about two feet above sea level with a probable seasonal range of 1.5 to 2.5 feet. Measurements of diurnal water level fluctuations indicate a tide influence of about 0.2 feet. Assuming that water levels at Muhe'enui are representative, the groundwater gradient in the lower slope of Hualalai is about 1.0 foot per mile. This gradient would appear to result in groundwater flow from two to four million gallons per day (mgd) per mile of aquifer width.

Within the NKDG property it is unlikely that any groundwater fresher than 1,000 milligrams per liter (mg/l) can be found. Salinity in the high range of 1,500 to 3,000 mg/l is expected from any wells drilled on the property.

2.3 OTHER DEVELOPMENT PROJECTS WITHIN THE RESORT NODE

Three existing or proposed development projects currently comprise the Kaupulehu/Kona Village/Kuki'o Resort Node of which the Manini'owali Residential Community is adjacent: the existing Kona Village Resort, the Kaupulehu Resort (under construction), and the planned Regent Kona Coast Resort at Kuki'o. While groundwater pumpage is presently restricted to the Kona Village's brackish wells of 150,000 gpd capacity, new wells to service the Kuki'o and Kaupulehu development, will begin pumping within the next several years. The projected estimated water demand of the nearby resort properties as shown in Table 1 is estimated to be 2.4 mgd of potable water and 3.0 mgd of brackish water. The impacts of this withdrawal rate on the brackish basal lens are somewhat unpredictable.

waimea water services



Source:
Dep...ent of Water Supply, County of Hawaii, 1971

County of Hawai'i Water Systems

MANINI'OWALI RESIDENTIAL COMMUNITY

FIGURE 5

TABLE 1

PROJECTED POTABLE AND NON-POTABLE WATER DEMAND KAUPULEHU/KONA VILLAGE/KUKI'O RESORT NODE

Development	Potable	Brackish	Total	Status
Hu'ehu'e Ranch (housing, golf)	530,000	0	530,000	Approved
Regent Kona Coast (hotel, housing, golf)	1,430,000	1,000,000	2,430,000	Approved
Kaupulehu (no housing units) (hotel, 2 golf courses)	350,000	1,800,000	2,150,000	Approved
Kona Village	100,000	200,000	300,000	Existing
Total	2,410,000	3,000,000	5,410,000	

2.4 ESTIMATE OF AQUIFER'S MAXIMUM SUSTAINABLE CAPACITY

Assuming that the demand area and resources over the shoreline length of about seven miles (which include the Kaupulehu, Kuki'o and Manini'owali coastline), the estimated sustainable capacity of the aquifer would be about 14 mgd. The existing and approved total demand listed in Table 1 (excluding the demand of the proposed project at Manini'owali) is estimated at 5.41 mgd, or about 38.6 percent of the estimated sustainable capacity.

2.5 PROPOSED WATER SUPPLY SYSTEM AND ALTERNATIVES

Based upon water resource studies by Island Resources Ltd., off-site fresh water wells north of Kailua-Kona must be located between the elevations of 1,500 to 1,800 feet. These wells would need to be properly located to integrate with the County water system and the neighboring private water systems for future cross connections. Additional well sites in this fresh water zone are not readily available as they are required to be properly oriented to the County and private water systems. Significant improvements to the existing or planned transmission system would be required to support the NKDG project. There are two planned private transmission corridors from the well development zone to the *makai* properties of the Kaupulehu/Kona Village/Kuki'o Resort Node. Alternatively, non-potable (brackish) water wells may be developed at lower elevations (600 feet msl) independent of the County and neighboring private potable water systems.

NKDG plans to develop its own brackish water wells and a desalinization plant. This system would have the lowest cost and could provide the ability for NKDG to control its own water supply.

As an alternative to the proposed brackish water/desalinization system, NKDG could participate in development of a regional water system, if such a plan is developed. In this scenario, NKDG would enter into a cost-sharing agreement with neighboring developments of Kuki'o and Kaupulehu in the development of potable and non-potable water wells, and the installation of the transmission system and storage tanks (Figure 6 and Table 2). Operation and maintenance costs in this scenario would be cost-shared by the developers in the Kaupulehu/Kona Village/Kuki'o Resort Node.

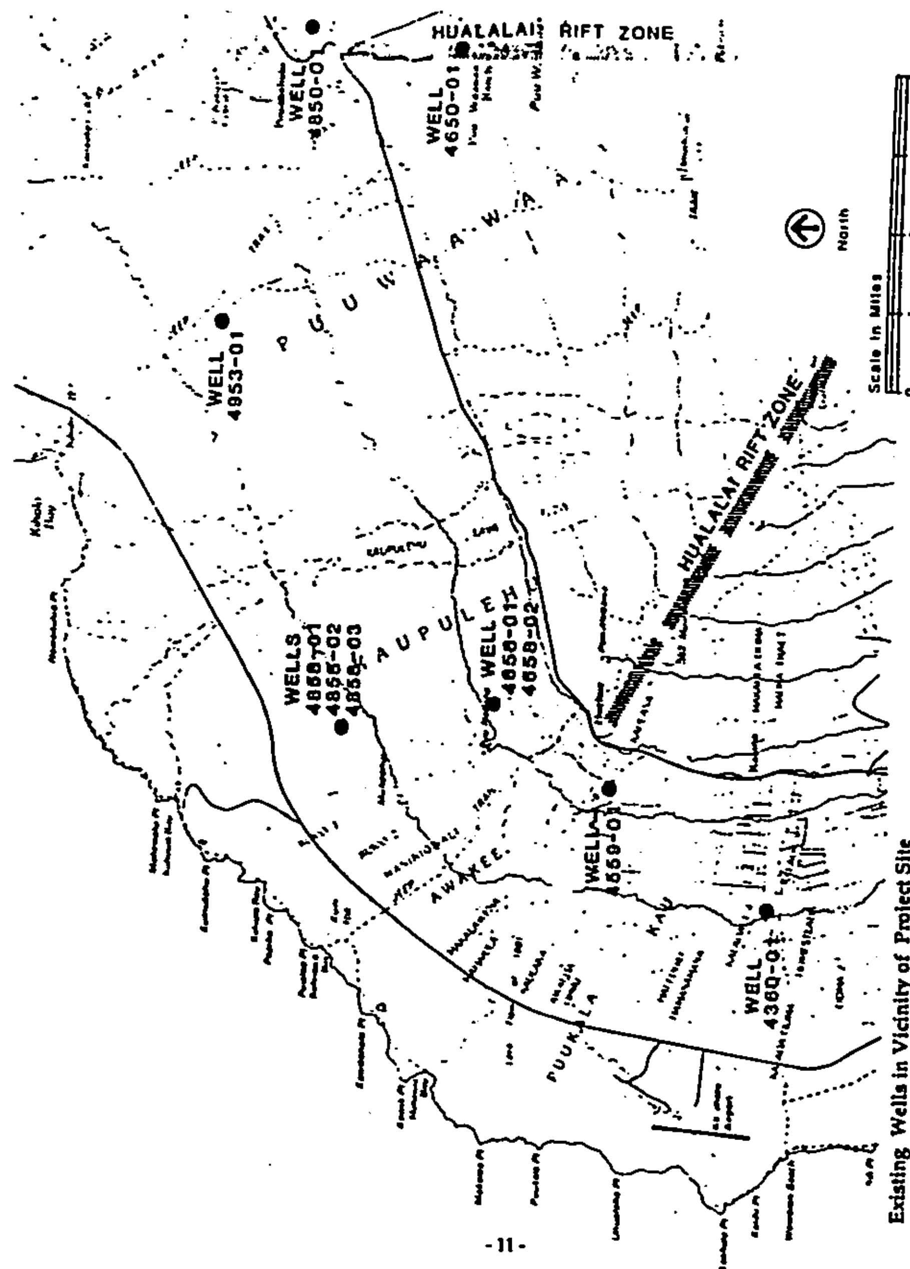


FIGURE 6

Existing Wells in Vicinity of Project Site

MANINI'OWALI RESIDENTIAL COMMUNITY

TABLE 2

SUMMARY OF WELLS IN VICINITY OF MANINI'OWALI

POTABLE WATER SOURCE ALTERNATIVE	Kaupulehu (Pu'u Nahaha)	Kaupulehu (Pu'u Nahaha)	Huehue Ranch	Kalaoa	Kona Village	Kona Village	Kona Village	Kiholo
WELL NUMBER	4658-01	4658-02	4359-01	4360-01	4558-01	4658-02	4858-03	4953-01
YEAR DRILLED	1981	1986	1965	1968	1960	1968	1973	1972
DISTANCE FROM SHORELINE (miles)	3.6	3.6	4.5	3.0	2.1	2.1	2.1	2.7
DISTANCE FROM MANINI'OWALI (miles)	1.1	1.1	1.3	5.2	1.8	1.8	1.8	6.9
GROUND ELEVATION (feet)	1,344	1,350	1,579	680	501	503	500	932
CASING DIAMETER (inches)	12	–	14	10	4	8	10	12
TOTAL WELL DEPTH (feet)	1,412	1,465	1,633	702	528	523	534	971
SOLID CASING LENGTH (feet)	1,362	1,350	1,579	682	517	503	514	926
LOUVERED CASING LENGTH (feet)	50*	80	30	20	11	20	20	40
OPEN HOLE LENGTH (feet)	0*	35	46	0	0	0	0	5
ELEVATION AT BOTTOM OF WELL (ft. msl)	-68	-115	-121	-22	-27	-20	-34	-39
STATIC WATER LEVEL (feet)	6.9*	12.6	+7.0	+3.2	+1.8	+1.8	+1.8	+2.6
PUMPING RATE (gpm)	500	575	350	150	25	90	100	700
DRAWDOWN (feet)	30	18.3	45	0.6	Not known	Not known	10.5	0.8
CHLORIDE CONTENT (mg/l)	40	38	90	740	360	430	600	345
CURRENT USE	Unused	Unused	Unused	Unused	Unused	Domestic	Domestic	Irrigation

SOURCE: BELT COLLINS AND ASSOCIATES, KAUPULEHU RESORT FINAL EIS, 1986.

* Data reported in "Kaupulehu Water Lands Source at Kaupulehu, North Kona, Hawai'i" by Fukunaga and Associates, Inc., July 1981
** Water level as presented in Water Resources International, Inc., Report to the State Division of Water & Land Development

The brackish water/desalinization system as proposed by NKDG will require gaining permission for use of State land *mauka* of the Queen Ka'ahumanu Highway in the Manini'owali and Awake'e *ahupua'a* as a site to develop brackish water wells, a storage facility, and desalinization plant (Figures 7 and 8). The focus area would be along the existing utility line easement. This proposed project would need to cover all costs to capitalize, supply, and operate the system in exchange for the land. Water derived from this system could possibly supply the State park facilities at Kua Bay.

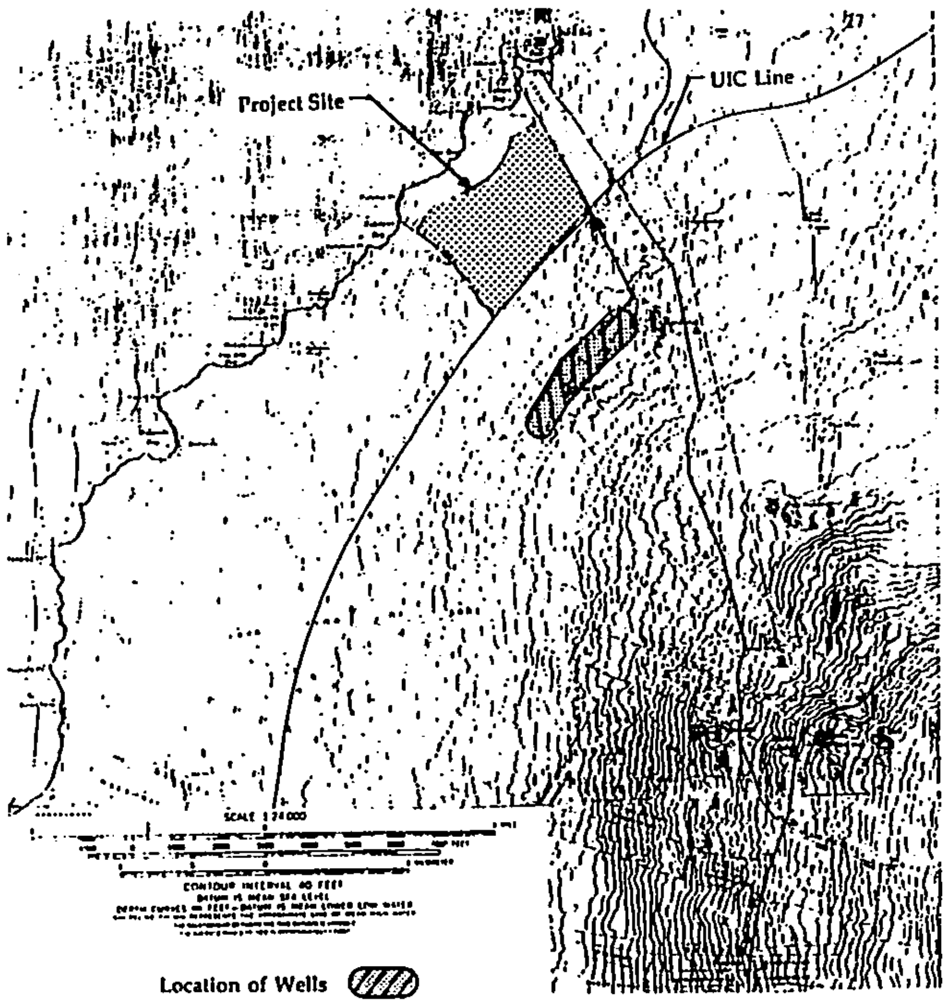
Water pumped from beneath State lands of Manini'owali and Awake'e, at approximately 600 feet above mean sea level, could be used directly for irrigation or blended with treated effluent, depending upon the chloride levels. The chloride level is anticipated to be approximately 1,000 mg/l, which is low enough that it may be used directly for irrigation water. The proposed system will involve well development, a desalinization plant, and installation of a dual water system with separate storage reservoirs.

If NKDG is unsuccessful in negotiations with the State for use of an upland location for well sites, on-site wells would be considered. The chloride level of brackish water from an on-site well is expected to be at such a high level (1,500 to 2,500 mg/l) that it may be less economical to develop and desalinate than using water from off-site wells upslope on State lands. On-site water would need to be treated to remove some of the salt for irrigation use, and further treatment to obtain potable water.

3.0 WATER DEMAND OF MANINI'OWALI RESIDENTIAL COMMUNITY

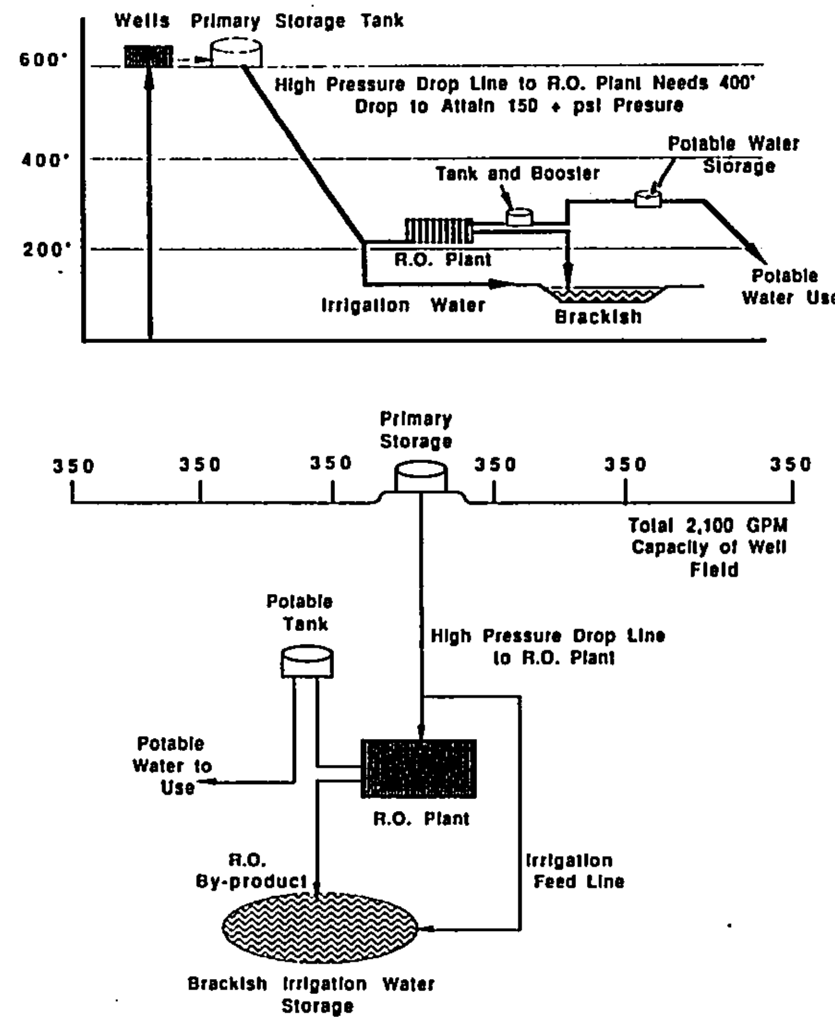
NKDG proposes to develop a dual water system to provide its residential and golf course development with potable and non-potable water. Separate transmission and distribution lines will be required from the well and reservoir site to the project site. This section addresses the total water demand of the proposed development.

waimea water services



Proposed Location for Brackish Water Wells

MANINI'OWALI RESIDENTIAL COMMUNITY FIGURE 7



Schematic Layout of Desalinization System

MANINI'OWALI RESIDENTIAL COMMUNITY FIGURE 8

An additional water burden was placed on NKDG as a condition of the land exchange with the State. Essentially, the condition states that the State shall have the right to connect to NKDG's water system for the planned shoreline park, if a water system is developed on its property. The water requirement of the park is not included in this analysis. This will be determined by the State in their park planning process.

3.1 POTABLE WATER DEMAND

The proposed project will require potable water for domestic residential users, the golf clubhouse, a tennis facility, and the golf course maintenance facility. The anticipated water requirements have been calculated using standards of the Hawai'i County Department of Water Supply (DWS) and professionally-accepted standards. As shown in Table 3, the potable water demand for the project amounts to an average daily demand of approximately 430,600 gallons per day (gpd) (with a maximum daily demand of 645,900 gpd). To create 430,600 gpd of potable water through the proposed reverse osmosis desalinization process, approximately twice, or 861,200 gpd of brackish water is required. The 430,600 gpd of by-product water will be used in irrigation after blending with less saline water.

3.2 BRACKISH WATER DEMAND

The project will also require non-potable, brackish ground water to irrigate the golf course and landscaped areas. An estimated average demand of 947,400 gpd will be required for irrigation of the golf course, driving range, and residential and common area landscaping. Of this amount, approximately 291,200 gpd will be treated effluent from the wastewater treatment facility, which is actually recycled potable water. To avoid double-counting this recycled water, the actual total brackish water requirement is the total demand quantity (Table 3) less the 291,200 gallons of recycled water, or 656,200 gallons per day. This amount is further reduced by the addition of 430,000 gpd of by-product water. The total non-potable adjusted demand is therefore 225,600 gpd (average daily demand).

TABLE 3

PROJECTED MANINI'OWALI RESIDENTIAL COMMUNITY
POTABLE AND NON-POTABLE WATER DEMAND

POTABLE WATER USE	AVERAGE DAILY DEMAND GAL/UNIT	AVERAGE DAILY DEMAND (GPD)(1)	MAXIMUM DAILY DEMAND GAL/UNIT	MAXIMUM DAILY DEMAND (GPD)
1,000 Housing Units	400(2)	400,000	600	600,000
1 Golf Club House and Tennis Center		20,000		30,000
1 Golf Maintenance Center		10,000		15,000
1 Sewage Treatment Plant		600		900
TOTAL POTABLE WATER DEMAND		430,600		645,900

NON-POTABLE WATER USE	AVERAGE DAILY DEMAND GAL/UNIT	AVERAGE DAILY DEMAND (GPD)	MAXIMUM DAILY DEMAND GAL/UNIT	MAXIMUM DAILY DEMAND (GPD)
1,000 Housing Units	300	300,000	450	450,000
Golf Course (86 acres turf) and Driving Range (7 acres),	4,800	446,000	7,200	670,000
Landscaping (40 acres)	4,800	192,000	7,200	288,000
3 Water Features	1,200	3,600	1,800	5,400
1 Sewage Treatment Plant	5,400	5,400	8,100	8,100
TOTAL NON-POTABLE WATER DEMAND		947,000		1,421,500
TREATED EFFLUENT (RECYCLED POTABLE WATER)		-291,200		
R.O. BY-PRODUCT WATER		-430,600		
ADJUSTED TOTAL NON-POTABLE WATER DEMAND		225,600		
TOTAL AVERAGE DAILY DEMAND			1,086,800(3)	

(1) gpd = gallons per day
(2) County of Hawaii DWS standard
(3) Average daily water demand from brackish well field

SOURCE: Waimea Water Services (October 1991)

3.3 BRACKISH WATER WELLS

A series of six wells are proposed to be developed on the State land mauka of Queen Ka'ahumanu Highway at approximately 600 feet elevation to draw brackish water for subsequent irrigation use or desalinization. Permission from DLNR and the Water Commission will be required for the development of these wells. In order to prevent possible occurrence of groundwater contamination by seepage around the well, the wells to be drilled will be cased into the aquifer and the annular spacing surrounding the casing will be grouted to just above the groundwater table. Water drawn for these wells will be either stored in the irrigation reservoir and/or delivered by the transmission lines to the RO plant.

3.4 DESALINIZATION PLANT

As mentioned previously, desalinization of brackish water is planned to produce sufficient water for potable use. The desalting process most commonly used in the United States and other parts of the world is reverse osmosis (RO). However, the Kona Village Resort has been using the electro-dialysis reversal (EDR) process for production of their potable water supply for more than 20 years. Projects and municipalities in Florida and the Caribbean use RO extensively for fresh water production. This process is approved by the EPA. By starting with an irrigation water production plant, proper testing would demonstrate the use of the water as a potable supply such to meet State Department of Health approval for drinking water. Figure 8 shows a diagram of the proposed desalinization process. Nearly double the volume of brackish source water is needed to create a desired potable water volume.

The State Department of Health has expressed caution in the extraction of water for potable use below the Underground Injection Control line. Provided that the source of water for the desalinization plant is *mauka* of Queen Ka'ahumanu Highway, there will be no issue regarding the UIC line. If NKDG requires wells on the project site, it will work closely with the State Department of Health regarding use of water below this UIC line.

3.5 WASTEWATER TREATMENT PLANT EFFLUENT AND BY-PRODUCT WATER

Wastewater treatment plant effluent will be a valuable source of irrigation water for this property and will help to reduce the overall water requirement by a significant amount. Effluent is usually of sufficiently low salinity to be used for irrigation. The cost involved with bringing water to the site is incurred in developing the drinking water supply. Used potable water or wastewater should be recovered as an irrigation resource once properly treated. The treated effluent would be pumped from the wastewater treatment facility to a pond located within the golf course where it would be blended with non-potable brackish well water for irrigation. A wastewater treatment facility will generate approximately 291,200 gpd of effluent. The pond will be lined to prevent infiltration.

By-product water from the RO plant will represent approximately 430,000 gpd (average daily demand). This water will be appropriately diluted to avoid water quality effects during irrigation use.

Combined together, treated wastewater and by-product water will provide 721,200 gpd for irrigation use.

3.6 FIRE PROTECTION SYSTEMS

This section references the requirement for fire protection for the project which was studied and evaluated by Park Engineering in a separate engineering study. The required fire flows for this project are listed in the County's DWS standards, Table 16. For residential areas, required fire flow depends on the character and congestion of housing units. For the golf clubhouse, maintenance facility, tennis center, and the wastewater treatment plant, the required fire flows depend on bulk, congestion, fire resistance, and the contents of the buildings. A reservoir of water is required to be maintained at all times for fire flow purposes. The potable reservoir volume is based upon a Maximum Daily Demand of 645,900 gallons. Therefore, a 0.75 million gallon reservoir is required. The non-potable reservoir volume required is estimated at 100,000 gallons because it is expected that the storage capacity of golf course pond(s) can handle most of the non-potable water demand of the project.

The potable distribution system will be sized for peak hour flow rates with a minimum residual pressure of 40 pounds per square inch (psi) and maximum velocity in the main of 6 feet per second. The Peak Hour Demand is equal to five times the Average Daily Demand. Non-potable water pipelines will be sized for Maximum Day flow rates with a residual pressure of 20 psi at the critical fire hydrant. Hydraulic analyses shall use three-quarters full tank water surface elevations as initial hydraulic grade line elevations.

The sizing of pumps for potable and non-potable systems in a dual system is based upon the Maximum Daily Demand with an operating time of 24 hours. The Maximum Daily Demand of 2.06 mgd or 1,695 gpm (from Table 3) requires use of four 575 gpm pumps, including one for standby.

4.0 IMPACT ON WATER RESOURCES

4.1 IMPACT ON SOILS AND GEOLOGY

The impact of developing the required potable and brackish water supplies on the topography, geology, and soils will not be significant. Well sites require only a modest amount of grading for drilling and constructing a concrete slab for the well head. Reservoir sites would be expected to be chosen on relatively flat topography and, thus, would require minimal grading. Trenching for pipelines would be expected to be accomplished by ripping. The main impact of these improvements would be the noise and dust created during the construction phase. Compliance with the County grading ordinance would provide adequate protection.

4.2 WITHDRAWAL RATES FOR MANINI'OWALI RESIDENTIAL COMMUNITY

The total water requirement for the proposed project is estimated at 1.08 mgd, which will be withdrawn out of the aquifer at a salinity of approximately 1,000 milligrams per liter (mg/l) chlorides. Approximately 0.43 mgd of this water will be desalinated for use as potable water for residential and commercial users. Approximately 0.94 mgd of non-potable water would be used for irrigation, of which, 0.43 mgd would be by-product

water from the RO desalinization plant. This water would be use to irrigate the landscaped residential areas, and when mixed with approximately 0.29 mgd of treated wastewater effluent, to irrigate the golf course. Brackish water withdrawal from the aquifer for this project would thus amount to less than eight percent of its total sustainable capacity of 14 mgd. The Manini'owali Residential Community and the resorts of the Kaupulehu/Kona Village/Kuki'o Resort Node would amount to under 50 percent of the water source capacity.

The project's average daily utilization of approximately 1.08 mgd of brackish water is well within the estimated sustainable yield and existing water use. Moreover, this use of brackish water to create potable water furthers the conservation of the existing freshwater resources of the Hualalai aquifer and will not affect any existing water resources or preclude the development of additional sources.

4.3 IMPACT ON EXISTING WATER RESOURCES

The development of wells on State land *mauka* of the project site is not expected to have any adverse impact on existing wells located *mauka* of the the project site, based upon generally accepted concepts of Hawaiian basal aquifer hydrology. By proper spacing and pumpage there is no expected adverse impact on other sources in the area.

There are no wells located *makai* of the proposed brackish water well site. However, any future *makai* wells that may be drilled may be affected over the long term by some increase in salinity as aquifer withdrawals approach sustainable yield. Possible long-term effects on wells located *makai* of the project will be mitigated by spacing wells 2,000 feet apart along the 600 foot contour and by designing and conducting adequate well pumping tests, including careful monitoring of drawdown and chloride, to obtain maximum information on aquifer characteristics and groundwater conditions.

4.4 IMPACT ON GROUNDWATER QUALITY

The development of brackish water resources at the proposed well sites at Manini'owali and Awake'e is expected to have a small impact on groundwater quality; however, with proper management impacts will be minimized. A Groundwater Quality Assessment report has been prepared by Oceanit Laboratories, Inc. (October 1991) which analyzes the anticipated impact of the project's use of treated wastewater effluent, fertilizers, and pesticides on groundwater resources.

The salinity of the basal aquifer is not expected to increase significantly. as a result of project activities. Mitigative measures will include shallow penetration of the basal aquifer and carefully conducting pumping tests on each well. An additional mitigative measure will include monitoring of groundwater conditions and maintaining good records on pumpage, water level, and chloride content.

5.0 MITIGATIVE MEASURES

Two means are primarily proposed for mitigating the impact of the water demand of the Manini'owali Residential Community. The first measure is the planned use of treated wastewater effluent for irrigation of the golf course. Approximately 291,200 gpd will be available. The second mitigation measure is the proposed use of salt-tolerant turf grass and landscaping plants suitable to the arid coastal climate on the golf course and landscaped areas, thus reducing the need for irrigation use of potable water.

To mitigate potential water quality impacts of the proposed desalinization system, as stated above, wells will be spaced a maximum practical distance apart, and there will be testing, monitoring, and maintenance of records of pumpage, water level, and the chloride content of the wells.

APPENDIX F

Oceanit Laboratories, Inc.
coastal & offshore engineering services • research & development

GROUNDWATER IMPACT ASSESSMENT FOR MANINIOWALI, HAWAII

submitted to:
Group 70

REVISION 1.0
OCTOBER 1991

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813

EXECUTIVE SUMMARY

Maniniowali is located 11 miles north of Kailua-Kona on the island of Hawaii's leeward side. Development plans include golf courses, single family residences and low rise condominiums.

The climate is relatively arid; annual rainfall of 10 to 20 inches occurs mostly in the winter months. The ground is composed of porous lava with little vegetation in the higher elevations. There are no perennial streams in the area, which indicates the ground surface has a high seepage potential.

An extensive literature survey on related studies in the region, and on dispersion of fertilizers and pesticides in soils was made. Findings from these reports were used to estimate the hydraulic budget, the flux of water entering the ocean, the concentration of nutrients entering the ocean, the amount of chemicals introduced from golf course activities, and the amount of chemicals introduced from residential activities. The Attenuation Factor (AF) model was used to estimate chemicals entering the groundwater from golf course activities.

Results indicate that the estimated rainfall input into the project area is 0.48 million gallons per day (mgd); when combined with existing groundwater flow, estimated seepage is found to be 0.82 mgd along the project's 6,000 foot coast.

Combined irrigation and residential activities are expected to produce a net increase in groundwater flow of approximately 23 percent. Nutrient concentrations are not expected to increase, except for groundwater nitrogen, which is expected to increase from an estimated 0.85 mg/l to approximately 2.60 mg/l with combined residential and golf course activities. This is well below State Department of Health limits of 10 mg/l in drinking water.

The potential for pesticides introduction into groundwater from residential and golf course activities will depend on golf course construction and management. Leaching can be minimized by constructing golf and other landscaped areas with adequate topsoil of suitable organic content. Concentrations calculated with 18 inches of 2 percent organic content topsoil result in values that are well below Health Advisory levels for drinking water.

Monitoring groundwater quality and behavior is recommended before, during and after commencing development activities so that appropriate mitigative action can prevent adverse groundwater quality impacts. The monitoring program should include wells to monitor groundwater quality and lysimeters to monitor quality of water percolating into the aquifer through the vadose zone.

Minor concentrations of chemicals introduced into the groundwater from golf course and residential activities are not expected to create a significant impact if adequate attention is given to construction and operations management.

RECOMMENDATIONS

- Owners must comply with State of Hawaii, Department of Health, eight golf course conditions (EGCC) relating to new golf course development.
- Employ lysimeters at selected locations to monitor the vadose zone.
- Install wells at selected locations and monitor groundwater quality.
- Monitor water quality of exposed water bodies close to the coast such as anchialine ponds.
- Runoff controls should be included at appropriate boundaries in the golf course to prevent contamination of surface waters by direct runoff.
- Slow release fertilizers should be used in golf courses, and residents should be encouraged to use slow release fertilizers on their lawns ans gardens.
- Controls should be exercised that prevent use of pesticides before heavy rain.
- Specific cutting disposal methods should be followed to prevent groundwater contamination by composting vegetation.

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I. INTRODUCTION

A. BACKGROUND

Planning is currently underway by North Kona Development Group (NKDG) to develop an approximately 388 acre property, referred to as Maniniowali, between the Queen Kaahumanu Highway and a line 1000 feet mauka from the shoreline shown in Figure I-1. It is located approximately 11 miles north of Kona on the leeward side of the island of Hawaii, approximately 7 miles north of the Keahole Airport. In general, the development plan includes a nine (9) hole golf course, single family residences and low rise condominiums.

Oceanit Laboratories, Inc. (OLI) was requested to investigate the development impacts to groundwater, as well as potential impacts to the marine environment (addressed in a separate report).

State owned land at the shoreline consists of a comparatively recent flow of rugged lava with finger formations indenting into the sea. The State-owned land extends approximately 1000 feet from the NKDG makai boundary. For the purpose of this investigation both portions of land will be treated as one.

A pocket beach with an extensive sand bed offshore lies at the center of the property's coastline. Lava and coral rubble form a berm about 30 feet above the water level. Chunks of lava and coral rubble have been thrown up by heavy wave action during the winter. This berm formation is more prominent along the property's southern boundary.

B. OBJECTIVE

The objective of this study was to investigate groundwater impact by estimating the concentration of nutrients and pesticides that may percolate into the groundwater, and ultimately enter the marine environment from proposed residential and golf course activities.

Existing information on geology, topography and hydrology of the general area was collected from studies of adjacent properties. Information was used to estimate groundwater and aquifer characteristics of Maniniowali.

The following parameters were determined from existing data, information gathered during a site visit and from anticipated golf course activities:

- hydraulic budget for the site
- flux of water entering the ocean
- concentration of nutrients entering the ocean
- amount of chemicals introduced from golf course activities
- amount of chemicals introduced from residential activities

This information was then used to estimate total impact and probable changes to the existing groundwater aquifer.

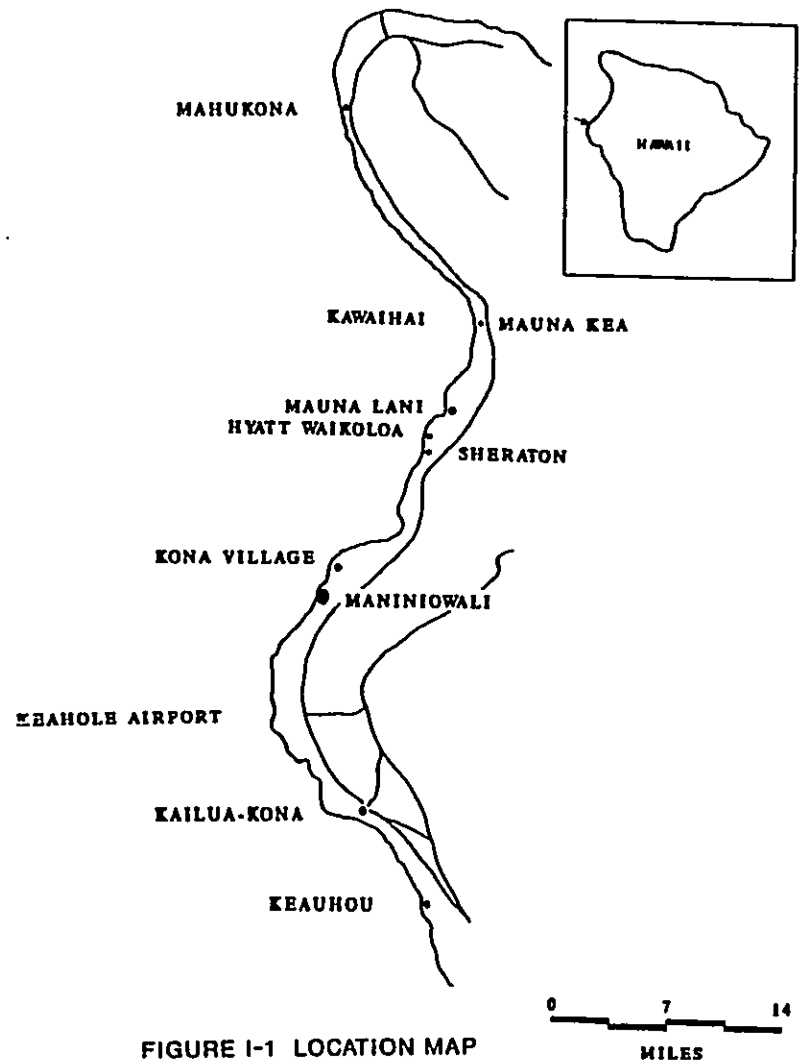


FIGURE I-1 LOCATION MAP

II. GENERAL SITE CONDITIONS

Several resort developments are planned for construction in the coastal area north of Kailua-Kona, on the west coast of Hawaii (Figure II-1). Climate in this area is arid and the land near the coast consists of relatively recent flows of lava from Mauna Loa, Mauna Kea and Hualalai volcanoes. Rainfall generally occurs as a heavy downpour that is absorbed into the ground relatively fast. There are no stream beds on the site indicating very low runoff even during heavy rainfall.

Fertilizers and some pesticides are necessary for maintaining healthy golf course turf. Water and nutrients needed to establish turf grasses and other vegetation for golf course operations must be supplied continuously due to the long dry periods. Residual nutrients and pesticides may leach into the ground if proper application and management measures are not followed.

Lava flows in this area are of the a'a and pahoehoe type and range in age from very recent (1801) barren a'a to prehistoric grass covered pahoehoe. The surface is porous, dry and devoid of vegetation near the sea. The area is underlain by lava from Hualalai volcanic series. No surface streams or indications of groundwater impounding dikes were observed in the area; however, these may be present below the surface.

This area is characterized by low rainfall, high to moderately high evaporation, high temperature and at times strong winds. Winter storms account for most of the annual rainfall. Mean annual rainfall ranges from 10 to 20 inches on the coastal plains. Tradewinds, generally from the east-northeasterly direction, are effectively blocked by the mountains reaching 13,000 feet in elevation. Groundwater recharge is due primarily to winter storms of moderately high intensity and short duration [1].

Average air temperature varies between 60 to 76 degrees Fahrenheit (F) from winter to summer and evaporation varies seasonally from 0.18 to 0.36 inches per day.

There are no perennial streams in the project area. Because of the highly porous permeable surface and low rainfall, water is lost to infiltration and evaporation and is not available for runoff.

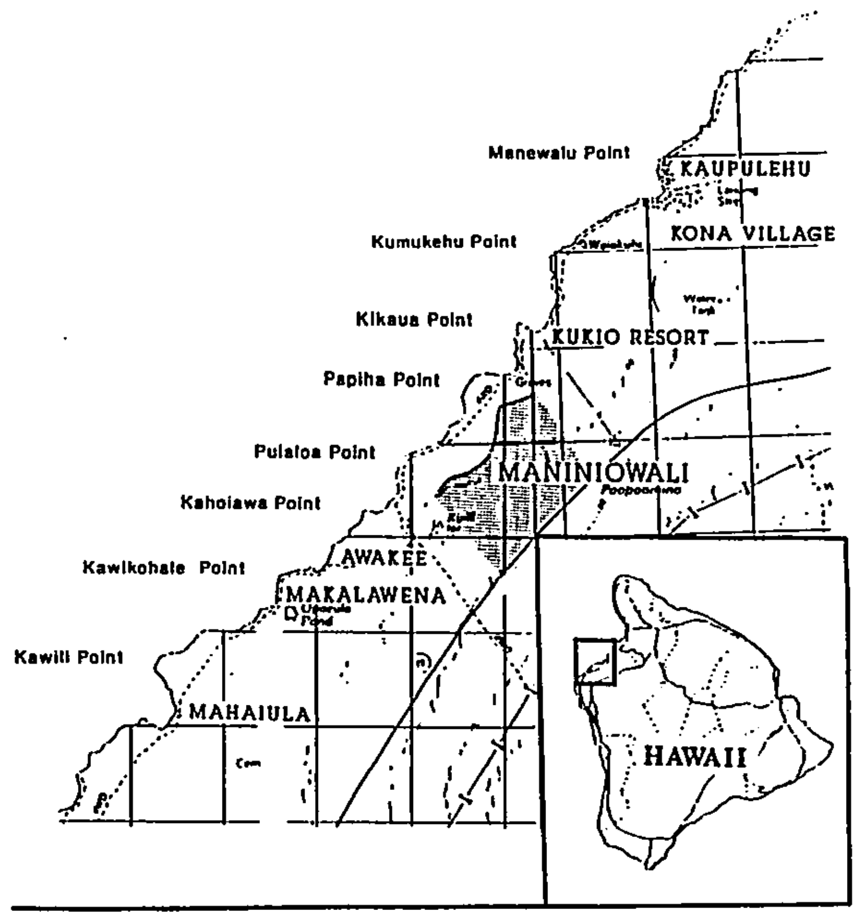


FIGURE II-1 PROJECT SITE

III. INVESTIGATION METHODOLOGY

Available geologic, meteorologic and hydrologic data for the project site are very limited. This, coupled with a scarcity of wells for water level observations, restricted the technical approaches that could be taken. As a result, we elected to use the attenuation factor (AF) model currently under evaluation by the Hawaii State Department of Agriculture, which enables us to determine the mass fractio of chemicals lost below the root zone. Other models such as the Pesticide Root Zone Model (PRZM) require more site specific environmental and soil data. Existing data from earlier studies for the general area were utilized to estimate hydraulic budget and water flux entering the ocean.

For the purpose of establishing model parameters, development areas designated for golf course and residential use were derived from the NKDG's land plan. Total area designated for golf course activities is 86 acres, with approximately 86 acres planned to contain turf grass. The area planned for residential development is 132 acres. For purposes of calculating chemical impact on groundwater, the 86 acre turfgrass golf course was used as the input. In the case of residential development, 66 acres of landscape area will be used (will be referenced) for estimating impact due to chemical usage.

A. HYDRAULIC BUDGET

Water budgeting or balancing is one of the principal methods applied in understanding groundwater behavior. It is basically an accounting of the total input, output, and change in storage of the region under consideration. One of the primary characteristics to be determined is the total flux of water through the area. This is accomplished by constructing a water balance equation.

Groundwater storage is the amount of water available in the aquifer. This is equal to the bulk volume of the saturated aquifer times its porosity. Highly porous material therefore contains a larger percentage of water than compacted earth.

Recharge is the addition of water to aquifer. This takes place by infiltration from precipitation, snowmelt, rivers and lakes and in some cases from the sea if the water table is sloping down toward land. Generally, recharge is only a fraction of the rainfall. In Hawaii only about 15 percent of the precipitation contributes to recharge [2].

If the budget is made for a complete climatic cycle, generally one year, seasonal changes in storage need not be considered. When the budget is averaged over a number of years, changes in storage during years of unusual rainfall can be eliminated. At Maniniowali both surface runoff and groundwater extraction are negligible. Under these conditions good estimates of groundwater discharge to the ocean can be made. If change in storage is negligible, the outflow of groundwater into the sea is equal to the recharge into the groundwater body.

In constructing the hydraulic budget all components that affect input and outflow of water from the area are estimated. Mean annual rainfall constitutes the only input of water to the area. The high permeability and the absence of natural gulches in the area indicate that losses from runoff are negligible.

Immediately after reaching the surface, part of the rainwater enters the ground through seepage. Once seepage water percolates down to the groundwater body, flow is governed by the slope of the water table. The direction of groundwater flow is determined by streamlines that are perpendicular to equipotential lines. In an area with homogeneous soil properties, equipotential lines generally follow surface contours. This assumption will be made for the project area for two reasons. The project area does not lie close to a boundary separating two geologically differing regions, and secondly, no underground impermeable dikes have yet been found in the area. Furthermore, there is presently no extraction of groundwater in this area that could distort groundwater flow patterns. When the boundaries of the area considered are selected along streamlines, using assumptions made herein, mean groundwater recharge equals the amount of flow into the sea.

The project site generally extends from the 200 foot contour to the coast. Sufficient data is not available to estimate the inflow of groundwater into the project site from surrounding areas. In order to overcome this problem, a larger area containing the project site is considered for water budget calculations at first. The lateral boundaries of this initial area are selected on streamlines, which are extended from the coast until they meet at the higher slopes of Hualalai. Lines perpendicular to the ground contours are used as streamline paths. This assumption is valid only when the permeability of an area is uniform. Using results from this budget, flow across the 200 foot elevation is calculated. The estimated groundwater flow across the 200 foot contour is assumed to be equal to the inflow through the upper boundary of the project site. The lateral boundaries of the project site lie nearly along lines of steepest slope; therefore, the error in assuming zero seepage input across these boundaries is negligible.

The lateral boundaries of the area for water budget considerations are approximated along streamlines to avoid lateral flow of groundwater into the budget area. The area selected for the primary water budget is shown in Figure III-2. The secondary water budget area covers the project site and is shown in Figure III-3. Two lateral boundaries for the primary area in this case meet at around the 5000 foot contour. The open boundary of the budget area is along the coastline. This boundary is approximately 5.6 miles long. The entire length of the coastal boundary of the project area is included within this line, i.e., coastline of the project area is about 6000 feet in length. Our calculations assume uniform flow across the entire coastal boundary.

The water balance equation can be written as follows:

$$P + R(in) + S(in) = E + R(out) + S(out) + DST \qquad \text{Equation (1)}$$

Where:
P = mean precipitation in the area
R(in) = surface runoff into the area
S(in) = seepage into the area
E = mean evapotranspiration from the area
R(out) = surface runoff out of the area
S(out) = seepage out of the area
DST = change in groundwater storage

As mentioned earlier, the surface flow terms in the above equation are negligible for this site.

Precipitation

Mean annual rainfall in the project area is about 20 inches, and ranges from 40 inches in the uplands to 10 inches in the coastal plains [3]. Most of the rainfall occurs during winter months; because of the arid climate, groundwater recharge takes place only during high intensity rainfall. Percolating water has a low resident time due to the high permeability of the surface. High intensity rainfall with variable duration and negligible runoff results in nearly all percolating water recharging the groundwater reservoir.

Mean annual rainfall intensities over the budget area are used for calculating the amount of water received. Distribution of mean annual rainfall over a period of 24 years is shown in Figure III-1 [2]. Lines of equal rainfall intensity divide the budget area into a number of sub-sections as shown in Figure III-2. Total annual rainfall volume for each sub-section is calculated by multiplying the area of the sub-section by the rainfall intensity. The total amount of water received from rainfall for the entire budget area is calculated by adding the totals from each sub-section.

Evaporation

Evaporation takes place when water is exposed to the atmosphere. In the project area evaporation can take place during and immediately after rain. Evapotranspiration is the loss of water due to evaporation from the soil and transpiration from trees. Water held at the soil surface layer undergoes evaporation from capillary action or is lost through uptake and respiration by plants (evapotranspiration).

Because most of the rain water percolates quickly below the soil zone it is difficult to estimate the total amount of actual evaporation without having daily rainfall and evaporation data over a long period. In general, the recharge fraction of mean rainfall for Hawaii has been found to lie between .15 and .20 [4]. Both of these values were used for estimating the groundwater recharge and flow into the sea.

Evaporation data or evapotranspiration data was not available for our analysis. The best data station near the area is Lalamilo, which is comparatively wetter than the project area. In an earlier study, evaporation measurement rates using evaporation pans were performed at Waikoloa in 1977 [2]. Waikoloa data is more suitable for Maniniowali because of similarities in climate. From this data we find that the potential annual evaporation in the project area can vary between 65 to 90 inches. This exceeds the mean annual rainfall in the area.

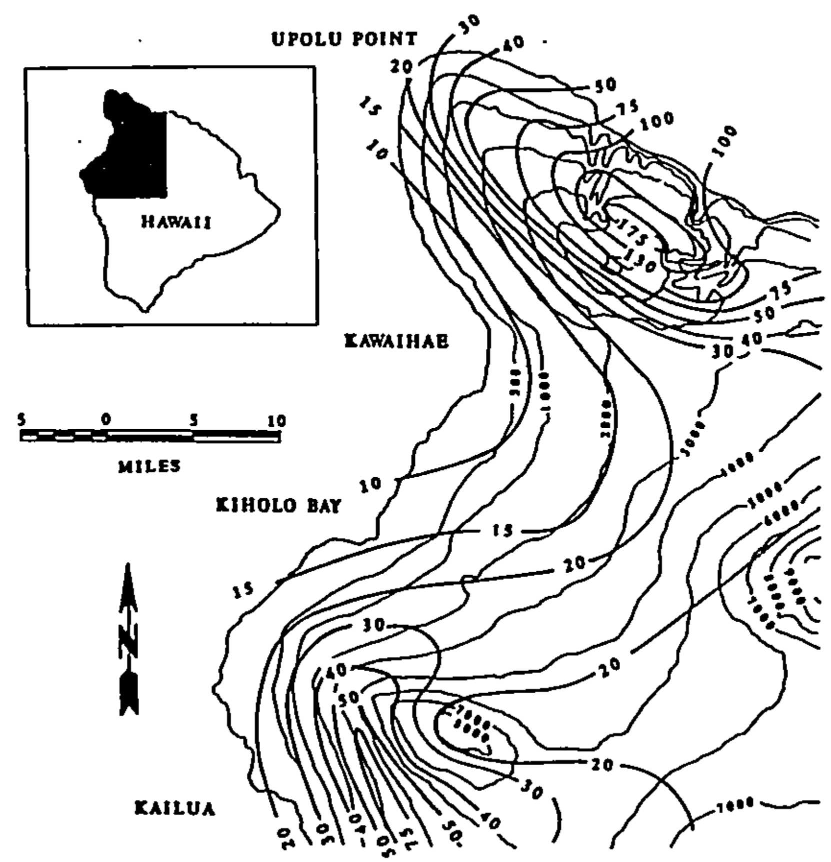


FIGURE III-1 MEAN ANNUAL RAINFALL DISTRIBUTION

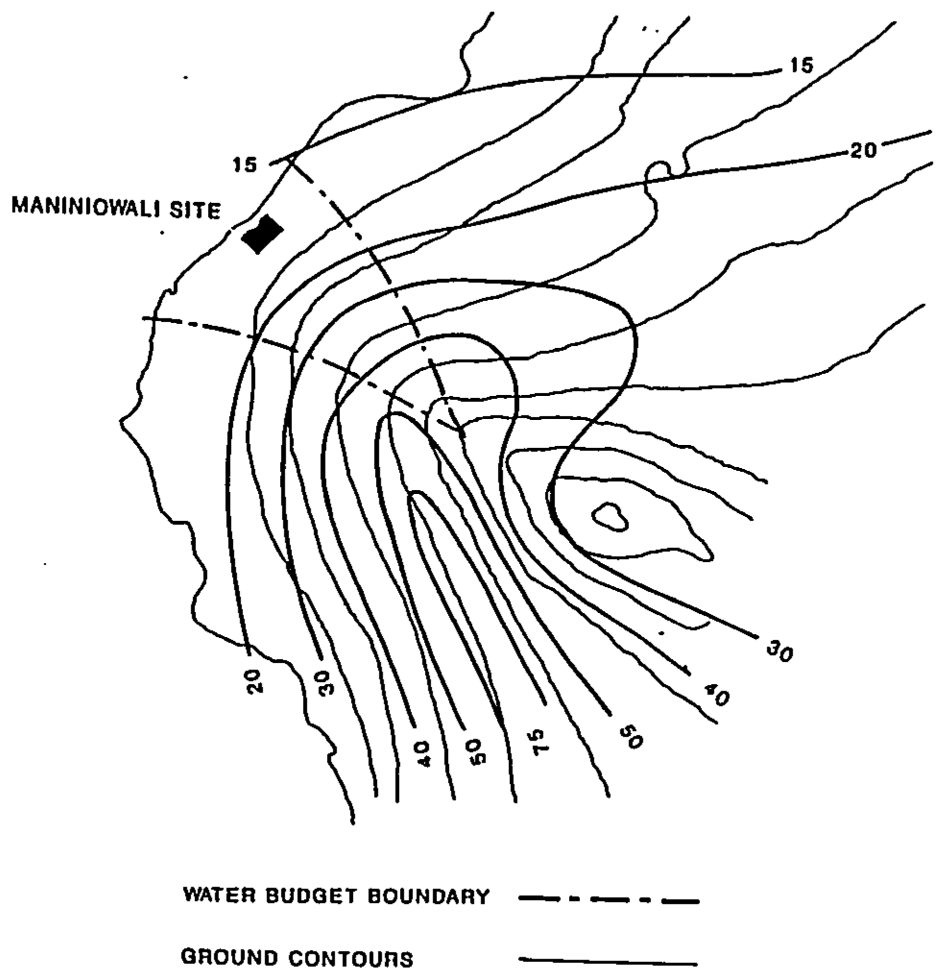


FIGURE III-2 PRIMARY WATER BUDGET AREA

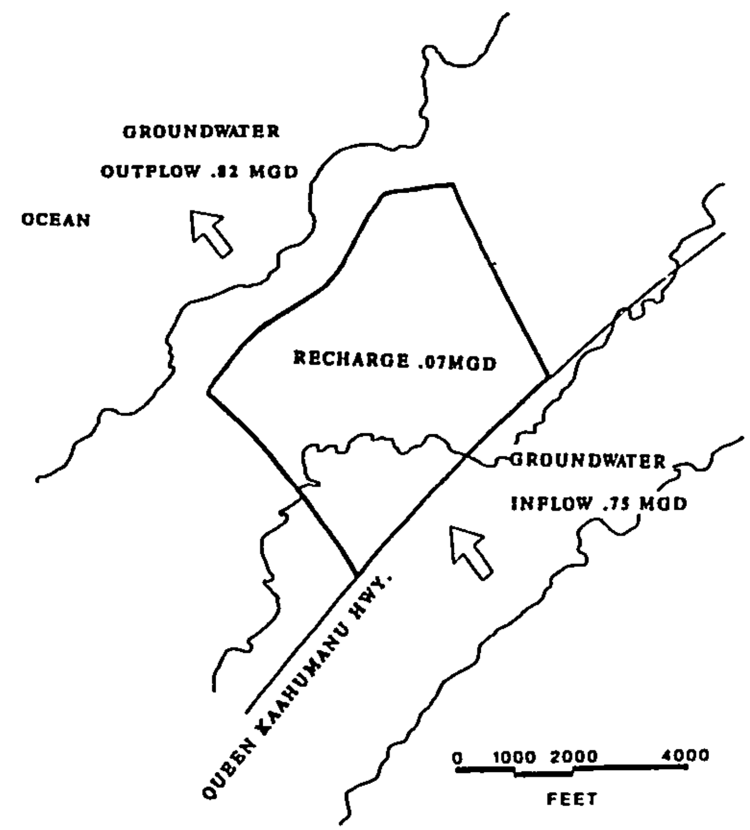


FIGURE III-3 SECONDARY WATER BUDGET AREA

B. GOLF COURSE CHEMICALS

Chemicals used in golf course maintenance activities include fertilizers and pesticides. Furthermore, nutrients from treated domestic wastewater will constitute additional input into the golf course. The amount and application pattern of these substances was obtained from a report prepared by Murdoch and Green [5].

Fertilizers

Fertilizers are applied to golf courses to maintain greens, tees and fairways. Turfgrasses utilize twice as much nitrogen as potassium and about four times as much nitrogen as phosphorus. Primary contaminants of groundwater and surface waters are nitrogen and phosphorous. Phosphorus attaches to soil, forms insoluble compounds and moves very little after application; therefore, it does not cause groundwater pollution. Nitrogen in the form of nitrates moves readily with water. Nitrogen losses can be partly controlled by applying fertilizers in a slow release form or by applying it in small amounts and irrigating the soil only enough to replace water lost by evapotranspiration. Excess watering washes nutrients through the top soil into the groundwater.

Treated irrigation wastewater contains about 10 to 25 parts per million nitrogen in solution [5]. This nitrogen is introduced continuously through golf course irrigation. Evaporation in the area is about 80 inches per year. Water use by warm season grasses can be estimated at 50 percent of a Class A evaporation pan [5]. The annual potential evaporation for Kona area is about 80 inches. Thus, about 40 inches of irrigation water is required to maintain the golf course. The effluent will contain dissolved salts in addition to nutrients. Salts will collect at the root zone if it is not leached with excess water. Because salinity can vary between 0.65 to 1.3 parts per thousand; an extra 20 percent irrigation water is necessary for leaching salts. A large portion of nitrogen in the leaching water can enter the groundwater. This can be partly prevented by balancing this nitrogen with nitrogen supplied from fertilizers.

Pesticides

Pesticides are applied to golf courses to control weeds, fungi and vegetation damaging insects. Chemicals are generally applied on a regular basis to golf courses in Hawaii and the quantities applied per acre per year are listed in Table IV-6 [5]. The North Kona Development Group (NKDG) is planning to implement an integrated pest management program (IPM) for their golf course which will result in lower chemical usage rates. This study analyzes a worst case scenario of regular pesticide application, which is the current practice in Hawaii.

Pesticides are used on golf courses only in limited areas as needed. Most of the pesticides have low toxicity [5]. Pesticides that are most likely to move below the root zone are metribuzin, mecoprop, dicamba, simazine, and trichlorfon. Leaching attenuation factors are a key parameter affecting the potential for contaminating groundwater. Attenuation factors are relatively low for pesticides used presently in Hawaii.

C. RESIDENTIAL CHEMICALS

Chemicals used in residential areas can be categorized into pesticides and fertilizers. Pesticides include herbicides, fungicides and insecticides for gardens and lawns, and also termicides that is used for termite control. Termite control activities can be controlled when carried out by professionals. Application of pesticides and fertilizers commercially available in Hawaii by individual home owners show wide ranges in chemical use and application.

Surveys were carried out in Wahiawa between 1988 and 1989 to assess potential groundwater contamination from urban development. The survey included termicide companies for types and amounts of termicides used, as well as residences in the area to estimate types of chemicals used in gardens and lawns. Results of these surveys are used in this study to assess the potential input of chemicals to the area by proposed residential activities.

IV. INVESTIGATION RESULTS

A. HYDRAULIC BUDGET

The hydraulic budget for the site was calculated from results of studies made for the general area. Initially the water budget was calculated for the area shown in Figure III-2. Once the flow through this area was estimated (Table IV-1), the flow rate seaward at the 200 foot contour (approximate site boundary) was used to calculate the inflow of water into the project site from the mauka side. The water budget for the project site (Figure III-3) was prepared next. Results from the initial water budget were used to calculate groundwater input into the project site. Water budget for Maniniowali project site is given in Table IV-2. It should be noted that these results are provided as average annual water flow values.

TABLE IV-1
WATER BUDGET FOR THE PRIMARY AREA

Component	Amount
Input from rainfall	22.3 mgd
Seepage into the area	0.0 mgd
Losses due to evaporation etc.	18.9 mgd
Seepage into the sea	3.4 mgd
Length of coastline	5.6 miles
Seepage per mile across coastline	0.6 mgd

The water budget for Maniniowali project is calculated using results from above. Water budget values for the site (secondary area) are given below.

TABLE IV-2
WATER BUDGET FOR THE PROJECT AREA

Component	Amount
Input from rainfall	0.48 mgd
Seepage across mauka boundary	0.75 mgd
Seepage across side boundaries	0.00 mgd
Losses due to evaporation etc.	0.41 mgd
Seepage into the sea at coastline	0.82 mgd

Water Flux Entering Ocean

Runoff at the project site is small because of the porous nature of the ground surface. Groundwater constitutes the main flux of water into the ocean. Initial water budget calculations show that the flux of groundwater across the shoreline is about 0.6 mgd per mile. This is a first approximation; the rate is averaged over a coastline 5.6 miles long. If greater accuracy and details are required, field measurements, including salinity, aerial infrared imagery and silicates may be necessary. Silicon nitrogen and salinity are commonly used to identify fresh water intrusion in the ocean. The rate of water flowing into the ocean through the project site, in the second budget calculation is slightly higher at about 0.82 mgd. This rate is more suitable because the input from rainfall is more accurately defined for the smaller area. Therefore, this figure is used as the outflow of groundwater into the ocean from the project site.

Groundwater enters the ocean along a 6000 foot coastline. Assuming uniform distribution of the flow across the entire length gives a groundwater discharge of about 140 gallons per day (gpd) per linear foot of coastline.

Nutrient Concentration Entering the Ocean

Ranges in nutrient values from anchialine ponds and coastal wells north of the project site are given in table IV-3 [3]. Water quality values samples taken at three different locations identified in Figure IV-1 are shown in Table IV-4. Results from samples taken beyond the lava toe indicate low salinity and high nitrogen and silicate.

Anchialine pond water level is the same as the groundwater table. Nutrient concentrations in groundwater close to the sea are expected to be equal to or slightly higher than those found in anchialine pond.

TABLE IV-3
NUTRIENT CONCENTRATIONS FROM EARLIER STUDIES

Location	Total Nitrogen	Total Phosphorus
Anchialine ponds	1330 to 2352 ug/l	114 to 163 ug/l
Inland wells	652 to 1200 ug/l	84.2
Ocean at Waialua	160.0 ug/l	–

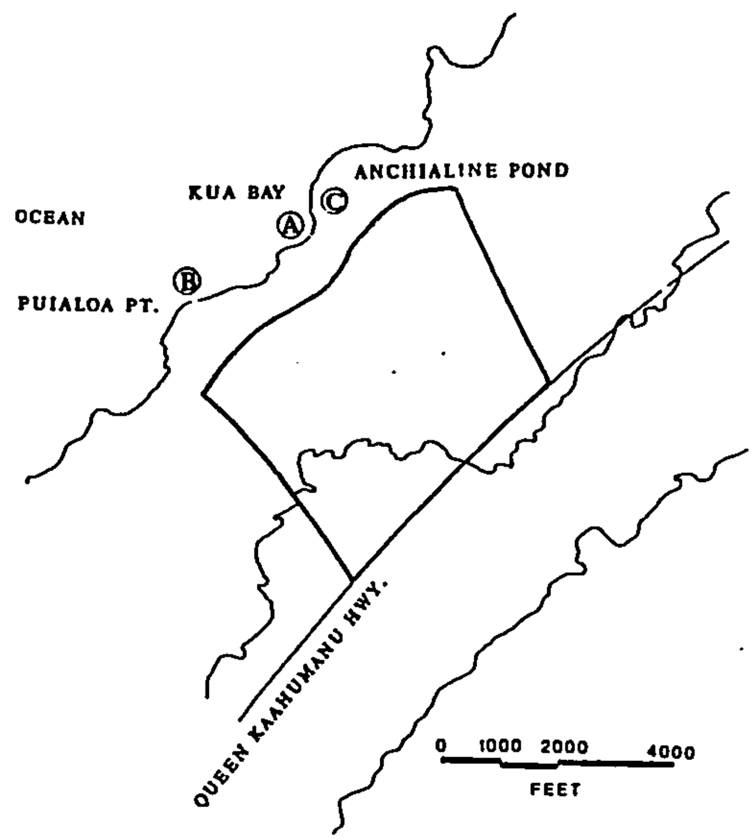


FIGURE IV-1 SAMPLE LOCATIONS

TABLE IV-4
NUTRIENT CONCENTRATIONS MEASURED DURING STUDY

Parameter	Anc. Pond	Beach	Off Lava
Turbidity (NTU)	1.04	0.35	0.23
Salinity (ppt)	6.11	33.88	34.55
T. Nitrogen (ug/l)	846.9	138.7	80.8
T. Phos. (ug/l)	· 35.6	4.3	4.3
NO2 + NO3 (ug/l)	502.2	44.4	4.5
Ortho Phos. (ug/l)	5.9	0.3	0.3
Silicates (ug/l)	23292.1	1054.2	252.6

Note: NTU = Nephelometric turbidity units
ug/l = micrograms per liter
ppt = parts per thousand

B. GOLF COURSE CHEMICALS INTRODUCED

Chemicals that will be introduced from golf course activities include fertilizers and pesticides.

Fertilizers

Fertilizers will be applied in defined application quantities, rates and frequencies for greens, tees, fairways and roughs. Approximate fertilizer use rates for a typical 18 hole golf course in Hawaii is given in Table IV-5 [5].

TABLE IV-5
ANNUAL FERTILIZER REQUIREMENTS OF A 86 ACRE GOLF COURSE

Type of Turf	Area Acres	Nitrogen lb/1000 ft²	Times Per Year	Tons N per Year/86 acres
Greens	3	0.5	26	0.85
Tees	3	1.0	17	1.15
Fairways	50	1.5	7	10.00
Roughs	30	1.0	4	2.60

The total nitrogen supplied by fertilizer is about 14.6 tons per year for an entire 86 acre golf course. The amount of potassium is 7.3 tons and the amount of phosphorus is about 3.7 tons. Lysimeter tests have shown that about 1.5 to 3 percent of nitrogen from frtilizers applied to California grass at the surface leach into groundwater [6]. This figure is used to calculate fertilizer leaching at Maniniowali.

As mentioned earlier, use of treated wastewater for irrigating golf courses will introduce additional chemicals into the ground. The most significant nutrient in treated waste water is nitrogen.

The area used for golf course activities in Maniniowali is approximately 86 acres. For a golf course of this size, the amount of water required for irrigation is 1.1 mgd including the leaching fraction, which is the excess water necessary to flush the salt that will build up in the root zone when treated wastewater is used for irrigation. Irrigation water for golf course avtivities is supplied partly by treated waste water effluent and brackish water extracted from the groundwater lens. The total amount of nitrogen leaching into the aquifer depend on the treated wastewater/brackish water ratio used for golf course watering. Waste water in general contains 10 to 25 parts per million (ppm) of nitrogen in solution, and groundwater at Maniniowali contains about 0.85 ppm of nitrogen. The irrigation wastewater will also add 260 to 520 tons of salt in solution annually.

Assuming a 20 percent over irrigation to prevent salt build up in the root zone, potential increase in concentration in groundwater from golf course activities was calculated for different wastewater/brackish water ratios. Results of these calculations is shown in Table IV-6.

TABLE IV-6
VARIATION OF NITROGEN CONCENTRATION IN AQUIFER
AS A FUNCTION OF IRRIGATION WATER BLEND

PERCENTAGE OF WASTEWATER	PERCENTAGE OF BRACKISH WATER	NITROGEN CONCENTRATION	
		LOW LIMIT *	HIGH LIMIT **
0.0	100.0	1.81	1.81
10.0	90.0	2.00	2.31
20.0	80.0	2.20	2.81
30.0	70.0	2.38	3.32
40.0	60.0	2.57	3.82
50.0	50.0	2.76	4.32
60.0	40.0	2.95	4.82
70.0	30.0	3.14	5.32
80.0	20.0	3.33	5.83
90.0	10.0	3.52	6.33
100.0	0.0	3.71	6.83

Concentration in Mg/l.
* Concentration of nitrogen in wastewater; 10 ppm
** Concentration of nitrogen in wastewater; 25 ppm

Pesticides

In Hawaii there are several types of turfgrass weeds, diseases and pests that require chemical pesticides. A typical pesticide program for an 86 acre golf course is given in Table IV-7 [5]. These amounts do not account for any reductions in pesticide use that are expected to result from the IPM program implementation.

TABLE IV-7
TYPICAL ANNUAL PESTICIDE REQUIREMENTS OF AN 86 ACRE GOLF COURSE

Chemical	Annual Requirement
1. Herbicides	
MSMA	816 lb. a.i.
Bensulide	144 lb. a.i.
Trimec-R-	161 pints
Metribuzin	93 lb. a.i.
2. Insecticides	
Chlorpyros	86 lb. a.i. *
3. Fungicides	
Metalaxyl	50 lb. a.i. *
Chlorothalonil	394 lb. a.i. *

Note: a.i. = Active ingredient
* Estimated total annual application, since pesticides are applied on an as needed basis.

Golf course and residential activities will introduce chemicals onto the ground. Some of these will be absorbed by turf and trees in the golf course, some will be partially degraded and a small fraction may enter the groundwater system. The area used for golf course turf in Maniniowali is 86 acres. The amount of chemicals that will be used in this situation is estimated in Table IV-8.

TABLE IV-8
ESTIMATED CHEMICAL REQUIREMENTS OF MANINIOWALI

Source / Chemical	Annual Input to Ground
1. Fertilizers	
Nitrogen	14.6 tons/year
Potassium	7.3 tons/year
Phosphorus	3.6 tons/year
2. Irrigation water	
Salts	320 to 640 tons/year
Nitrogen	9.9 tons/year
3. Herbicides	
MSMA	816 lb. a.i.
Bensulide	144 lb. a.i.
Trimec-R-	161 pints
Metribuzin	93 lb. a.i.
4. Insecticides	
Chlorpyrifos	86 lb. a.i.
5. Fungicides	
Metalaxyl	50 lb. a.i.
Chlorothalonil	394 lb. a.i.

Note: Estimated golf course area is 86 acres

C. RESIDENTIAL CHEMICALS

The projected area for residential development at Maniniowali is 132 acres. Landscape area is assumed to be about 50 percent of this value. Therefore an area of 66 acres will be available as home gardens and lawns. This figure is used to estimate the input of fertilizers and pesticides; however, it may be adjusted once the landscape area for residential development is finalized.

A recent national survey shows that about 69.5 percent of pest control companies use Dursban TC as the principal termicide. Sixteen percent of the pest control operators use Demon TC as the principal termicide. A few others use Tribute, Pryfon 6, Dragnet FT and Torpedo as principal termicides. The choice of pesticides depends heavily on the existing problem [6].

In the same study carried in Wahiawa, door to door surveys were made to determine the patterns of pesticide and fertilizer usage by home owners. Data on the type and application of chemical used were also collected. Users can be separated into three categories with regard to pesticide usage: 1) no pesticide usage, 2) spot pesticide usage, and 3) lawn application of pesticides. Spot usage of pesticides include application on or around ornamental plants or fruit trees as well as in vegetable gardens. Lawn applications included spray, granular, and dust formulations as well as combinations of pesticides and fertilizers.

Summary of pesticide and fertilizer usage patterns found from the above study is given in Tables IV-9 and IV-10. Data collected for the Waipio area on actual use of pesticides show an average annual rate of pesticide application amounting to about 43 lb/acre for lawns. Spot rates are assumed at 25 percent of the lawn usage. The amount of pesticides used calculated on this basis is about 1190 lb per year. This is about 48 percent of the amount of pesticides used on the golf courses.

TABLE IV-9
SUMMARY OF PESTICIDE USE

Pesticide Usage	Percentage of Households
No usage	50
Spot usage	11
Lawn application	39
Total	100

Fertilizer usage also can be separated into the same categories as pesticides. Residents use fertilizers with varying ratios of nitrogen-phosphorus-potassium. Potassium is affected by ion exchange processes in the soil. Therefore, any potassium unconsumed by plants will be likely to remain in the soil. Phosphorus binds to soils containing iron and aluminum hydroxides that are abundant in Hawaiian soils. Therefore, in terms of groundwater contamination the greatest concern is nitrogen. Although ammonium nitrogen is less likely to leach downward, nitrogen applied in the ammonium form is converted into nitrate form by nitrifying bacteria. Nitrate nitrogen is relatively unaffected by adsorption and has a high potential for leaching into groundwater.

The average annual rate of fertilizer use on lawns is about 140 lb/acre. In the absence of accurate data spot usage rate is assumed to be 25 percent of this value.

TABLE IV-10
SUMMARY OF FERTILIZER USE

Fertilizer Usage	Percentage of Households
No usage	35
Spot usage	7
Lawn application	58
Total	100

Earlier studies on California grass irrigated with secondary sewage effluent show a 69 percent removal of nitrogen. Lysimeters used in the same study indicate only a 3 percent leaching into the ground. The remaining 28 percent nitrogen was lost as gas [6].

The total amount of nitrogen estimated for home garden and lawn applications is about 5520 lb. Nitrogen available for leaching is 31 percent of this which amounts to 1712 lb. for the Maniniowali Project residential area. This is about 25 percent of the nitrogen leaching from irrigation water. Leaching of this amount of nitrogen into groundwater will result in an increase of nitrogen concentration in the groundwater by about 0.65 mg/l.

D. FATE OF CHEMICALS

Several models are available that assess the potential of pesticide movement through the soil to groundwater. The Attenuation Factor (AF) model developed by Rao and co-workers is at present under evaluation by the Hawaii State Department of Agriculture. AF is defined as the fraction of the chemical remaining in the soil after a single application when the water recharge is sufficient to carry the chemical to a given depth. The AF values are calculated using properties of the pesticide and site specific environmental data. AF values range from 0 (total attenuation) to 1 (no attenuation). Attenuation of chemical movement by the soil includes both retardation of movement due to absorption by soil organic matter and biological and chemical degradation.

Organic content of the soil and the thickness of the soil layer are important factors in determining the attenuation factor. This relationship is shown in Table IV-10 for the pesticide metribuzin [5].

TABLE IV-11
VARIATION OF ATTENUATION FACTOR OF METRIBUZIN WITH SOIL PROPERTIES

Soil Thickness Inches	Organic Carbon Content of Soil (Percentage by Weight)			
	0.25	0.5	1.0	2.0
3.9	0.42	0.32	0.18	0.058
11.8	0.075	0.032	0.0058	0.00019
19.6	0.013	0.0032	0.00019	0.00000064

Table IV-11 shows how the chemical leaching potential of pesticides change with soil layer thickness and the organic carbon content. It is seen that a logarithmic relation exists between the attenuation factor and the soil thickness. Metribuzin is identified as a pesticide with a large potential for leaching into groundwater [5]. An 18 inch thick layer of soil with an organic carbon content of 2 percent will reduce the attenuation factor for metribuzin to as low as .000064 percent. Using the attenuation factor calculated for metribuzin for other pesticides will give higher levels of chemical content for other pesticides. For the purpose of this study, these values will be utilized. It is assumed that attenuation factors of all pesticides that may be used on the Maniniowali golf course will show similar dependance on the thickness and the organic carbon content of the soil layer. Decrease in concentration over time while the chemicals reach the groundwater, or any absorption possible by the porous medium are not taken into account. Potential levels of groundwater contamination for three

different soil thicknesses and three different organic carbon contents, and resulting concentrations of pesticides reaching the groundwater and eventually the coastal waters calculated (ppb: parts per billion) using the above assumptions are given in Tables IV-12 to IV-14.

TABLE IV-12
VARIATION OF ATTENUATION FACTOR OF PESTICIDES WITH SOIL THICKNESS *

Pesticide	Soil Thickness in Inches	
	12	18
Herbicides		
MSMA	0.06	0.00019
Bensulide	0.010	0.000035
Trimec (R)	0.011	0.000039
Metribuzin	0.006	0.000023
Insecticides		
Chlorpyrifos	0.06	0.000021
Fungicides		
Metalaxyl	0.003	0.000012
Chlorothalonil	0.027	0.00010

* Organic carbon content of soil 2 percent
Note: Based on 86 acres of golf course
Concentrations in parts per billion (ppb)

TABLE IV-13
VARIATION OF ATTENUATION FACTOR OF PESTICIDES WITH SOIL THICKNESS *

	Soil Thickness in Inches	
Pesticide	12	18
Herbicides		
MSMA	1.8	0.058
Bensulide	0.31	0.010
Trimec (R)	0.35	0.011
Metribuzin	0.21	0.007
Insecticides		
Chlorpyrifos	0.19	0.006
Fungicides		
Metalaxyl	0.11	0.004
Chlorothalonil	0.86	0.028

* Organic carbon content of soil 1 percent
Note: Based on 86 acres of golf course
Concentrations in parts per billion (ppb)

Table IV-14
VARIATION OF ATTENUATION FACTOR OF PESTICIDES WITH SOIL THICKNESS *

	Soil Thickness in Inches	
Pesticide	12	18
Herbicides		
MSMA	9.9	0.98
Bensulide	1.7	0.17
Trimec (R)	1.9	0.19
Metribuzin	1.1	0.11
Insecticides		
Chlorpyrifos	1.0	0.10
Fungicides		
Metalaxyl	0.6	0.06
Chlorothalonil	4.8	0.48

* Organic carbon content of soil 0.5 percent
Note: Based on 86 acres of golf course
Concentrations in parts per billion (ppb)

Results show that there can be large variation in the degree of potential leaching of chemicals to groundwater, depending on the type of pesticides used, the frequency and amount of pesticides applied, and the composition and thickness of the golf course soil. The variation of attenuation factor of pesticides with soil thickness and organic carbon content is shown diagrammatically in Figure IV-2. Ranges in concentrations from pesticide leaching with respect to soil parameters is shown in Table IV-15.

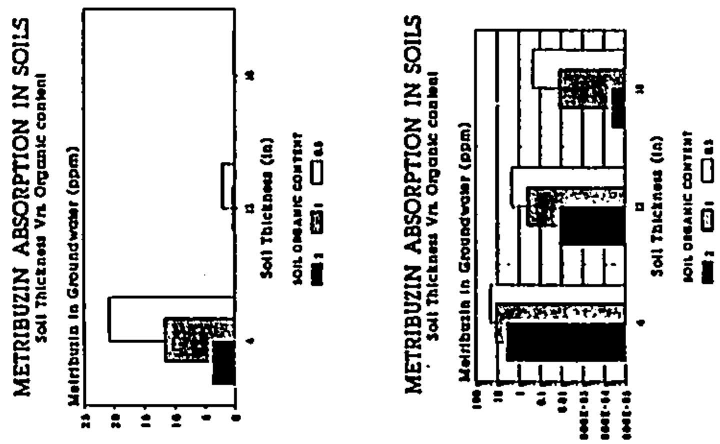


FIGURE IV-2 ATTENUATION OF PESTICIDES IN SOIL

TABLE IV-15
EXPECTED RANGE OF PESTICIDE CONCENTRATION
IN GROUNDWATER

Pesticide	Minimum *	Maximum **	HAL
MSMA	0.00019	1.8	N/A
Bensulide	0.000035	0.31	66 c 231 a
Trimec (R)	0.000039	0.35	N/A
Metribuzin	0.000023	0.21	200
Chlorpyrifos	0.000021	0.91	105
Metalaxyl	0.000012	0.11	420
Chlorothalonil	0.00010	0.8	2

Note: Based on 86 acres of golf course with no IPM program
Concentrations in ppb
* Soil thickness 18 inches and 2 percent organic carbon
** Soil thickness 12 inches and 1 percent organic carbon
c = child
a = adult

TABLE IV-16
HEALTH ADVISORY LEVELS FOR SELECTED PESTICIDES [7]

Pesticide	HAL (ppb)
Atrazine	3.0
Carbaryl	700.0
Chlorthalonil	2.0
DBCP	0.03
Dicamba	200.0
EDB	0.0004
ETU	0.2
Metribuzin	200.0
Simazine	4.0

V. DISCUSSION AND IMPACTS

A. GENERAL IMPACT

Some chemicals may reach the groundwater at the development site due to golf course and residential activities. The extent of leaching these chemicals will depend on the golf course design and the pesticide management procedures used during golf course operation and maintenance. Impact on the environment will depend on final concentrations and resident times of specific chemicals that eventually reach coastal waters. Groundwater in this area exists as a thin Gyzen-Herzberg lens. Because the water table slope is very mild (1 to 2 feet per mile) [3] the depth of groundwater at Maniniowali is almost equal to the ground elevation at any location. Water table depth from the surface increases the time taken for water to reach the aquifer, allowing a higher degree of pesticide decomposition and nutrient absorption. (e.g. phosphates).

Selecting appropriate parameters for top soil and following proper pesticide application procedures will minimize impacts to groundwater quality. Groundwater in this area is not suitable for drinking due to the high salinity. Therefore, small amounts of pesticides in groundwater will not have a direct impact on the health of residents. Minor concentrations of chemicals leaching into the groundwater are not expected to have a significant effect on the quality of water in the anchialine pond or in the nearshore area. Concentrations of chemicals brought to the nearshore area with groundwater will decrease several orders of magnitude during a short time due to rapid mixing in the surf zone. Dilutions expected and the impact on the marine environment is discussed in the marine study (Oceanit Laboratories, Inc., July 1991). However, if the concentration of chemicals leaching into groundwater is kept low by proper design and pesticide management practices, nearshore corals, fish and biota are not expected to be adversely affected.

B. IRRIGATION WATER IMPACT

The Maniniowali climate is arid. Annual rainfall ranges from 10 to 20 inches, but potential evaporation is almost 80 inches per year. If rainfall were evenly distributed throughout the year this deficit would result in no groundwater recharge. However, the small amount of rainfall during storms occurs as a heavy downpour. Excess water from these heavy rains is sufficient to recharge the aquifer. The average amount of recharge occurring within this area was estimated at about 0.07 mgd.

In the project area nearly all nutrients used for maintaining golf course vegetation needs will be applied artificially. As discussed earlier, nitrogen is the most probable element that will affect the aquifer. The amount of nitrogen available as fertilizer can be controlled by applying slow release fertilizers; this will reduce nitrogen leaching. Leaching potential from fertilizers can further be reduced by avoiding applications immediately before heavy rain storms, which provide most of the recharge.

Golf course irrigation must occur on a regular basis depending on turfgrass and other plant water requirements. If the minimum amount of water required by the plants is

supplied then there will be no groundwater recharge. However, this degree of control is almost impossible in practice. As a result, excess water will be available for seepage. Another factor that will be taken into account is the quality of irrigation water. It is assumed that at this site, treated wastewater will be used for irrigation of golf courses. Wastewater contains about 0.65 to 1.3 ppt dissolved salts. These salts will crystallize out at the root zone if only the minimum required amount of water is supplied. Excess water must be supplied for leaching salt out of the root zone. In general, 20 percent excess is required for adequate leaching. This water will continuously seep through the root zone and reach the water table. The total excess irrigation water required at Maniniowali is about 0.102 mgd. The introduction of irrigation water will impact the aquifer by changing the existing recharge pattern and increasing the total mean annual recharge volume by over 100 percent (0.07 mgd from rainfall recharge and 0.102 mgd leaching water). The impact of this increase on the existing water table and the groundwater streamlines is shown diagrammatically in Figure V-1.

The total amount of groundwater entering the project area presently is 0.75 mgd. An additional 0.07 mgd is supplied as recharge from rainfall to the area. Thus the present average amount flowing through is 0.82 mgd. Surplus water added to the aquifer by irrigation of golf courses is estimated to be 0.22 mgd. Although this irrigation water will be about three times the normal rain recharge to the site, it amounts to about a 25 percent increase in the groundwater flow. The recharge from irrigation water will act as a continuous source of water at this site. This will distort the groundwater flow pattern slightly. Streamlines will tend to diverge at the site due to the source effect. There will be a slight rise of the mean groundwater table (estimated to be 0.6 to .8 inches) at the site to accommodate the additional water. This will result in about a 10 percent increase in the water table slope in the area between the golf courses and the coast. The divergence of the streamlines will spread some of the water away from the site into adjacent areas on the sides. The spread will be about 90 feet beyond the boundaries of the irrigation area. This can be prevented by locating the golf courses so that their boundaries will be more than 90 feet from the property boundaries.

C. SALTS IMPACT

Groundwater salinity in the area is higher than allowable salinity for drinking water. Earlier measurements in the wells to the north have shown that the natural salinity in groundwater range from .3 to 1.5 ppt. Thus the predicted increase of salt by about .65 to 1.3 ppt will not have a significant impact on the groundwater quality. The predicted increase in mean salinity will be less than 5 percent, which is within the natural variation during the year.

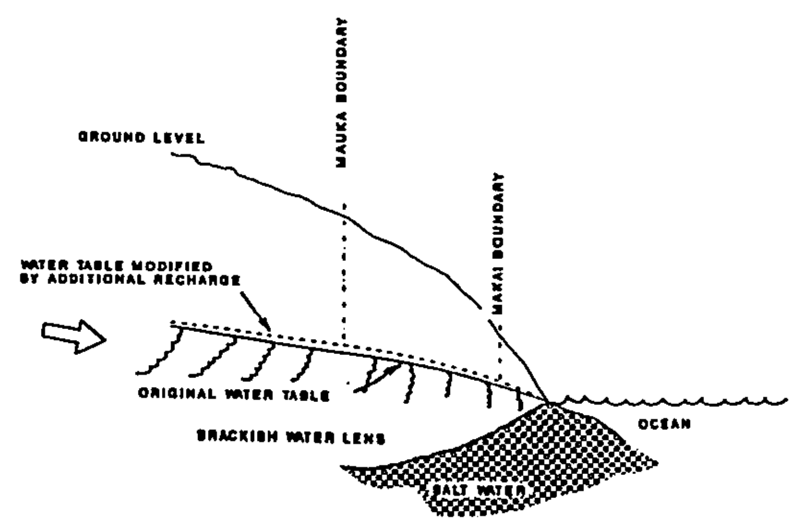
D. NUTRIENTS IMPACT

The nutrients under consideration are nitrogen, phosphorus and potassium from fertilizers and irrigation water. Phosphorus and potassium, however, are not expected to leach into groundwater. Nitrogen is the main pollutant that can reach the aquifer in inorganic form. Use of slow release fertilizers will help in reducing leaching of nutrients from fertilizers. The path of the nutrients from the golf course to the coastal waters is shown diagrammatically in Figure V-2. Fertilizers from residential developments will also contribute to increase in nitrogen concentrations in the groundwater. This increase is estimated at 0.65 mg/l.

Part of the nitrogen from the irrigation water will reach the aquifer due to incomplete absorption and heavy rainfall. If we assume a leakage fraction of 20 percent, the amount of nitrogen leaching into the aquifer will be 1.0 to 2.1 tons per year depending on the fraction of treated wastewater used in irrigation. The nitrogen will be in the form of nitrates and nitrites and, if all the nitrogen in the excess water remains without absorption, then the concentrations in the recharge water will be about 7 mg/l.

This water will eventually mix with the groundwater flowing through the project site. The concentration of the mixture will rise from its current measured level of 0.847 mg/l to about 1.92 mg/l due to mixing with the irrigation water. The nitrogen leaching from residential activities and fertilizers applied in the golf course will increase the average concentration further to 2.57 mg/l. Existing levels of nitrogen in ground water in anchiline ponds and some drinking water sources are shown in Figure V-3. Sources and potential amounts of leaching of nitrogen from fertilizers and irrigation water is shown diagrammatically in Figure V-4.

The nutrient laden water enters the ocean at the surface level. At the shore, breaking waves immediately mix and dilute the incoming groundwater and longshore currents produced by waves move it along the beach and offshore through rip currents. However, in some areas topographic conditions such as rocks and lava layers complicate the path of the water into the ocean. Along a rocky coastline, water can flow under the rock layers and into the ocean at some distance offshore, forming submerged springs of brackish water. In such cases mixing due to waves is poor; mixing and advection due to currents is important for flushing nutrients out of the area. The coastline of Maniniowali is rugged and offshore currents are strong and the concentration of pesticides is expected to lower significantly in a short time.



SECTION VIEW OF NKDG PROPERTY

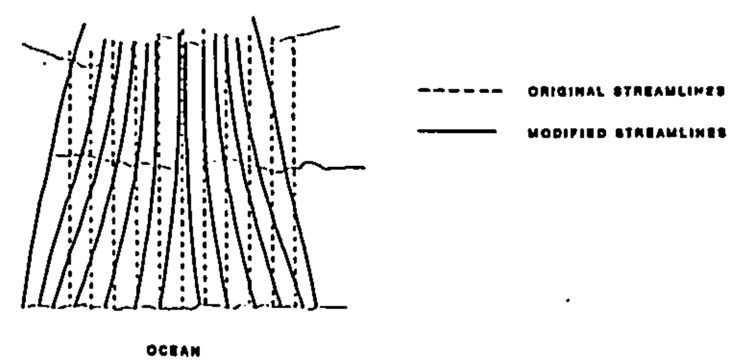


FIGURE V-1 CHANGE IN THE WATER TABLE DUE TO IRRIGATION WATER

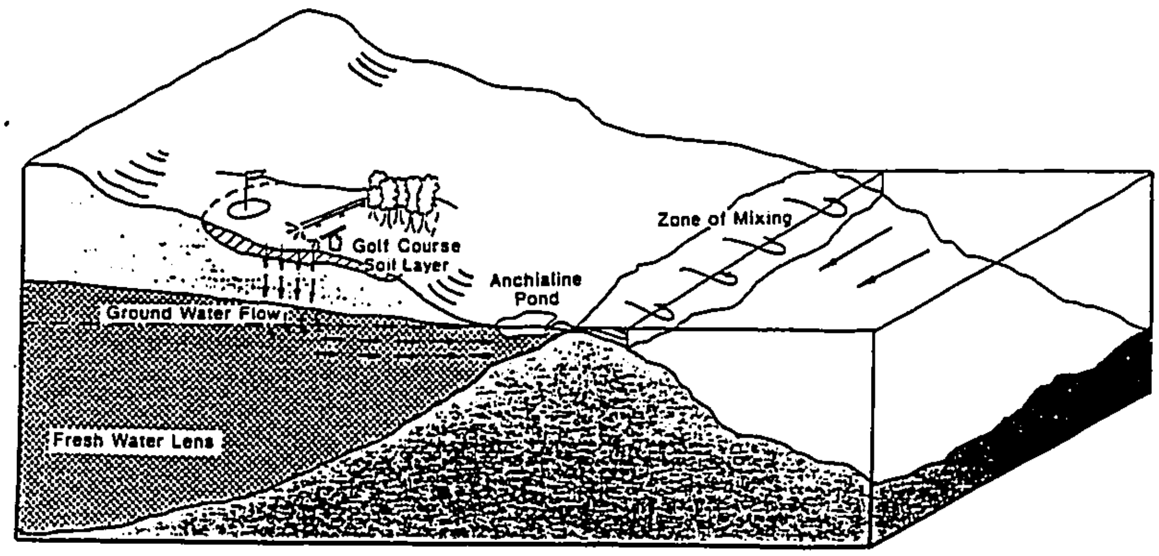
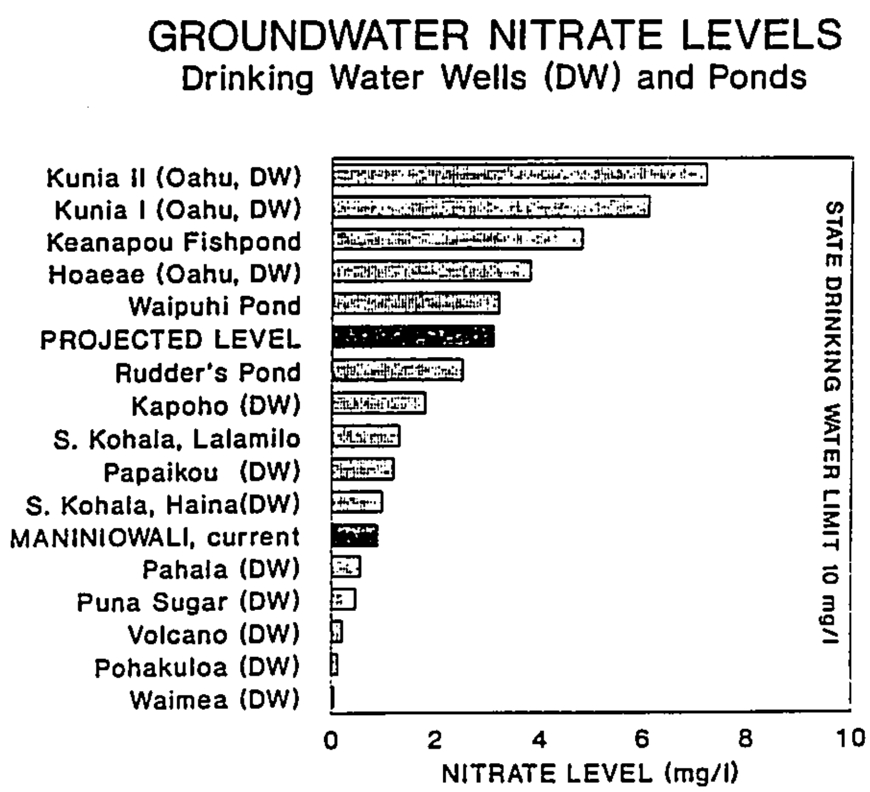


FIGURE V-2 *PATH OF LEACHED IRRIGATION WATER AND CONSTITUENTS*

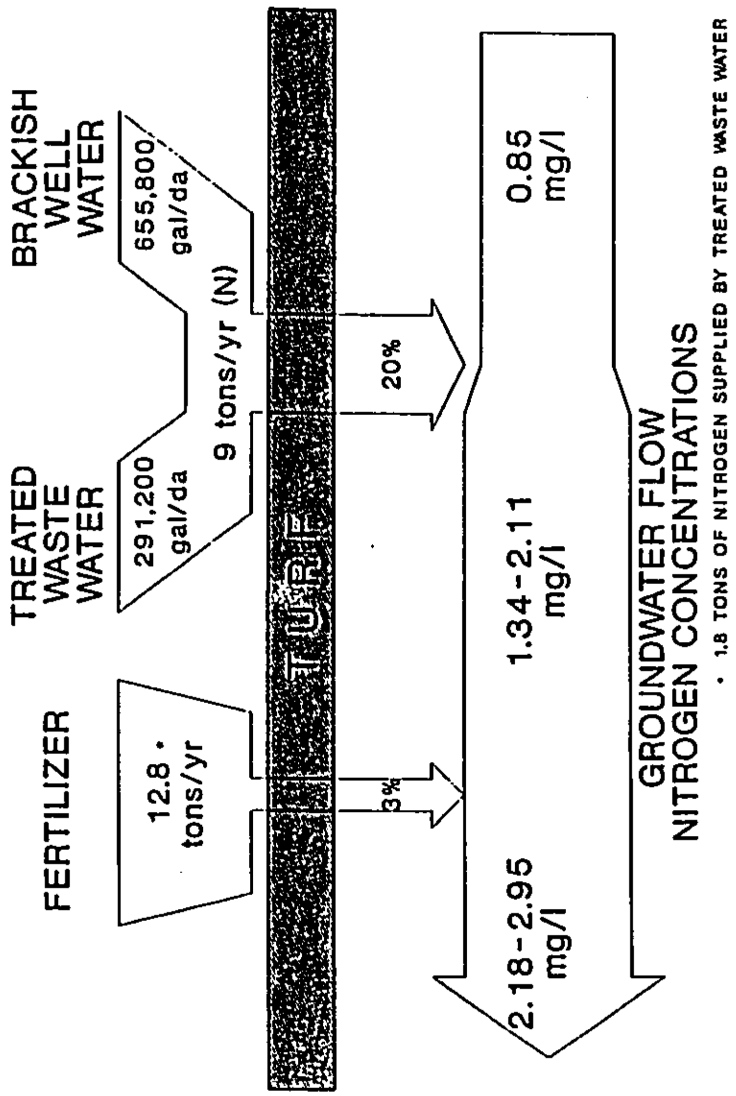
Oceanit Laboratories, Inc.

FIGURE V-3 GROUNDWATER NITRATE LEVELS



Oceanit Laboratories, Inc.

FIGURE V-4 SOURCES OF GROUNDWATER NITROGEN



• 1.8 TONS OF NITROGEN SUPPLIED BY TREATED WASTE WATER

E. PESTICIDES IMPACT

Potential leaching of pesticides in small amounts into groundwater and eventually to shoreline waters is of concern. The project area consists of recent lava; there is hardly any topsoil and insignificant organic carbon content in soils. Porous lava type soils show very poor absorption and most pesticides can reach the groundwater. Almost all topsoil needed for golf course development will be imported. The amount of pesticide leaching to the aquifer can be minimized by selecting a topsoil with a high organic carbon content and by maintaining a topsoil thickness of 12 to 18 inches. NKDG anticipates using adequate topsoil thickness with sufficient carbon content to avoid adverse leachir· ··ditions.

Groundwater at Maniniowali exists as a thin lens and consist of slightly saline water. The salinity is too high for use as a source of potable water. Thus, contamination of groundwater by leaching does not pose a direct threat to the health of residents. Groundwater on its way to the ocean, flows through anchialine pond close to the sea. With proper mitigative design measures pesticide concentrations reaching the pond can be kept below harmful levels. There are no comprehensive studies available on the impact of contaminants on fauna and flora in anchialine ponds. However, it has been observed that a pond located immediately adjacent to the Waikoloa golf course shows no signs of negative impact after golf course construction and several years of golf activity [1]. The anchialine pond at Maniniowali is nearly 1000 feet from the proposed golf course and there is no surface runoff from the higher levels into the pond. The project is not expected to introduce adverse concentrations of pesticides into the ponds. With proper design of golf course top soil and by strictly following IPM planned by NKDG pesticide levels in groundwater could be kept at levels well below Health Advisory Levels.

VI. CONCLUSIONS AND RECOMMENDATIONS

Results of existing studies were used extensively in the preparation of this report. Nearly all studies were performed along the Kona Coast, but most of these addressed groundwater problems to north of the project site. Geology of the project site is similar to most of the northern area and the assumptions regarding similarities in groundwater flow were based on similarities in geology. The following conclusions are drawn from results and discussion presented herein.

A. CONCLUSIONS

1. Potential change to the groundwater elevation and flow patterns from development activities is small. The average rise in the water elevation at the site from extra recharge is about 0.9 inches. This is well below normal fluctuations in groundwater elevations from other phenomena. Groundwater exists here as a thin lens at a large depth from the ground surface because the small slope of the water table and the steep slope of land. Therefore, the small change in the groundwater elevation is not expected to alter spring locations along the coast.

2. Fertilizer application at golf courses and residential areas will cause an increase in groundwater nitrogen concentration; the expected change is significant. Nitrogen concentration in groundwater in Maniniowali at present is estimated at 0.846 mg/l. This concentration is expected to increase to 2.67 mg/l under the worst case scenario of all nitrogen in excess irrigation water reaching groundwater. This concentration is comparable to nitrogen concentrations which have been measured in Anaehoomalu and Lalamilo areas [7]. These measurements showed concentrations of nitrogen from 2.5 mg/l at Ruddle's pond to 4.8 mg/l in Keanapou fishpond.

3. Phosphorus and potassium, the other principal nutrients in fertilizer, are not expected to leach into groundwater. Potassium not consumed by plants is expected to remain in the soil because of ion exchange processes. Phosphorus binds tightly with iron and aluminum hydroxides that are abundant in Hawaiian soils and will not likely leach to the groundwater.

4. The amount of pesticides reaching groundwater depends on the types used, thickness and composition of soils, and pesticide management procedures followed. Leaching of pesticides will be minimized by NKDG by installing an adequate soil layer (12 to 18 inches), proper management of storage, handling, and application of pesticides. In addition, implementation of an IPM program will reduce application rates of pesticides significantly, e.g., up to 50 percent.

B. RECOMMENDATIONS

This study precluded any site specific measurements related to the quality and flow of groundwater. Greater accuracy in our calculations will occur with site specific measurements. Methods used in this study to predict potential leaching of fertilizers and pesticides into groundwater employ the AF model and are the best available to date. This science is evolving rapidly. Higher accurasy in prediction will be available in future models with additional site specific data. Under these conditions the following recommendations are made for controlling the degree of possible chemical leaching into groundwater.

1. Owners must comply with State of Hawaii, Department of Health Eight Golf Course Conditions (EGCC) relating to new golf course development and maintenance, and follow all necessary monitoring requirements.

2. Employ lysimeters at selected locations for measuring pesticides and nitrogen leaching past the top soil layer.

3. Install wells at selected locations and monitor groundwater quality before development activities commence. This will establish the background levels of contaminants in the groundwater. Any subsequent changes observed could be used for correcting shortcomings.

4. Monitor water quality of exposed water bodies close to the coast such as the anchialine ponds. This will indicate pollution from runoff. At present there is virtually no runoff due to the high porosity of the lava surface. Development activities will change the porosity of the ground surface by establishing top soil and vegetation. This will decrease seepage, and may cause surface runoff to reach these water bodies. The extent of this risk can be established early by this measurement.

5. Runoff controls should be included at appropriate boundaries in the golf course to prevent contamination of surface waters by direct runoff. Runoff potential is expected to increase from new vegetation cover provided by golf courses, which will reduce seepage capacity. During heavy rainstorms residual pesticides will be washed down by runoff and may reach anchialine ponds. Proper runoff controls will prevent this type of contamination of surface water.

6. Slow release fertilizers should be used on the golf courses. Residents should also be encouraged to use slow release fertilizers on their lawns and gardens. This will retard the rate of leaching of nutrients into groundwater by giving more time for grass absorption.

7. Controls should be exercised that prevent use of pesticides before heavy rain. Pesticides will remain on the foliage for some time; rain will tend to wash down chemicals with runoff toward the turf grass boundaries. This will produce higher concentrations of pesticides and act as contaminant sources for surface and groundwater.

8. Specific cutting disposal methods should be followed to prevent groundwater contamination by composting vegetation. Decomposing vegetation will produce nitrates and could act as sources of nitrogen pollution. Decomposing vegetation is not presently found in this area and grass cuttings should be disposed of in a manner that avoids changes to the existing environment.

VII. REFERENCES

[1] Belt, Collins & Associates. Final Environmental Impact Statement. Prepared for Kaupulehu Resort, Kaupulehu, North Kona, Hawaii, June 1986.

[2] Brian Y. Kanehiro. A Hydrogeologic Study of the Kiholo to Puako Area on the Island of Hawaii. A Masters Thesis in Geology and Geophysics, University of Hawaii, August 1977.

[3] Alison E. Kay, L. Stephen Lau, Edward D. Stroup, Stephen J. Dollar, David P. Fellows and Reginald H. F. Young. Hydrologic and Ecologic Inventories of the Coastal Waters of West Hawaii. Water Resources Research Center, University of Hawaii, April 1977.

[4] Brian Y. Kanehiro and Frank L. Peterson. Groundwater Recharge and Coastal Discharge for the Northwest Coast of the Island of Hawaii. A Computerized Water Budget Approach. Technical Report No 110, Water Resources Research Center, University of Hawaii, July 1977.

[5] Charles L. Murdoch and Richard E. Green. Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Maniniowali Golf Course. Prepared for Group 70, Ltd., Honolulu, Hawaii, March 1991.

[6] Delwyn S. Oki, Robert N.Miyahira, Richard E. Green, Thomas W. Giambelluca, Stephen L. Lau, John F. Mink, Randi C. Schneider, and David N. Little. Assessment of the Potential for Groundwater Contamination due to Proposed Urban Development in the Vicinity of the U.S. Navy Wahiawa Shaft, Pearl Harbor, Hawaii. Water Resources Research Center, University of Hawaii, March 1990.

[7] Doak C. Cox, Frank L. Peterson, William M. Adams, Chester Lao, John F. Campbell, Richie D. Huber. Coastal Evidences of Groundwater Conditions in the Vicinity of Anaehoomalu and Lalamilo, South Kohala, Hawaii. Water Resources Research Center, University of Hawaii, March 1969.

VIII. BIBLIOGRAPHY

Adams, William M., Frank L. Peterson, Surendra P. Mathur, Larry K. Lepley, Clifton Warren and Richie D. Huber. A Hydro-geophysical Survey from Kawaihae to Kailua-Kona, Hawaii. Technical report No. 32, Water Resources Research Center, University of Hawaii, September 1969.

Belt, Collins & Associates. Final Environmental Impact Statement. Prepared for Kaupulehu Resort, Kaupulehu, North Kona, Hawaii, June 1986.

Cox, Doak C., Frank L. Peterson, William M. Adams, Chester Lao, John F.Campbell and Richie D. Huber. Coastal Evidences of Groundwater Conditions in the Vicinity of Anaehoomalu and Lalamolo, South Kohala, Hawaii. Water Resources Research Center, University of Hawaii, March 1969.

Dames and Moore. Environmental Assessment and Supplemental EIS, Hydrological Section. Modification of Proposed Action to Permit Alternative Methods of Seawater Return Flow Disposal at NELH, Keahole, Kona, Hawaii, August 1986.

Davis, Dan A. and George Yamanaga. Preliminary Report on the Water Resources of the Kona Area, Hawaii. Circular C46, Prepared by the United States Geological Survey in Cooperation with Division of Land and Water Development, Department of Land and Natural Resources, State of Hawaii, June 1968.

Davis, Dan A. and George Yamanaga. Water Resources Summary, Island of Hawaii. United States Geological Survey in cooperation with Division of Water and Land Development, Department of Land and Natural Resources, State of Hawaii, April 1973.

Environmental Impact Consultants. Fertilizer and Pesticide Management Plan for the Proposed Puako Residential and Golf Community, February 1991.

Group 70 Limited. Environmental Assessment for Awake'e/Maniniowali Land Exchange. North Kona Development Group, October 1990.

Helber, Hastert, Van Horn & Kimura, Planners. Final Environmental Impact Statement: Awake'e Resort, North Kona, Hawaii, February 1987.

Kanehiro, Brian Y. A Hydrogeologic Study of the Kiholo to Puako Area on the Island of Hawaii. A Masters Thesis In Geology and Geophysics, August 1977.

Kanehiro, Brian Y. and Frank L. Peterson. Groundwater Recharge and Coastal Discharge for the Northwest Coast of the Island of Hawaii. A Computerized Water Budget Approach. Technical Report No 110, Water Resources Research Center, University of Hawaii, July 1977.

Kay, Alison E., L. Stephen Lau, Edward D. Stroup, Stephen J. Dollar, David P. Fellows and Reginald H. F. Young. Hydrologic and Ecologic Inventories of the Coastal Waters of West Hawaii. Water Resources Research Center, University of Hawaii, April 1977.

Murdoch, Charles L. and Richard E. Green. Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Maniniowali Golf Course. Prepared for Group 70, Ltd., March 1991.

Oki, Delwyn S., Robert N.Miyahira, Richard E. Green, Thomas W. Giambelluca, Stephen L. Lau, John F. Mink, Randi C. Schneider, and David N. Little. Assessment of the Potential for Groundwater Contamination due to Proposed Urban Development in the Vicinity of the U.S. Navy Wahiawa Shaft, Pearl Harbor, Hawaii. Water Resources Research Center, University of Hawaii, March 1990.

Rainfall of the Hawaiian Islands. Water Resources Research Center, University of Hawaii.

Tagomori, Manabu. Hawaii Water Resources Regional Study. Preliminary Report, Water Resources Research Center, University of Hawaii, February 1975.

Taliaferro, William J. Supplement to Kona Rainfall. Prepared for the Hawaii Water Authority, September 1959.

Yee, Johnson J.S. Hawaii Ground-Water Quality. U.S. Geological Survey Open File Report 87-0721.

APPENDIX G

Oceanit Laboratories, Inc.
coastal & offshore engineering services • research & development

MARINE ENVIRONMENTAL ASSESSMENT

FOR

MANINIOWALI, HAWAII

submitted to:

Group 70

REVISION 1.0
OCTOBER 1991

Century Square 1188 Bishop Street, Suite 2312, Honolulu, Hawaii 96813
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EXECUTIVE SUMMARY

The proposed Maniniowali development is located approximately 10 miles north of the Keahole airport on the island of Hawaii. The property encompasses 388 acres along 6,000 feet of the Queen Kahumanu Highway between the highway and the seaward boundary set 1000 feet inland from the shore.

Studies were performed to investigate impacts to the marine environment from proposed development activities that include an 18 hole golf course and residential development. Information derived from various studies conducted at similar and adjacent nearshore environments was used to assess probable impacts. A general nearshore field survey was conducted at the site, including select water samples from the anchialine pond and coastal waters.

The marine environment off Maniniowali is similar to other areas along the north Kona coast. Nearshore water quality is classified by the State as AA and is typical of a pristine leeward open coastline. There is a single known anchialine pond on the state land (between the project site and the coast) with biota and water quality similar to other mature anchialine ponds on the Kona coast.

The offshore bathymetry consists of a comparatively shallow slope reaching a depth of 600 feet 5 miles offshore. Nearshore bathymetry is determined by the character of lava flows that enter the sea at the property edge. The a'a flow forming Kapapa Bay and Papiha Point affords a great deal of vertical relief and increased surface area that dissipates high wave energy and forms substrate for abundant coral growth. By comparison the relatively smooth sides of the pahoehoe flow at Pulaloa Point support a much less abundant growth of corals. Kua Beach, between the points, is a permanent pocket beach contiguous with a large gently sloping offshore sand patch.

The Benthic marine community structure follows the general pattern described for other areas of the Kona coast. In 5 to 15 feet of water coral growth is dominated by rose coral Pocillopora meandrina with a few colonies of green encrusting lobe coral Porites lobata. Large boulderlike colonies of lobe coral Porties lobata are common at depths of 20-40 feet with finger coral, Porites compressa becoming more dominant in deeper areas. There is no "deep slope" zone (as is found on the south Kona coast) and mixed colonies of Porites corals continue down to a depth of about 125 feet where light becomes the limiting factor for coral growth. Tropical reef fish assemblages and large game-fish of several species were abundant in shallow waters indicating that the coast is still relatively pristine and has not yet experienced over-fishing.

Fresh water enters the nearshore environment along the proposed development coastline. Salinity values were found to vary from 6.11 parts per thousand (ppt) in the anchialine pond to 33.8 and 34.5 ppt at nearshore sampling stations. Levels of silicates and nitrates in these few samples suggest that the reduced salinity is due to groundwater input.

Assuming that a golf course fertilization management plan is adopted, the concentration of groundwater nitrogen is estimated to increase from its current level of 0.85 mg/l to an about 2.57 mg/l. A similar increase in nitrogen levels is expected to occur in the nearshore anchialine pond. These ponds penetrate directly into the groundwater lens and offer little opportunity for dilution by mass transfer from mixing and advection. However, because the predicted increased concentration of nitrogen is within the range of values found in other anchialine ponds, we do not expected an adverse impact to the ecological character of the anchialine pond.

Once groundwater (and any entrained chemicals) reaches the ocean, nearshore dilution and dispersion will depend on currents and waves. Generic tidal and wave influenced mixing was assessed to determine the amount of dilution in the nearshore environment. Based on various assumptions, results indicate that approximately fifty percent of the time concentrations of nutrients and pollutants in nearshore water less than 10 feet deep are diluted no more than 70:1. Twenty percent of the time concentrations of nutrients and pollutants are diluted no more than 20:1. If nearshore currents are considered, dilution estimates would be greater. Historical information was used to estimate the influence of offshore currents on mixing, dispersion and transport of groundwater discharge. Results indicate that offshore currents will carry mixed groundwater north parallel to the coast. Drogue studies and observations during various wave conditions are necessary to determine the character and effect of nearshore currents.

If the golfcourse is carefully operated, the concentrations of pesticides in the groundwater [illegible] expected to be small and below human health advisory levels. The use of a lysim[illegible] will provide feed back on golfcourse operations to ensure that concentrations are kept to or below acceptable levels.

Provided that there are no unforseen unusual or unique physical oceanographic conditions, we do not expect an adverse impact to the marine environment or anchialine sands. Additional measurements of water quality and nearshore circulation will identify unique conditions that will require close monitoring.

A major potential impact on the marine environment may result from increased harvest or use of marine resources due to improved public access to the proposed State park land between the project site and the ocean. These impacts include: direct impact on the anchialine pond, littering, human waste and fisheries resource depletion.

To minimize impacts to the marine invironment, the following recommendations are suggested.

- Golf course design, construction and maintenance practices should be developed along the lines of the State Department of Health Golf Course Monitoring Plan guidelines to minimize the introduction of nutrients and pesticides into the marine environment.
- A water quality and biological monitoring program should be designed to monitor golf course groundwater contamination.
- Further study is needed to identify major areas of groundwater introduction into the marine environment and should include additional measurements of water quality.
- A program should be undertaken to monitor water quality and biota in the anchialine pond.
- Further study is needed to identify currents in the small bays along the projects coastline.
- Marine resource management methods should be explored to protect the nearshore marine environment adjacent to the new State park.

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I. INTRODUCTION

A. BACKGROUND

Planning is currently underway by North Kona Development Group (NKDG) to develop approximately 388 acres of land referred to as Maniniowali, between the Queen Kaahumanu Highway and approximately 1000 feet from the shoreline. The site is on the "Big Island" of Hawaii approximately 11 miles north of Kona (Figure I-1). In general, the development plan includes an eighteen hole golf course, single family residences and low rise condominiums. A State Beach Park is being planned on State land between the NKDG site and the shoreline.

There have been several marine surveys conducted near the site (Figure I-2). We have compared information from these surveys and other studies to conditions found at the Maniniowali site during a preliminary site survey.

B. OBJECTIVE

Our study makes an assessment of the nearshore marine environment along the Maniniowali seashore and determines potential impacts from the proposed development.

Two major categories of probable impact include;

(1) nearshore water quality changes brought about by increased nutrients and chemicals contained in groundwater entering the ocean from the NKDG site.

(2) Increased direct human interaction with the environment at the proposed State park causing pollution and overuse of natural resources.

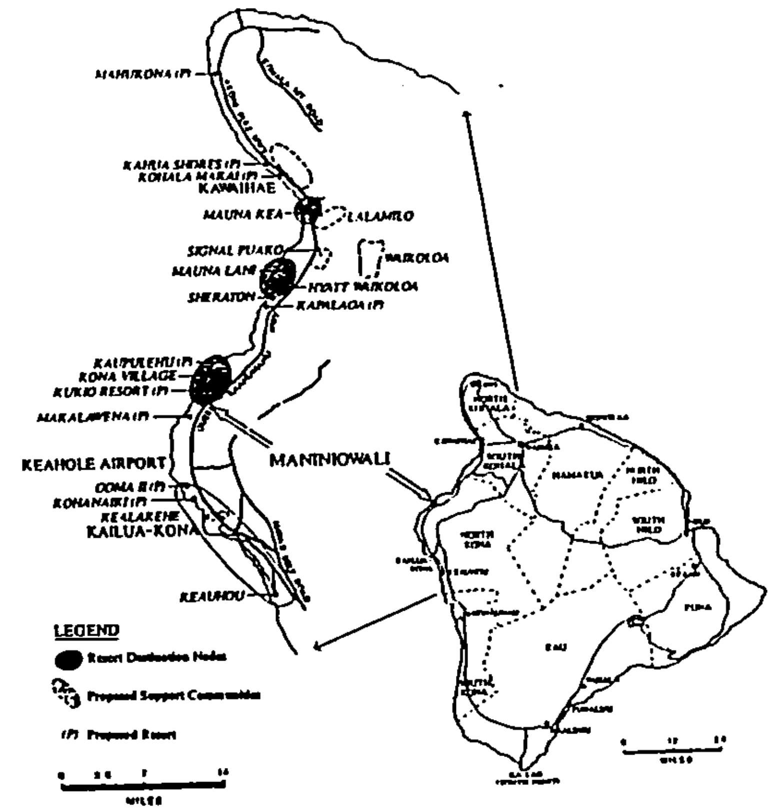

FIGURE I-1 LOCATION MAP

Maniniowali is located on the Kona Coast of the Island of Hawaii approximately 5 miles north of the Kona airport.

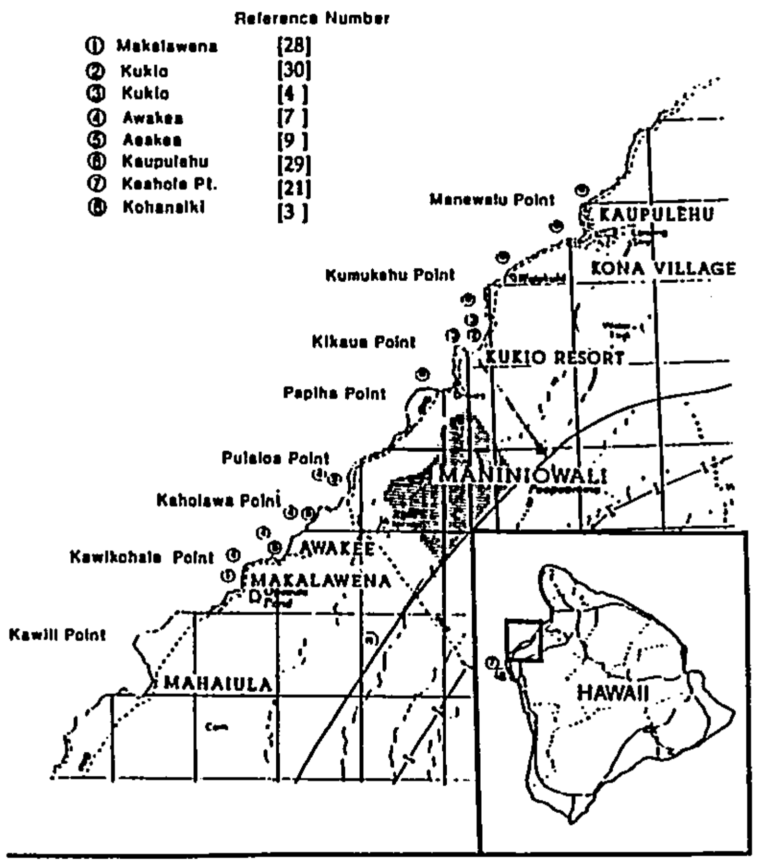

FIGURE I-2 LOCATION OF COMPARABLE MARINE LIFE / WATER QUALITY SURVEYS

II. GENERAL SITE CONDITIONS

The marine environment makai of the NKDG site comprises about 6,000 feet of State owned shoreline, from Kikaua Point (Kukio) at the northern boarder to Awakee at the southern boarder. The shoreline (Figure 11-1) displays examples of several biotypes. Kakapa Bay at the north is a shallow bay with a sculptured basalt bottom. Papiha Point was formed by a recent (1801) flow of a'a lava and is characterized by high relief boulder and lava outcroppings in shallow water and a nearshore ledge that drops from 5 feet of water down to 25 feet. Kua Bay is unique along the Kona coast in that the bottom is uninterrupted sand from the beach out into deep water, forming a permanent beach with significant sand reserves. Puialoa Point was formed by a relatively old flow of pahoehoe lava. As 5 to 10 foot ledge is cut at the current sea level and the sea floor slopes gradually out into deep water.

Kua Beach is the primary focus of people currently entering the area for recreation. The southern end of the beach is backed by an old lava flow covered with fountain grass, small groves of Klawe trees and miscellaneous shrubs. The northern end of the beach is backed by a low sandy swale between the old lava flow directly behind the beach and the more recent 1801 a'a flow to the north. This sandy back-beach area is covered with a variety of beach grasses, morning glory vines, small shrubs, and palm trees, and is also the site of the only anchialine pond identified on the site.

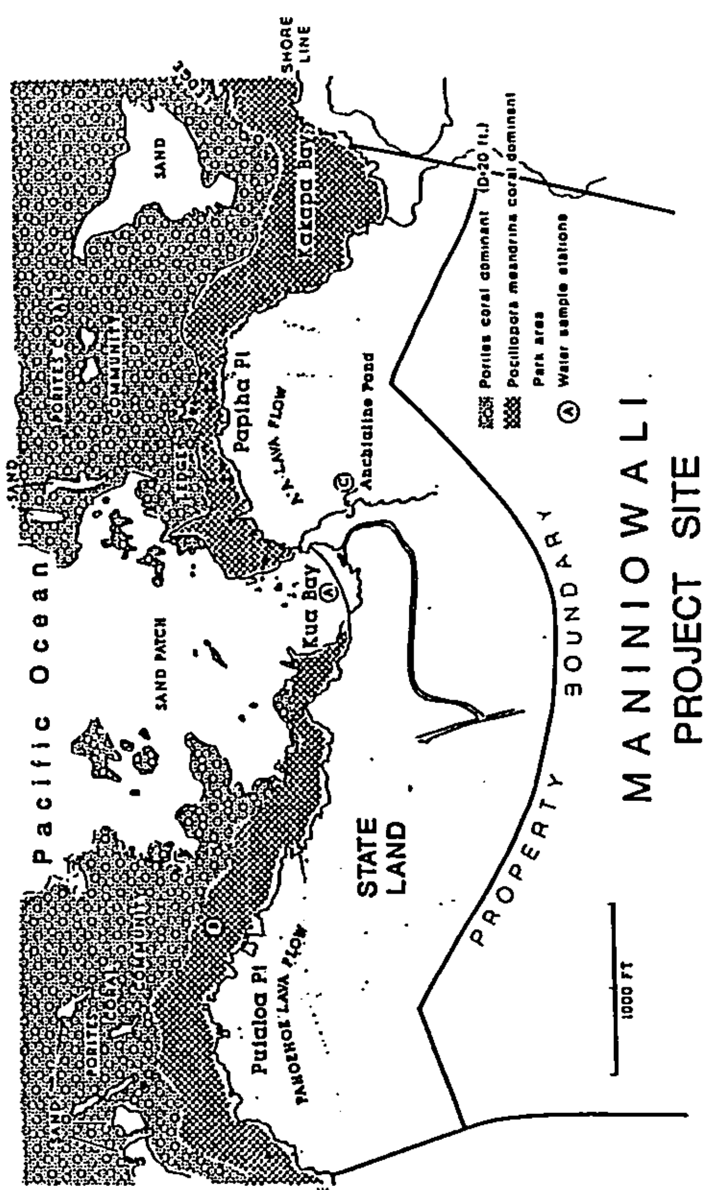

FIGURE II-1 COASTAL FEATURES OF MANINIOWALI MAKAI OF THE PROJECT SITE

III. INVESTIGATION METHODOLOGY

A coastal survey was conducted on March 29, 1991. The coastline was observed on foot from the high waterline to the tide pools. In-water observations were made from the surface along the project coastline from the surge zone out to a depth of about 60 feet. Photographs were taken to document observations.

A. WATER QUALITY

Three water quality samples were taken for comparison to values reported from other Kona coast studies. Two samples were obtained from the nearshore area and one was taken from the single anchialine pond on the State Park land, as shown in Figure II-1. Ocean samples were taken in 5 feet of water at the middle of Kua Beach and in 10 feet of water off the middle of the rocky headland, Puialoa Point, south of Kua beach. These one liter water samples were stored on ice for laboratory analyses. In the laboratory, measurements of salinity, turbidity, total suspended solids, nitrate plus nitrite, total nitrogen, orthophosphate, total phosphate, and silicate, were performed according to standard laboratory methods. Results were compared to published and unpublished water quality data from adjacent sites along the Kona coast.

B. BATHYMETRY

Preliminary in-water reconnaissance surveys were conducted and aerial photographs analyzed to ascertain the general bathymetry of the nearshore environment. Comparisons were made with published U.S Coast and Geodetic Survey charts.

C. NEARSHORE OCEAN WAVES AND CURRENTS

The general nature of nearshore ocean currents off this coastline were estimated from published information [1,2]. These studies focused their attention on the impact of currents to the Natural Energy Laboratory approximately 7 miles south of the development site. Nearshore waves and currents were noted during the field visit.

D. CORAL & MARINE LIFE SURVEY

A brief reconnaissance survey was performed to ascertain the general benthic community structure along the coast. Visual and photographic observations were made along the length of the shoreline from the shore out to a water depth of about 60 feet. Observations were compared to survey results from nearby sites.

E. ANCHIALINE POND SURVEY

Anchialine pond observations were made on the survey day. The general character of the pond was noted, a water quality sample taken and common biota identified.

IV. INVESTIGATION RESULTS

A. WATER QUALITY

Nearshore waters off this portion of the Kona Coast are classed by the State Department of Health as AA, and are considered pristine. Water clarity is normally excellent, but may decrease on occasion because of heavy surf or surface macroplankton blooms. There are no surface water streams with sediment loads entering the ocean near the area, although, as is typical on the Kona coast, there is significant natural inflow of highly nutrified groundwater.

Single water quality samples were taken from the anchialine pond, beach, and Pulaloa point during the single site study visit. Water quality results are presented in Table IV-1. Average water quality data published from other Kona coast anchialine pond studies is given in Table IV-2. Water Quality data published from other nearshore sites along the Kona coast are summarized in Table IV-3. There is a significant body of unpublished data in the form of reports to developers, particularly from the Kukio and Kohanaiki sites that will be published, probably within the next year [3,4].

TABLE IV-1
WATER QUALITY RESULTS

Parameters	Anchialine Pond	Kua Beach	Pulaloa Point	State Standard Geometric Mean
Turbidity (NTU)	1.04	0.35	0.23	0.20
Salinity (ppt)	6.11	33.88	34.55	---
Tot Nitrogen (ug/l)	846.90	138.70	80.88	110
Tot Phosphate (ug/l)	35.60	4.30	4.30	16
Nitrate + Nitrite (ug/l)	502.20	44.40	4.50	3.50
Ortho Phosphate (ug/l)	5.90	0.30	0.30	5
Silicate (ug/l)	23292.1	1054.2	252.6	---

NTU = Nephelometric Turbidity Units
ppt = Parts Per Thousand
ug/l = Micrograms/l

Groundwater nutrient concentrations have increased in shoreline areas fronting some existing Kona coast golf course developments. At Keauhou Bay nitrogen levels in nearshore waters increased by 127 percent [5]. At the Waikoloa resort the concentration of nitrogen and phosphate in anchialine ponds increased by 98 percent and 55 percent, respectively [5]. However, other locations such as the Mauna Lani and Westin Mauna Kea, have exhibited no observable increase in near shore nitrogen levels [6,7,8].

TABLE IV-2
ANCHIALINE POND WATER QUALITY **

Parameters	AWAKE'E [7,9]	WAIKALOA [10]	KAUPULEHU [11]
Salinity (ppt)	6-10	9.3 (5-19)	2-4
Total Nitrogen (ug/l)		829 (305-1680)	1290-2300
Nitrate + Nitrite (ug/l)		686 (273-1288)	
Total Phosphate (ug/l)		113 (37-226)	23.8-56.1
Silicate (ug/l)			
Tot. Susp.Solids (mg/l)			

TABLE IV-3
NEARSHORE WATER QUALITY **

Parameters	AWAKE'E [7,9]	O'OMA [12]	MAUNA LANI [6]	KEAHOLE NELH [12]
Salinity (ppt)		34.7	32.6	34.8
Total Nitrogen (ug/l)		95.9	134.8	60.8
Nitrate + Nitrite (ug/l)	9.7	1.81	12.59	2.8
Total Phosphate (ug/l)		9.08	13.67	7.4
Silicate (ug/l)	406	145.3	642.9	82.6
Tot. Susp. Solid (mg/l)				0.61

** Results summarized as range or geometric mean.

B. BATHYMETRY

The bathymetry off Maniniowali coast conforms to the general pattern observed all along the north Kona coast. The underwater slope of the mountain is considerably less than seen above sea level, and reaches an approximate depth of 300 feet 2 miles offshore and 600 feet 5 miles offshore. At 600 feet, the slope increases and the bottom rapidly descends into the depths. Outside of the breaker zone the bottom is composed of a flat basaltic shelf that is a continuation of the main island basalt mass. The basalt may be overlain by coral communities or sand patches. At depths of 20 to 40 feet, the bench is sculptured by wave action and diverse coral growth into a series of ledges, ridges, pinnacles and pits. From 40 to 60 feet, there is less vertical relief, and more sand patches, and the diverse coral colonies tend to give way to colonies of finger coral (P.compressa) with some lobe coral (P.lobata). In deeper zones, not seen during this survey, the coral becomes scarce and the bottom is strewn with unconsolidated sand and coral rubble. This general pattern is augmented in the nearshore areas by specific characteristics of the shoreline landform.

The character of the nearshore area bathymetry is largely determined by the topography, age and type of lava flow at the seashore. Headlands formed by lava entering the sea have created exposed points and sheltered coves relative to the direction of storm waves. The type of lava flow (a'a or pahoehoe) markedly affects the character of the surf and intertidal zones. Boulders from the a'a flow provide increased vertical relief and more shelter from the surf. Bays formed between headlands will also vary in character depending upon their age, depth, and the type of bottom.

At the north end of the Maniniowali Coast, Kakapa Bay is a shallow wide embayment formed between the Kukio pahoehoe flow to the north (Kikaua Point) and the more recent 1801 a'a lava flow to the south (Papiha Point). The Bay is fairly shallow (10-15 feet), and the irregular basalt bottom has both coral and lava rock outcroppings forming a variety of habitat for fish and invertebrates. There is little or no sand within the bay; white areas along the high water mark that appear to be sand beaches from aerial photographs are actually accumulations of white coral rock tossed up by high waves.

Papiha Point was formed by the 1801 a'a lava flow. The surface of the flow is relatively flat with a slope of about 3 to 100. The edge of the flow at the high water mark has been shaped by heavy surf to form a sloping natural revetment of black a'a rocks and white coral rubble. The slightly concave slope of the seaward face averages 15-20 degrees (3 to 1) and extends from the water level to a height of about 15 feet above sea level.The slope continues at a shallow angle through the surf zone and out to the edge of a vertical ledge 200 to 300 feet offshore. The shallow slope is studded with large boulders and lava outcroppings many of which reach the surface. The ledge at the end of the a'a flow drops vertically from a depth of about 10 feet to 30 feet.

Caves and overhangs are common along the vertical face of the ledge, which stands on a fairly flat sand and limestone-covered basalt base.

Kua Bay rests on a relatively old lava flow between the 1801 a'a flow to the north and the older pahoehoe flow to the south. The beach is one of the rare permanent pocket beaches along the coast, with sand extending from the land downward to at least 60 feet of water. Depending on season and wave action, greater or lesser rock surface area may be exposed on the beach. However, because the toe of the beach continues unbroken into a large sand patch, it is unlikely that the beach would ever completely disappear. The offshore sand patch acts as a reservoir of sand for natural beach nourishment. The sand patch appears to be deeper than the basaltic ledges to either side. This shallow valley continues out to a depth of at least 60 feet beyond which the sand patch probably becomes contiguous with the sand and coral beds of the bordering areas. The back-beach sand dune area has a relatively low flat topography and supports a variety of trees, shrubs and grasses. This back-beach area contains the only known anchialine pond on the property.

Pulaloa Point at the southern end of the property was formed by an older pahoehoe flow that approaches the seashore at a relatively steep (1 to 10) slope. The seashore typically consists of a ragged shelf several feet above sea level that drops directly into 5 to 10 feet of water. Tide pools are not as plentiful or abundant when compared to the edge of the a'a flow forming Papiha Point. The sea bottom slopes gradually to the depths, with intermittent sand and coral patches as described later in this report.

C. NEARSHORE OCEAN WAVES AND CURRENTS

There is no data on nearshore currents in the immediate vicinity of the project site. Current data was obtained from general oceanographic studies [13] off the Big Island of Hawaii, and from studies conducted along the Kona coastline [1] and at the shelf edge approximately 8 miles WNW of Kua Bay [2]. Currents in the very nearshore environment are dependent upon wind, waves, tides and ocean currents. Circulation within the shallow bay is probably most strongly governed by wind and waves, but without direct measurements it is impossible to estimate the effect of offshore currents or other factors.

Kua Bay is partly protected from ocean swells approaching from the west and north due to the presence of other islands in the Hawaiian chain (Figure IV-1). However, local winds from these directions acting on the limited fetch can produce waves of shorter period. The general north-south orientation of the shoreline receives waves approaching from the west in a band from 225 degrees (SW) to 14 degrees (NNE). The Hawaiian island chain to the northwest reduces this scope by intercepting most of the waves approaching from 300 degrees north to 355 degrees. This limited exposure (225 - 300 degrees plus 355 - 015 degrees) exempts the bay from most drastic wave activity generated by North Pacific storms.

In general, wave heights in the north tropical Pacific deep ocean vary from 1.5 feet to 13 feet with wave period varying from 6 to 18 seconds. Some waves are filtered through the island chain or approach Kua Bay through Alenuihaha channel, but most of the long swells approach from the northwest. The variation of deep water wave direction during the year, combined with seasonal tides and wind can result in a wide variation of nearshore currents. The combined effect can only be estimated by relating the driving parameters and resulting currents with actual field measurements over a period of time.

During the summer season, dominant southern swells approach around Keahole Point and cause a northerly littoral drift along the coast. Waves approaching from east to northwest could result in a littoral drift in either direction depending on the degree of deformation in shallow water and actual deep water wave direction. Waves undergo deformation after entering the bay, due to refraction, diffraction and shoaling. The breaking depth of a wave is determined by its height; thus, large waves will break further offshore than smaller ones.

Refraction causes wave energy to converge at headlands and diverge at the center of bays between headlands. Wave energy convergence may cause higher waves at headlands and lower wave heights in the middle. Wave height distribution will therefore depend on bathymetry, wave direction and wave period. Wave induced circulation within Kua Bay will vary widely depending on the current wave conditions.

Previous studies [1,2] indicate the presence of a longshore current generally toward the north, which may change direction and intensity with tidal cycles as displayed in Figure IV-2. This long-shore current is caused by a cyclonic eddy off the Kona coast generated by the currents and winds wrapping around the Big Island (Figure IV-3). The two dominant eddies off the big island seem to be stable but not stationary features. Movement of the eddies on or offshore, or up and down the coast can dramatically effect the nearshore current regime. Data is also available for offshore currents at Keahole Point. Deep water (1000 feet) currents around Keahole Point vary from 0.1 foot/second to over 6 feet/second. The most dominant currents are in the range of 2 to 3 feet/second, i.e., the range expected for tides. Currents are strongest in the longshore direction.

Observations during our survey indicate surface currents are generated by sustained winds in the longshore direction. Current measurements centered around Keahole Point have yielded information on the macrocurrent environment. If it is important to understand the microcurrent climate at the site, then these measurements must be made in the field at the point of interest.

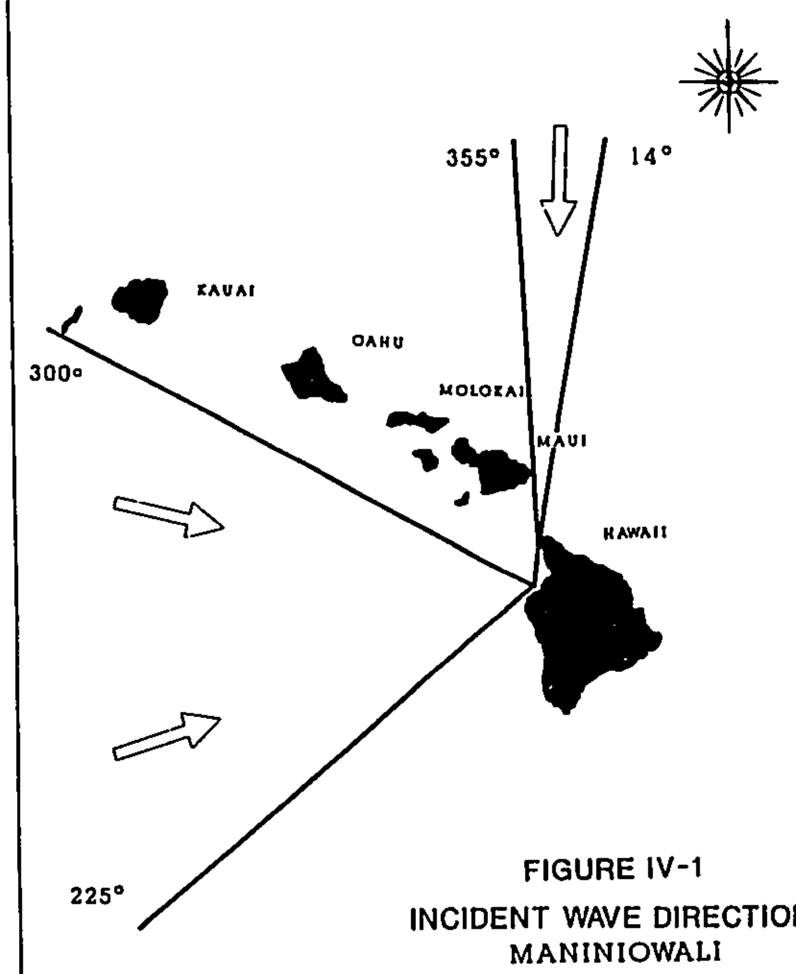

FIGURE IV-1
INCIDENT WAVE DIRECTION
MANINIOWALI

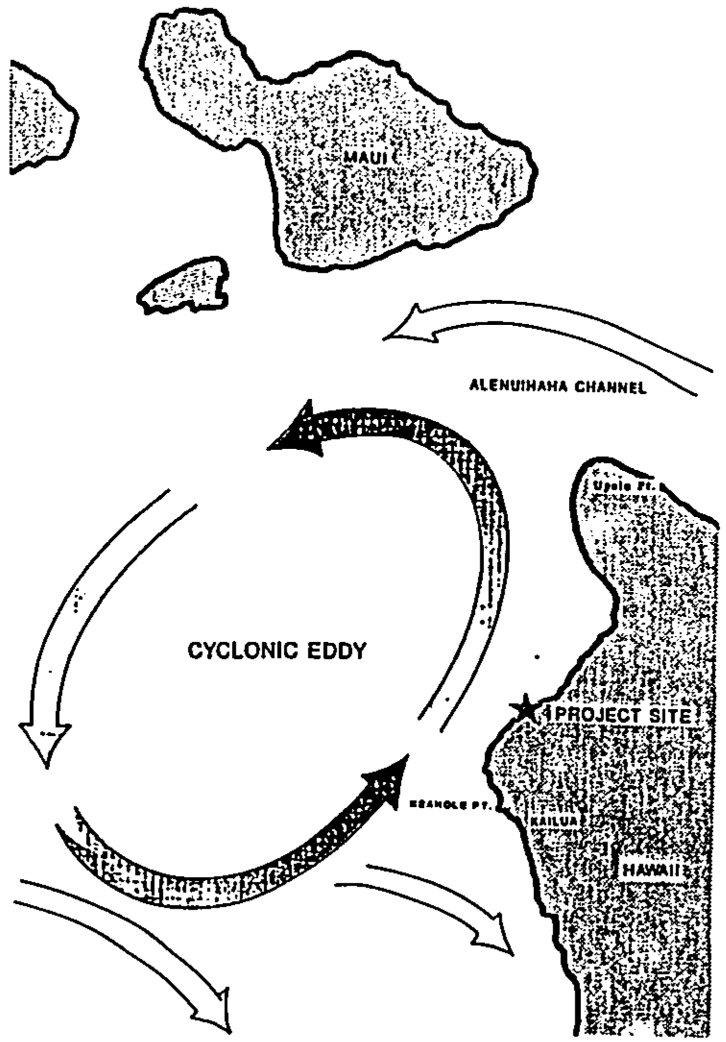

FIGURE IV-2 MAJOR OFF-SHORE CURRENT PATTERN

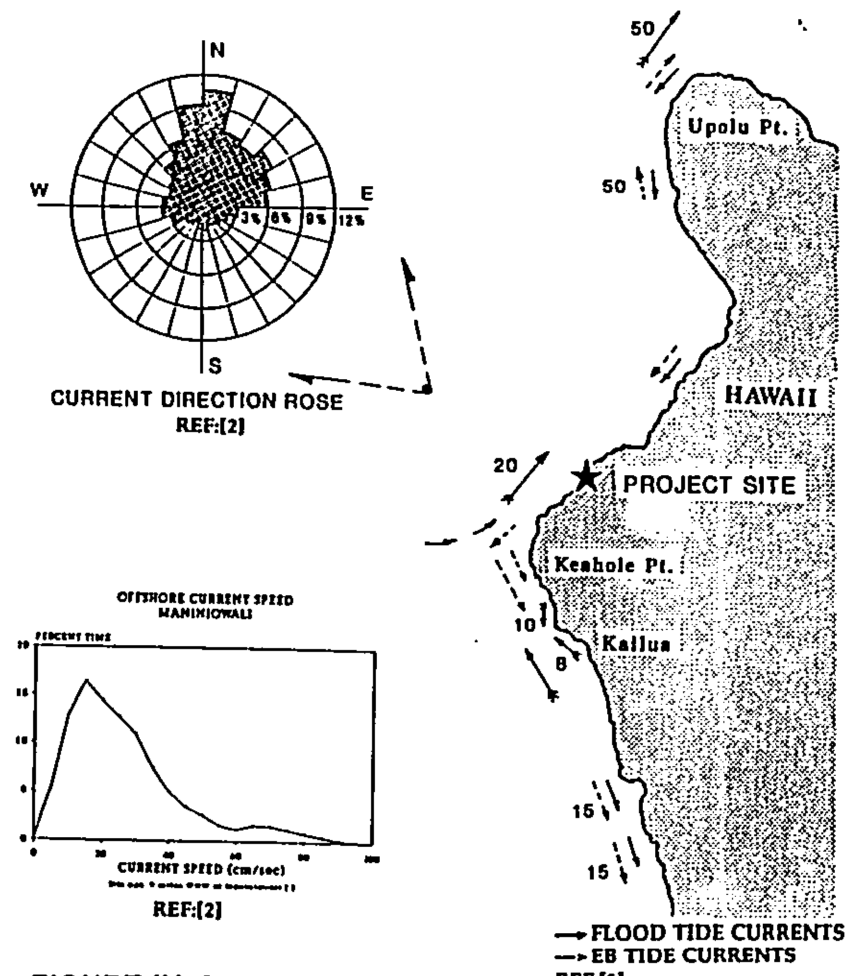

FIGURE IV-3
LONG SHORE CURRENTS OFF NORTH KONA

D. CORAL & MARINE LIFE SURVEY

Shoreline Area - High splash zone to subtidal breaker zone

The variety and abundance of marine life within the surge, breaker and intertidal zones is determined to a great extent by wave energy, and by the topography and bathymetry of the shoreline that affords shelter to aquatic life. The shoreline topography and bathymetry are largely determined by the age and type of lava flow at the seashore. Headlands formed by lava entering the sea create exposed points and sheltered lee habitats relative to the direction of storm waves. The type of lava flow (a'a or pahoehoe) will markedly affect the character of habitat in the surf and intertidal zones. Boulders from an a'a flow provide increased vertical relief and more shelter from the surf. Bays formed between headlands will also vary the type of biota they support depending upon their age, depth, and the type of bottom. The shoreline along this section of the coast may be characterized into three main types: a'a flow, pahoehoe flow, and sandy beach.

The beach face of Papiha Point was shaped by seasonally large waves forming a natural sloping revetment. The distribution of large boulders and lava outcroppings forms a series of tide pools where the lava flow enters the water. Intertidal seaweeds including Turbinaria ornata, Ahnfeltia concinna, Sargassum echinocarpum and Porphyra sp. are abundant but close-cropped, probably as a result of wave action. Sea urchins, including Echinometra mathaei and Echinometra oblonga are plentiful in protected cracks between boulders. Several small "rose" coral heads, Pocillopora meandrina, were noted in deeper tide pools.

The white sand of Kua Beach stretches along approximately 450 feet of coastline. A few Goast Crab (Ocypode ceratophthalma) burrows were visible along the beach. Because of the lack of cover, marine life over the large sand patch offshore of Kua Beach is largely limited to transient fish species and other fish or invertebrate species that are adapted to hide in or just above the sand. One school of opelu (Decapterus sp.) was seen, but no cryptic or sand dwelling species were noted during the survey.

The shoreline south of Kua Beach is dominated by an older pahoehoe lava flow that forms a ledge at the waterline dropping immediately into 5-10 feet of water along most of this coast. This makes for excellent shorefishing but dangerous swimming. Tide pools, some quite large, are formed where the pahoehoe flow has formed fissures or become submerged below the mean sea level. Dominant algae include Turbinaria ornata and Sargassum echinocarpum. The tide pools are not as numerous or as richly populated as those at the tip of the a'a flow on the northern end of the property, Papiha Point.

Nearshore Communities

Nearshore subtidal marine communities are generally defined by the physical nature of the bottom substrate. Unconsolidated sand or rubble will support a relatively low population of surface dwelling invertebrates and fish. Hard substrate may either be basalt (lava) or calcarious in nature and in general provides more niches for fish and invertebrate habitation. Calcarious substrate may either be formed by the buildup and overgrowth of stony corals, or more commonly by consolidation of coralline (limestone) sands. In several locations the solid basaltic lava flow is covered by a thin veneer of consolidated limestone sand.

Because of the geologically young age of the Big Island and the relatively slow growth of corals in these subtropical waters, most corals are growing on a substrate of basalt and do not form true "coral reefs", but rather coral communities. In other studies along the Kona coast, coral communities are described forming four general zones of coral habitation based upon community structure that vary specifically with depth [14] or with wave energy [15]. Each zone is characterized by a depth range, substrate type, and primary coral species (Table IV-4).

TABLE IV-4
CORAL HABITATION ZONES AT DIFFERENT DEPTHS

Depth (ft.)	1975 Study [14]	1981 Study [15]
0-25	Pocillopora meandrina Boulder Zone	High Surge Shallow Water
20-45	P. lobata Reef Building Zone	Moderate Surge Shallow water
40-100	P. compressa Slope Zone	Moderate Surge Deep Water
100+	P. lobata Rubble Zone	Low Surge Deep Water

We performed no quantitative transect or census studies, however, nearshore benthic communities off of Awakee, just south of State coastal land at Maniniowali were previously quantified by others [7,9]. Their general description is applicable to the communities off the Maniniowali coast.

In the "High Surge" zone, from the tidal zone down to about 15 to 20 feet, harsh physical conditions limit the growth of flora and fauna. Coral cover in this shallowest zone is relatively low varying from 27% to 39% [7,9], but there are high numbers of coral species and higher diversity than in deeper zones. A distinct difference in percent coral cover is found between Papiha Point (north) and Pulaloa Point (south). Percent coral cover has been found to be much greater (estimated 25-40 percent) off of Papiha Point than off Pulaloa Point (estimated 5 percent cover). The jagged lava boulders and high vertical relief at the end of the a'a lava flow forming Papiha Point probably serve to lessen the impact from storm waves thereby allowing more coral growth. The most abundant coral species in the high surge zone are rose coral (Pocillopora meandrina) and encrusting colonies of lobe coral (Porites lobata). These species seem to survive better than others in this zone of extreme water motion. However, several other species of corals were noted on the bare basalt bottom and coral cover seems more limited by physical conditions than by intra-species competition.

At moderate depths (30 feet) on a transect site just south of Maniniowali, surveyors [7,9] reported typically higher coral cover (36% to 66%) than in the high surge zone. This increased cover is attributed to the lower effect of waves at this depth. Principle species of coral were finger coral (Porites compressa) and lobe coral (Porites lobata). In this zone the lobe coral typically has a greater vertical relief as compared to the encrusting form common in shallow water. These colonies often form large mushroom shaped boulders that create habitat for other reef animals and plants. Finger coral is rather fragile but has a relatively rapid growth rate and tends to over-grow less competitive species in this zone. Therefore, even though total coral cover is much greater in this zone there is actually less coral species diversity than in the high surge zone. Occasional heavy surf can break or overturn coral even at this depth thereby allowing for other coral species to colonize available space.

At depths greater than about 45 feet there is seldom any disruption from all but the most extreme storms. Coral cover is highest in this zone (63% to 69%), but diversity is low [7,9]. Coral is limited primarily to lobe coral and finger coral. Because of the low surge at this depth the finger coral is able to form a spreading growth that extends over unconsolidated substrate uninhabitable by other species of coral. The relatively flat slope of the basalt bottom off of Maniniowali allows for large expanses of coral communities intermixed with sand patches. These communities probably extend down to depths of about 125 feet where the availability of light becomes the limiting coral growth factor.

Reef fish were noted to be abundant during our brief survey. The presence of large gamefish including parrotfish (Scarus sp.), ulula (Caranx sp.), goatfish (Parupeneus sp. and Mulloides sp.) and squirrel fishes (Holocentrus and Myripristis sp.) indicate that this area has not yet been subjected to heavy fishing pressure. Qualitatively the reef fish community off Maniniowali was typical of sites along the north Kona coast.

Endangered or Protected Species

With the exception of the hawksbill turtle (Eretmochelys imbricata; endangered) green sea turtle (Chelonia mydas; protected) and humpback whale (Megaptera novaeangliae; endangered), there are no other protected or endangered species known from the Kona marine environment. The proposed development should have no impact on these species.

E. ANCHIALINE POND SURVEY

The single anchialine pond located on the State's beach park land approximately 250 feet behind the beach was first briefly described in a 1974 pond survey of the entire Kona coast [16]. Anchialine ponds are nearshore ponds with measurable, normally low, but highly variable salinity. The water levels of anchialine ponds rise and fall with the tides although they have no surface connection to the ocean. The shallow bottom of the pond is covered with sandy mud that supports a rich colony of blue green algae (Schizothrix sp.) growing on other unidentified freshwater algae similar to hornwort (Ceratophyllum sp.). The pond supports a large population of mosquitofish (Poecilia sp.) and at least one species of shrimp, probably Palaemon debilis. No other shrimp species (Macrobrachium, Halocaridina or Metabetaeus) were seen.

The anchialine pond has a surface area of approximately 16 square yards and may be classified as a mature pond. The salinity of the anchialine pond was about 6 ppt (35 ppt = full seawater) which is on the high side of normal for a mature anchialine pond. Similarly, both the nitrogen level and silicate level were slightly higher than those of an average anchialine pond, but entirely within the normal range for a mature pond.

The anchialine pond has been previously altered by man. The pond was partially covered by a'a rocks as the apparent result of construction in the area. There are several non-endemic plants surrounding the pond. One small tree has recently been planted adjacent to the pond. The exposed nature of the pond and its proximity to the public beach make misuse and/or vandalism of the pond a realistic possibility.

V. DISCUSSION

A. GENERAL DISCUSSION

The proposed development includes a residential community, condominiums, and an 18-hole golf course on land which extends between 1000 to 5000 feet from the coastline. A State owned beach park with public facilities is being planned for the land between the shore and the project site boundary. The 1000 foot wide park will minimize the potential impact on the nearshore environment from construction or operation of the Maniniowali project facilities.

There have been many in-depth marine ecosystem surveys within a few miles of the Maniniowali coastline [4-13,27-30] (Figure I-2). Ongoing surveys are being conducted at Kukio [4] and Kohana Iki [3] to the north and south, respectively, of the Maniniowali coastline. Additional studies have sought to characterize the Kona coast marine ecosystems in more general terms [11,14,16,17]. Information provided by these surveys has been adequate to characterize the general marine environment at the Maniniowali coastline. Site specific measurements may be needed later to address specific environmental issues that may be identified.

Water Quality

Water quality in the nearshore ocean off the Maniniowali coast generally conforms to State 'AA' coastal water standards. The two nearshore water samples taken (Table IV-1) are well within the normal ranges established by other monitoring programs from along the Kona coast. They are also within the State's water quality standards for dry open coastline (Table IV-1) for all parameters except nitrate + nitrite. However, the relatively high level of nitrate + nitrite is normal for areas of groundwater influx.

The sample taken off Kua Beach was of slightly lower salinity, higher silicate and higher nitrogen. Groundwater is commonly very high in both nitrogen and silicate. However, these constituents are normally low in the marine environment and are rapidly removed from the water through biological action. The measurement of high nitrogen and silicate near the beach is consistent with the hypothesis that this is a major site of freshwater inflow. The second water sample taken from the pahoehoe headland, Pulaloa Point, is more typical of oceanic water (lower nitrogen and silicate), possibly indicating a lower groundwater flow or higher mixing rate in this area.

Golf course and residential activities are expected to add some nutrients to the nearshore marine environment. Nutrification of the aquatic environment can affect the ecosystem by stimulating growth of phytoplankton or benthic algae, but may also affect coral growth. However, nutrification implies a balanced increase in nutrients

(nitrogen: phosphorus : potassium: trace minerals) required to stimulate plant growth. Groundwater in Kona is high in nitrogen and low in phosphorous and potassium. The addition of excess nitrogen to an environment already high in nitrogen should not stimulate plant growth. Nearshore ocean water productivity is limited by low phosphorous levels. Estimates indicate that the existing groundwater level of nitrogen (approximately 0.8 mg/l) may be increased by about three times to 2.76 mg/l by anticipated golf course and residential fertilization [19]. Previous studies [5,12] indicate that this magnitude of nutrient increase has not affected anchialine pond biota or nearshore marine life. However, there have been no studies to estimate the cumulative impact brought about by multiple inputs along the Kona coast. There is some evidence from Keahole Point [20,21] supporting the theory that nearshore nitrogen levels may have already slightly increased.

The concentration of nutrients in the groundwater is expected to be managed by NKDG through a golf course groundwater monitoring plan, which will be prepared for the State Department of Health. Through appropriate golf course fertilization, monitoring and management programs impacts can be limited [31].

Anchialine pond

Anchialine ponds along the Kona coast penetrate the freshwater (brackish) lens near the seashore. Water within these ponds generally has a high turnover rate and characterizes the nature of groundwater entering the ocean. There is a single known anchialine pond on State Park land between Maniniowali and the sea. Any addition of nutrients, pesticides or other chemicals that enter the groundwater from the development should be seen in the anchialine pond prior to changes in the nearshore environment. Therefore this single pond will be of importance to the monitoring program that may be instituted.

Bathymetry

Available data indicates that the slope of the seabottom off of the Maniniowali coast is comparatively slight, reaching a depth of 300 feet about 2 miles off shore and 600 feet at about 5 miles. Around most of the Big Island the nearshore bottom slope is relatively steep. This forms a very narrow band of shallow water (<125 feet) around the island capable of supporting the growth of stony corals and associated communities. Along the north Kona coast, however, the relatively low slope of the Hualalai volcano has formed a flat shelf that extends about 5 miles offshore of Maniniowali to a depth of only 600 feet. At the same distance offshore of Kailua Kona the water is about ten times deeper (6000 feet). The nearshore bathymetry is shaped by the topography of geologically recent lava flows that have entered the sea forming small promatories and bays.

Currents

Tidal currents are likely to be on the order of 0.3 to 0.7 feet/sec generally in the northern direction parallel to shore. Little is known about the nearshore currents, at the Maniniowali coast and their ability to disperse pollutants. If the predominant offshore current caused by the cyclonic eddy does not mix well with nearshore currents, then nutrients could build in nearshore waters as currents move slowly north along the coast receiving additional input from other developments along the way.

Corals and Marine Life

The general character of the nearshore benthic community conforms to the pattern described in previous studies [9,14,15]. This pattern is augmented in the shallow surge and tidal zones by the nearshore topography that forms habitats either exposed to or protected from heavy surf. In addition, the shallow bathymetric slope off the north Kona coast effectively eliminates the "deep slope" zone described by others and replaces it with a zone of competing lobe coral and finger coral colonies down to a depth of about 125 feet, where light becomes the limiting growth factor.

Because groundwater tends to spread out on the surface layers as it enters the ocean, it is not likely that coral communities beneath the immediate surface will be affected by any increased nutrients from the inflow of groundwater. However, benthic communities within the tidal and surge zones may experience some increase in nutrified groundwater. The extent of this impact is expected to be small because nitrogen, which is the primary nutrient likely to be increased by golf course and residential development, is already in the groundwater and is in excess in the nearshore environment. Intertidal algal growth at some locations could possibly shift toward rapid growth species more adept at taking advantage of increased nitrogen levels.

It is speculated that rapid water turnover within the anchialine pond prevents algae blooms from occurring. There has been no indication that increased nutrient levels are impacting anchialine ponds adjacent to golf course developments [5,10,12]. Similarly, there have been no reported adverse impacts on nearshore marine biota from increased nitrification of groundwater caused by golf course fertilization.

There is still much to learn regarding the physical processes undertaken by golf course chemicals leaching through groundwater and into the marine environment. However, no pesticides used in golf course activities in Hawaii have been measured in the nearshore environment nor has there been any evidence directly implicating golf course pesticide use with impacts on the nearshore ecology. NKDG plans to employ special management practices for the use of the golf course, which will result in substantially less chemicals as compared to traditional courses. However, biological minimum level-of-effect concentrations are often below our measuring instruments'

detection threshold, and certain animal species may bioaccumultate pesticides. Therefore, despite adequate planning and controls, there is always a slight possibility that pesticides could reach and accumulate in the near shore environment.

The incidence of ciguatera fish poisoning in the Hawaiian Islands has been on the increase during the past 20 years. There is no known causative correlation between golf course development and ciguatera poisoning. Present theories suggest that fish become ciguatoxic by eating and accumulating toxins that are produced by a single celled marine diatom named <u>Gambierdiscus toxicus</u>. This diatom species (and probably others) produce a toxin as they grow attached to the surface of large benthic algae or dead coral. Fish ingest toxin by eating the algae (with attached diatoms). The toxin is passed up the food chain from herbivorous fishes and concentrated in higher level predatory fishes. A population bloom of <u>Gambierdiscus</u> can coat benthic algae with up to 500,000 diatom cells per gram of algae. The State of Hawaii Department of Health has indicated that any concentration of <u>Gambierdiscus</u> greater than 20 cells per gram should be considered potentially toxic.

In general, ciguatera poisoning has been correlated with coastal disturbances, such as dredging or the construction of breakwaters. When there is a disturbance in the nearshore environment, either man-made or natural, an opportunity exists for diaton population blooms. If <u>Gambierdiscus</u> populations bloom the fish in this area have an increased potential to become ciguatoxic.

The State Department of Health requires groundwater monitoring for all golf course developments. Monitoring can also detect any significant changes to the water chemistry of the nearshore environment. Concerns for increased risk for ciguatera poisoning are best addressed through monitoring, which could measure population levels of <u>Gambierdiscus</u> as well as levels of toxins in fresh tissue.

B. POTENTIAL IMPACTS

Short-term impacts on the marine environment from construction projects of this type are most likely to come from airborne dust and increased siltation in runoff waters. However, because of the wide buffer between the development and the ocean, the low normal rainfall, and extreme porosity of the landscape, this threat appears to be minimal.

There are two conditions that could have a long-term impact on the marine environment:

1. The use of pesticides, fertilizers and golf course irrigation with secondary treated waste water. The potential impact on the nearshore marine environment will depend on the concentrations introduced and residence time.

2. Increased public access to the Maniniowali Coast through the planned State beach park raises concern about the management of nearshore marine resources.

These potential impacts are discussed in separate sections below.

(1) GROUNDWATER INPUT TO THE OCEAN

Nutrients, pesticides or other chemicals are likely to enter the groundwater as a result of this development. This creates the potential for affecting the nearshore marine environment where the groundwater enters the ocean. Concentrations of these chemicals in the nearshore environment will be dependent on the groundwater flow rate, concentration of chemicals in the groundwater, and the rates of mixing and dilution by waves, currents and diffusion. These factors are discussed separately below.

<u>Transmission into the Ocean</u>

Existing groundwater seepage velocity (flow rate) is estimated from discharge values given in the literature [26] as 136.6 gpd/foot or 13.6 gal per day per square foot, assuming flux occurs across the first 10 feet of depth from mean sea level. This results in velocities of 21.93 inch/day or 0.91 inch/hour.

Preliminary studies [19] estimate that a total of 2.2 tons of nitrogen per year will enter the groundwater flow as a result of development activities. This will increase the concentration of nitrogen in groundwater entering the ocean from its present level of 0.85 mg/l to about 2.57 mg/l. These studies also indicate that concentrations of pesticides or other toxic substances emminating from development activities into the groundwater should be below detection levels.

Groundwater that is transmitted into the ocean is subject to various forces that cause it to mix and disperse. Dilution is a function of waves, currents, wave induced currents, relative densities and the bathymetry of the coastline. Discharge of groundwater will not be evenly distributed along the coastline, nor will it become instantly mixed into the water column as it enters the ocean.

When groundwater is discharged into another body of water, mixing of the two begins immediately. The initial stage of the mixing depends on the density differences between the discharge and the receiving water. If the density of the discharge is lower than the receiving water density (e.g. freshwater into the ocean) at the discharge point, the water tends to rise to a layer where the density difference vanishes due to mixing, or when the surface is reached.

Turbulent motion occurs during the upward movement of discharge through receiving waters; dilution occurs rapidly. This results in the formation of a nearfield plume. After initial dilution, the water begins to diffuse and spread due to advection by currents and eddy diffusion. This secondary dilution causes a farfield plume. If low density fresh water is discharged close to the surface, as is often the case of a fresh groundwater lens outlet, the discharge tends to stay at the surface and spread horizontally into a large area.

<u>Groundwater Effluent Mixing by Wave Induced Currents</u>

Wave activity will tend to increase mixing in the surface layers at the shoreline. The velocity distribution due to the presence of progressive waves is a function of depth, wave height and wave period. Water particles move in circular orbits in deep water; however, as the depth decreases, the particle paths become elliptical.

Water particle motion due to waves at the ocean's bottom is parallel to the bottom. The effect of the surface waves is limited to depths of one-half the wave length. When water depth is less than one-twentieth of the wave length, particle motion is nearly horizontal throughout the water column, as occurs with tidal motion and other long waves.

We can calculate the bottom velocity using Equation 1.

$$Ub = \frac{pi^{*}H}{T^{*}\sinh(k^{*}h)} \qquad \text{Equation 1}$$

Where: Ub = bottom velocity, T = wave period, L = wavelength, H = wave height, k = wave number, h = depth of water

Waves become unstable as water depths decrease; eventually breaking occurs. Breaking waves create heavy turbulence and mixing in an area referred to as the "breaker zone," typically located at wave height to depth ratios of 0.6 to 0.8 [22,23].

Complete turbulent mixing occurs in the breaker zone and is a function of wave statistics, given in Table V-1. Results indicate that the breaker zone occurs at depths less than or equal to 3.2 feet 52.5% of the time.

TABLE V-1
STATISTICAL DISTRIBUTION OF BREAKER ZONE DEPTHS

Depth (ft)	% Time Fully Mixed
[illegible]	99.8
1.9	99.6
3.2	52.5
4.5	12.9
5.8	6.3
7.1	1.7
8.3	1.0
9.6	0.8
10.9	0.2

Calculated statistical interpretation made from data measure at Keahole Point [24]

Deep water waves are generally identified where the depth (h) is greater than one-half the wavelength (L). Shallow water waves occur approximately where depth is less than one-twentieth of the wavelength. No dilution occurs on the bottom as a result of deep water waves. The intermediate area between the deep and shallow water zones experiences some dilution; the shallow water zone experiences much more dilution.

If we consider waves with 7 second periods, we find that the division between deep and intermediate water occurs at a depth of 125 feet. The division between intermediate and shallow water occurs at a depth of 13 feet. If waves are 4 feet high in 25 feet of water, we expect to find horizontal particle velocities at the bottom of 2.7 f/s with horizontal displacements of 3 feet, resulting in some turbulent mixing.

Additional considerations include irregularities of the seabed. Although there are no detailed depth profiles available for measuring bottom undulations, we will assume that the standard deviation of the seabed is on the order of one-foot for profiles taken in the longshore direction. This standard deviation gives a Nikurradse roughness of about 32 inches [25,26]. The elevation where the Prandtl-Von Karman velocity field is exactly zero occurs at elevation "Zo" and is only a function of roughness. The resulting layer between the seafloor and Zo, referred to as a psuedo-stationary layer, was calculated using Equation 2 and was found to be one inch [25].

$$Zo = \frac{\varepsilon}{33} \qquad \text{Equation 2}$$

If we ignore buoyancy effects resulting from density differences, seepage velocity results in an average resident time of 1.1 hours within the psuedo-stationary layer before the water is introduced into the upper levels, assuming that horizontal velocities within the layer are so small as to be negligible small. Buoyancy considerations will result in more rapid mixing. Once the upper levels are reached (greater than one inch), dilution will occur due to turbulence.

If we assume 50% dilution occurs when speeds are greater than 2 inch/s, we can statistically describe depths of dilution, as given in Table V-2.

- o depths less than or equal to 10 ft (0-10') are mixed 50.4 percent of the time
- o depths less than or equal to 4.5 ft (10-4.5') are mixed 76.0 percent of the time

TABLE V-2
NEARSHORE DILUTION

Depth (ft)	Probability of Water Column Mixing Due to Waves
less than 3.5	100.0
4.5	76.0
6.0	56.0
7.0	53.0
10.0	50.4
25.0	50.0
50.0	47.78
75.0	40.0
100.0	27.5
125.0	17.5
150.0	12.0
175.0	10.0
200.0	7.5

Calculated statistical interpretation made from data measured by others [24].

Water column residence time in the nearby coastal area is governed by current speeds and time required to flush a volume of water out from the seepage area. We do not know the micro-current climate and cannot estimate nearshore residence time. However, once water reaches the offshore current regime, we can estimate residence time as follows:

Average Width of Seepage Area = 6000 ft
Mean Current = 32 cm/s = 1.05 ft/s
Offshore Resident Time = 1.7 hours

The residence time of the water in the offshore coastal area is about 1.7 hours. Groundwater discharge into the ocean across the 6000 foot coastline is calculated to be 0.82 mgd or 136.6 gallons per day per foot. If groundwater flux occurs across the first 10 feet from mean sea level, then the flux of water is 13.6 gallons per square foot or 1.8 cubic feet per square foot per day.

The average seabed slope in the area is estimated to be about 1 to 10. In this case, the 10 foot depth contour occurs at about 100 feet offshore. In the absence of current data for the nearshore area, it is not possible to make an estimate of the resident time for the water in this area. Therefore, resident time is assumed to be in the range of the tidal period. Thus, water will be completely replaced every 12.25 hours, or roughly twice a day. This assumption is conservative, because other types of currents arising from wind, waves and ocean circulation can reduce the resident time drastically especially within the breaker zone. In the breaker zone the resident time may be as low as a few minutes, depending on the wave climate.

Groundwater will seep in along the bottom of the sea in an area spanning mean sea level to a depth of 10 feet. We can divide the 100 foot wide mixing zone into 8 segments, 7 that are each 10 meters wide, the shallowest segment will be 35 feet wide. Assuming complete mixing within the segment and no mixing across the segment boundaries, we can calculate an estimated profile for concentration of any pollutant introduced from groundwater. The degree of mixing decreases with increasing depth as shown in TABLE V-2.

Distribution of golf course chemical concentration in the mixing zone is calculated by estimating sampling distribution. The probability of getting a value from segments is proportional to the volume of water in the segment. The sampling distribution is the same as the concentration distribution because each segment will have different concentrations. The concentration distribution and the degree of mixing can be combined to estimate the percentage of dilution in the 100 foot wide mixing zone. The resulting probability distribution is normalized and a cumulative distribution is calculated for estimating the exceedance statistics. Exceedance probability for dilution of pollutant in the 100 foot wide mixing zone is shown in figure IV-3.

Results show that if we only consider wave statistics and tidal flushing, approximately 50 percent of the time, groundwater entrained chemicals in the nearshore area will be diluted 1:70; 20 percent of the time concentrations will be diluted 1:20. However, dilutions are probably greater because of nearshore currents. More accurate determinations can be made with site specific nearshore current measurements.

TABLE V-3
EXCEEDANCE PROBABILITIES FOR CONCENTRATION DISTRIBUTION

Segment Number	Groundwater Volume cu.ft/tide	Absolute Dilution *	Sampling Probability	Dilution Probability Normalized	Cumulative probability **
1	3.15	9.7	0.1111	0.1871	0.1871
2	0.9	22.2	0.0726	0.093	0.2801
3	0.9	27.8	0.0907	0.0916	0.3717
4	0.9	33.3	0.1088	0.0993	0.471
5	0.9	38.5	0.127	0.1112	0.5822
6	0.9	43.5	0.1451	0.1246	0.7068
7	0.9	50.0	0.1633	0.1395	0.8463
8	0.9	55.6	0.1814	0.1536	0.99

* See vertical axis Figure V-1 below
** See horizontal axis Figure V-1 below

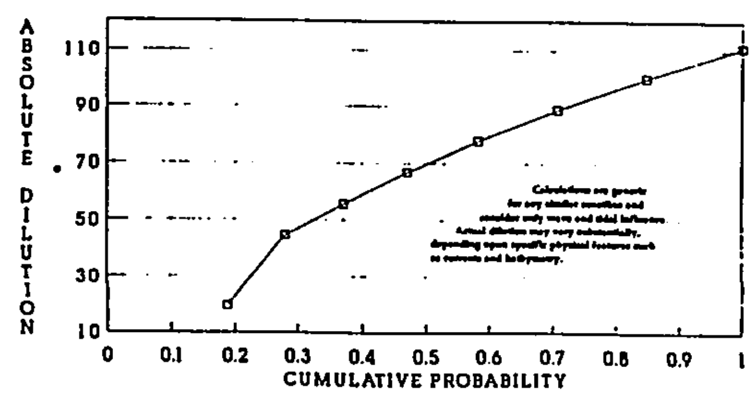

FIGURE V-1
DILUTION OF NEARSHORE GROUNDWATER CHEMICALS

(2) INCREASED PUBLIC ACCESS

Increased Harvest of Fish and Invertebrates

The North Kona coast has historically provided very limited public access to beaches. This has limited the harvest of nearshore living marine resources to within levels sustainable by the resource. With increased public access there will be increased pressure on resources. Unrestricted fishing pressure will lead to a decrease in abundance, primarily of larger game fish and desirable invertebrates such as lobster and octopus (squid, He'e). Without controls the area will eventually become over-fished and there will be a decreased ability to naturally replenish fish stocks. The impact from unmanaged overuse of marine resources is likely to be far greater than any other impact on the nearshore environment.

Damage to Single Existing Anchialine Pond on the State Land Parcel

The single anchialine pond will attract attention and possible contamination or disruption by visitors. Because the pond will probably provide an important biological indicator for measuring impact from groundwater contamination, any disruption of the pond could have serious ramifications.

Waste Control

People are inclined to contaminate natural settings by littering and through human waste. Proper design of facilities and an ongoing maintenance program can minimize impacts to the marine environment.

VI. CONCLUSIONS AND SUMMARY OF POTENTIAL MARINE IMPACTS

This marine assessment was performed to investigate the potential impacts from proposed development at Maniniowali upon the nearshore marine ecosystem. Our conclusions are based largely on information gathered from the literature and in-depth studies performed by various researchers at other sites along the Kona Coast and in other areas of the tropical Pacific. Specific observations at Maniniowali were limited to a single site visit. This type of survey is adequate to define the general character of an area. Once concerns are identified a basis for recommendations and/or future data collection can be made.

Our conclusions concerning impact from the proposed development activities at Maniniowali to the nearshore marine environment include the following:

- The 1000 foot wide park acts as an effective buffer between the development site and the nearshore marine environment, and minimizes the potential impact from runoff, dirt and dust, irrigation over-spray or other development activities.
- There is a single anchialine pond on park land. An anticipated increase in nitrogen levels within the pond is not expected to impact the pond. The character and quality of this pond could be adversely altered by activities from people visiting the park.
- The fisheries resource of the nearshore areas are currently abundant and do not appear to be over-utilized. These resources are threatened by improved access and potentially unregulated influx of fishermen into the park.
- The quality of the groundwater flowing beneath the development and into the nearshore ecosystem will be affected. There will be a measurable increase in dissolved groundwater nitrogen; however, because increases are similar we do not anticipate any probable adverse impact to the environment. Pesticides will migrate from the development site into the groundwater. However, the low concentrations (expected to be below measurement capabilities) and limited effective lifetime of the pesticides that are proposed for use, are not expected to cause an impact on the nearshore environment. Additionally, although micro-environment current measurements will provide a more accurate estimate of dilution in nearshore waters, mixing and dispersion will further dilute concentrations of groundwater entering the marine environment.

VII. RECOMMENDATIONS

Our preliminary marine environmental assessment recommends the following actions be considered:

- Golf course design, construction and maintenance practices should be developed along the lines of the State Department of Health Golf Course Monitoring Plan guidelines to minimize the introduction of nutrients and pesticides into the marine environment.
- A water quality and biological monitoring program should be designed to monitor golf course groundwater contamination.
- Further study is needed to identify major areas of groundwater introduction into the marine environment and should include additional measurements of water quality.
- A program should be undertaken to monitor water quality and biota in the anchialine pond.
- Further study is needed to identify currents in the small bays along the projects coastline.
- Marine resource management methods should be explored to protect the nearshore marine environment adjacent to the new State park.

MITIGATIVE ACTIONS

- NKDG is expected to implement an Integrated Pest Management (IPM) program. The IPM program can reduce the use of pesticides, e.g., to less than 50% of typical golf course chemical use.
- Slow release nitrogen fertilizer are planned to be used on the golf course and residential areas. If employed, only 1.5% of applied nitrogen may leach into groundwater, resulting in groundwater concentration up to 13 times lower than that predicted using soluble nitrogen fertilizer.

VIII. REFERENCES

[1] Bathen K.H. An Evaluation of Oceanographic and Socio-Economic Aspects of a Nearshore Ocean Thermal Energy Conversion Pilot Plant in Subtropical Hawaiian Waters prepared for NSF/RANN, 1975

[2] Noda, E.K. Current data from the Kahe Point, Oahu and Ke-ahole Point, Hawaii OTEC Benchmark Sites, June 1980 - June 1981. University of Hawaii, James K. Look Laboratory of Oceanographic Engineering, Technical Report No. 49, (U Hawaii-Look Lab-81-2), 1981.

[3] Oceanic Institute Inc. Kohanaiki Resort Water Quality Monitoring Studies. 1991 (Ongoing Studies).

[4] Brock, R. and A. Kam. Water Quality Studies for Kukio. Environmental Assessment Co. for Huihui Ranch Associates Ltd., 1991 (Ongoing Study).

[5] O.I.Consultants Inc. Postdevelopment Survey of the Aquatic Biota and Water Quality Characteristics of the Anchialine Ponds at Anaehoomalu, Hawaii. Prepared for Waikoloa Land Co., 1984.

[6] Marine Research Consultants Preliminary Assessment of the Marine and Pond Environments in the Vicinity of the Proposed Mauna Lani Cove, South Kohala, Hawaii. In: Mauna Lani Cove E.I.S. prepared by Belt, Collins & Associates, 1990.

[7] Dollar, S. Baseline Assessment of the Marine and Anchialine Pond Environments at Awake'e, North Kona, Hawaii. Marine Research Consultants, 1990. In: Environmental Assessment for Awake'e/Maniniowali Land Exchange, prepared by Group 70 Limited, Oct. 1990.

[8] Brock, R.E. Aquatic Survey of the Anchialine Pond System at Lahuipuaa, South Kohala, Hawaii. Submitted to Mauna Lani Resort, Inc., 1985.

[9] Dollar, S. Baseline Assessment of the Marine and Anchialine Pond at Awakea, North Kona, Hawaii. Marine Research Consultants, 1986. In: Awakea Resort Development Final E.I.S., prepared by Group 70 Limited, 1986.

[10] Oceanic Institute Consultants Inc. Anchialine Pond Survey of the Northwest Coast of Hawaii Island. Final Rpt. Prepared for Transcontinental Development Co. Honolulu 39p., Appendix A-E, 47 plates. Jan. 1988.

[11] Oceanic Institute Consultants Inc. Impact Analysis of Resort Development at Kohanaiki on the Near-shore Marine Environment and Anchialine Pond Resource. D. Ziemann, 1986. In: Kohana-Iki Resort Community Kohana-Iki, North Kona, Hawaii Final E.I.S., prepared by Helbe, Hastert, BanHorn &

Kimura, Planners, August 1986.

[12] Marine Research Consultants Inc. Assessment of Chemistry of nearshore waters in the vicinity of the O'oma II development, North Kona, Hawaii by S. Dollar, In: O'oma E.I.S., for: Herbert Hastert & Kimura Planners.

[13] Emery, William J. A Monitoring Program For Upper-Layer Structure In Hawaiian Waters. In: Hoe: The Hawaiian Ocean Experiment prepared by Lorenz Magaard, Rita Gujalet and Vicki Gaynor, 1985.

[14] Dollar, S.J. Zonataion of Reef Corals off the Kona Coast of Hawaii. Master of Science Thesis. University of Hawaii Department of Oceanography, 1975.

[15] Nolan, R.S. and D.P. Chaney. West Hawaii Coral Reef Inventory. U.S. Army Corps of Engineers, Pacific Ocean Division, Honolulu, 1981.

[16] Maciolek, J.A. and R.E. Brock. Aquatic Survey of the Kona Coast Ponds, Hawaii Island. Sea Grant Advisory Report UNIHI-SEAGRANT-AR-74-04, University of Hawaii Seagrant Program, 1974.

[17] Kay, E.A., L.S. Lau, E.D. Stroup, S.J. Dollar, D.P. Fellows & R.H.F. Young. Hydrologic and Ecologic Inventories of the Coastal Waters of West Hawaii. Technical Report No. 105, Sea Grant Cooperative Report UNIHI-SEAGRANT Report CR-77-02 (Water Resources Research Center), 1977.

[18] Madden, W.D. Marine Reconnaissance of Six South Kona Sites, Kona, Hawaii. Prepared for Grey, Rhee and Associates. Inc., Honolulu, 1980.

[19] Oceanit Laboratories, Inc. Impact of Proposed Development on Groundwater Quality at Maniniowali, North Kona Coast, Hawaii. Submitted to Group 70, Ltd., Honolulu, Hawaii, 1991.

[20] Walsh, T.W. A Description of the Water Quality of the Surface Seawater Intake at NELH (1982-1989); and a Comparison with DOH Water Quality Standards Report to NELH HOSTPARK 1989.

[21] NELHA Annual Report for the Comprehensive Environmental Monitoring Program at NELH July 1989 - June 1990. 1990

[22] Dean, Robert G. and Dalrymple, Robert A. Water Wave Mechanics for Engineers and Scientists. New Jersey: Prentice-Hall, Inc. 1984.

[23] Kinsman, Blair. Wind Waves, Their Generation and Propagation on the Ocean Surface. New Jersey: Prentice-Hall Inc., 1965

[24] Noda, Edward K. and Associates. Oceanographic Criteria for Design and Development of the Cold Water Pipe System 1986

[25] Coastal Engineering, Harbor and Beach Problems. Volume II, Coastal Engineering Group, Department of Engineering, Delft University of Technology, Delft, Netherlands, 1980.

[26] Kay, J.M. and Nedderman, R.M. An Introduction to Fluid Mechanics and Heat Transfer. Cambridge: Cambridge University Press, 1977.

[27] Dames and Moore. Environmental Assessment and Supplemental EIS, Hydrological Section. Modification of Proposed Action to Permit Alternative Methods of Seawater Return Flow Disposal at NELH, Keahole, Kona, Hawaii, August 1986.

[28] Brewer, W.A. Baseline Marine and Coastal Pond Surveys, Makalawena, North Kona, Hawaii, 1986. In: Makalawena Resort Final E.I.S., Prepared by Phillips Brandt Reddick & Assoc (Hawaii), Inc., Dec. 1986.

[29] Dollar, S. Baseline Assessment of the Offshore Marine Environment in the Vicinity of Kaupulehu Development, North Kona, Hawaii. Marine Research Consultants, 1985. In: Kaupulehu Resort Kaupulehu, North Kona, Hawaii Final E.I.S., prepared by Belt Collins & Associates, June 1986.

[30] Brewer, W.A. Coastal Baseline Survey, Kukio Resort, North Kona Island of Hawaii. William A. Brewer & Associates, 1984; In: Kukio Beach Resort Final E.I.S. Prepared by Phillips Brandt Reddick & Assoc., May 1986.

[31] Klein R.D. Protecting the Aquatic Environment from the Effects of Golf Courses. Community & Environmental Defense Associates P.O. Box 206 Maryland Line, Maryland, 1990.

APPENDIX H

BOTANICAL SURVEY
MANINI'OWALI PROJECT SITE
NORTH KONA, ISLAND OF HAWAI'I

by

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Prepared for: GROUP 70

May 1991

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BOTANICAL SURVEY
MANINI'OWALI PROJECT SITE
NORTH KONA, ISLAND OF HAWAI'I

INTRODUCTION

The Manini'owali site is presently State-owned land which will be exchanged for the adjacent, privately-owned Awake'e parcel. Both the Awake'e parcel and a shoreline portion of the Manini'owali property will be incorporated into a proposed State regional park. The Manini'owali site proposed for the exchange is bound by the Queen Ka'ahumanu Highway to the east; the Awake'e parcel to the south; the ±1,000 ft. wide "shoreline park" boundary to the west; and by Kuki'o 1 to the north.

The Manini'owali site consists of approximately 388 acres of land. A residential community covering 137 acres is planned for a portion of the site with the remainder, about 216 acres, supporting an 18-hole golf course and ancillary facilities, roads, and open land. About 35 acres are located on the slopes of Pu'u Kuili and are of limited (constrained) use.

Field studies to assess the botanical resources found on the subject property were conducted on 21 April 1991; a total of three botanists were 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 plants protected by Federal and/or State endangered species' laws.

SURVEY METHODS

Prior to 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 topographic maps were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

Access onto the site was from the Queen Ka'ahumanu Highway. From the highway, a 4-wheel drive jeep road follows along the south portion of the site over 'a'a and prehistoric pahoehoe lava flows to the shoreline. A walk-through survey method was used following along the contour of the property (north-south transects). The portion of the site directly abutting the State's "shoreline park" was surveyed more intensively as the pololei fern (Ophioglossum concinnum), a candidate endangered species, is known from the shoreline park area. Also areas with very weathered pahoehoe lava substrate were surveyed intensively as the pololei fern is often associated with this type of lava flow.

Notes were made on plant associations and distributions, substrate types, topography, exposure, available moisture, etc. Species were identified in the field; plants which could not be positively determined were collected for later identification in the herbarium (University of Hawai'i, Manoa: HAW) and for comparison with the most recent taxonomic treatment of the Hawaiian flora.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions under which the survey was made. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight variations in the species checklist especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

There have been a number of botanical studies conducted in the general area by the principal investigator. These include studies on the adjacent Makalawena (Char 1986), Awake'e (Char 1986b), and Kuki'o (Char 1984) properties; the Kuki'o property included the portions above (mauka) and below (makai) the Queen Ka'ahumanu Highway. The Ka'upulehu resort area, located north of the project site, has also been surveyed by Char (1985, 1988, 1991). Vegetation within this general area consists of fountain grass grassland on very weathered pahoehoe lavas, while the geologically more recent flows, largely 'a'a flows, support very little vegetation. The shoreline areas support a narrow band of coastal vegetation with beach naupaka shrubs the most common plant especially on the Ka'upulehu and Kuki'o properties.

Two vegetation types are recognized on the Manini'owali property and are described below. A checklist of all those species inventoried during the field studies is presented at the end of this report.

Fountain Grass Grassland

This vegetation type occurs on weathered pahoehoe lava covered in places by a thin layer of soil material; this substrate is classified as "rock land" (rRO) on soil survey maps (Sato et al. 1973). Pahoehoe outcrops cover 50 to 90% of the surface. The vegetation consists of a very dense cover of fountain grass (Pennisetum setaceum), varying from 70 to 90% cover, with scattered individuals or small stands of kiawe trees (Prosopis pallida), from 6 to 12 ft. tall. Also occurring commonly throughout this grassland are shrubs and subshrubs of 'ilima (Sida fallax), 'uhaloa (Waltheria indica), a'ali'i (Dodonaea viscosa), and indigo (Indigofera suffruticosa). On the more rocky pahoehoe knolls, pili grass is locally abundant.

Pu'u Kuili cinder cone and the smaller cinder cone on the northern portion of the site also support this vegetation type. Substrate is a reddish-brown, cinder-ash-pumice material. Kiawe trees are more numerous around the bases of these cones and form a dense ring of trees, from 15 to 18 ft. tall. 'Ilima, threadstem carpetweed (Mollugo cerviana), 'ihi (Portulaca pilosa), cheeseweed (Malvastrum coromandelianum), and goosefoot (Chenopodium murale) are locally more abundant on this substrate than on the weathered pahoehoe lava.

Scrub Vegetation on Lava

A large portion of the property is covered by 'a'a lava flows, especially on the area north of the small cinder cone or pu'u, below the highway, and along a portion of the 4-wd access road. These flows support very sparse vegetation, about 1 to 3% plant cover. The plants tend to cluster in depressions or on pahoehoe outcroppings within the 'a'a flow; species commonly found here include the ubiquitous fountain grass, pluchea (Pluchea symphytifolia), Natal redtop (Rhynchelytrum repens), hairy spurge (Chamaesyce hirta), kiawe, and 'uhaloa. Two endemic natives which occur on these 'a'a flows are pua-kala (Argemone glauca) and nehe (Lipochaeta lavarum).

Smaller areas on the property are covered by younger pahoehoe flows which tend to be rough and broken, as near Pu'u Kuili. A large collapsed lava tube system can be found near the smaller cinder cone. These pahoehoe flows are also sparsely vegetated. A few clumps of the native panic grass (Panicum faurei) and a native sedge species, Fimbristylis hawaiiensis, occur on these flows. Lava tubes and cracks provide a somewhat moisture habitat and occasionally support a few plants of hairy sword fern (Nephrolepis multiflora) and kumu-niu (Doryopteris decipiens).

THREATENED AND ENDANGERED SPECIES

In the botanical assessment report prepared for the land exchange (Char 1989c), it was noted that two candidate endangered species, the pololei fern (Ophioglossum concinnum) and 'ohai (Sesbania tomentosa, formerly S. arborea) might occur on the site as they have been found on nearby properties. After the heavy rains in December 1990, many patches of Ophioglossum were reported growing in midden around the large archaeological complex at the end of the access road (B. Camara, pers. comm., 02 January 1991). A visit to the site on 19 January 1991, found several large patches of plants in small depressions in the old pahoehoe lava flow near the coast. Specimens were collected and have been deposited in the herbarium at HAW (University of Hawai'i, Manoa).

During the field studies in April 1991, several dried fronds of the Ophioglossum were observed, again in the same locations within the State's proposed "shoreline park". No Ophioglossum plants were found further mauka on the Hanini'owali project site; also no plants of 'ohai occur on the property.

The Ophioglossum is a Category 1 candidate endangered species and is thus expected to be listed as officially endangered sometime within the next two years. The Ophioglossum is a small, perennial fern with paddle-shaped leaves, 3 to 5 inches long. The plants appear after the first heavy downpour of the rainy season, quickly produce leaves and a simple, spiked reproductive structure, and then dieback with the onset of the dry season. Only the wiry, black underground stems survive until the next rainy season. The fern has been recorded from O'ahu, Moloka'i, Maui, Lana'i, and Hawai'i (Degener and Degener 1932 et seq.). On West Hawai'i, recent findings have included a small population on the slopes of Pu'uanahulu at about the 640 ft. elevation and on the Mauna Lani resort area (Char 1989a, 1989b). It is associated with very weathered pahoehoe flows and fountain grass grassland. The plant

appears to be widely scattered along the leeward coast of Hawai'i from Pu'ukohola Heiau to Manuka. Given its ephemeral nature, the plants could be easily overlooked if botanical surveys were conducted during the drier months of the year.

DISCUSSION AND RECOMMENDATIONS

Vegetation consists of a fountain grass grassland with scattered kiawe trees and smaller shrubs on portions of the site with very weathered, ancient pahoehoe and a thin layer of soil. This grassland vegetation also occurs on the cinder cones found on the site; a dense ring of kiawe trees is found at the base of the cinder cones. On the geologically more recent 'a'a flows and on some areas with younger pahoehoe, the vegetation is very sparse, consisting primarily of fountain grass with a few very scattered kiawe trees. Of a total of 36 species inventoried on the site, 25 (69%) are introduced or alien species; 1 (3%) is originally of Polynesian introduction; and 10 (28%) are native. Of these natives, 5 are indigenous, i.e. native to the Hawaiian Islands and elsewhere, and 5 are endemic, i.e. native only to the Hawaiian Islands. None of these native species are officially listed threatened or endangered species (U. S. Fish and Wildlife Service 1989); nor are any proposed or candidate for such status (U. S. Fish and Wildlife Service 1990). The pololei fern (Ophioglossum concinnum), a candidate endangered species, occurs within the State's proposed "shoreline park". Although an intensive search was made for the fern on the subject property, none were found. It is possible, however, that there may be a few plants on the site.

Botanically, there is little of interest or concern on the site. The vegetation consists largely of alien species, the two dominant components being fountain grass and kiawe. The native species found on the site occur throughout the islands in similar environmental conditions and the proposed development will not have a significant negative impact on the total island populations of these species. The flora on this parcel is rather depauperate and may reflect past disturbances such as large numbers of goats. Similar low numbers of plant species have been recorded from Awake'e and Makalawena where goat damage to vegetation was common (Char 1986a, 1986b).

The proposed project is not expected to have a significant negative impact on the botanical resources and there are no botanical reasons to impose any restrictions, constraints, or impediments to the development of the site. It is recommended that native plants be used for landscaping. Native lowland, dry forest species are adapted to the thin soils, low rainfall, high temperatures, etc., and would be less expensive to maintain. Among the natives suggested for planting are wiliwili (Erythrina sandwicensis), the nehe species found on the site already, the native caper or maiapilo (Capparis sandwichiana), a'ali'i, 'ilima, and alahe'e (Canthium odoratum). Although rather unimpressive, the pololei fern could also be planted around archaeological sites which will be preserved.

LITERATURE CITED

Char, W. P. 1984. Assessment of flora, Kuki'o I, North Kona, Hawai'i. Prepared for PBR HAWAII, Honolulu. November 1984.

______. 1985. Botanical survey for Ka'upulehu Developments, Ka'upulehu, North Kona, Hawai'i. Prepared for Belt Collins & Associates, Honolulu. May 1985.

______. 1986a. Flora survey, Makala-wena Resort Development Project, North Kona, Island of Hawai'i. Prepared for PBR HAWAII, Honolulu. July 1986.

______. 1986b. Botanical survey, Awake'e Resort Development, North Kona, Island of Hawai'i. Prepared for Helber, Hastert, van Horn & Kimura. October 1986.

______. 1988. Botanical survey, Ka'upulehu Resort CDUA, Water-line and maintenance roadway, Ka'upulehu, North Kona, Hawai'i. Prepared for Belt Collins & Associates, Honolulu, December 1988.

______. 1989a. Botanical survey, West Hawai'i sanitary landfill site, North Kona District, Hawai'i. Prepared for R. M. Towill, Honolulu. January 1989.

______. 1989b. Botanical survey, Mauna Lani Marina, Mauna Lani Resort, Island of Hawai'i. Prepared for Belt Collins & Associates, Honolulu. April 1989.

______. 1989c.Botanical assessment report, Kakapa Project, North Kona, Hawai'i. Prepared for Group 70, Honolulu. September 1989.

Char, W. P. 1991. Botanical survey, Ka'upulehu Resort CDUAs, Temporary substation, water reservoir, and sewage treatment plant, Ka'upulehu, North Kona, Island of Hawaii. Prepared for Belt Collins & Associates, Honolulu. February 1991.

Degener, O. & I. Degener. 1932 et seq. Flora Hawaiiensis. 7 vol. Privately published.

Lamoureux, C. H. 1984. Checklist of the Hawaiian pteridophytes. Unpublished manuscript.

Porter, J. R. 1972. Hawaiian names for vascular plants. College of Tropical Agriculture, Univ. of Hawai'i, Manoa, Departmental Paper No. 1. April 1972.

Sato, H. H., W. Ikeda, R. Paeth, R. Smythe, and H. Takehiro, Jr. 1973. Soil survey of the island of Hawaii, State of Hawaii. U. S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

St. John, H. 1972. 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.

_____. 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. University of Hawai'i Press and Bishop Museum Press, Honolulu. 2 vol. Bishop Museum Special Publication 83.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

Char, W. P. 1991. Botanical survey, Ka'upulehu Resort CDUAs, Temporary substation, water reservoir, and sewage treatment plant, Ka'upulehu, North Kona, Island of Hawai'i. Prepared for Belt Collins & Associates, Honolulu. February 1991.

Degener, O. & I. Degener. 1932 et seq. Flora Hawaiiensis. 7 vol. Privately published.

Lamoureux, C. H. 1984. Checklist of the Hawaiian pteridophytes. Unpublished manuscript.

Porter, J. R. 1972. Hawaiian names for vascular plants. College of Tropical Agriculture, Univ. of Hawai'i, Manoa, Departmental Paper No. 1. April 1972.

Sato, H. H., W. Ikeda, R. Paeth, R. Smythe, and H. Takehiro, Jr. 1973. Soil survey of the island of Hawaii, State of Hawaii. U. S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

St. John, H. 1972. 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.

_____. 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. University of Hawai'i Press and Bishop Museum Press, Honolulu. 2 vol. Bishop Museum Special Publication 83.

PLANT SPECIES LIST -- Manini'owali Project Site

Following is a checklist of all those vascular plants inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns follow Lamoureux (1984); the flowering plants, Monocots and Dicots, are in accordance with the most recent treatment of the flora by Wagner et al. (1990), in most cases. 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:
   - E = endemic = native only to the Hawaiian Islands
   - I = indigenous = native to the islands and also to other geographic areas
   - 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 vegetation types recognized on the project site (see text for discussion):
   - fgg = Fountain grass grassland
   - lava = Scrub vegetation on lava

Scientific name	Common name	Status	Vegetation type fgg	Vegetation type lava
FERNS				
NEPHROLEPIDACEAE (Sword Fern Family)				
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	-	+
SINOPTERIDACEAE (Cliffbrake Fern Family)				
Doryopteris decipiens (Hook.) J. Sm.	kumu-niu, 'iwa'iwa	E	-	+
MONOCOTS				
CYPERACEAE (Sedge Family)				
Fimbristylis hawaiiensis Hillebr.		E	-	+
POACEAE (Grass Family)				
Aristida adscensionis L.	sixweeks threeawn	X	-	+
Cenchrus ciliaris L.	buffel grass	X	+	+
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X	+	-
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili, pili grass	I	+	-
Panicum faurei Hitchc.	native panic grass	E	-	+
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X	+	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	+
DICOTS				
ASTERACEAE (Sunflower Family)				
Ageratum conyzoides L.	maile hohono	X	+	+
Bidens pilosa L.	beggar's tick, Spanish needle	X	+	-
Conyza bonariensis (L.) Cronq.	hairy horseweed, 'ilioha	X	+	-
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	+	-

Scientific name	Common name	Status	Vegetation type fgg	Vegetation type lava
Gnaphalium purpureum L.	purple cudweed	X	+	-
Lipochaeta lavarum (Gaud.) DC.	nehe	E	+	+
Pluchea symphytifolia (Mill.) Gillis	pluchea, shrubby fleabane	X	+	+
CHENOPODIACEAE (Goosefoot Family)				
Chenopodium murale L.	'aheahea	X	+	-
EUPHORBIACEAE (Spurge Family)				
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	+	+
FABACEAE (Pea Family)				
Crotalaria pallida Aiton	rattlebox	X	+	-
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	-
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X	+	-
Prosopis pal[illegible]da (Humb. & Bonpl. ex Willd.) [illegible]nth	kiawe	X	+	+
GENTIANACEAE (Gentian Family)				
Centaurium erythraea Raf.	bitterherb	X	+	-
LAMIACEAE (Mint Family)				
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	-
MALVACEAE (Mallow Family)				
Malvastrum coromandelianum (L.) Garcke	cheeseweed	X	+	-
Sida fallax Walp.	'ilima	I	+	+
MOLLUGINACEAE (Carpetweed Family)				
Mollugo cerviana (L.) Ser.	threadstem carpetweed	X	+	+
NYCTAGINACEAE (Four o'clock Family)				
Boerhavia repens L.	alena	I	+	-
PAPAVERACEAE (Poppy Family)				
Argemone glauca (Nutt. ex Prain) Pope	native poppy, pua-kala	E	-	+

Scientific name	Common name	Status	Vegetation type fgg	Vegetation type lava
PORTULACACEAE (Purslane Family)				
Portulaca pilosa L.	'ihi, pigweed	X	+	+
PROTEACEAE (Protea Family)				
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X	+	-
RUBIACEAE (Coffee Family)				
Morinda citrifolia L.	noni	P	+	+
SAPINDACEAE (Soapberry Family)				
Dodonaea viscosa Jacq.	a'ali'i	I	+	-
STERCULIACEAE (Cocoa Family)				
Waltheria indica L.	'uhaloa, hi'aloa	I?	+	+
VERBENACEAE (Verbena Family)				
Lantana camara L.	lantana, lakana	X	+	-

APPENDIX I

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT AWAKEE/MANINI OWALI, NORTH KONA, HAWAII

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by

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1 October 1990

INTRODUCTION

The purpose of this report is to summarize the findings of a three day (9-10 September 1989, 27 September 1990) bird and mammal field survey of lands located at Awakee/Manini Owali, North Kona, Hawaii.. 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 (estimated) 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 or near the property identify what features of the habitat may be essential for these species.

4- Identify any special or unique habitats for wildlife that may occur on the property and note what importance these sites may have for the fauna in this region.

GENERAL SITE DESCRIPTION

The property surveyed lies makai of Queen Kaahumanu Highway (Fig.1). Large areas of the site contain barren lava with patches of open parkland habitat made up primarily of Kiawe (*Prosopis pallida*) and Fountain Grass (*Pennisetum setaceum*). Milo (*Thespesia populnea*) also occurs in the coastal sections of Awakee. The largest and most dense patches of vegetation are located along the shoreline and around the base of Puu Kuili. Opaeula Pond is located adjacent to Awakee and a much smaller pond occurs just mauka of Kua Bay (see Fig.1).

Weather during the field survey was variable with clear mornings and partly cloudy afternoons. All days of the survey had easterly winds.

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. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity. At various locations (see Fig.1) eight minute counts were made of all birds seen or heard. Between these counts (census) stations observations of birds seen or heard were also noted. These data provide the basis for the relative

(estimated) abundance figures given in this report (Table 1). Published and unpublished reports of birds known from similar habitat on lands close to this site and elsewhere in West Hawaii were also consulted in order to acquire a more complete picture of the possible species that might occur in the area (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1986, 1988a, 1988b, 1989a, 1989b, 1989c, 1990a, 1990b; Hawaii Audubon Society 1989; Pratt et al. 1987; David 1989, 1990). Observations of feral mammals were limited to visual sightings and evidence in the form of skeletal remains, scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative (estimated) abundance and distribution. Two evenings were 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); Mammal Species of the World (Honacki et al. 1982); Hawaiian Coastal Plants and Hawaiian Forest Plants (Merlin 1977a, 1977b).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land and Water Birds:

No Short-eared Owl or Pueo (Asio flammeus sandwichensis) were observed but this bird could potentially occur on occasion at this location. Pueo are relatively common on the island of Hawaii particularly at higher elevations (Berger 1972, Hawaii Audubon Society 1989; Pratt et al. 1987). On 10 September 1989 and 27 September 1990 Black-necked Stilt (Ae'o) (Himantopus mexicanus knudseni) were seen flying along the shore from Awakee toward Opaeula Pond. This endemic and endangered species is not as common on Hawaii as it is on some of the other islands in the State. Suitable habitat such as shallow ponds with small islands free of mammalian predators are scarce on the Big Island especially along the Kona Coast. Opaeula represents a vital resource for this species as well as for other waterbirds both native and migratory (Bruner 1986).

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay through the summer months as well (Johnson and Johnson 1983). Of all the shorebirds species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) are the most abundant. Plover prefer open areas such as exposed intertidal reef, rocky shorelines, mud flats,

lawns, pastures, plowed fields and sparce grasslands. 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) and Johnson et al. (1989) have 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 nine Pacific Golden Plover were recorded during the three days of the survey. These birds were observed along the shoreline and on open lava flows. Much of the property, however, is covered in brush and tall grass and is therefore unsuitable for plover. A total of five Wandering Tattler (Heteroscelus incanus) were also recorded along the rocky shoreline of the property. This species is usually solitary (Pratt et al. 1987). Other possible shorebirds which should be expected although not found on this survey include: Ruddy Turnstone (Arenaria interpres) and Sanderling (Calidris alba).

Resident Indigenous (Native) Birds:

No indigenous species were recorded. Black-crowned Night Heron (Nycticorax nycticorax) are found at Opaeula Pond (Bruner 1986).

<u>Resident Indigenous (Native) Seabirds</u>:

No seabirds were observed on the property. Some seabirds nest and roost on barren lava flows in Hawaii but at much higher elevation (Pratt et al. 1987).

<u>Exotic (Introduced) Birds</u>:

A total of 12 species of exotic birds were recorded during the field survey. Bruner (1986) found 11 species on the adjoining Makalawena property. The most abundant species were Zebra Dove (<u>Geopelia striata</u>), Yellow-fronted Canary (<u>Serinus mozambicus</u>) and Yellow-billed Cardinal (<u>Paroaria capitata</u>). Common Myna (<u>Acridotheres tristis</u>) and House Sparrow (<u>Passer domesticus</u>) are most often found in urban areas and hence their scarcity or absence on this property. The Yellow-billed Cardinal has in the last 10 years expanded its range along the Kona Coast. A close relative, the Red-crested Cardinal (<u>Paroaria coronata</u>), is common on Oahu. Like its relative, the Yellow-billed Cardinal, it prefers lowland disturbed habitats and does not range into upper elevation forests.

Given the habitats found on the property as well as data from surveys elsewhere in West Hawaii (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1986, 1988a, 1988b, 1989a, 1989b, 1989c, 1990a, 1990b) and information provided in Berger (1972); Hawaii Audubon Society (1989); Pratt et al. (1987) and David (1989, 1990) the following exotic bird species might also be expected

to occur on or near the property: Barn Owl (<u>Tyto alba</u>), Ring-necked Pheasant (<u>Phasianus colchicus</u>), Erckel's Francolin (<u>Francolinus erkelii</u>), California Quail (<u>Callipepla californica</u>), Japanese Quail (<u>Coturnix japonica</u>), Northern Mockingbird (<u>Mimus polyglottos</u>), Saffron Finch (<u>Sicalis flaveola</u>) and Lavender Waxbill (<u>Estrilda caerulescens</u>).

<u>Feral Mammals</u>:

Small Indian Mongoose (<u>Herpestes auropunctatus</u>), mice (<u>Mus musculus</u>), feral cats and goats were found on the survey. Feral donkeys have been recorded on the nearby Kaupulehu property (Bruner 1985, 1988b). No trapping was conducted in order to assess the relative abundance of mammals.

Records of the endemic and endangered Hawaiian Hoary Bat are sketchy but the species has been reported from Hawaii (Tomich 1986; Kepler and Scott 1990). None were observed on this field survey despite evening searches of the area. This species roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii. Bruner (1984d) found bats on the Sheraton Waikoloa Beach Resort Property.

CONCLUSION

A brief field survey such as this one can at best provide only a limited perspective of the wildlife. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. 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 a 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 ecosystem (Williams 1987). Thus only long term studies can provide a comprehensive view of the bird and mammal populations in a particular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to bird and mammal activity on the property.

1- All representative types of habitat found on the property were censused. The more densely forested coastal sections of the property support the greatest number of birds. The more open parklands were virtually devoid of avifauna save for the Warbling Silverbill (Lonchura malabarica).

2- The Awakee site particularly the makai section with its anchialine ponds is a more valuable habitat for wildlife than property located to the north. Native birds such as Black-crowned Night Heron and Black-necked Stilt rely on these wetlands for foraging and nesting. Exotic birds likewise depend on these ponds for drinking water and forage in the dense vegetation surrounding the ponds.

3- The property supports the normal array of exotic species of birds one would expect in this type of environment in Hawaii. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief, or that their numbers are so low that they went undetected or a combination of these and other factors. The low numbers of some species may be attributed to lack of specific food resources such as, flowering kiawe trees.

4- In order to obtain more definitive data on mammals a trapping program would be required. However, the brief observations obtained on this survey did not find that the numbers of feral mammals differed dramatically from data gathered on other faunal surveys in similar habitat in West Hawaii.

TABLE 1

Exotic (introduced) birds recorded at Awakee/Manini Owali, North Kona, Hawaii

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Gray Francolin	Francolinus pondicerianus	U = 3
Black Francolin	Francolinus francolinus	R = 3
Spotted Dove	Streptopelia chinensis	U = 2
Zebra Dove	Geopelia striata	A =12
Common Myna	Acridotheres tristis	R = 5
Yellow-billed Cardinal	Paroaria capitata	A =13
Northern Cardinal	Cardinalis cardinalis	U = 4
Japanese White-eye	Zosterops japonicus	C = 6
Nutmeg Mannikin	Lonchura punctulata	R = 4
Warbling Silverbill	Lonchura malabarica	C = 6
House Finch	Carpodacus mexicanus	R = 8
Yellow-fronted Canary	Serinus mozambicus	A =10

* (see page 12 for key to symbols)

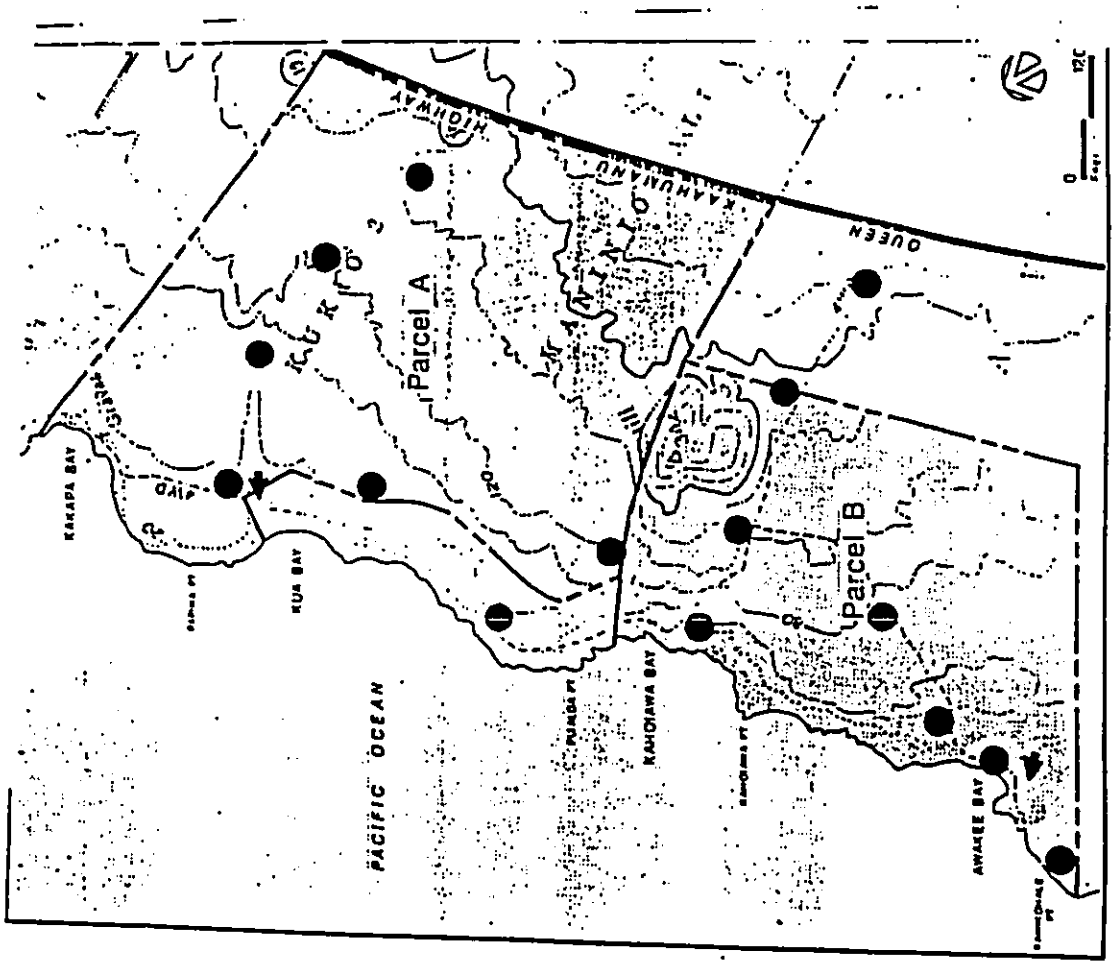

Fig. 1. Location of faunal survey with census stations marked by solid circles. Arrows indicate the location of wetland habitat in the form of small anchialine ponds. Those ponds at Awakee are more numerous and of greater importance to birds than the pond located at Kua Bay. Opaeula Pond lies to the south of Awakee.

KEY TO TABLE 1

Relative (estimate) abundance = number of times observed during survey or average number on eight minute counts.

A = abundant (ave. 10+) number which follows is average of data from all survey days

C = common (ave. 5-10) number which follows is average of data from all survey days

U = uncommon (ave. less than 5) number which follows is average of data from all survey days

R = recorded (seen or heard at times other than on 8 min. counts or on one count only) number which follows is the total number seen or heard over the duration of three survey days.

SOURCES CITED

American Ornithologist's Union 1983. Check-list of North American Birds. 6th edition. American Ornithologist's Union, Washington, D.C.

Berger, A.J. 1972. Hawaii Birdlife. The Univ. Press of Hawaii, Honolulu.

Bruner, P.L. 1979. An avifaunal and feral mammal survey of Makuhona Properties, Hawaii. Unpubl. ms.

———— 1980. An avifaunal and feral mammal survey of Olohana Properties and Mauna Loa Lands, Hawaii. Unpubl. ms.

———— 1983. Territorial behavior of wintering Pacific Golden Plover in Hawaii. Ms. (Paper presented at 100th meeting of the Amer. Ornith. Union).

———— 1984a. An avifaunal and feral mammal survey of Mauna Lani. Hawaii. Unpubl. ms.

———— 1984b. An avifaunal and feral mammal survey of Mauna Kea Properties, Hawaii. Unpubl. ms.

———— 1984c. An avifaunal and feral mammal survey of Waikoloa Beach Pesort Property. Hawaii. Unpubl. ms.

———— 1984d. Letter to A. Yoklavich concerning recovery of a specimen of the Hawaiian Hoary Bat at Sheraton Royal Waikoloa, Hawaii. Date: 10 oc. 84.

———— 1985a. An avifaunal and feral mammal survey of additional Waikoloa Beach Resort Property, Hawaii. Unpubl. ms.

———— 1985b. An avifaunal and feral mammal survey on property proposed for a resort-residential development at Kaupulehu, Hawaii. Unpubl. ms.

———— 1986. An avifaunal and feral mammal survey of property proposed for development at Makalawena, North Kona, Hawaii. Unpubl. ms.

———— 1988a. Survey of the avifaunal and feral mammals at Waikoloa Village Property, Waikoloa, Hawaii. Unpubl. ms.

Bruner, P.L. 1988b. Survey of the avifauna and feral mammals at Kaupulehu Property, Hawaii. Unpubl. ms.

——— 1989a. Survey of the avifauna and feral mammals at Queen Liliuokalani Trunst Property, Kailua, Kona, Hawaii. Unpubl. ms.

——— 1989b. Survey of the avifauna and feral mammals at Kaupulehu, North Kona, Hawaii. Unpubl. ms.

——— 1989c. Survey of the avifauna and feral mammals at Kealakehe Property, North Kona, Hawaii. Unpubl. ms.

——— 1990a. Survey of the avifauna and feral mammals at Lands of Kau TMK 7-2-05:01, North Kona, Hawaii. Unpubl. ms.

——— 1990b. Survey of the avifauna and feral mammals at Keauhou, North Kona, Hawaii, Hawaii. Unpubl. ms.

David, R.E. 1989. North Kona Christmas Bird Count - 1988. 'Elepaio 49(9):55-56.

——— 1990. North Kona Christmas Count 1989. 'Elepaio 50(5):41-42.

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 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.H. Scott. 1990. Notes on distribution and behavior of the endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus) 1964-1983. 'Elepaio 50(7):59-64.

Merlin, H.D. 1977a. Hawaiian Forest Plants. Oriental Publishing Co. Honolulu, Hawaii.

——— 1977b. Hawaiian Coastal Plants. Oriental Publishing Co. Honolulu, Hawaii.

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 J

MS 122391

ARCHAEOLOGICAL INVENTORY SURVEY OF THE LAND EXCHANGE PARCEL IN MANINI'ŌWALI/KŪKIO 2 AHUPUA'A NORTH KONA DISTRICT, HAWAI'I ISLAND

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December 1991

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ACKNOWLEDGEMENTS

The successful completion of this project was the combined effort of many talented individuals. We would like to acknowledge them here. Mr. Jeffrey Pantaleo, the principal investigator, provided diligence and coordination for this project. Mr. Peter Mills co-directed the field phase of the project. Both their efforts and guidance are greatly appreciated. A hard working and dedicated crew participated in the field phase of this project. They include Ron Holt, Tina Mangieri, Heather Caldwell, Bobby Camara, and Stephan D. Clark. Without their hard work and enthusiasm, this report would not be possible. We would especially like to thank Bobby Camara for his expert help in the geological and botanical identifications, as well as sharing his prior knowledge of the site area. Ron Holt's enthusiasm and expertise in mapping was invaluable.

Gratitude is extended to Ms. Hannah Kihalani Springer for her concern and contributions with the historical and oral interviews.

We would also like to thank the North Kona Development Corporation for their participation and interest in Historic Preservation. We would especially like to thank Mr. Michael Hands for his patience and understanding. Also to Jeff Overton and Yukie Ohashi at Group 70 for working closely with us throughout the various phases.

At Bishop Museum, Ms. Angela Steiner-Horton supervised laboratory identification and cataloging of cultural materials. Her hard work and dedication in the lab was very helpful. Ron Holt drafted the final figures with assistance from Tina Mangieri, and Grace Valiente, Girlie Tacazon, and Lana Pigao, produced the report. Ms. Sydney Taylor, with persistent effort, produced the tables.

Special thanks to Stephan D. Clark for providing constructive comments that resulted in a more cohesive report presentation. His comments and support were greatly appreciated. Also to Aki Sinoto, who initially conceived the research program.

ABSTRACT

At the request of the North Kona Development Corporation, the Applied Research Group, Bishop Museum, conducted an archaeological inventory survey on a 388-acre parcel of land in Manini'ōwali/Kūkio 2, North Kona District. Twenty-five sites comprised of 1,313 features were recorded. Pits were the predominant feature type, totalling 1,191. Six test units were excavated in locations of probable cultural deposit. In addition, 150 lava tubes, crevices, and pits were examined.

Four radiocarbon samples were submitted for dating analyses. The earliest date obtained was from State Site 50-10-18-5348 (BH Site 50-Ha-D21-64), a lava tube, which indicated initial occupation from A.D.1020 to 1280.

Artifacts of traditional Hawaiian manufacture recovered from the sites include cowrie shell octopus lures, coral files, a bone point, volcanic glass and basalt flakes.

Results of these investigations did not fully determine the function of the pits. The presence of trails and habitation areas throughout the project area indicates specialized activities taking place in the middle zone.

INTRODUCTION

At the request of North Kona Development Corporation, the Applied Research Group (ARG), Bishop Museum, conducted an archaeological inventory survey on a 388 acre parcel of land in Manini'ōwali/Kūkio 2, North Kona District, Hawai'i Island (Fig. 1). This parcel, exchanged with the State for a parcel in Awake'e *ahupua'a*, is slated for residential and golf course development. Field work was conducted between 18 March and 10 May 1991, by the authors and a six person crew, all members of ARG.

In addition to conducting an archaeological inventory survey, the participation of various individuals, community groups, and pertinent agencies, who expressed concerns over the proposed land exchange of Manini'ōwali/Kūkio 2 and Awake'e, was coordinated. These concerns, given as testimony before the legislature, included preservation of significant archaeological sites, including trails, burials, *heiau*, as well as the integrity of the environment. The reader is referred to Sinoto and Pantaleo (1990) for a summary of the concerns expressed.

PROJECT AREA DESCRIPTION

The project area is situated in the *makai* (seaward) portion of Manini'ōwali and Kūkio 2 *ahupua'a* (traditional Hawaiian land division) (Fig. 1). It encompasses 388 acres of land and is bounded by Kūkio 1 *ahupua'a* to the north, Awake'e *ahupua'a* to the south, Queen Ka'ahumanu Highway to the east, and coastal lands retained by the State of Hawai'i to the west.

An unpaved, bulldozed road bisects the project area, extending west from Queen Ka'ahumanu Highway to the beach, which currently provides public access to Kua Bay.

ENVIRONMENTAL SETTING

Geology

According to Sato et al. (1973), the land type in the project area includes aa and pahoehoe flows, cinder lands, and rock lands. Cinder lands occur on and are adjacent to the two small cinder cones situated in the

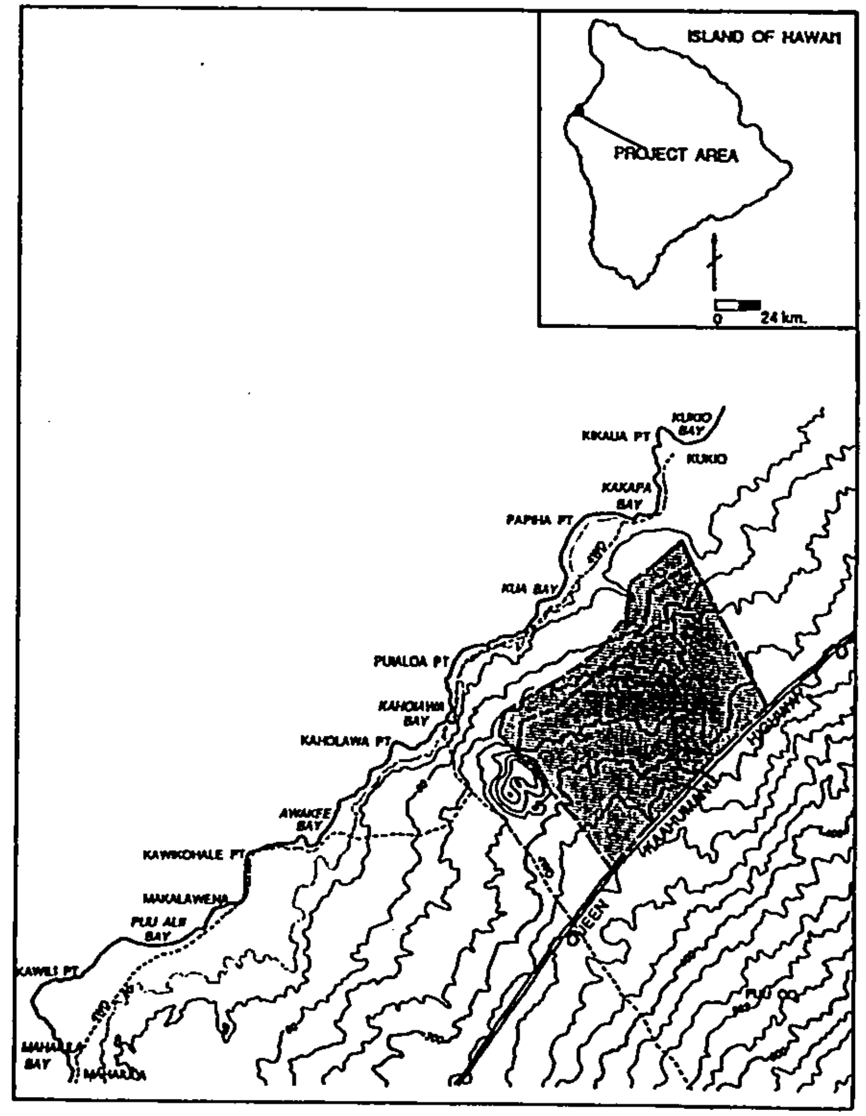


Fig. 1. Manini'owali/Kukio 2 Project Area Location.

northern portion of the project area and on Kuili, just outside the project area to the south. These lands are composed of bedded cinder, pumice, and ash.

The rocklands occur in the *makai* (seaward) portions of the project area. These lands consist of pahoehoe lava bedrock covered in places by a thin layer of soil material (ibid). Dominant slope is between 10 and 15 percent. Pahoehoe outcrop occupy 50 to 90 percent of the surface. The average depth of the soil deposits is between 6 to 8 inches, although in some places, the soil extends into cracks in the lava.

During thousands of years of intermittent eruptions, Hualalai volcano built a gently sloping lava delta. Manini'ōwali occupies a portion of that delta on the northwest rift zone of Hualalai.

Several eruptions produced lavas on the surface of the project area. One series 10,000 years ago formed the cinder cone known as Kuili (elevation 340 feet) in the southern boundary of the property, as well as two smaller cinder cones (*pu'u*) in the northern portion of the property. Upon close inspection, dense bombs of olivine basalt may be found on the *pu'u*. Subsequent pahoehoe lava flows covered the entire property. Those were in turn partially buried by two fingers of aa, one on the west side of the project area, which reached the base of Kuili, and the other on the east side, flowing into the sea to form Papiha Point. The pahoehoe and aa flows fall into the 3,000 to 5,000 year old range, and likely issued from Pu'u Nahaha, a spatter cone on the northwest rift zone of Hualalai (Frank Trusdell, personal communication).

On the two cinder cones located on the northern portion of the project area, fragile communities of mosses and lichens persist on soils derived from cinders. These soils, based on the presence of mosses and lichens, are called cryptogamic. In several areas where significant growth has occurred, the mosses and lichens formed thick mats.

A prominent lava channel extends from Queen Ka'ahumanu Highway to the two smaller *pu'u*, where it is buried by an aa flow near the *makai* edge of the easternmost *pu'u*.

During an eruption when a lava channel is active, fluctuations in volume of lava produced may cause the channel to overflow. This process builds levee walls of gassy, often shelly pahoehoe. A majority of pit features in the

project area are on these levee slopes. The thin shell of lava over blisters, generally less than 20 centimeters thick, made it relatively easy to break holes in the surface.

The aa flow on the eastern edge of the property is notable for the large number of big (up to 10 meters diameter) accretionary boulders, which occur on its surface. Frequently, areas around the bases of the boulders have been modified, perhaps either for temporary shelter, storage, or agricultural purposes.

During fieldwork, pebbles of waterworn pumice, pale grey with black inclusions, were found in several pit features in the project area. The pumice does not appear to have been modified. Preliminary information from geologists indicate a strong likelihood of an exotic source for such pumice (Frank Trusdell, personal communication).

Climate

Geographically, Manini'ōwali belongs to a larger region called Kekaha-wai-ole (Kekaha without fresh water).

Since rainfall is the primary agent for weathering lava into soil, the minimal rainfall in Manini'ōwali has resulted in a slowed rate of erosional activity.

Jones (1942) described the weather pattern typical of Kona:

> "Other lee slopes, sheltered by the high mountains, are places of abundant calm. These calm sectors may receive light southwest breezes while strong northeast trades blow over the general region. The southwest winds may be eddies or they may be convectional sea breezes induced by the strong heating of calm lee slopes...In these localities, in the summer season of strongest heating and convection, clouds blanket the slopes almost every afternoon because of expansional cooling of the ascending sea breeze. In Kona, a summer maximum of rainfall is thus produced in what would otherwise be a semiarid region".

The leeward portion of Hawaii is one of the most arid regions of the Hawaiian Islands. Rainfall rarely exceeds 20 inches a year on the coast, contributed mostly by winter Kona storms. At 2000 feet elevation, rainfall averages twice as much rain a year.

No streams or drainages are located in the area. Rainwater may pond in depressions during a heavy rain, but soon percolates through the porous rock rather than forming runoff streams.

An additional water source is the heavy dews, which occur periodically when environmental factors are appropriate. Because of the countless hollows and cracks in the lava, moisture from rain or dew collected in those sheltered places can sustain plant life.

In addition to the predominant southwesterly daytime winds, occasionally, when the trades are particularly strong, a forceful wind will blow in from the northeast. As is typical on larger islands, winds at night in North Kona blow from the mountains out to sea. If the mountains are snowcapped, the night breezes will be particularly chilly.

Vegetation

Even though Kekaha is considered an arid lava desert, except for *kiawe* and fountain grass, close inspection revealed a varied flora. Due to the local rainfall patterns, many species in the project area are seasonal.

According to R. L. Hind (1983), fountain grass, the dominant species in the area, appeared in the region prior to A.D. 1919. *Kiawe*, the only tree species on the site, was introduced to Hawaii in the early 1800's, and later encouraged in arid areas by ranchers eager to supplement sparse grasses.

Native species on the site are rare. Among the more noticeable are *nehe* (*Lipochaeta lavarum*) and *puakala* (*Argemone glauca*). Because of the dry climate, native ecosystems take thousands of years to fully mature. Early inhabitants undoubtedly had a major impact on the native flora, likely utilizing lowland tree species for fuel or timber.

A rare endemic fern (*Ophioglossum concinuum*), also grows at Manini'ōwali along the coast in State land. Highly seasonal, it appears only after periods of heavy rain, and then only for a few weeks. This fern is often found growing in backdirt piles at vandalized sites.

Table 1 lists flora seen at specific sites, as well as other locations in the project area. By the time fieldwork ended in early May 1991, many of the annual, seasonal species were clearly dying because the of lack of rain.

TABLE 1
VEGETATION LIST

FAMILY	SCIENTIFIC NAME	HAWAIIAN and\or COMMON NAME	CLASS*
Asteraceae	*Ageratum conyzoides*	*maile hohono*	A
	Gnaphalium sandwicensium	*'ena'ena, cupweed*	E
	Lipochaeta lavarum	*nehe*	E
	Pluchea symphytifolia	*Indian fleabane*	A
Cactaceae	*Opuntia ficus-indica*	*pānini*	A
Capparaceae	*Capparis sandwichiana*	*puapilo, maiapilo*	E
Chenopodiaceae	*Chenopodium ambrosioides*	Mexican tea	A
	Chenopodium murale	*'āheahea*	A
Convolvulaceae	*Ipomoea indica*	*koali'awa*	I
	Merremia aegyptia	*hairy merremia, koalikuahulu*	
Cuscutaceae	*Cuscuta sandwichiana*	*kauna'oa*	E
Euphorbiaceae	*Chamaesyce hirta*	garden spurge	A
Fabaceae	*Prosopis pallida*	*kiawe*	A
	Indigofera suffruticosa	indigo, *'iniko*	
Gentianaceae	*Centaurium erythraea*	bitter herb	A
Lamiaceae	*Hyptis pectinata*	comb hyptis	A
	Ocimum gratissimum	wild basil	A
Malvaceae	*Sida fallax*	*'ilima*	I
Molluginaceae	*Mollugo cerviana*	threadstem carpetweed	A
Nyctaginaceae	*Boerhavia glabrata*	*alena*	I
Papaveraceae	*Argemone glauca*	*puakala*	E
Portulacaceae	*Portulaca pilosa*	*'akulikuli*	A
Proteaceae	*Grevillea robusta*	silver oak, *'oka kilika*	A
Sapindaceae	*Dodonaea visosa*	*'a'ali'i*	I
Sterculiaceae	*Waltheria indica*	*'uhaloa*	I
MONOCOTS			
Cyperaceae	*Fimbristylis hawaiiensis*	-----	
Poaceae	*Eragrostis tenella*	*Kawelu,* lovegrass	E
	Heteropogon contortus	*pili*	A
	Panicum pellitum	Guinea grass	I
	Pennisetum setaceum	fountaingrass	E
	Rhynchelytrum repens	Natal redtop	A
			A
FERNS			
Adiantaceae	*Doryopteres*		E
Dryopteridaceae	*Nephrolepis multiflora*		A
Ophioglossaceae	*Ophioglossum concinuum*		E

*Plants are listed by family. Nomenclature follows that of the "Manual of the Flowering Plants of Hawai'i". "Class" refers to whether the species is endemic (E), native (I) or Alien (A).

Feral goats seen in the area also contribute to the lack of vegetation.

Soil is generally lacking in the area. A few small shallow pockets of soil were found, but generally the only significant amounts of soil are found on the *pu'u* and lava tube floors.

Increased human activity throughout the subject parcel, including the bulldozed road to Kua Bay, has added a few species, which would otherwise not have been introduced. *Opiuma* (*Pithecellobium dulce*), rattlepod (*Crotalaria* sp.), and butterfly bush (*buddleia* sp.), all grow in the disturbed parking area immediately adjacent to the Queen Ka'ahumanu Highway, but have not been included on the list since they have not yet been dispersed to other locations on the property.

PREVIOUS ARCHAEOLOGICAL WORK

Previous archaeological investigations within Manini'ōwali and Kūkio 2 *ahupua'a* have been conducted by Reineke (1930), Renger (1970), Cordy (1978; 1981; 1986), Soehren (1982a; 1982b), Carter (1985), Walker and Donham (1986), Walker and Rosendahl (1988), Rosendahl and Sullivan (1989), Ladefoged (1989), and Pantaleo and Sinoto (1990). In this section, brief summaries of archaeological investigations within Manini'ōwali and Kūkio 2 are presented, followed by a discussion of previous archaeological studies in areas immediately adjacent to the Manini'ōwali/Kūkio 2 project area.

Manini'ōwali and Kūkio 2

Seven previous archaeological investigations have been conducted in Manini'ōwali and Kūkio 2 *ahupua'a*. All but one have been reconnaissance surveys. Reineke (1930) was the first archaeologist to conduct a fairly systematic survey along the coast from Kailua to Kawaihae, including coastal areas immediately *makai* (seaward) of the current project area. However, his site descriptions only included limited site dimensions and architectural information. Reineke's Sites 104 through 107, consisting of 18 ± features, were situated along the coast in Manini'ōwali *ahupua'a*. Site 108, consisting of four features, was located in Kūkio 2. Identified feature types include platforms, natural and artificial shelters, house sites, pens, and caves.

Cordy (1978; 1981), as part of his study of social change and the development of complex societies in prehistoric Hawai'i, included

archaeological sites in coastal portions of Manini'ōwali and Kūkio 2. He surveyed, mapped, and conducted test excavations in structures (five of which encompass Reineke's sites) situated just *makai* (seaward) of the current project area in the State of Hawaii's exchange parcel. He reported 12 sites (23 features) along the coast in Manini'ōwali and 8 sites (23 features) in coastal areas of Kūkio 2. Feature types recorded in Manini'ōwali include five platforms, three long, narrow, open-ended enclosures (canoe sheds), one C-shaped wall, five caves, six low enclosures, one walled pit, one paving, and one partial enclosure. In Kūkio 2, Cordy recorded eleven platforms, one long, narrow, open-ended enclosure, one C-shaped wall, one cave, five low enclosures, two pavings, and two high-walled enclosures.

From these feature types, Cordy identified 10 permanent households and two men's houses in Manini'ōwali and 12 permanent households and two men's house variants in Kūkio 2 (1981; 162-163). According to Cordy, a household "consists of one or more adjacent permanent structures, one of which is a sleeping house" (*Ibid*:155). A permanent structure was identified on the basis of such criteria as size (greater than 16-19 m^2), construction (substantial), lack of numerous subsurface features (firepits, lenses, etc.), and the presence of associated, smaller, structures having specialized functions.

In order to evaluate social rank, Cordy then examined men's houses and men's house variants. Based on his observations, men's houses within the permanent households demonstrated very little or no difference in the labor expended to build them (stone quantity and architectural complexity). Cordy concluded that all the households in coastal Manini'ōwali and Kūkio 2 were members of one social rank equivalent to the low or commoner echelon.

Using the volcanic glass hydration rind dating method to determine absolute ages, Cordy (Ibid; 166) reported that the permanent households in Manini'ōwali date from A.D. 1490 to Contact. In Kūkio 2, permanent households date from A.D. 1530 to Contact.

Cordy placed these dated households into 50-year time units to show changes in the number of households within the commoner rank echelon over time as well as changes in population. Population estimates were derived by counting the number of sleeping houses in identified households and multiplying this number by six. Results of this study demonstrated different population trends for Manini'ōwali and Kūkio 2. In Manini'ōwali, the population reached a peak (42 persons) at around A.D. 1600-1650 and began to decrease at the time of Contact or shortly after. In Kūkio 2, Cordy reported the population was fairly stable (24 persons) prior to Contact and began to increase at Contact.

Cordy's analysis of societal boundaries indicated that settlements (communities) in North Kona, including Manini'ōwali and Kūkio 2, were separated by an unoccupied buffer zone and that this unoccupied zone was present from the beginning (initial settlement). The dating of permanent households revealed that the entire area (North Kona) was unoccupied before A.D. 1400-1450. This was interpreted as a major societal buffer zone or border.

In 1982 Soehren conducted two reconnaissance surveys within and just seaward of the Manini'ōwali/Kūkio 2 project area (Soehren 1982a, 1982b). Soehren surveyed a proposed road and utility line corridor that was 50 yards wide and extended from the Queen Kaahumanu Highway to just before the coast. He recorded a Hawaiian trail in the inland portions of the corridor and a C-shape and a cave near the coast. He recommended that the proposed road should terminate prior to impacting sites on the coast (Soehren 1982a).

Soehren also surveyed four, small, proposed house lots at Kua Bay on the coast at Manini'ōwali. He recorded ten sites, but provided only very brief descriptions. In spite of Cordy's previous work in this area, Soehren indicated that no evidence of permanent habitation was found at Kua Bay, but a number of features were typical of casual, temporary occupation (Soehren 1982b).

In 1986 Cordy conducted a field inspection of possible grading violations at Kua Bay that may have destroyed several archaeological sites (Cordy 1986). Sites that were impacted include portions of a coastal trail, an anchialine pond, and Site 50-Ha-D21-41 (several cave features). Cordy re-examined these sites at Kua Bay and found a previously unrecorded feature. This was a low-walled enclosure with a smaller, associated enclosure built on the seaward point of a high aa ridge overlooking the anchialine pond at the north end of Kua Bay. Midden, basalt flakes, and a coral abrader were identified on the surface in the enclosure, which suggests permanent habitation (*Ibid*:5).

Ladefoged (1989) conducted a preliminary reconnaissance survey of seaward portions of Manini'ōwali and Kūkio 2 *ahupua'a*, from Queen Ka'ahumanu Highway to the coast. A total of 131 archaeological sites were identified, consisting of 2,703 features. He observed that the majority of sites were concentrated in the coastal zone. These sites along the coast were identified

as permanent habitation complexes and/or ceremonial features. Further inland, the density of sites decreased. Sites within the middle zone included overhang shelters, C-shapes, and pits. These sites were interpreted as temporary habitation. Trails linked the coastal sites with inland sites.

The most recent survey of the project area was conducted by Sinoto and Pantaleo (1990). They relocated sites previously recorded by Ladefoged (1989) in the Manini'ōwali/Kūkio 2 project area (including the State of Hawaii's exchange parcel), in order to apply appropriate initial significance evaluations for preparation of a cultural resource management plan. A total of 101 sites were recorded, consisting of 1,004 features. These features include: 329 pits (or pahoehoe clearings), 25 cupboards, 6 depressions, 54 mounds, 38 cairns, 24 lava tubes, 53 overhang shelters, 16 trails, 4 modified outcrops, 23 C-shaped enclosures, 1 L-shaped enclosure, 1 U-shaped enclosure, 29 other enclosures, 12 platforms, 5 canoe houses, 58 alignments, 8 terraces, 1 anchialine pond, 20 pavements, and 3 hearths. Three hundred plus features were identified at Kakapa Bay, including enclosures, overhang shelters, platforms, pavements, depressions, petroglyphs, C-shaped enclosures, trails, mounds, terraces, cupboards, alignments, and a possible *heiau*.

In Sinoto and Pantaleo (1990), they indicated that the three settlement or activity zones generally recognized for the North Kona region (Rosendahl 1973) are applicable for Manini'ōwali, although only two, the shoreline and the middle zones, are present within the project area. Variations within the project area, as well as in neighboring *ahupua'a*, were interpreted to be caused by localized geological/topographical characteristics rather than by significant cultural or temporal differences. Most of the larger, permanent habitation structures are situated in the State's land exchange parcel on the coast.

<u>Kūkio 1, Ka'ūpūlehu, Awake'e</u>

Renger (1970) conducted a reconnaissance survey of coastal portions of Kaloko and Kūkio 1 for Huehue Ranch. In Kūkio 1, situated immediately adjacent (north) to Kūkio 2, Renger surveyed from the coast to about 0.5 mi. inland. The objective of the survey was to determine the number of sites in the survey area and to plot their locations. He recorded twelve cave/lava tube shelters, five enclosures, eleven platforms, two walled shelters, two trails, one C-shaped shelter, and eight small fishponds in association with five *ahu*. He concluded that a majority of the structures were concentrated along the coast and that further study would aid in our understanding of

Hawaiian culture, subsistence patterns, and socio-cultural functions of the sites.

Walker and Donham (1986) conducted an archaeological reconnaissance survey of a 350-acre parcel for the proposed Awake'e Resort Development, situated adjacent to the current project area in the *ahupua'a* of Awake'e. The objectives of the survey were: 1) to identify (find and locate) all sites and site complexes present within the project area; 2) to evaluate the potential general significance of all identified archaeological remains; 3) to determine the possible impacts of proposed development upon the identified remains, and; 4) to define the general scope of any subsequent data collection and/or mitigation work that might be necessary or appropriate.

Eighty-four archaeological sites (with 239 feature components) were identified within the Awake'e project area. In their discussion on site distribution, Walker and Donham indicated that 63 of the sites (153+ features) were found in the immediate coastal zone (extending from the coast to approximately 1,000 feet inland). Tentative functional site types include habitation features, possible agricultural features, possible burials, religious, transportation, aquaculture, recreation, and sites of indeterminate function. Walker and Donham tentatively assigned "temporary habitation" functions to 12 sites and "habitation" (not further specified as to permanent/short-term) functions to 21 sites in the coastal zone.

In inland portions of the project area (not broken down further into zones), 21 sites (with 86+ feature components) were recorded in an area of c. 225 acres. Tentative functional site types include possible agricultural features, a jeep road marker, ceremonial, habitation, transportation, survey markers, and features of indeterminate function. Walker and Donham tentatively assigned "habitation" functions to 4 sites in inland portions of the project area.

Twenty-eight formal site types were represented among the 239 recorded features. Over half (59.4%) were accounted for in seven formal categories: cairns, C-shape wall shelters, wall shelters, cave shelters, terraces, platforms, and enclosures. Walker and Donham suggest that these frequencies reflect the relatively low degree of variability between the sites located. Although not mentioned in their discussion, Walker and Donham (1986; 20, 21) recorded six pahoehoe clearings in three locations (Sites T122, T131, and T133). At Site T122 they note that waterworn boulders were present and possibly used in breaking bedrock. Present at Site T133 was a single waterworn, basalt, cobble manuport.

Walker and Donham's survey confirmed the presence of numerous archaeological sites of both prehistoric- and historic- period occupation and exploitation. The range of sites included both temporary and probably permanent habitation. A majority of the sites were concentrated in the immediate coastal zone, near the shoreline. Within this zone, multiple component habitation sites appear concentrated in the vicinity of Kahioawa Point, Kahioawa Bay, and Awake'e Bay. The inland portions of the project area have a distinct paucity of sites and features, with the exception of multiple component site complexes and features situated along or near a coastal-inland oriented foot trail (Site T183). Walker and Donham also suggested that the distribution of sites conforms to the general pattern of aboriginal Hawaiian settlement that has been reconstructed on the basis of archaeological, ethnohistoric, and ethnographic sources for the portion of North Kona to the north of Kailua (Roshendahl 1973: 60-61). The sites and features identified within the Proposed Awakee Resort Development area show evidence of occupation of the narrow coastal zone, and the movement of people and produce along the foot trails through the barren intermediate zone that connected the coastal and further inland areas of habitation and exploitation.

Carter (1985) conducted an archaeological reconnaissance of a 2,800-acre parcel for Barnwell Industries situated in the *ahupua'a* of Ka'ūpūlehu. The project area, including the coast, extended inland 2.0 to 3.0 km.

Carter located 195 sites (802 feature components) in the project area, 151 of which were previously unrecorded. Twenty-five formal feature types were identified including trails, cairns, shelters, shelter caves, burial caves, burial cysts, platforms, enclosures, partial enclosures (C-, L-, U-, E-, T- and crescent-shapes), alignments, circular enclosures, shrines, pahoehoe clearings, modified ridge gardens, rectangular depression, petroglyphs, papamu, midden scatters, and historic walls. She noted an absence of large religious structures (e.g. *heiau* and men's houses) along the coast and suggested that if there were any such sites present here, it is likely that they were bulldozed during construction of the Kona Village Resort.

Of the 25 feature types recorded, pahoehoe clearings were present with highest frequency (450 or 56.1%). Pahoehoe clearings were identified by the "purposeful displacement of the pahoehoe surface. The surface layer of the pahoehoe flow is first broken, then the natural rubble is cleared to form an area free of pahoehoe blocks" (Carter 1985; 17).

Even though 450 pahoehoe clearings were recorded, Carter indicated that another 1,700 (total is over 2,150) exist. She suspected a probable functional relationship between shelter caves and pahoehoe clearings, but was not certain of the nature of this relationship.

In Carter's discussion, interpretation of the pahoehoe clearings, based primarily on ethnohistoric information, indicates agriculture. She also presented other observations by Barrera (1971) and Bevacqua and Moore (1972) who identified these features as pahoehoe holes in coastal areas of Anaehoomalu and Waikoloa.

Walker and Rosendahl (1988) conducted archaeological survey and testing in the 650-acre Ka'ūpūlehu Makai Resort project area, located in Kūkio 1 and Ka'ūpūlehu *ahupua'a* adjacent to the northeastern section of the subject project area. This survey included a portion of Carter's 1985 survey area. During the survey and testing, 53 sites (201 component features) were located. Recorded archaeological features included: 2 walled shelters, 13 trails, 1 lava formation, 8 walls, 41 cairns, 10 platforms, 1 cleared area, 3 L-shaped walls, 4 petroglyphs, 2 circular rock alignments, 1 retaining wall, 33 lava tubes, 17 pits (pahoehoe clearings), 6 enclosures, 11 C-shaped enclosures, 6 overhang shelters, 3 cupboards, 22 terraces, 6 modified outcrops, 1 midden deposit, 1 rectangular cobble pile, 1 level cobble area, 2 walled shelters, 5 paved areas, 1 burial cave, 1 burial, and 1 possible ramp.

The following observations were made concerning coastal sites in the Ka'ūpūlehu/Kūkio 1 project area:

> "(a) most sites in the coastal zone are near anchialine ponds; (b) age determination results indicate that early occupied sites are situated near the coast; (c) sites within or adjacent to the coastal zone, in comparison with sites in other zones in the project area, exhibit the greatest variety of functional types; (d) sites in the coastal zone include: the 3 sites inferred to have been occupied on a permanent basis, three of five features interpreted to be shrines, and six of nine sites containing suspected burial remains; and (e) one primary coastal trail and a portion of a primary coastal-inland trail are situated within the coastal zone" (Walker and Rosendahl 1988:198).
>
> A study of the distribution of functional types in the project area indicates that, relative to inland sites, coastal sites evidence more permanent habitation and more ceremonial activities; and that inland sites evidence coastal-inland foot trails, temporary habitation features, and a slightly lesser amount of burials and shrines. The functional distribution of sites in the project area conforms to the pattern of aboriginal Hawaiian settlement for the portion of North Kona, north of Kailua, put forth by Rosendahl-a pattern based on archaeological, ethnohistoric, and ethnographic sources (Rosendahl 1973:60-61)".

Ten burials were encountered in lava tube shelters. Seven were reported as prehistoric burials and three as historic period burials. Prehistoric burials include a fragment of a human cranium found inside a 10.0+ m long by 1.0 to 3.5 m wide cave inside a lava channel. The entrance was partially walled with basalt boulders. Inside another cave, three burials were found on a bedrock shelf located c. 2.0 m above the cave floor and c. 25 m from the entrance. These burials, all adults, were placed within constructed crypts in flexed or semi-flexed positions. Capstones were present on two of the crypts. Covering the torso and part of the cranium of one burial was a very fibrous material (possibly the remains of *kapa*). Near the right ilium was a gourd wrapped in sennit mesh (a partially decomposed, tightly woven fabric was present under the second burial). Capstones had fallen onto the third burial leaving only a few infracranial and cranium fragments.

Three historic period burials were found inside a cave with walled entrances. Numerous historic period items were found inside the cave, including: wooden planks, glass (window pane), clothes (blue jeans, blue and white shirts), *pulu*-like material, a felt hat, a *lauhala* hat, canvass leggings with metal grommets, round- and square- head nails, leather, an ornamental iron object, and a *lei* offering, which had recently been placed inside the cave. The burial remains were scattered.

The results of age determination analyses (radiocarbon and volcanic glass) indicate initial occupation of the project area may have occurred as early as the eleventh century and may have continued into the historic period. Radiocarbon dates from Sites 10954, 10959, 10969, 10979, 10988, and 10989, revealed that this dry, marginal area has been inhabited for approximately 1000 years. The earliest date (from Site 10959) indicated that this area was occupied by A.D. 1030 to 1290. Additional dates from other sites suggested that this occupation continued through to the late 18th century. The volcanic glass dates ranged from A.D. 1282 to 1567, falling within the parameters of the radiocarbon dates. Two sources for the volcanic glass found in the project area were reported to be from Pu'uwa'awa'a and Pu'uanahulu.

Rosendahl and Sullivan (1989) conducted a program of archaeological data recovery within the 650 acre Ka'upulehu Makai Resort project area, situated in Ka'ūpūlehu and Kūkio 1 *ahupua'a*, North Kona. At present, only the interim report was available. These investigations followed the inventory survey summarized above. Data recovery work consisted of detailed recording, subsurface testing, burial disinterments, and reconstruction of excavated features at sites to be preserved. One new site was located, in which two complete wooden shark hooks were recovered. Also, an additional 32 features were identified at three previously recorded sites. One of these features included a lava tube shelter. A minimum of 28 burials, and other cultural material including numerous long poles, planks, gourd fragments, matting, cloth, and coconut husks were found inside the cave. This cave was discovered when a cairn, consisting of stacked aa slabs and blocks, was dismantled.

INVENTORY SURVEY

In September 1990, the Applied Research Group, Bishop Museum, conducted a field assessment of the Manini'ōwali/Kūkio 2 parcel, which included the current project area. Together with the data generated from another previous surface survey (Ladefoged 1989), preliminary site significance evaluations to assess the feasibility of the land exchange and other planning requirements were made possible. Several previously recorded sites were redefined and grouped together into larger complexes. This process allowed the identification of preliminary preservation precincts and coastal setbacks.

The land exchange approved in early 1991 defined the coastal setback area to be retained under State ownership. The current inventory survey was conducted in the portion of Manini'ōwali/Kūkio 2 parcel under private ownership.

SCOPE OF WORK

The tasks undertaken during the current phase of work include:

1) historical literature and documents search;
2) informant interviews;
3) burial assessment;
4) instrument-aided, detailed plan and locational mapping;
5) limited subsurface testing;
6) appropriate laboratory procedures; and
7) report writeup, review, and production.

RESEARCH QUESTIONS

The archaeology was guided by research questions aimed at recovering data to aid in the reconstruction of the prehistory and history of the area. These questions are:

1. How do these sites relate to the overall settlement pattern of Manini'ōwali/Kūkio *ahupua'a* and the region?

2. What were the functions of the sites? What activities took place at the sites? Were any of these activities of a specialized nature?

3. What were the temporal origins of the sites? Are all of the sites contemporaneous? How were the sites temporally and functionally associated with one another?

4. What exploitative strategies were being employed by the inhabitants? How did they adapt to the micro-environments in the area? What marine ecozones were being exploited?

The results of the current phase of work are preliminary and can only address some of the questions. However, the data generated will aid in the formulation of a detailed research design for subsequent work.

METHODOLOGY

This section presents the methods and procedures used during field investigations (survey, mapping, excavations) and laboratory analyses of cultural materials recovered in the field.

Field Methods

Based on previous work (Ladefoged 1989; Sinoto and Pantaleo 1990), the majority of the site locations were known. At the onset of fieldwork, survey teams went to known site locations and began mapping. Prior to recording a site, an additional survey was conducted to ensure that all features in the area had been identified. Resulting from this method, new sites and features were encountered. Each one was marked with a temporary site number (e.g. T1), which was written with indelible ink on orange or pink flagging tape.

All field maps were produced at a 1:200 scale. Mapping was conducted by tape and compass (Silva, Suunto, and Brunton).

Professional surveyors located permanent datum points for all sites in order to incorporate site locations on plan maps and reduce potential error from magnetic anomalies of different lava flows.

Site and feature descriptions were recorded on Bishop Museum feature forms and sketches were drawn of each feature. Detailed feature descriptions included interior and exterior dimensions, construction type and material, associated features, and cultural material. Measurements were recorded using the metric system. Selected surface artifacts were collected for further analysis and located on site/feature maps before collection. All site areas as well as selected features were photographed in black and white and in color.

During field investigations, features selected for testing included: (1) surface structures and caves that contained an observable deposit, as well as (2) numerous quarried areas with exposed, or opened, small lava tubes and blisters containing little or no sedimentary deposit. The lava tubes and blisters were examined for burials and cultural remains using flashlights and lanterns. Rocks were often moved to determine if they sealed passageways or chambers.

Subsurface testing in surface structural features and caves containing sediments incorporated standard archaeological excavation and recording procedures. Six test units, ranging in size from 0.50 by 0.50 m to 1.00 by 0.50 m, were excavated by stratigraphic layers subdivided into 5 to 10 cm levels. At three sites, the excavated matrix was screened through nested 1/4-in. and 1/8-in. screens in the field. At these sites, the cultural materials were sorted and bagged in the field. At one site, the excavated matrix was predominately gravel, cobble, and small boulders and was sorted through by hand. At another site, the excavated matrix was bagged unscreened for sorting and analysis in the laboratory.

Soil descriptions for each layer were recorded using the Munsell chart to describe color, which was recorded wet (w.), moist (m.) or dry (d.). The *Handbook for Soil Descriptions* (Smith 1963) was used to describe the soil/sedimentary characteristics, including texture, dry, moist, and wet consistence, root quantities, estimated percentage of rock inclusions, and lower boundary topography.

Laboratory Procedures

Midden and artifact analyses were conducted at the Bishop Museum archaeology laboratory in Honolulu. Midden remains were sorted, weighed, and identified to genus and species levels using Kay (1979) and reference collections to aid identification. Bags of unscreened matrix from test excavations were screened through nested 1/4-and 1/8-inch mesh in the laboratory. Due to time constraints, the abundant materials recovered from the 1/8-inch screen from Sites 50-10-18-5348, Feature 3.1, and Site 50-10-18-5354, Feature 2, were not analyzed. These samples are being curated at the Bishop Museum for future analysis.

Lithic material and historic bottle glass were cleaned prior to analysis and cataloguing. An artifact card was completed for each artifact with a drawing, metric traits, and provenience data. The catalogue numbers assigned consist of the Bishop Museum site numbers and sequential accession numbers. (For example, 50-HA-D21-53-1, was the first artifact catalogued for site D21-53).

Four charcoal samples were submitted to Beta Analytic, Inc., Coral Gables, Florida, for radiocarbon age determination. One wood sample and other vegetal materials were processed for identification.

All field notes, photographs, maps, and drawings were filed under project 467, and stored in the Department of Anthropology Documents Room at the Bishop Museum. Black and white photographs were catalogued under roll numbers Ha(a) 662 to Ha(a) 672.

Burials

Exploratory testing of potential burial features identified during previous phases of work were undertaken and resulted in the discovery of 14 burials within the project area. In accordance with the Burial Treatment Plan and Act 306, Chapter 6E, the State Historic Preservation Division, Department of Land and Natural Resources was notified.

A separate burial report, regarding results and recommendations for all burials found within the project area, will be submitted to the State Historic Preservation Division, Department of Land and Natural Resources.

SITE DESCRIPTIONS

Presented in this section are site descriptions and results from radiocarbon, midden, and artifact analyses.

Twenty-five sites comprised of 1,313 features, including 1,191 pits, were recorded within the project area (Fig. 2). Table 2 presents the frequency of feature types found in the project area. Figure 3 shows the archaeological site locations divided into a grid system (A3-F24) (Appendix C). The coordinates begin near the northwest corner of the project area. Numeric columns increase eastward and alphabetic rows are sequential to the south. Matchpoints can be used to reconstruct Sites 5337 and 5338 in Appendix C. Insets with map designation "G" are not part of Appendix C, but are included in the site description section.

Pits were the prominent feature type in the project area, accounting for 91% of all feature type modifications (Table 2). The pit features characteristically included a quarried area in the pahoehoe flow with numerous pahoehoe cobble/boulders situated either around the pit's perimeter, inside the pit, or both. The largest dimensions of the pits were used in determining size. In 23 pits, rounded, smooth basalt, cobble/boulder hammerstones were found. Manuports were found in 8 pits. Small pebble/coarse gravel-sized pumice were found in 17 pits. Coral was found in 9 pits. Midden remains (primarily marine shell) were observed in 19 pits.

Close examination of the pits revealed two feature variations: (1) excavated or quarried areas in the pahoehoe that resulted in a pit or that exposed a small lava tube or blister. Associated blocky pahoehoe cobble/boulders were usually situated around the opening; (2) areas excavated or quarried into the vertical face of a pahoehoe cliff, or an accretionary boulder, which did not result in a pit or opening of a lava tube. Associated blocky chunks of pahoehoe occurred around the quarried area.

State Site 50-10-18-5337 (Site 50-Ha-D21-53)

This site, a *mauka-makai* trail through the project area, measures approximately 1,900 meters long. It was identified by a worn path on pahoehoe as well as steppingstones and cobble/pebble paved areas on aa flows (Fig. 4) (Appendix C). This type "A" trail (Apple 1965) is characterized by single-file prehistoric paths, roughly 25 to 50 cm wide. The trail extends from above Queen Ka'ahumanu Highway to the *makai* side of a small cinder cone

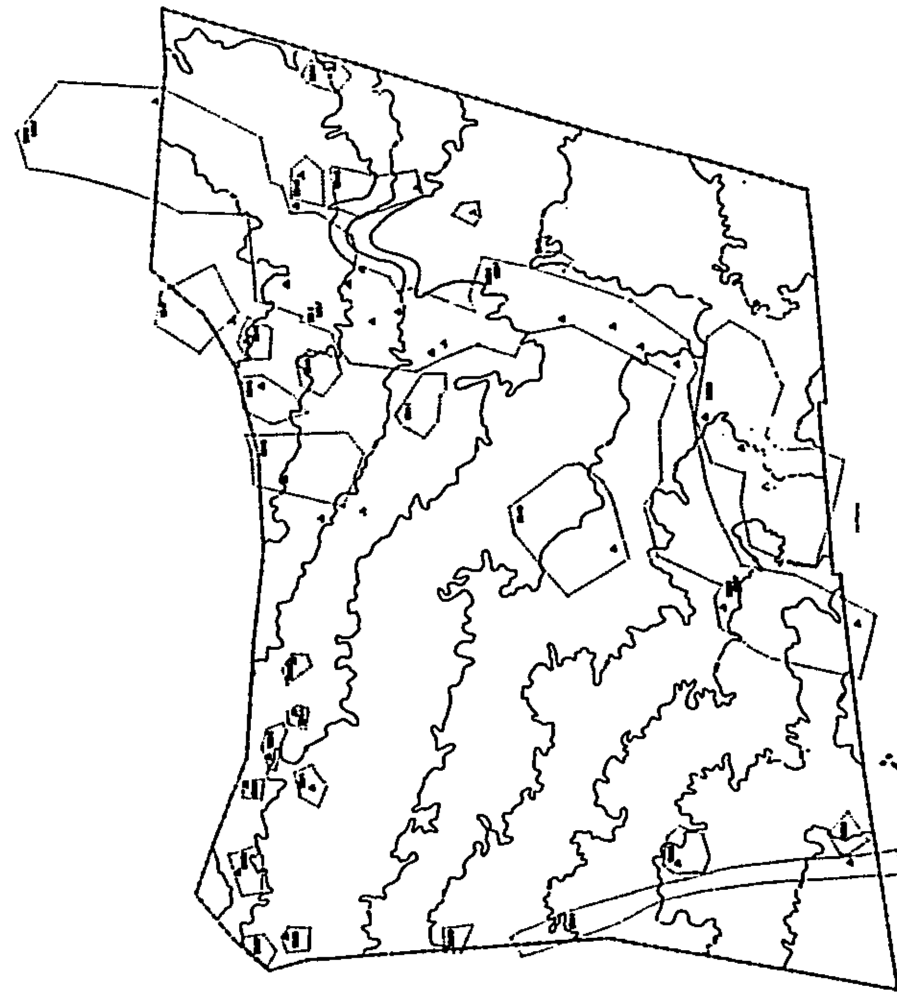


Fig. 2. MANINI'ŌWALI/KŪKIO 2 PROJECT SHOWING LOCATIONS OF ARCHAEOLOGICAL SITE AREAS.

TABLE 2
FREQUENCY OF FEATURE TYPES IN THE MANINI'ŌWALI/KŪKIO 2 PROJECT AREA

Feature Type	Number	Percentage
Pit	1,191	90.7
Lava Tube	29	2.2
Overhang Shelter	12	0.9
Modified Outcrop	13	0.9
Cupboard	17	1.3
Crevice	19	1.4
C-Shaped Shelter	7	0.5
Trail	5	0.3
Enclosure	6	0.4
Cairn	4	0.3
Mound	2	0.15
Lava Sink	2	0.15
Terrace	3	0.2
Platform	2	0.15
Wall	1	0.1
TOTAL	1,313	99.65

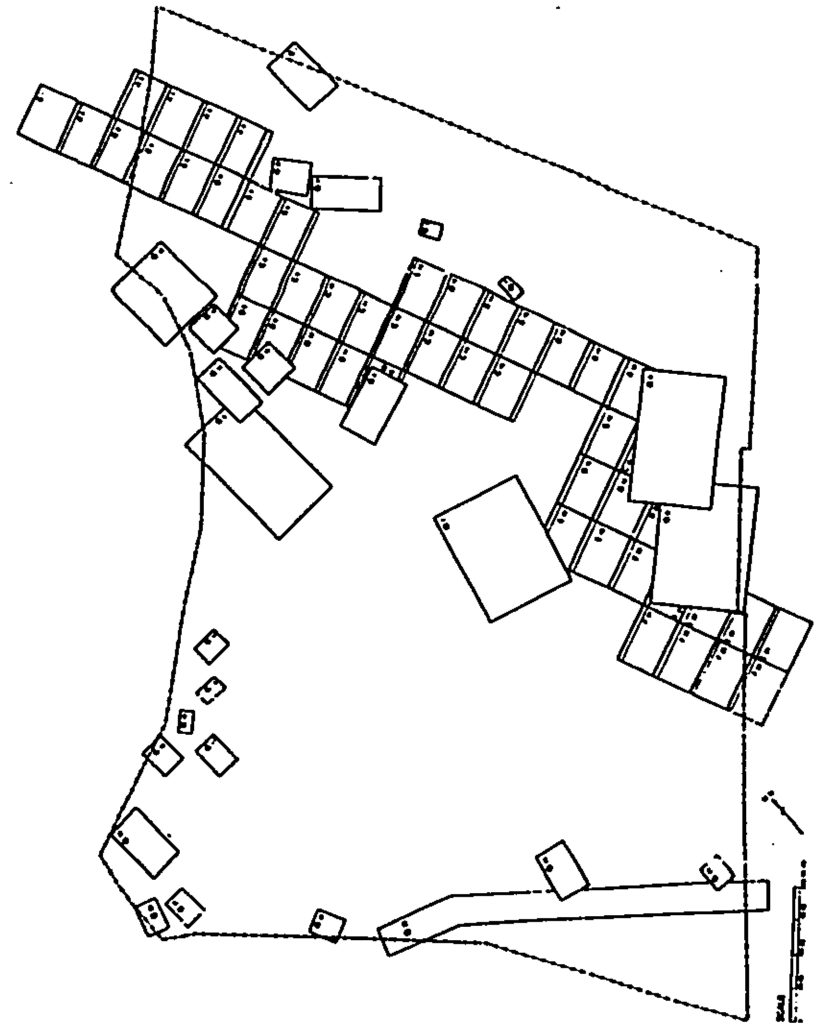


Fig. 3. MANINI'ŌWALI/KŪKIO 2 SITE LOCATIONS SHOWING REPORT FIGURE INSETS. PLANVIEW OF SITES 50-10-18-5337 (TRAIL) AND 5338, FEATURES 1 THROUGH 887 (MAPS A3 THROUGH F24).

Fig. 4. STATE SITE 50-10-18-5337 (SITE 50-Ha-D21-53), STEPPING STONE TRAIL IN AA. View to East. BH Neg. No. Ha(a) 667-6.

where it divides into two trail segments. The southern segment extends to the *heiau* (State Site 50-10-18-14664) at Kakapa Bay and the northern segment extends to habitation complexes at Kakapa Bay.

State Site 50-10-18-5338 (Site 50-Ha-D21-54)

This site is the most extensive site in the project area (Fig. 5) (Appendix C) . It is located 45.7 m (150 ft) to 1,386 m (4,550 ft) from the coast at an elevation of 7.6 m (25 ft) to 76.2 m (250 ft), measuring 1,668.78 m (5,475 ft) by 426.72 m (1,400 ft), and is associated with the *mauka-makai* trail (State Site 50-10-18-5337). Vegetation on the pahoehoe included fountain grass (occasional), *kiawe* (occasional), *ilima* (occasional), Guinea grass (rare), *neho* (rare), *uha* (occasional), mint (rare), morning glory (rare), lovegrass (rare), cudweed (rare), lichen (rare), and pink star (rare). Vegetation on aa lava included *puapilo* (rare), *kiawe* (rare), fountain grass (rare), *ihi* (rare), *uha* (rare), *ilima* (rare), *Mollugo* (rare), and *Ageratum* (rare).

A total of 886 features were recorded. Pits were the predominate feature type, totaling 847 or 96% of all feature components (Appendix C) (Fig. 6). Other features included 19 crevices, 5 overhang shelters, 3 lava tubes, 5 modified outcrops, 4 cupboards, 2 C-shaped shelters, 2 enclosures, a cairn, and a burial. Cultural material observed at Site 5338 included 2 octopus lures, 13 cobble-sized hammerstones, 6 waterworn manuports, coral, crab claws, midden, volcanic glass, and pumice.

Out of 847 pits, only 45 (5%) had associated cultural materials/ artifacts. Traditional Hawaiian artifacts included: octopus lure fragments (located 2.0 m southeast of Features 498 and 499); an octopus lure located between Features 737 and 738 on the *aa*; seven rounded basalt cobble hammerstones found inside of pits (Features 58, 95, 274, 377, 398, 755, and 756); three rounded, basalt cobble hammerstones found outside of pits (one 0.3 m north of Feature 489, one 0.4 m south of Feature 815, and one 1.0 m west of Features 384 and 385); three angular basalt cobble hammerstones inside pits (two in Feature 450 and one in of Feature 495); and three rounded basalt pebble/cobble manuports outside of pits (Features 19, 621, and 642) and one inside a pit (Feature 293). Other cultural material inside pit features included coral (Features 79, 275, 523, 685, 737, 738), marine shell (Features 79, 110, 155, 275, 367, 560, 619, 687, 702, and 738), pumice (Features 74, 88, 89, 146, 148, 352, 353, 366, 384, 388, 766, 770, 819, 823, 824, 827, 829, 830, and 836), soil (Features 3, 4, 5, 8, 17, 26, 27, 36, 50, 51, 52, 68, 88, 89,

Fig. 5. STATE SITE 50-10-18-5338 (SITE 50-Ha-D21-54), OVERVIEW. View to South. BM Neg. No. Ha(a) 670-34.

Fig. 6. STATE SITE 50-10-18-5338 (SITE 50-Ha-D21-54), FEATURE 259, PIT. View to Northwest. BM Neg. No. Ha(a) 671-15.

181, 183, 184, 225, 323, 355, 365, 366, 388, 389, 390, 456, 458, 459, 460, 461, 462, 662, 680, 855, 856, and 876), and burnt wood (Feature 220). Cultural material outside of pits includes coral (Feature 161, 162, 267, and 523), and marine shell (Feature 146, 172, 282, and 506).

Feature 129 is a quarried crevice. It measured 4.4 by 3.5 m and 0.98 m deep. A scatter of seven cowrie shells and one coral fragment was located 1.0 m to the west of the crevice.

Features 155 and 156 (cupboards) both contained crab claws. The crab claw in Feature 155 was located underneath pahoehoe slabs in the western end of the cupboard. The cupboard measured 1.0 m long and 0.45 m wide. The crab claw in Feature 156 was located on the surface. The cupboard measured 0.8 m long and 0.3 m wide.

Feature 297, an overhang shelter, consists of a leveled area below a pahoehoe overhang adjacent to an aa flow. The entrance opens to the north. The height of the shelter measures 1.8 m. The interior of the shelter is 4.5 m by 1.5 m in size. A surface scatter of sea urchin was located outside the entrance.

Feature 367 is a lava tube, measuring 2.0 m by 1.85 m and 1.1 m high. Small boulder-sized aa clinkers were piled by the entrance of the tube (approximately 1.1 m high). No cultural material was observed.

Feature 370 is an overhang shelter in the aa on the west side of an accretionary boulder. An area 2.3 m by 1.4 m in size was cleared of cobbles and boulders, and piled on accretionary boulders to a maximum height of 1.45 m. No cultural material was observed.

Feature 406 is a modified crevice, measuring 3.15 m by 1.1 m and 0.35 m deep. No cultural material was present.

One lava tube (Feature 110) contained cultural remains. Sparse marine shell and sea urchin were concentrated near the entrance. Pahoehoe slabs (roof fall) had been removed in the lava tube and set outside the entrance. The tube measured 1.26 m long and 0.45 m wide with an interior height of 1.20 m.

Feature 619, two adjacent rectangular enclosures on pahoehoe, was terraced into the aa flow to the east. The northern enclosure is rectangular in shape and measures 3.0 m by 2.5 m. The southern enclosure is rectangular

in shape and measures 2.5 m by 2.5 m. Both enclosures share a common wall. These walls, 0.30 to 0.60 m thick, are low piled alignments constructed of angular cobbles/boulders. An isolated marine shell and a coral fragment along with recent historic refuse was observed on the surface in both enclosures.

Feature 620 is an oval-shaped enclosure on pahoehoe. The interior of the enclosure measures 3.65 m in diameter, and the exterior measures 5.45 m to 5.55 m in diameter. The walls, which are constructed of piled aa boulders and cobbles, abut the aa flow. The walls measure 0.9 to 0.95 m thick and 0.52 m high. One coral fragment was recorded on the surface of the enclosure. A thin deposit of sandy silt covers the floor.

Of the two C-shaped shelters recorded, Feature 559 and 808 only one contained cultural material, a conus shell fragment (Feature 559). Feature 559 was in poor condition with only two upright pahoehoe slabs standing, approximately 0.72 m in height. The remnants of the structure form a C-shape 3.25 m by 2.65 m in size. It is located northeast of a trail (Site 5337).

Feature 732 is a deep, narrow pit (1.5 m in depth) probably used for agriculture (Fig. 7). It was formed by removing boulder and cobble-sized clinkers from the aa flow. It is located just north of a steppingstone trail (State Site 50-10-18-5337).

Six modified outcrops were located on the aa lava. Feature 733 consisted of an oval-shaped rock wall constructed of piled cobbles/boulders incorporating the eastern side of an accretionary boulder (1.15 m in diameter). The rocks inside the structure were removed to a depth of 0.30 to 0.45 m below surface. The wall measures 0.5 to 1.0 m thick, 1.6 m in height, and 1.15 m in exterior height. Two rounded basalt cobbles were incorporated into the southern section of the wall. This feature is adjacent to the trail (State Site 50-10-18-5337), which leads to the *heiau* (State Site 50-10-18-14663) at Kakapa Bay. No cultural deposit was identified.

Feature 734 consists of an alignment of boulder-sized aa clinkers, southeast of two accretionary boulders (approximately 1.5 m in diameter). The alignment measures 4.0 m by 0.5 m and 0.2 m high. The area between the alignment and the accretionary boulders has been modified. This feature is located along the eastern side of a trail (State Site 50-10-18-5337) leading to the *heiau* (State Site 50-10-18-14663). An isolated marine shell was located on the western side of the trail. Two waterworn pebbles were located on the eastern side of the accretionary boulders. A coral fragment was located on the northern accretionary boulder.

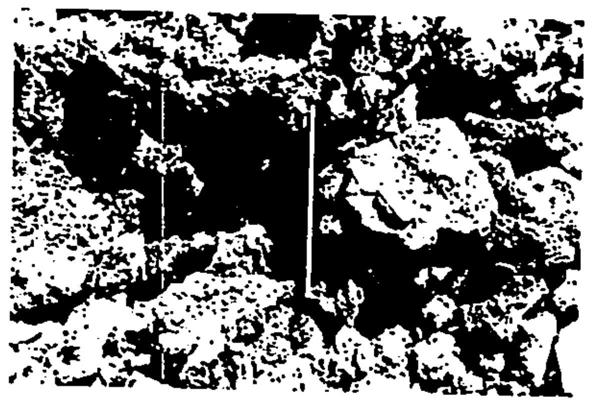


Fig. 7. STATE SITE 50-10-18-5338 (SITE 50-Ha-D21-54), FEATURE 364, PIT IN AA. View to Northeast. BH Neg. No. Ha(a) 667-8.

Feature 735 is a modified outcrop on the eastern side of a steppingstone trail (State Site 50-10-18-5337) leading to the *heiau* (State Site 50-10-18-14663). The western side of the accretionary boulders was modified by the removal of boulders and cobbles to form a pebble and gravel surface 3.1 m by 1.9 m in size. The aa below the northern accretionary boulder was removed to form a small pit approximately 0.25 m deep and 0.5 m in diameter. Isolated marine shell was recorded both on the northern and southern side of the feature. Sea urchin was found on the western side of the trail. An isolated piece of coral was located on the trail at the northern end of the feature.

Feature 736, a modified outcrop in the aa flow, consists of a stacked wall around a pit. This feature is located on the eastern side of a paved trail leading to the beach at Kakapa Bay. The pit measures 2.0 m by 1.1 m and 1.2 to 1.65 m deep. The walls are approximately 0.6 to 8.0 m thick and 0.6 m high. No cultural deposit was observed.

Feature 739 is a modified outcrop, consisting of an oval-shaped wall constructed of piled cobbles/boulders. The interior of the structure measures 2.0 m by 1.0 m in size. The walls are approximately 0.7 m wide. No cultural deposit was present.

Feature 743 is a modified outcrop on the eastern side of a steppingstone trail (State Site 50-10-18-5337), which leads to the *heiau* (State Site 50-10-18-14663). The modified outcrop consists of a rock alignment on the western side of an accretionary boulder. The alignment measures 1.1 m by 0.75 m and 0.3 m wide. The area between the alignment and the accretionary boulder was cleared of boulders and cobbles. A coral fragment was located on the accretionary boulder. No cultural deposit was present.

Feature 789 is a crevice that was filled with cobble-sized pahoehoe slabs. The southern end of the crevice has been quarried. The crevice measured 3.1 m by 1.2 m and 0.5 m deep. No cultural material was present.

Feature 808, a C-shape, is constructed on pahoehoe with upright pahoehoe slabs leaning on one another to form a wall approximately 0.45 m high and 0.4 to 0.5 m thick. The diameter of the C-shape measures 1.5 m. This feature is similar in construction to Feature 8 at State Site 50-10-18-5346.

Feature 810 is a burial located in a crevice along the base of a lava channel. One burial (an infant or small child), located in a crypt constructed of piled aa cobbles, was recorded in this crevice. Crab claw was observed in association with the burial. The crevice measured 5.7 m long by 2.8 m wide and 1.5 m deep.

Feature 858 is a lava tube with three quarried openings. The northwest entrance measured 3.0 m by 1.4 m, the eastern entrance measured 0.6 m by 0.45 m, and the southwestern entrance measured 2.2 m by 1.3 m in size. Pumice and clay silt loam were observed in the northwest end of the tube. No cultural deposit was observed.

State Site 50-10-18-5339 (Site 50-Ha-D21-55)

This site is located in the eastern portion of the project area, approximately 1,120 m (3,675 ft) to 1,352.5 m (4,437.5 ft) from the coast at an elevation of 45.7 to 61.0 m (150 to 200 ft). It measures 449.58 m (1,475 ft) long and 213.36 m (700 ft) wide. All the features are located on pahoehoe except a portion of the trail near Queen Ka'ahumanu Highway, which is on aa lava (Fig. 8). Vegetation included fountain grass (occasional), *uha* (rare), *ilima* (rare), and *Pluchea* (rare).

A total of 182 features were recorded. This site consists of 173 pits, 4 lava tubes (one with a burial), 3 cairns, an overhang shelter, and a trail.

Out of the 173 pits, six pits (3.5%) had associated cultural material, including five rounded basalt pebble manuports, one rounded basalt cobble hammerstone, one shark tooth, fish bone, sparse midden, and coral. One rounded, basalt pebble manuport was located 0.6 m south of a pit (Feature 134).

One shark tooth, five rounded basalt pebble manuports, and fish bone were recorded on the surface inside Feature 127.

One rounded, basalt, cobble hammerstone was found outside of Feature 144.

An isolated cowrie shell (*Cypraea* spp.) was found inside Feature 103 (pit) and outside Feature 25 (pit) approximately 0.5 m to the east.

Feature 102 is a lava tube containing one burial and sparse marine shell (Fig. 9). The burial tube measures 7.25 m wide and 0.80 m high. Four tube segments extend from the entrance, creating a tube 13 m long and another tube approximately 9.5 m long. The entrance is 1.25 m by 1.0 m in size.

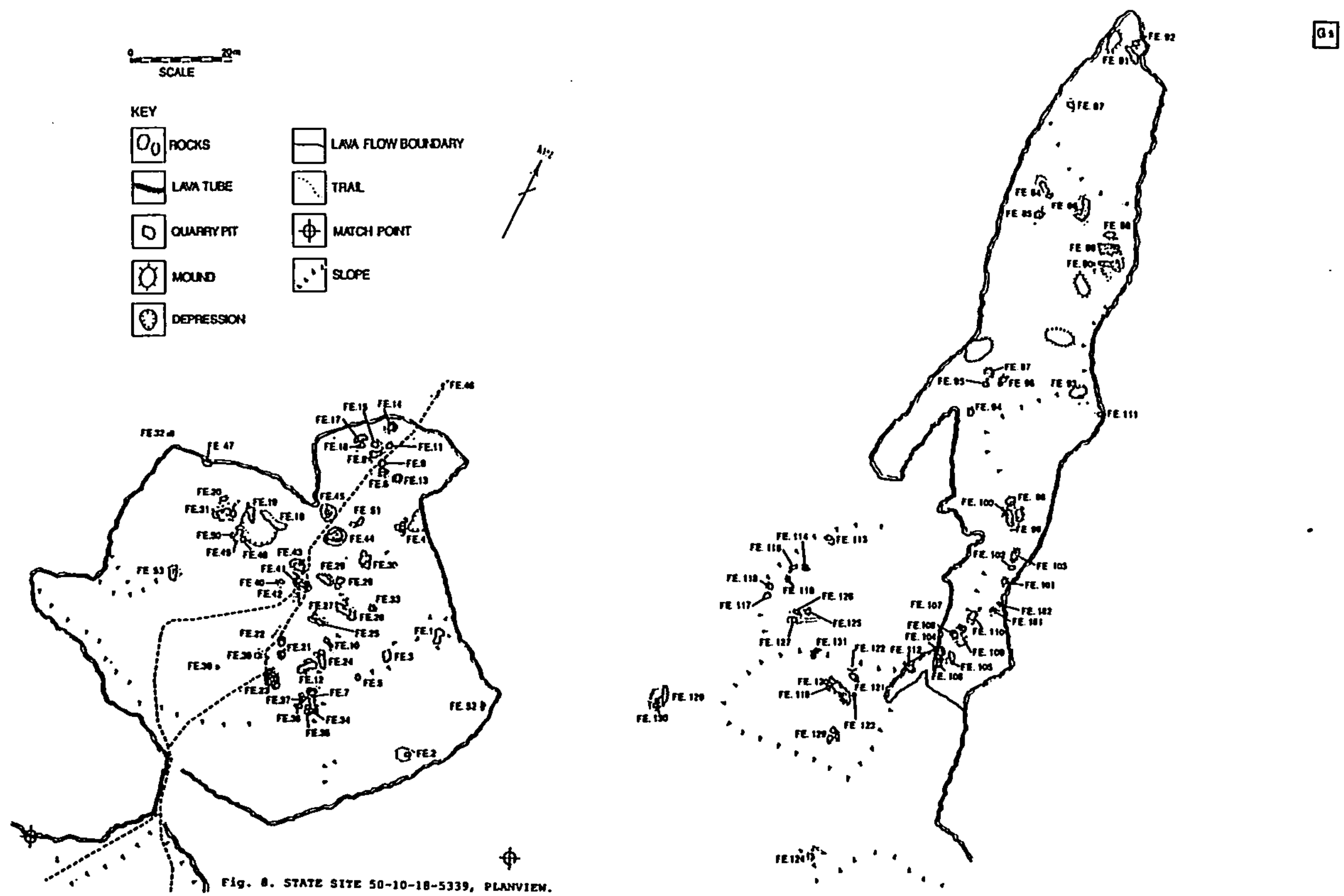


Fig. 8. STATE SITE 50-10-18-5339, PLANVIEW.

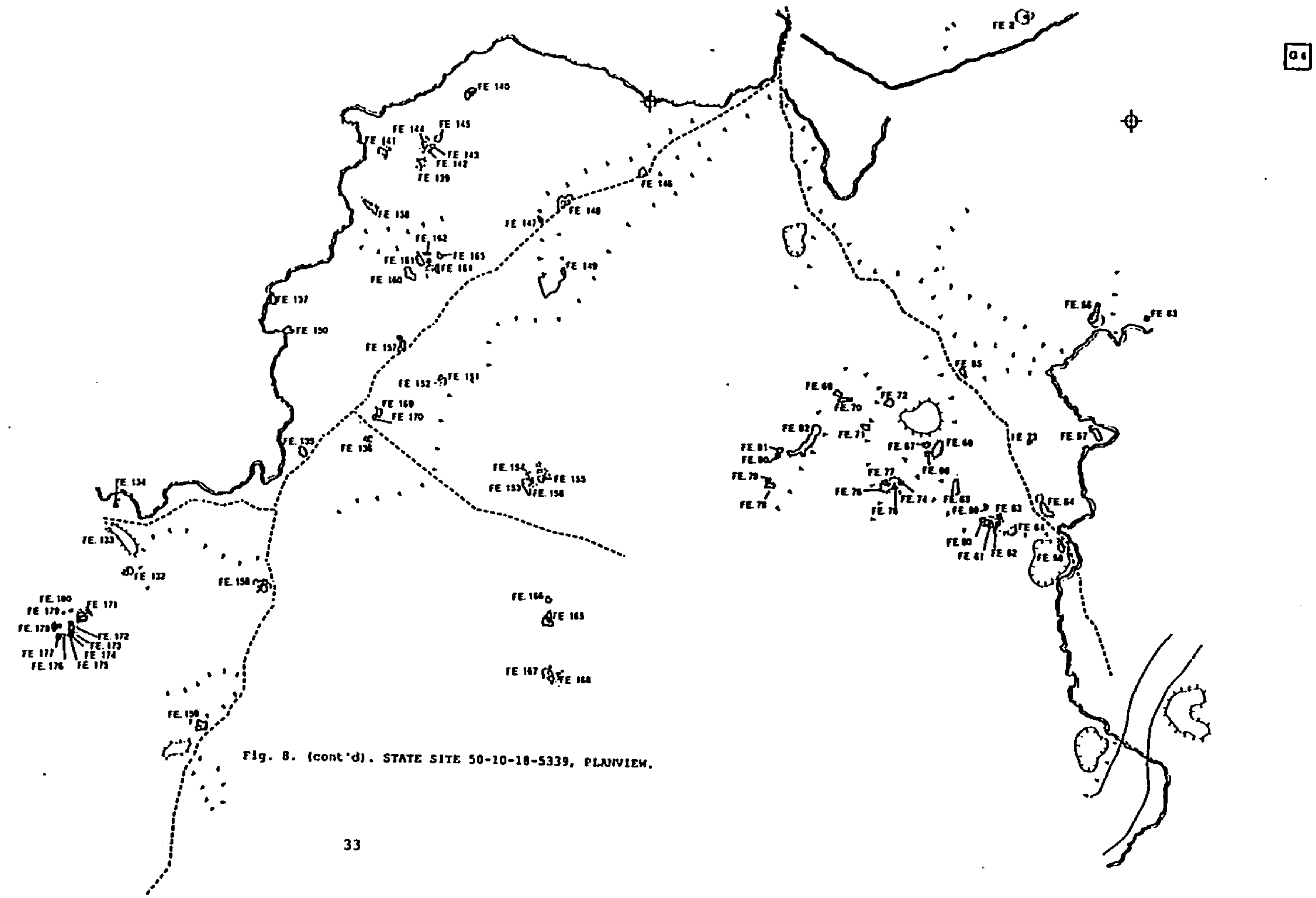


Fig. 8. (cont'd). STATE SITE 50-10-18-5339, PLANVIEW.

Fig. 9. STATE SITE 50-10-18-5339 (SITE 50-Ha-D21-55), FEATURE 102, LAVA TUBE WITH BURIAL. View to North. BH Neg. No. Ha(a) 666-15a.

State Site 50-10-18-5340 (Site 50-Ha-D21-56)

This site consists of an overhang shelter on aa lava ridge (Fig. 10). It is located in the northern section of the project area 922 m (3,025 ft) from the coast at an elevation of 44.2 to 47.3 m (145 to 155 ft). Vegetation included fountain grass (occasional) and *kiawe* (occasional).

This feature was constructed by placing an aa slab on two large boulders. It measures 3.75 m by 1.6 m and 1.05 m high. No cultural material was recorded.

State Site 50-10-18-5341 (Site 50-Ha-D21-57)

This site is located in the northwestern section of the project area on the *makai* side of a small cinder cone (Fig. 11). It measures 114.3 m (375 ft) by 49.53 m (162 ft), and is 617 m (2,025 ft) to 670.5 m (2,200 ft) from the coast at an elevation of 30.5 m (100 ft) to 38.1 m (125 ft). Vegetation included *kiawe* (frequent), *ilima* (frequent), *Mollugo* (frequent), fountain grass (frequent), *ihi* (frequent), and *Ageratum* (occasional).

Seven features were recorded, including five pits, one lava tube, and one rectangular enclosure.

Feature 3 is a rectangular enclosure located at the base of a small cinder cone. Exterior dimensions measure 3.6 by 4.1 m and interior dimensions 2.2 by 1.8 m. The walls, 0.7 m wide by 0.5 m high, are constructed of stacked pahoehoe slabs and aa clinkers. A paved entrance was located at the north end of the enclosure. The wall at the entrance measures 0.25 m high. The floor of the enclosure was paved with pahoehoe slabs. One test unit was excavated inside the enclosure, which exposed cultural material (see Excavation Results). Rock concentrations around the enclosure appear to be wall tumble.

Located 10 m north of the enclosure is a lava tube (Feature 1), containing abundant marine shells, volcanic glass, *kukui*, and waterworn basalt manuports (Fig. 12). The midden was concentrated near the entrance and formed a thin deposit (approximately 1-2 cm in depth) throughout the main lava tube chamber. The lava tube was L-shaped with the main tube chamber extending east-west and measuring approximately 16.1 m by 2.0 m and 2.0 m in height. A smaller tube segment extended 15+ m to the north from the eastern end of the chamber and measured approximately 0.75 m in height.

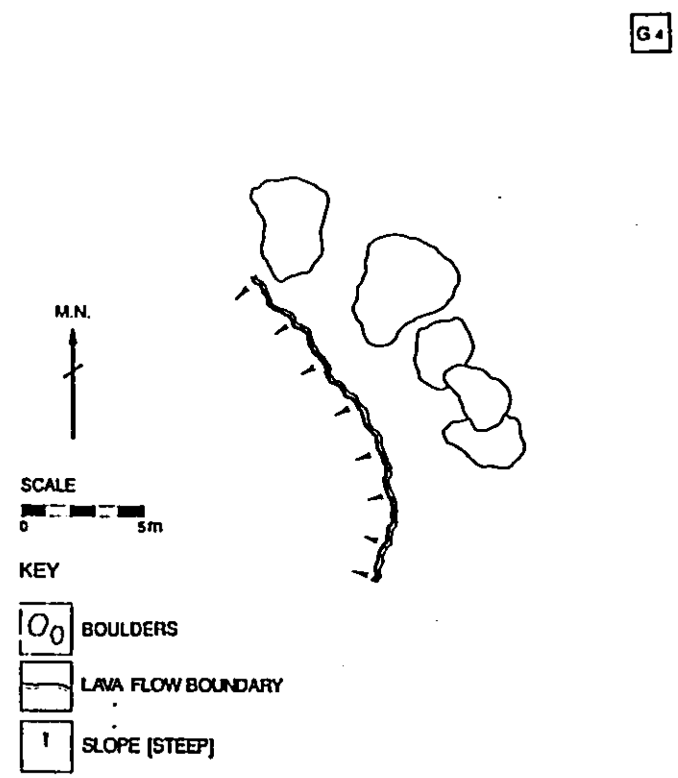


Fig. 10. STATE SITE 50-10-18-5340, PLANVIEW

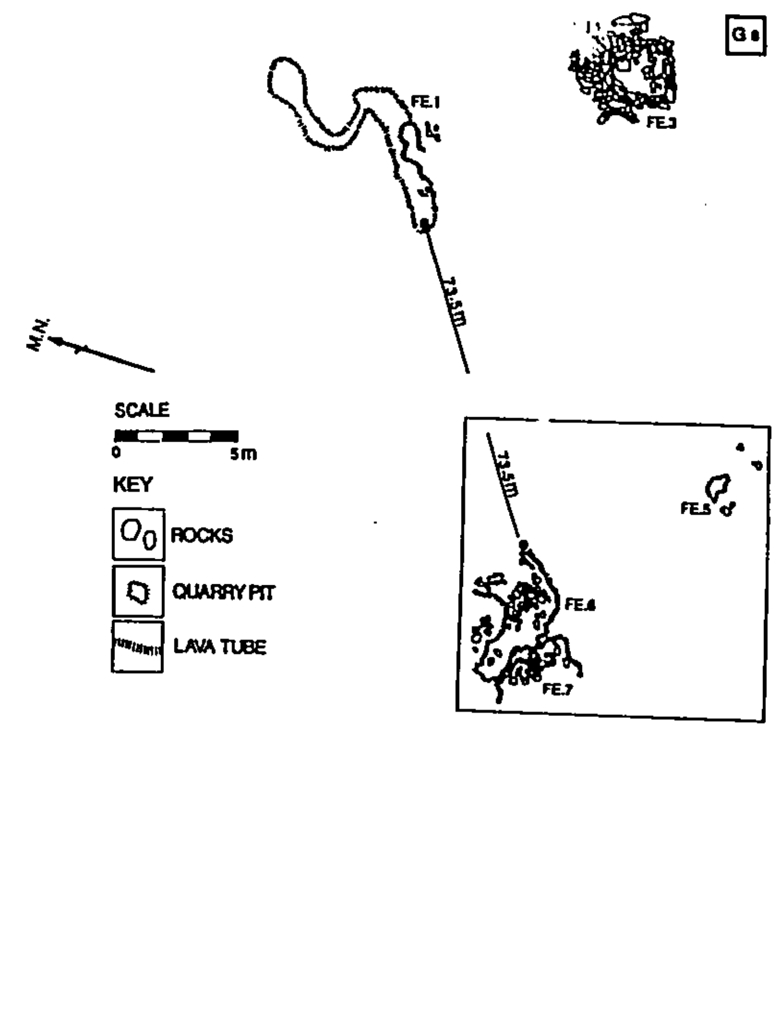


Fig. 11. STATE SITE 50-10-18-5341, PLANVIEW.

Fig. 12. STATE SITE 50-10-18-5341 (SITE 50-Ha-D21-57), FEATURE 1, LAVA TUBE. View to North. BH Neg. No. Ha(a) 671-8.

State Site 50-10-18-5342 (Site 50-Ha-D21-58)

This site is located in the northern section of the project area, approximately 777.24 m (2,550 ft) to 792.5 m (2,600 ft) from the coast at an elevation of 38.1 m (125 ft). It measures 7.6 m (25 ft) wide by 15.2 m (50 ft) long. The site is situated on the northeastern side of a small cinder cone at the boundary between the cinder cone and aa ridge (Fig. 13). Vegetation included fountain grass (frequent), *uhaloa* (frequent), *ihi* (frequent), *ilima* (frequent), threadstem carpetweed (frequent), *kiawe* (occasional), pink star (occasional), *Chenopodium* sp. (occasional), and *Pluchea* (rare).

Two features present at this site include a modified outcrop and a terrace. Feature 1 is a modified outcrop, which consists of a filled crevice between two accretionary boulders. Two pieces of coral were found on the surface.

Feature 2, a terrace, is located on the cinder cone approximately two meters west of the aa flow. The terrace was constructed of aa clinkers, has a soil floor, and measures 1.0 m in diameter and 0.3 m in height. No cultural material was observed.

State Site 50-10-18-5343 (Site 50-Ha-D21-59)

This site is situated approximately 579.1 m (1,900 ft) to 716.3 m (2,350 ft) from the coast at an elevation of 22.9 m (75 ft) to 38.1 m (125 ft), and measures 19.05 m (62.5 ft) by 144.78 m (475 ft). This site is located on the northeastern side of a small cinder cone at the boundary between the cinder and aa lava (Fig. 14).

Vegetation included *ihi* (frequent), *ilima* (frequent), threadstem carpetweed (frequent), *kiawe* (occasional), fountain grass (occasional), *uha* (occasional), mint (rare), and hairy merremia (isolate).

Fifteen features were recorded at this site, including four cupboards, five pits, two C-shaped shelters, two overhang shelters, one trail, and one wall. Recorded surface artifacts include one rounded, cobble hammerstone found inside a pit (Feature 14) (Fig. 15).

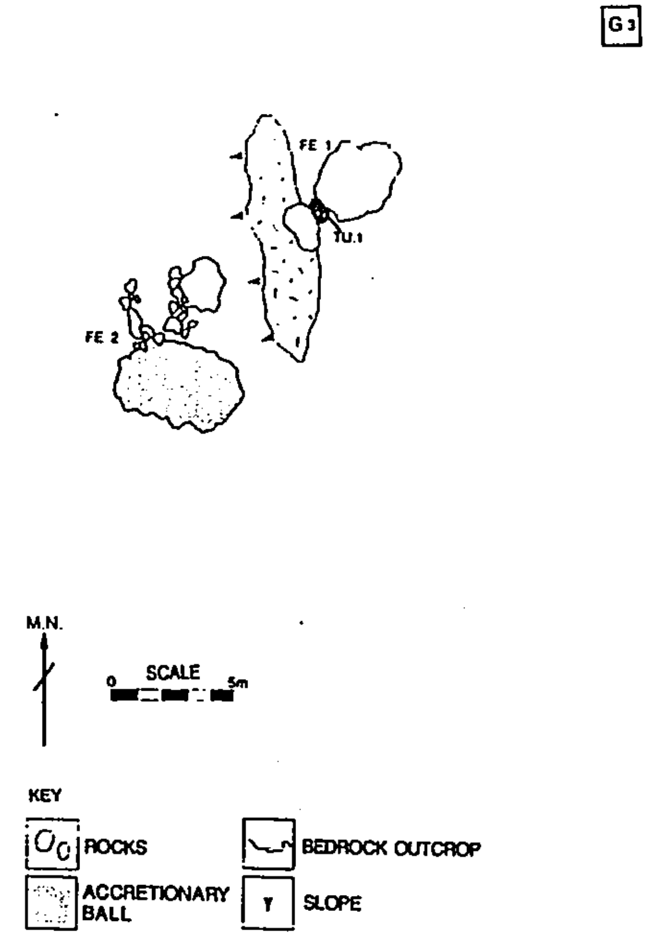


Fig. 13. STATE SITE 50-10-18-5342, PLANVIEW.

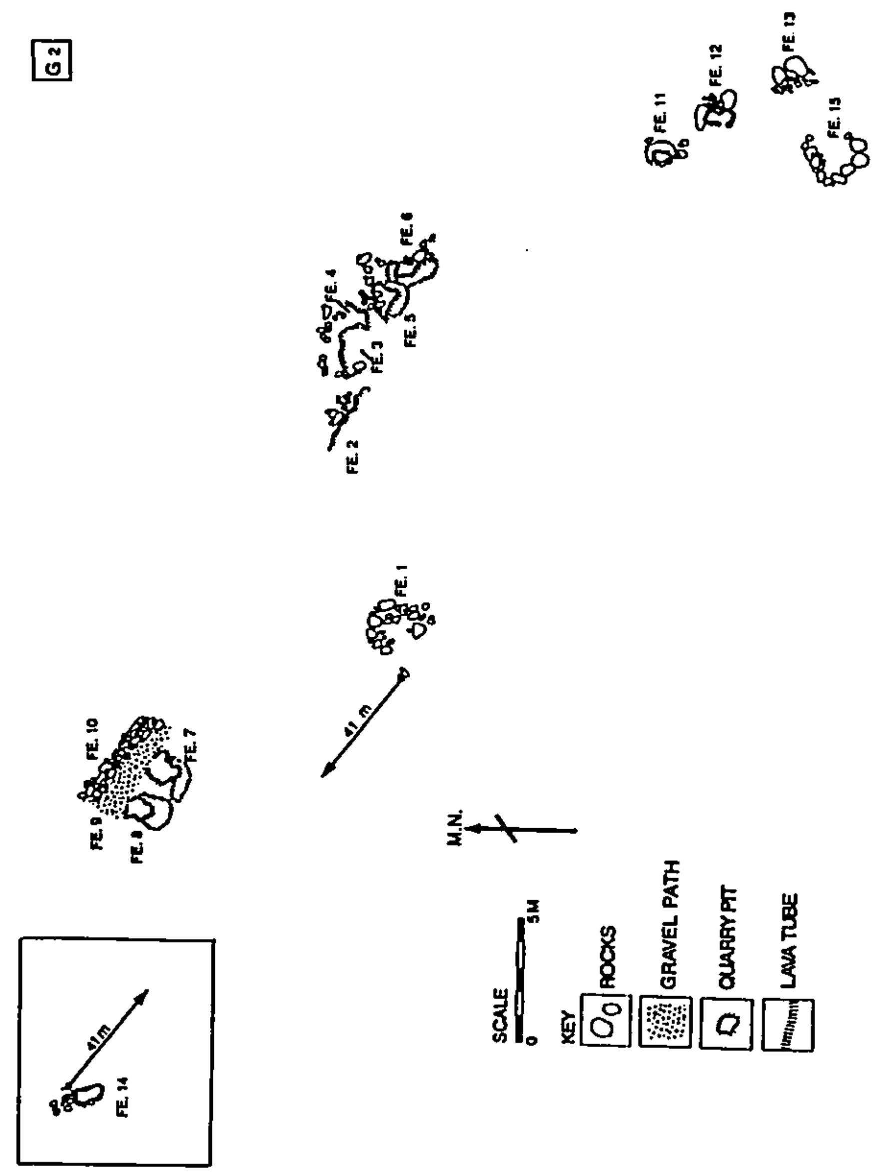


Fig. 14. STATE SITE 50-10-18-5343, PLANVIEW.

Fig. 15. STATE SITE 50-10-18-5343 (SITE 50-Ha-D21-57), FEATURE 7, PIT WITH HAMMERSTONE. View to South. BM Neg. No. Ha(a) 667-16.

Both C-shaped shelters were constructed of piled aa cobbles/boulders on a pahoehoe flow. Interior dimensions measure 1.5 m by 1.5 m, and the exterior dimensions measure 2.2 m by 2.2 m. The walls measure 0.4 m thick and 0.4 m high. The entrance of the structure is approximately 1.0 m wide and opens towards the small cinder cone.

Feature 2, an overhang shelter, measures 4.0 m by 0.8 m and 0.9 m in height (Fig. 16). Aa clinkers were removed from inside the shelter to form a level surface. Crabs claw fragments were found in the shelter wedged between rocks.

Feature 15, a C-shaped structure, is constructed on cinder. Interior dimensions measure 1.5 m by 1.5 m, and the exterior dimensions measure 3.0 m by 3.0 m. The walls measure 0.75 m to 1.0 m in thickness and 0.75 m height (see Fig. 15). The C-shape opens toward the coast (west).

Feature 13, an overhang shelter, measures 1.5 m in height and 0.7 m in depth. The floor of the shelter has been filled with gravel to the edge of the cinder.

Two cupboards (Features 3 and 4) are located in an aa ridge. The floor of the cupboards consisted of fine gravel and rodent bone fragments.

A wall (Feature 8) was constructed on the eastern side of the aa ridge where a trail (Feature 9) continues.

Feature 9 is a trail that extends along an aa ridge near the cinder cone. The trail was identified by worn aa gravels and pebbles.

Features 11 and 12 (cupboards) are located near Feature 13 (overhang shelter). Feature 11 was constructed by the removal the aa clinkers below an accretionary boulder to form an opening 0.6 m by 0.6 m in size and 0.42 m in height.

Feature 12 is a cupboard measuring 1.3 m by 1.0 in size and 0.6 m in height. It was constructed on the south side of two accretionary boulders. The crevice between the boulders was filled with aa cobbles and boulders.

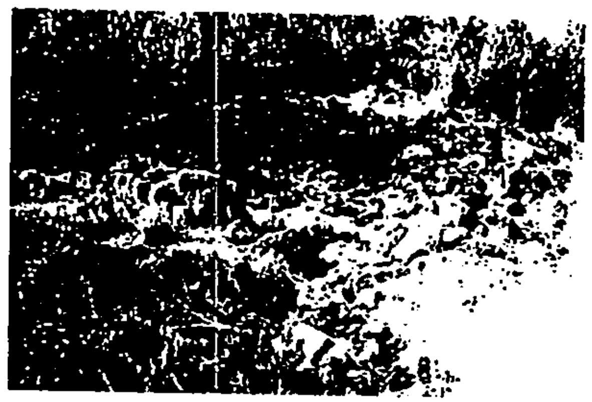


Fig. 16. STATE SITE 50-10-18-5343 (SITE 50-Ha-D21-57), FEATURE 3, TU1 RECTANGULAR ENCLOSURE. View to Southeast. BM Neg. No. Ha(a) 667-34.

State Site 50-10-18-5344 (Site 50-Ha-D21-60)

This site is located on a pahoehoe ridge surrounded by aa lava in the northwest portion of the project area (Fig. 17). It is 441.9 m (1,450 ft) to 502.9 m (1,650 ft) from the coast at an elevation of 15.2 m (50 ft) to 24.3 m (80 ft). It measures 76.2 m (250 ft) by 53.3 m (175 ft) in size. Vegetation included fountain grass (occasional), *kiawe* (rare), threadstem carpetweed (rare), *uha* (rare), swordfern (rare), *Pluchea* (rare), lovegrass (rare), *pili* grass (rare), and Guinea grass (isolate).

Five pit features were recorded at this site. Two rounded basalt cobble manuports were found at Feature 4.

State Site 50-10-18-5345 (Site 50-Ha-D21-61)

This site is located in aa lava in the northwest portion of the project area, approximately 487.7 m (1,600 ft) to 575.3 m (1,887.5 ft) from the coast at an elevation of 15.2 m (50 ft) to 22.9 m (75 ft). It measures 79.3 m (260 ft) by 18.3 m (60 ft) in size. Thirteen features were recorded, including eight pits, three lava tubes, one C-shaped shelter, and one cupboard (Fig. 18). Vegetation included fountain grass (rare) and swordfern (isolate).

Feature 5 is a lava tube, measuring 2.8 m by 1.45 m and 1.65 m in height. Marine shell was found on the surface in the cave. Several crab claw fragments were found near the entrance of the lava tube wedged between aa clinkers.

Feature 6 is a lava tube located in the aa. The floor was leveled by the removal of cobble and boulder-sized aa clinkers. The tube measures 1.8 m in width and 1.7 m in depth, and 0.8 m in height. No cultural material was observed.

Feature 7 is a lava tube located in the aa. At the eastern side of the entrance, piled cobbles and boulders forms a wall approximately 1.1 m high. The lava tube entrance is 2.3 m wide and 2.0 m high. The lava tube measures 3.5 m by 1.9 m and 2.0 m in height. A bone point (50-Ha-D21-61-0001) and crab claw fragments were found inside the tube. One rounded hammerstone was recorded on the surface approximately 5 m north of the lava tube.

A C-shaped shelter (Feature 10) was constructed on the aa. The walls, piled aa cobbles and boulders, measure 0.25 m to 0.50 m thick and 0.25 m to

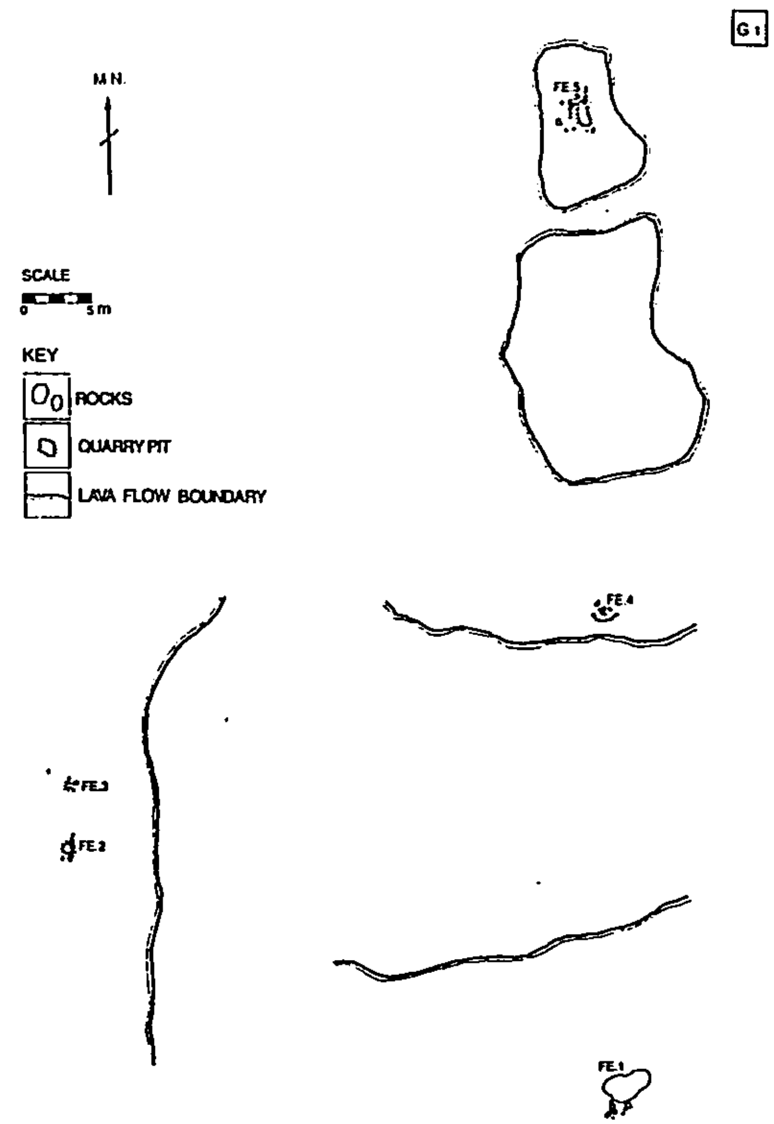


Fig. 17. STATE SITE 50-10-18-5344, PLANVIEW.

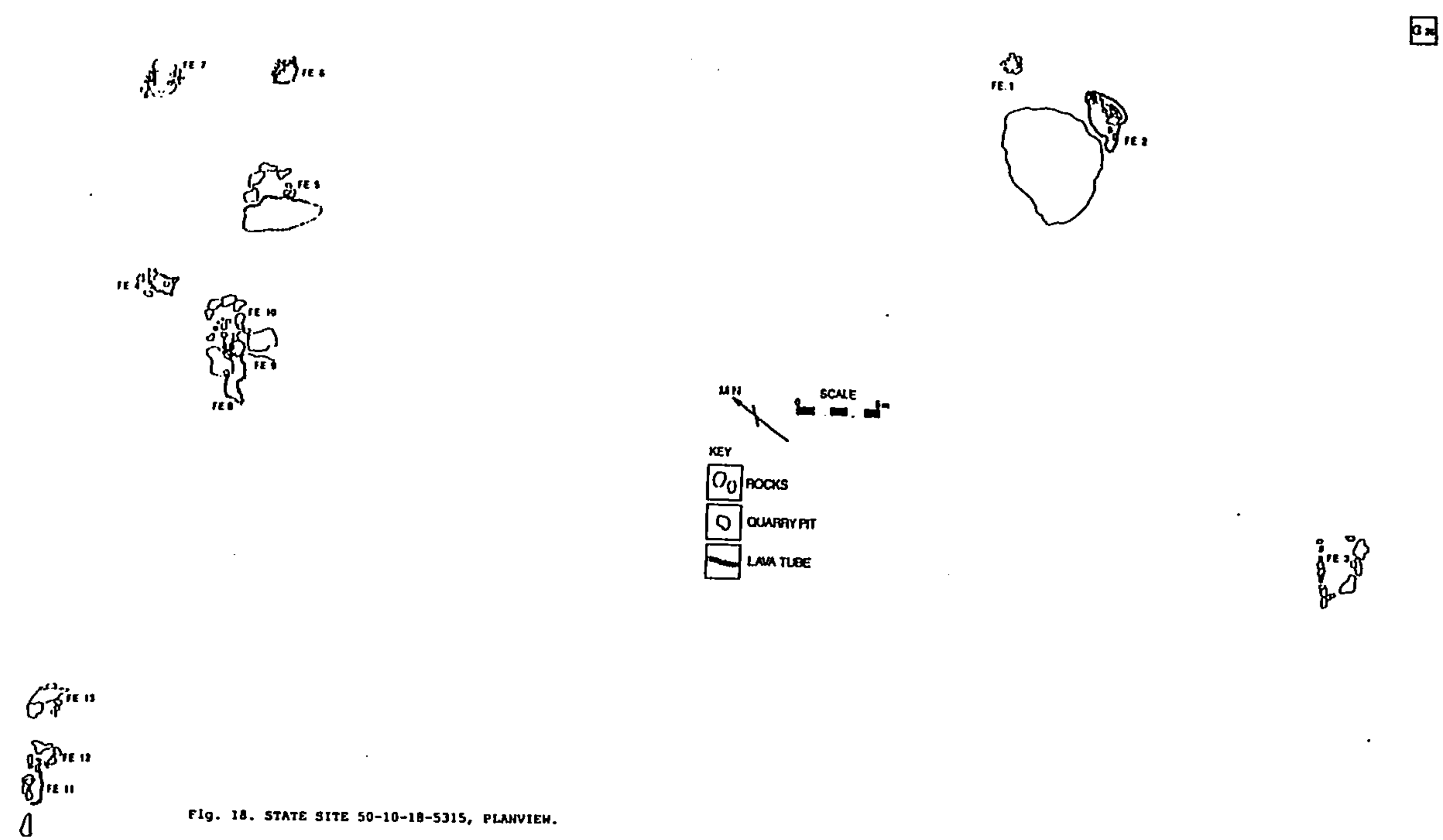


Fig. 18. STATE SITE 50-10-18-5315, PLANVIEW.

0.5 m high. The diameter of the structure is 1.15 m. The entrance (1.15 m wide) faces north. No cultural material was observed.

State Site 50-10-18-5346 (Site 50-Ha-D21-62)

This site is located on pahoehoe, approximately 327.7 m (1,075 ft) to 495.3 m (1,625 ft) from the coast at an elevation of 7.6 m (25 ft) to 33.5 m (110 ft). It measures 83.8 m (275 ft) by 144.8 m (475 ft) in size. Thirty-seven features were present, comprised of 29 pits, four lava tubes, two overhang shelters, one crevice, and one C-shaped shelter (Fig. 19, 20, and 21). Vegetation included fountain grass (frequent), *uha* (occasional), *ilima* (occasional), lovegrass (occasional), *kiawe* (rare), threadstem carpetweed (rare), *Pluchea* (rare), *pili* grass (rare), garden spurge (rare), natal redtop (rare), and *Ageratum* (rare).

Feature 6 is an overhang shelter, measuring 3.0 m wide, 2.0 m in depth, and 1.6 m in height. No cultural material was present.

Feature 8, a C-shape structure constructed of upright pahoehoe slabs leaned against each other to form a wall measuring 0.55 m high and 0.30 thick, measured 2.10 m wide at the entrance and 1.3 m in length. No cultural material was identified.

Hammerstones were found outside pit Features 21, 32, and 36. Pumice was found inside pit Feature 33, and isolated piece of coral was found outside pit Feature 12.

Of the two overhang shelters present at this site, only Feature 12 contained cultural material, an isolated piece of coral. This shelter measured 1.25 m wide at the entrance, 1.00 m in length, and 1.40 m in height. A thin deposit of silt covered the floor.

State Site 50-10-18-5347 (Site 50-Ha-D21-63)

This site is located on aa lava in the northwest portion of the project area, approximately 304.7 m (1,000 ft) from the coast at an elevation of 6.1 m (20 ft), and measured 91.4 m (300 ft) by 114.3 m (375 ft). Nineteen features were recorded, including 12 pits, 3 modified outcrops, 2 cupboards, 1 overhang shelter, and 1 enclosure (Fig. 22). Cultural material recorded includes

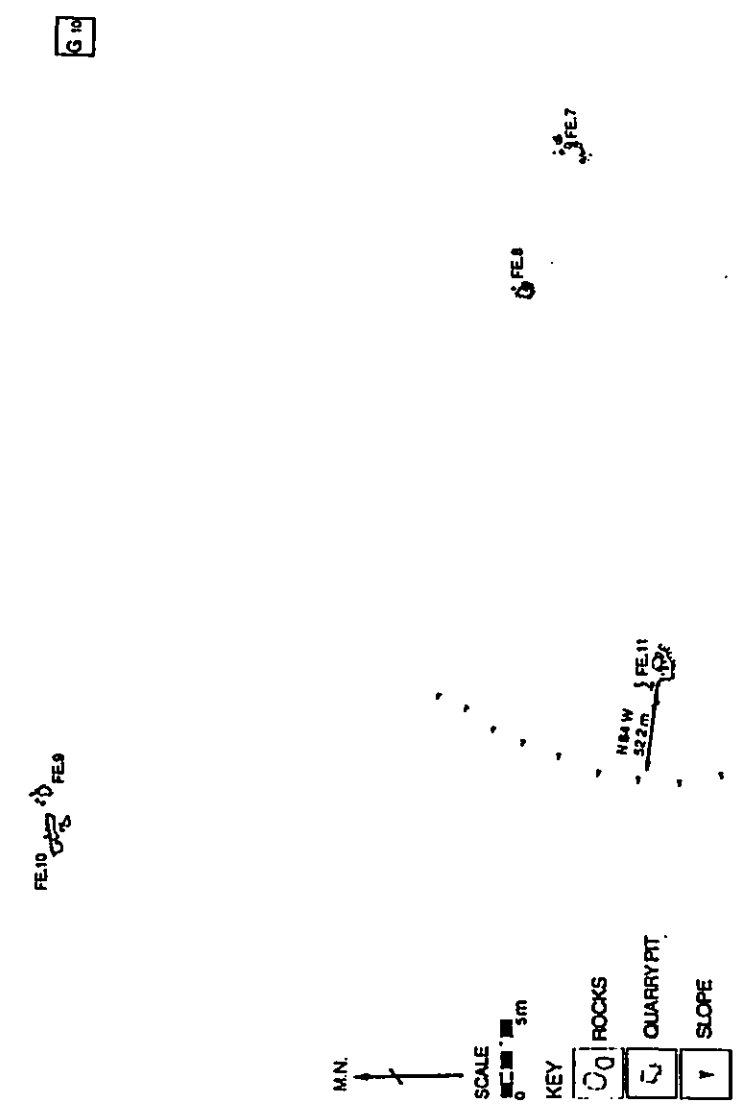


Fig. 19. STATE SITE 50-10-18-5346, PLANVIEW OF FEATURES 7 THROUGH 11.

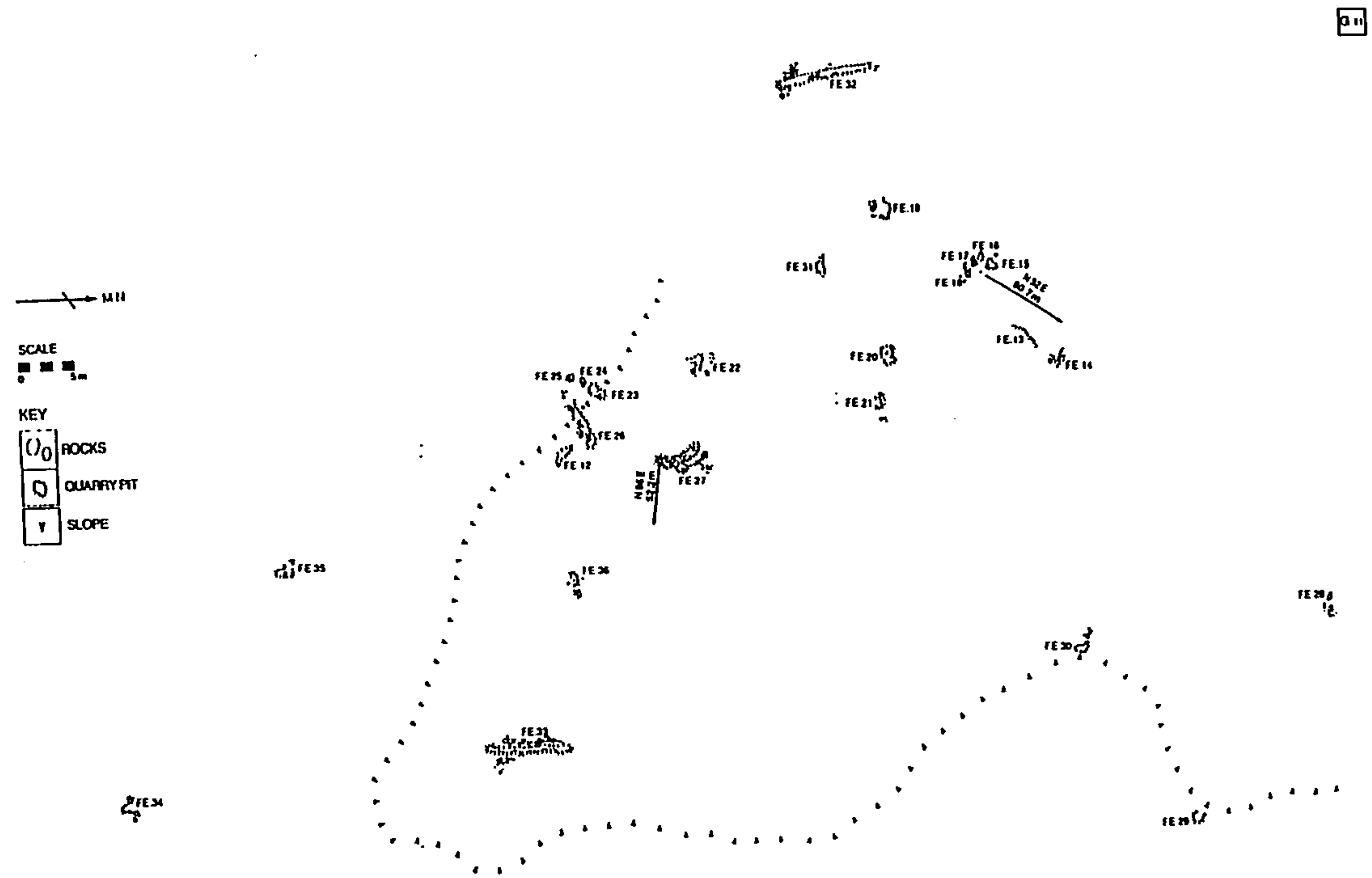


Fig. 20. STATE SITE 50-10-18-5346, PLANVIEW OF FEATURES 12 THROUGH 36.

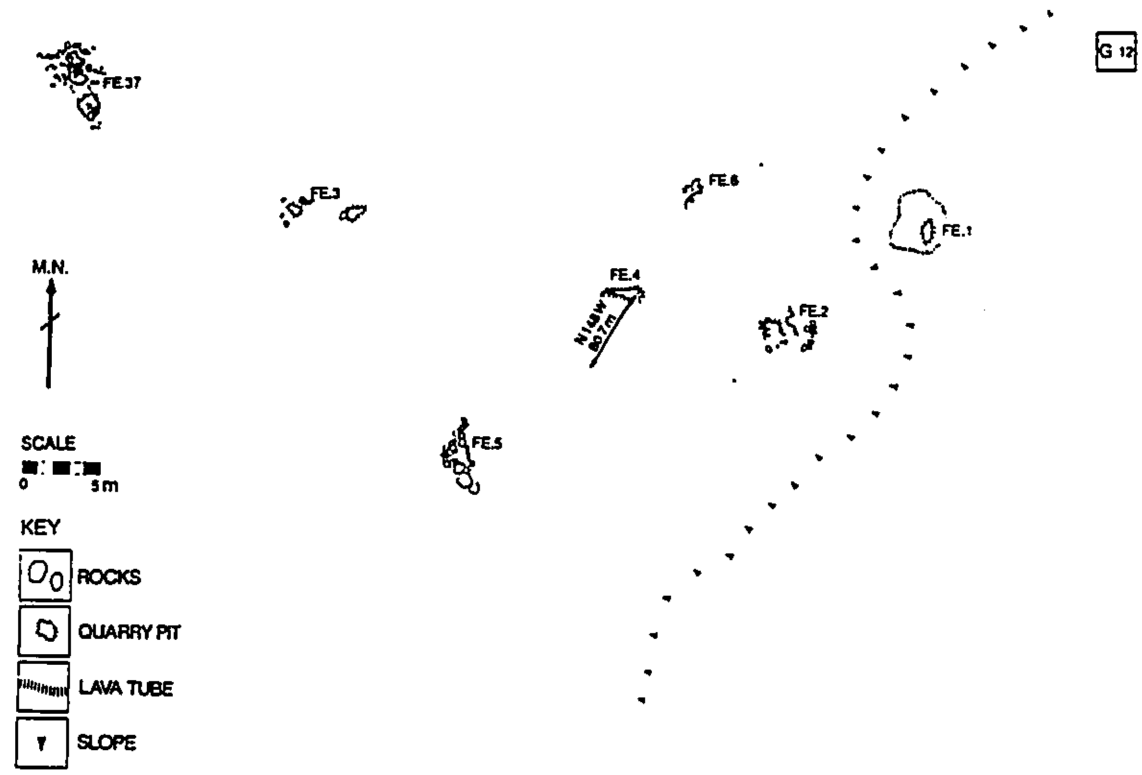


Fig. 21. STATE SITE 50-10-18-5346, PLANVIEW OF FEATURES 1 THROUGH 6 AND 37.

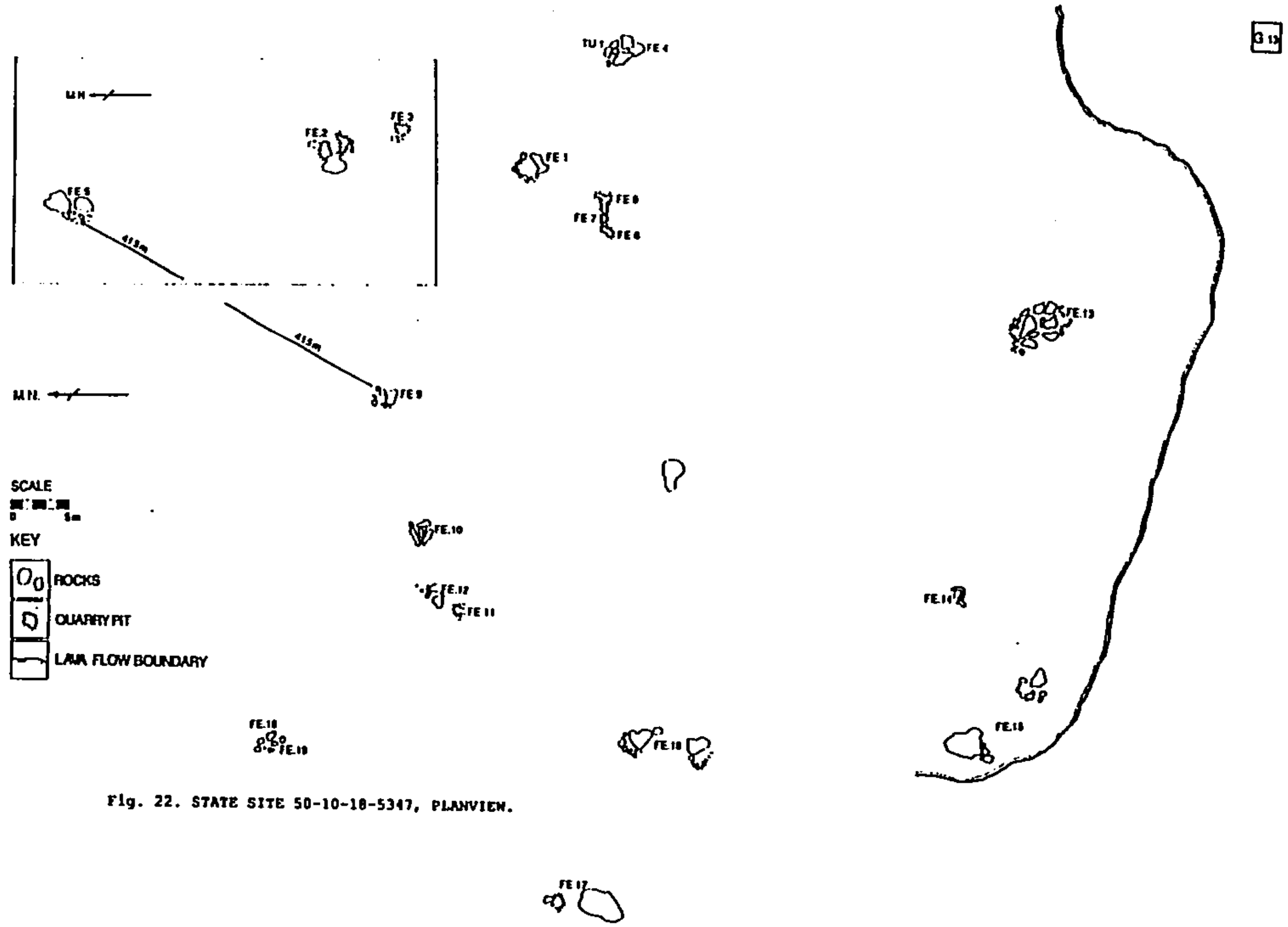


Fig. 22. STATE SITE 50-10-18-5347, PLANVIEW.

sparse marine shell inside Feature 10 (cupboard), and two pieces of coral and one marine shell inside Feature 15 (pit). Vegetation included fountain grass (rare).

An oval-shaped enclosure (Feature 1), constructed of piled aa boulders/cobbles, measured 4.7 m by 4.1 m. The walls measured 0.45 to 1.30 m high and approximately 0.8 m thick. Cobbles and boulders had been removed from the interior, creating a leveled surface.

Feature 4, an overhang shelter, was formed when an accretionary boulder split in half. The floor was leveled by the removal of rocks. The shelter measured 1.8 m by 1.5 m and 0.80 m in height. A test unit was placed on the floor of the shelter (see Excavation Results).

Feature 9, a modified outcrop, consisted of an oval-shaped wall constructed of piled cobbles and boulders. The exterior of the structure measured 2.0 m by 1.7 m and the interior measured 1.0 m by 1.3 m. The wall measured 0.4 to 0.6 m thick and 0.4 to 0.6 m high. Boulder and cobble-sized rocks had been removed from the interior of the structure, forming a leveled surface.

Feature 12, a modified outcrop, consisted of an oval-shaped wall. The piled rock wall incorporated the northern side of an accretionary boulder. The exterior of the structure measured 1.6 m by 1.2 m and the interior measured 1.25 m by 0.85 m. The wall was approximately 0.35 m thick and 0.8 m high. Boulder and cobble-sized rocks were removed from inside the structure, forming a leveled surface.

Feature 13, a modified outcrop, consisted of a fractured accretionary boulder, which formed sheltered areas in the crevices. No cultural material was observed.

Feature 16, a modified outcrop, consisted of an oval-shaped wall. The piled wall incorporated the west side of a accretionary boulder. The exterior dimension of the structure measured 2.2 m by 1.6 m and the interior dimension measured 1.4 m by 1.1 m. The wall was approximately 0.4 m to 0.5 m thick and 0.3 to 0.4 m high. Boulders and cobbles had been removed from the structure, forming a leveled surface.

State Site 50-10-18-5348 (Site 50-Ha-D21-64)

This site occurs on pahoehoe in the western portion of the project area, approximately 152.4 m (500 ft) by 228.6 m (750 ft) in size, 335.3 m (1,100 ft) to 487.7 m (1,600 ft) from the coast, and 15.2 m (650 ft) to 38.1 m (125 ft) in elevation. Vegetation included fountain grass (frequent), *kiawe* (occasional), *uha* (occasional), *ilima* (occasional), *Ageratum* (occasional), natal redtop (rare), garden spurge (rare), *ihi* (rare), *Pluchea* (rare), threadstem carpetweed (rare), *pili* grass (rare), and *alena* (isolate).

Fifty-four feature designations were assigned to this site including 41 pits, one crevice, two overhang shelters, two lava sinks (collapsed lava tubes), one C-shaped shelter, one modified outcrop, one enclosure, one mound, one trail, and three lava tubes (Fig. 23). Artifacts recorded include four rounded, cobble hammerstones, one grindstone, and one adze (50-Ha-D21-064-0001).

Twelve pits had associated cultural materials (artifacts and/or midden). Rounded, smooth, basalt cobble hammerstones were found inside Features 12 and 29 and outside Features 10 and 33. A basalt grindstone was recorded on the surface, approximately 1.5 m between Features 20 and 21. Sparse marine shell was recorded outside Features 14, 18, 26, 48, and inside Features 24 and 37. Midden consisted primarily of cowrie (*Cypraea* spp.) and sparse *Nerita picea* and *Thais* spp.

Features 1-4, 2 lava sinks, a pit, and a lava tube, contained 11 human burials as well as habitation features. Results of investigations (survey and test excavations) at this feature will be provided in an appended report available through the State Historic Preservation Division, Department of Land and Natural Resources.

Feature 17, a lava tube, consisted of five quarried entrances, which ranged in size from 0.45 m by 0.36 m to 1.8 m by 0.65 m. One rounded basalt cobble manuport was found inside the eastern portion of the tube. Sparse marine shell, consisting of cowrie (*Cypraea* spp.) and an isolated drupa (*Thaididae*), was scattered on the surface.

Feature 24, a lava tube with a quarried entrance, measured 20 by 0.6 m and 0.5 m in height. An isolated marine shell was found on the surface.

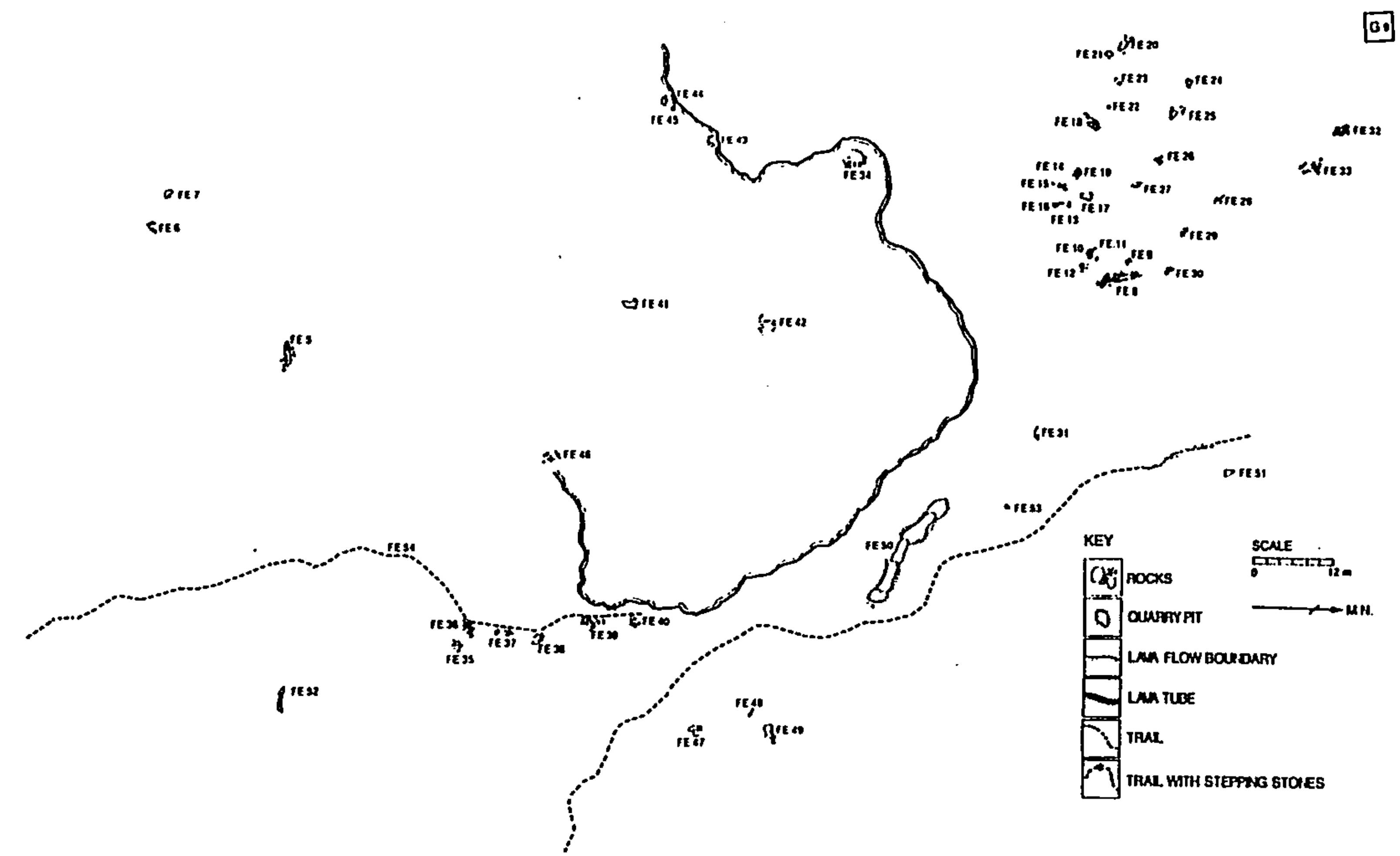


Fig. 23. STATE SITE 50-10-18-5348, PLANVIEW OF FEATURES 5 THROUGH 54.

Feature 34, an oval-shaped enclosure, was constructed of piled boulders and cobbles. The interior of the enclosure measured 1.3 m by 1.25 m. The wall measured 1.45 m in height and 0.3 m in thickness. A rounded, cobble basalt hammerstone was found about 4.0 m south of the enclosure.

Feature 34, a lava tube with a collapsed central portion and short tube segments extending both north and south from the collapsed portion, measured 19.8 m by 3.1 m and 3.1 m in height. Two small entrances are located on the southern end of the tube, measuring 2.4 m by 1.9 m and 0.5 m by 0.4 m in size. Moderate quantities of surface midden, including marine shell (*Cypraea* spp., *Nerita picea*, and *Conus* spp.), sea urchin, and fish bone, were observed throughout both tube segments.

Feature 41, a mound, was constructed of piled pahoehoe slabs, measuring 0.8 m in diameter and 0.5 m in height.

Feature 42, a modified outcrop, measured 2.4 m in diameter. Rocks were piled, approximately 0.5 to 0.75 m high, forming a C-shape. Sparse marine shell was observed on the surface.

Feature 47, an overhang shelter with a wall (2.0 m long, 0.5 m high, and 0.5 m thick) located at the entrance of the shelter, measured 3.0 m in wide and 1.65 m in depth, and 0.8 m in height.

Feature 51, a C-shaped shelter, was constructed of piled boulder and cobble pahoehoe slabs. It measured 2.4 m by 1.0 m in size. The walls measured 0.60 to 0.66 m in height and 0.65 m in thickness. Sparse marine shell and a rounded, basalt cobble manuport were observed on the surface.

Feature 52, an overhang shelter, contained a surface scatter of marine shell, including *Cypraea* spp., *Norita picea*, and *Drupa ricina*. The shelter measured 4.3 m in width, 1.5 m in depth, and 2.2 m in height. No cultural material was observed.

Feature 53, a lava tube, measured 2.5 m by 1.0 m and 1.20 m in height. A polished basalt adze (50-D21-064-0001) and a rounded basalt cobble manuport were found on the surface.

State Site 50-10-18-5349 (Site 50-Ha-D21-65)

This site, located on pahoehoe in the middle of the project area, is approximately 792.5 m (2,600 ft) to 914.4 m (3,150 ft) from the coast at an elevation of 40.5 m (133 ft) to 53.3 m (175 ft). It measured 175.26 m (575 ft) by 167.64 m (550 ft) in size. Vegetation included fountain grass (frequent), *kiawe* (occasional), and *pili* grass (rare).

Forty-six features were recorded at this site, including 41 pits and five lava tubes (Fig. 24).

One basalt cobble manuport was recorded near pit Feature 45.

Cultural material was found inside all five lava tubes. Sparse marine shell was scattered on the surface in Feature 39. One piece of coral and bird bone was also found on the surface. The lava tube measured 40.0 m by 1.8 m and 1.43 m in height. Extensive looting was evident in this feature.

Feature 40, a lava tube, contained sparse surface marine shell near the entrance. The lava tube measured 15.0 m by 2.3 m and 1.5 m in height.

Feature 41, a lava tube, contained surface midden. Looting occurred at this site, evident from the disturbed nature of the midden and recent historic refuse (beer bottles). Two basalt flakes and volcanic glass were recorded outside the entrance. Two coral fragments, one rounded, basalt cobble hammerstone and one rounded, basalt pebble, were also found outside the feature.

Feature 43, a lava tube with one main chamber, which divides into two small tube segments, contained abundant midden, including sea urchin, cowrie, and bird and rodent bones. The main chamber measured 8 m by 4 m and 0.8 m in height. The entrance of the tube, measuring 1.8 m by 1.8 m, was modified.

Scattered cowrie shells and one rounded, basalt cobble manuport were recorded inside Feature 27 (lava tube) on the surface.

State Site 50-10-18-5350 (Site 50-Ha-D21-66)

This site is located on pahoehoe in the southeast portion of the project area (Fig. 25). It is approximately 1,356.3 m (4,450 ft) to 1,363.9 m (4,475 ft) from the coast at an elevation of 76.2 m (250 ft), and measures

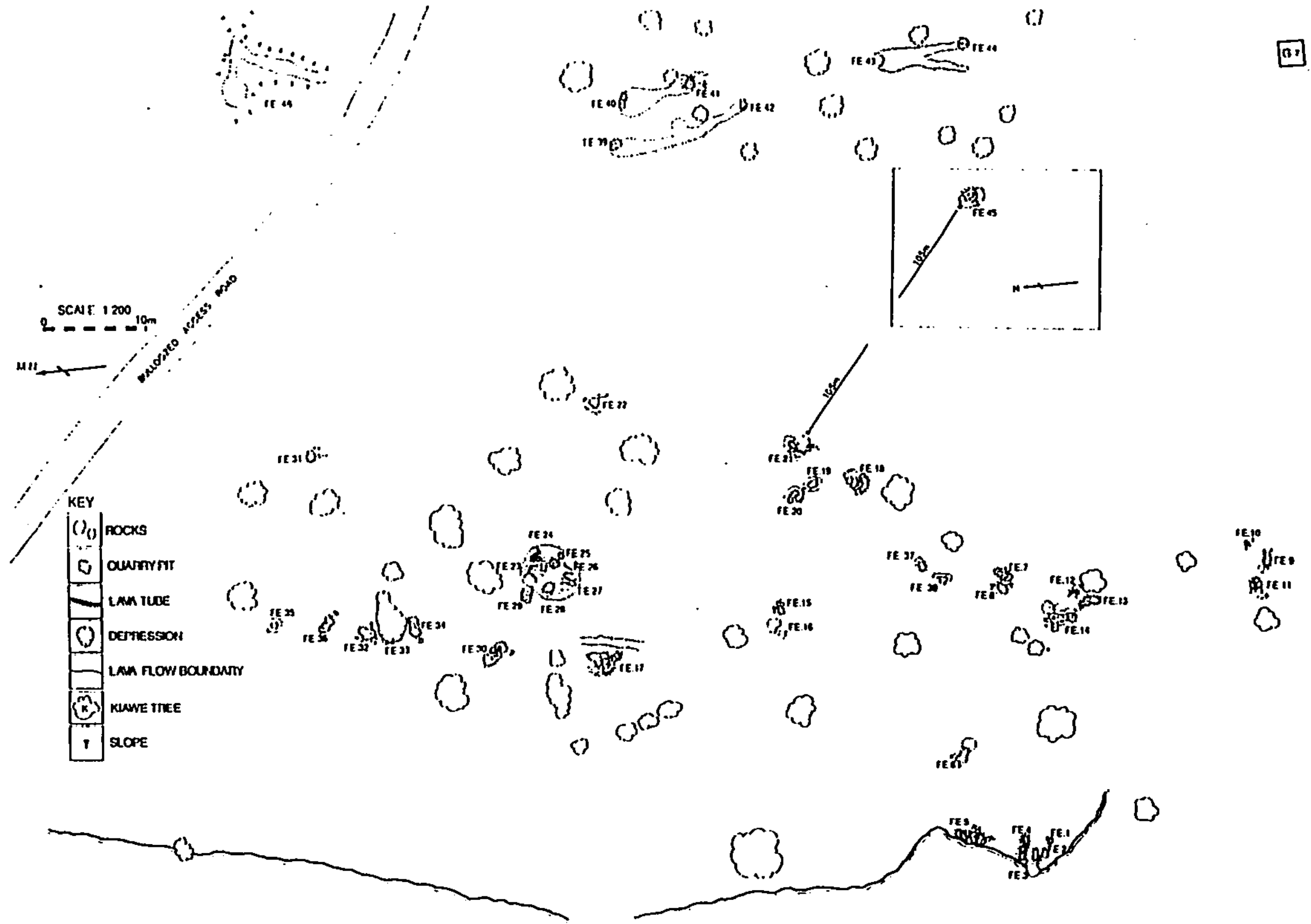


Fig. 24. STATE SITE 50-10-18-5349, PLANVIEW.

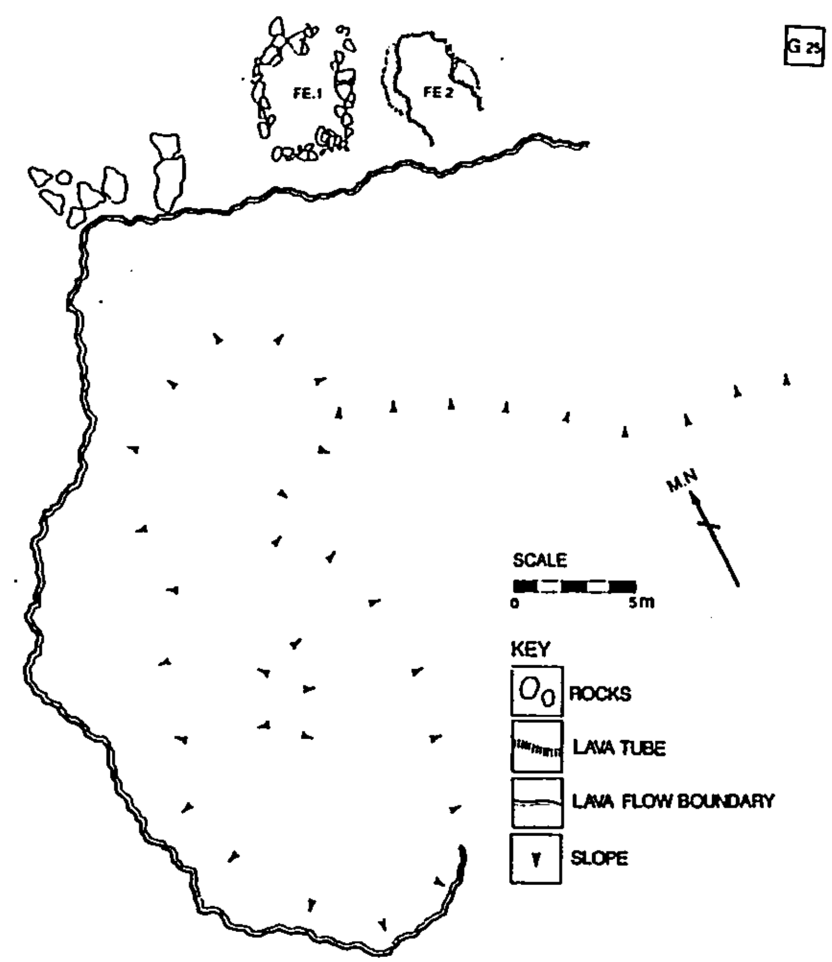


Fig. 25. STATE SITE 50-10-18-5350, PLANVIEW.

53.54 m (175 ft) by 38.1 m (125 ft). Vegetation included fountain grass (occasional) and *kiawe* (occasional).

Two features, a rectangular enclosure and a lava tube, were recorded at this site. Marine shell was found in both features.

Feature 1, a rectangular enclosure, was constructed of piled pahoehoe slabs. Occasional marine shell and one coral cobble manuport were found on the surface in the structure. The enclosure measured 3.0 m by 2.7 m, and the walls measured 0.45 m by 0.45 m.

Feature 2, a lava tube shelter, contained scattered marine shell. The lava tube measured 8.2 m in length and 6.0 m in width. Much of the lava tube had collapsed.

<u>State Site 50-10-18-5351 (Site 50-Ha-D21-67)</u>

This site is a *mauka-makai* steppingstone trail on an aa flow located in the southern section of the project area (Fig. 26). The trail, measuring 678.18 m (2,225 ft) in length, was identified by pahoehoe slabs, waterworn cobbles, and worn aa pebbles/cobbles. Vegetation included fountain grass (occasional) and *kiawe* (rare).

<u>State Site 50-10-18-5352 (Site 50-Ha-D21-68)</u>

This site is located in the southeast portion of the project area. It is approximately 1,047.75 m (3,437.5 ft) from the coast, 68.58 m (225 ft) in elevation, and measures 30.48 m (100 ft) by 68.58 m (225 ft) in size. Four features were recorded, including two pits, a pavement, and a cupboard that contains a burial (Fig. 27). Vegetation included fountain grass (rare), threadstem carpetweed (rare), lovegrass (isolate), indigo (isolate), and *puahala* (isolate).

Feature 1 and 3, modified outcrops, were identified by quarrying.

Feature 2, a cupboard, contained a burial (see appendix report for details). The cupboard was constructed by the removal of aa clinkers. The interior dimensions measured 1.0 m in length, 0.5 m in width, and 0.8 m in height.

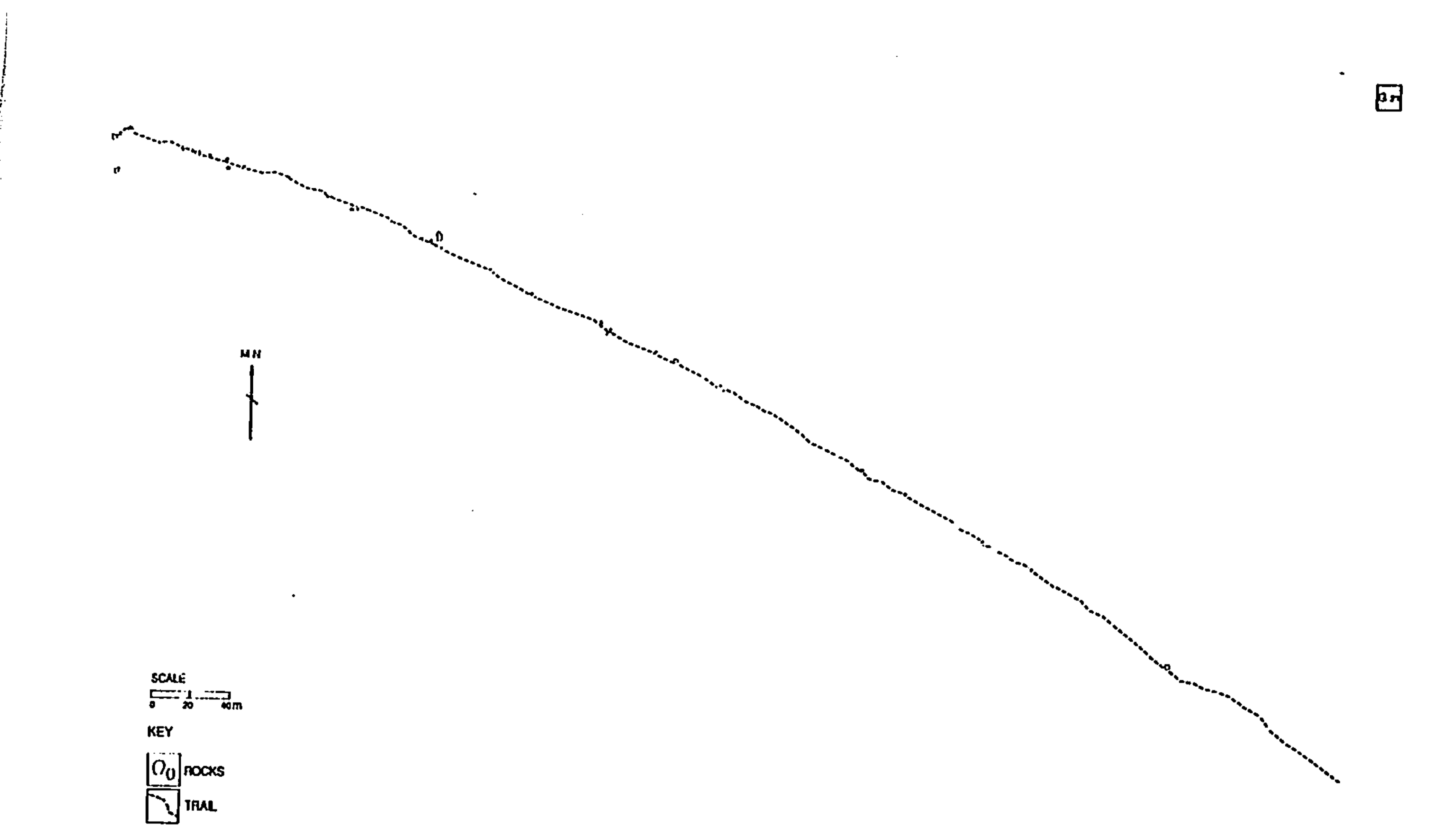


Fig. 26. STATE SITE 50-10-18-5351, PLANVIEW.

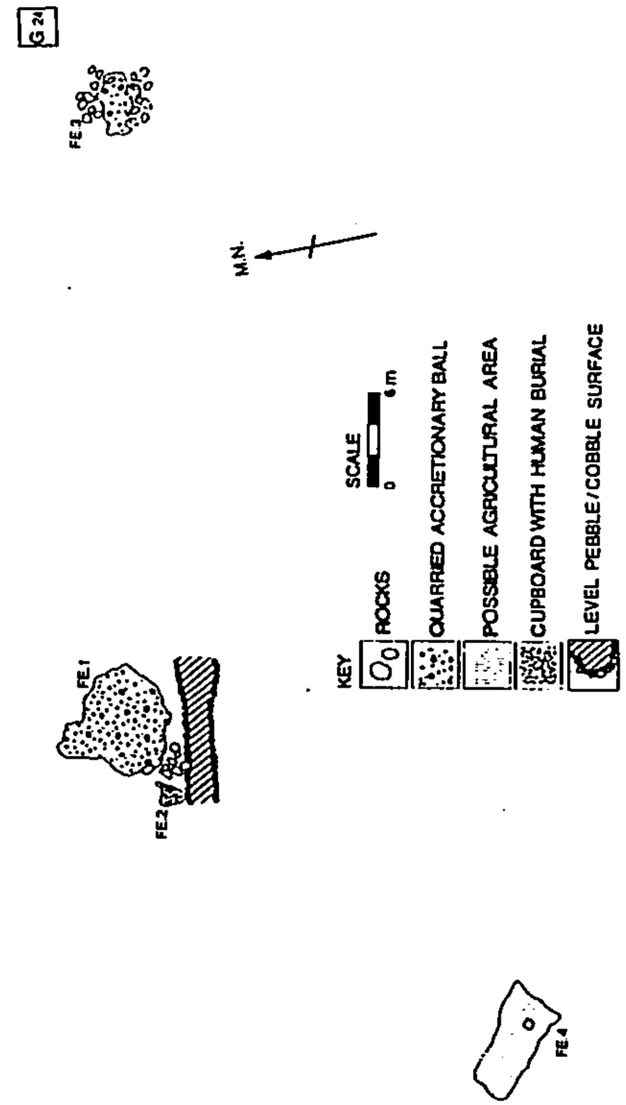


Fig. 27. STATE SITE 50-10-18-5352, PLANVIEW.

Feature 4, a modified outcrop, measured 5.0 m by 5.3 m. Cobbles/boulders were removed, forming a leveled area.

State Site 50-10-18-5353 (Site 50-Ha-D21-69)

This site is located in the southwest portion of the project area near the base of Kuili. It measures 784.6 m (2,575 ft) to 883.6 m (2,900 ft) from the coast, 53.54 m (175 ft) in elevation, and 22.8 m (75 ft) by 64.8 m (212.5 ft) in size. Four features recorded include two terraces and two cupboards (Fig. 28). Vegetation included fountain grass (occasional), *kiawe* (rare), and *ilima* (rare).

A two-tiered terrace is located on the southwest corner of the aa flow. Feature 1, a terrace, measures 3.0 m by 1.8 m in size. Feature 2, a terrace, measures 2.4 m by 1.4 m in size. Both terraces were faced with pahoehoe slabs and leveled. Scattered drupe shells were identified on Feature 2.

Feature 3, a cupboard, was constructed by the removal of aa clinkers. It measured 1.0 m by 0.8 m and 0.8 m in depth.

Feature 4, a cupboard, was constructed by the removal of aa clinkers adjacent to an accretionary boulder.

State Site 50-10-18-5354 (Site 50-Ha-D21-70)

This site consists of two lava tubes formed in pahoehoe lava (Fig. 29, 30). It is located in the western portion of the project area, approximately 365.8 m (1,200 ft) to 407.7 m (1,337.5 ft) from the coast, 30.5 m (100 ft) to 38.1 m (125 ft) in elevation, and 28.9 m (75 ft) by 7.6 m (25 ft) in size. Vegetation included fountain grass (frequent), *kiawe* (occasional), *pili* grass (occasional), threadstem carpetweed (rare), *ihi* (rare), *uha* (rare), lovegrass (rare), and garden spurge (rare).

Feature 1, a lava tube, measured 6.0 m by 4.0 m and 0.60 m in height. Marine shell and one coral cobble manuport were scattered on the surface of the lava tube near the entrance.

Feature 2, a lava tube with four entrances, measured 7.5 m by 4.5 m and 0.7 m in height. Sparse marine shell was located both inside and outside the

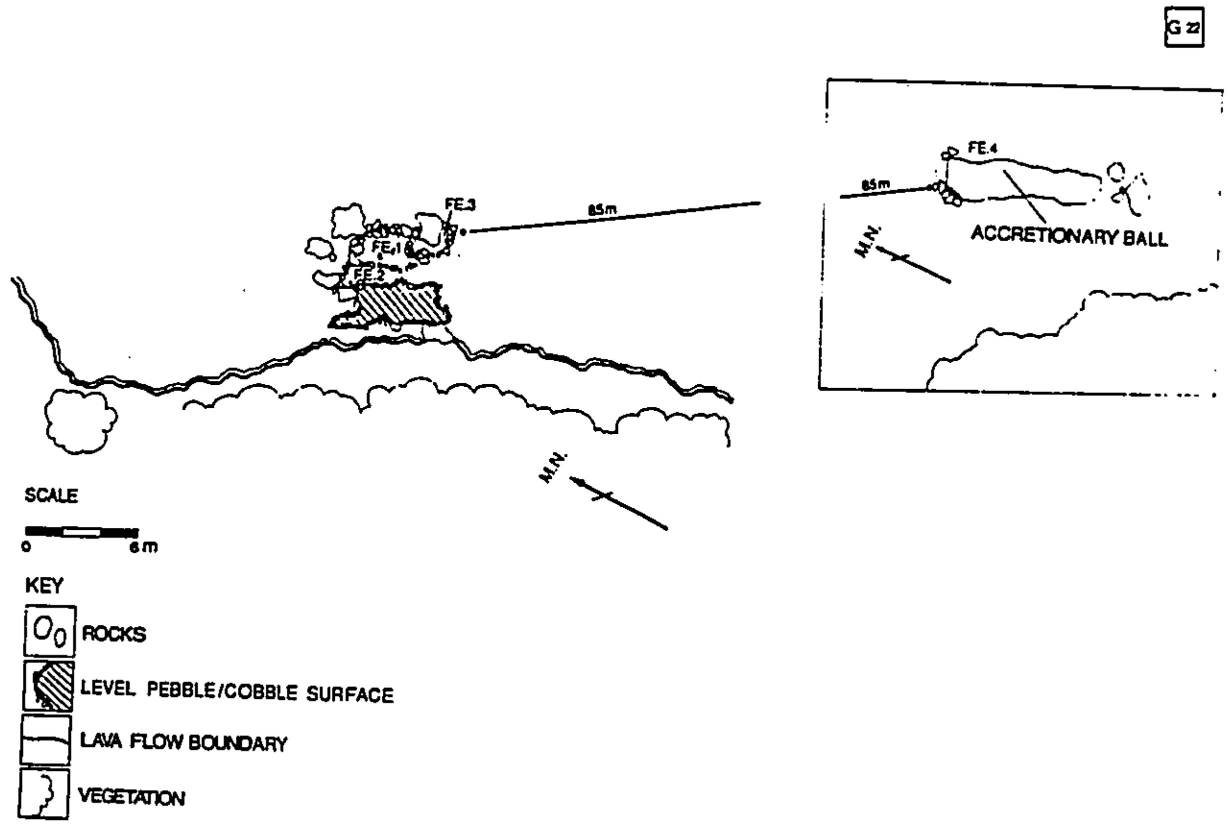


Fig. 28. STATE SITE 50-10-18-5353, PLANVIEW.

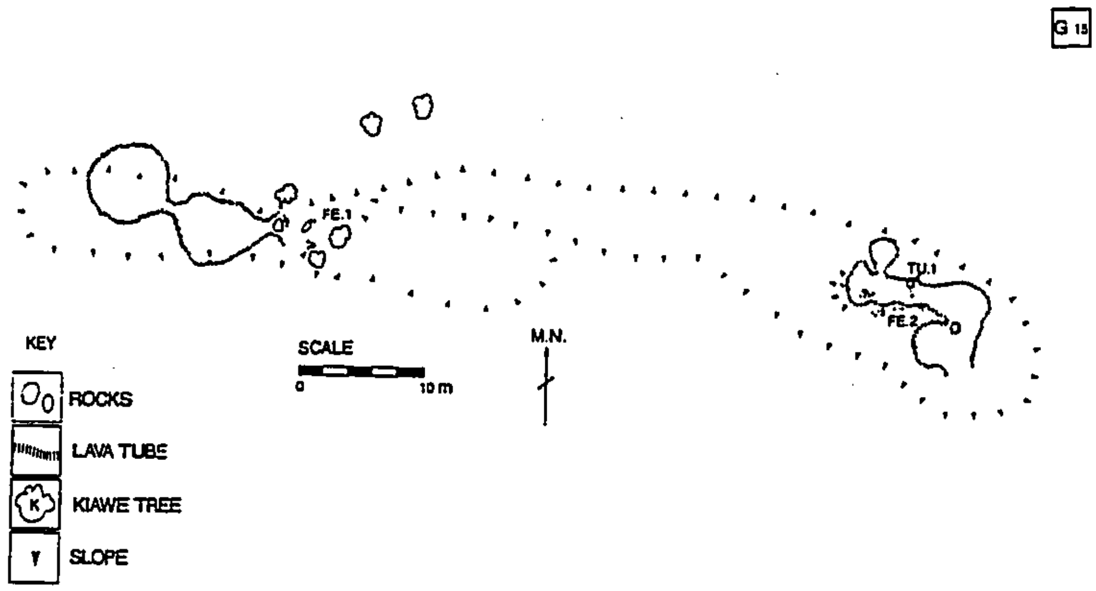


Fig. 29. STATE SITE 50-10-18-5354, PLANVIEW.

Fig. 30. STATE SITE 50-10-18-5354, OVERVIEW.
View to East. BH Neg. No. Ha(a) 662-25.

lava tube. A test unit was excavated inside the western entrance of the lava tube into a midden deposit (see Excavation Results). A waterworn basalt grindstone (not collected) was located nearby among a small cache of beach cobbles.

State Site 50-10-18-5355 (Site 50-Ha-D21-71)

This site is located in the western portion of the project area on pahoehoe lava (Fig. 31, 32). It is approximately 388.6 m (1,275 ft) to 407.7 m (1,337.5 ft) from the coast at an elevation of 30.5 m (100 ft) to 38.2 m (125 ft), and measures 22.9 m (75 ft) by 22.9 m (75 ft). Two features were recorded, including a modified outcrop and a platform. Vegetation included fountain grass (abundant), *kiawe* (occasional), *pili* grass (occasional), *ilima* (rare), uha (rare), and *aalii* (isolate).

Feature 1, a modified outcrop, consisted of piled pahoehoe boulders and cobbles, forming a mound. A quarried depression was located on top of the mound, measuring 3.3 m by 0.9 m. Cultural material recorded included one grindstone and two rounded basalt, cobble manuports. Approximately 20 pieces of coral were scattered on the surface. One test unit (TU 1) was excavated into this feature (see Excavation Results).

Feature 2, a platform, was constructed of piled pahoehoe slabs forming a mound 4.55 m by 4.53 m and 0.85 m in height. Cultural material on the surface of the platform included three rounded, basalt cobble manuports, basalt flakes, coral (including branch coral), and marine shell (including cowrie shells and conus shells).

State Site 50-10-18-5356 (Site 50-Ha-D21-72)

This site is located in the southwest portion of the project area, approximately 365.8 m (1,200 ft) to 377.19 m (1,237.5 ft) from the coast at an elevation of 30.5 m (100 ft) to 38.1 m (125 ft). The site measured 7.6 m (25 ft) by 11.4 m (37.5 ft) and consists of two pits quarried along a crevice (Fig. 33). No cultural material was recorded.

Vegetation included fountain grass (occasional), *ihi* (rare), *uha* (rare), and *pili* grass (rare).

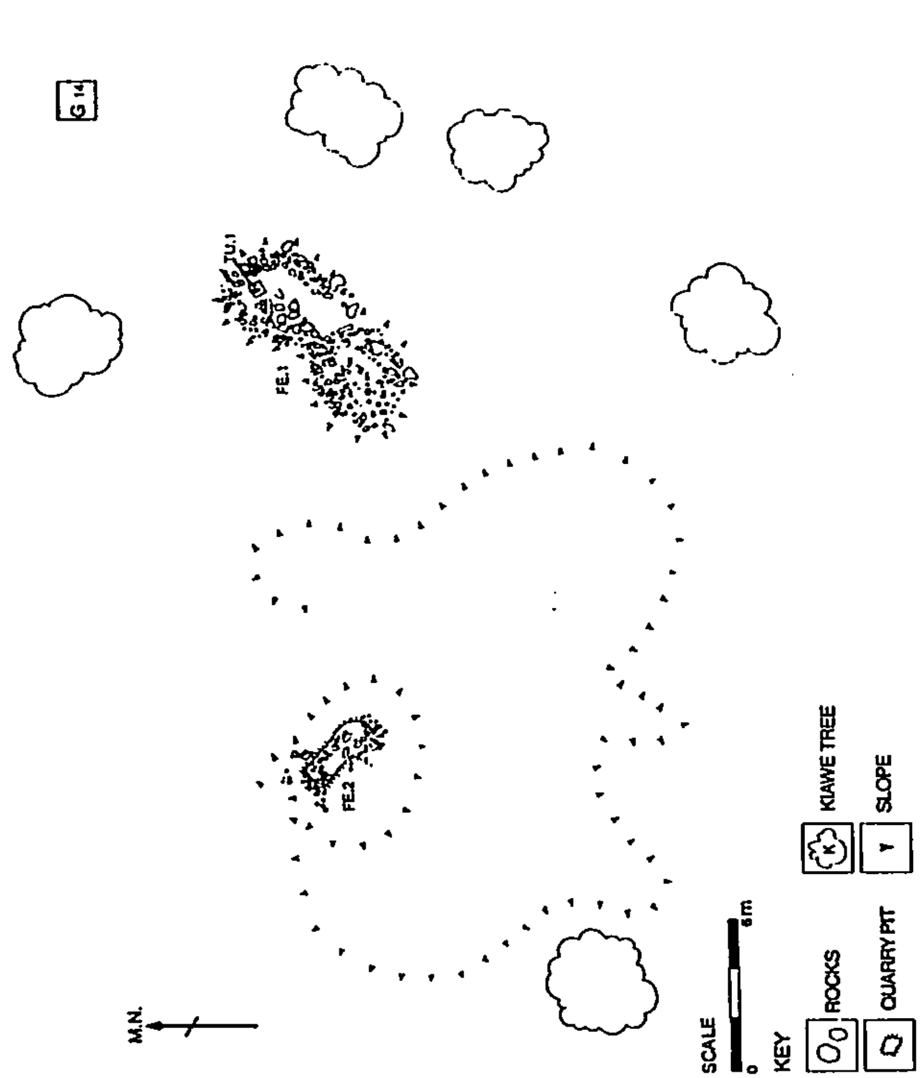


Fig. 31. STATE SITE 50-10-18-5355, PLANVIEW.

Fig. 32. STATE SITE 50-10-18-5355, OVERVIEW.
View to East. BM Neg. No. Ha(a) 662-27.

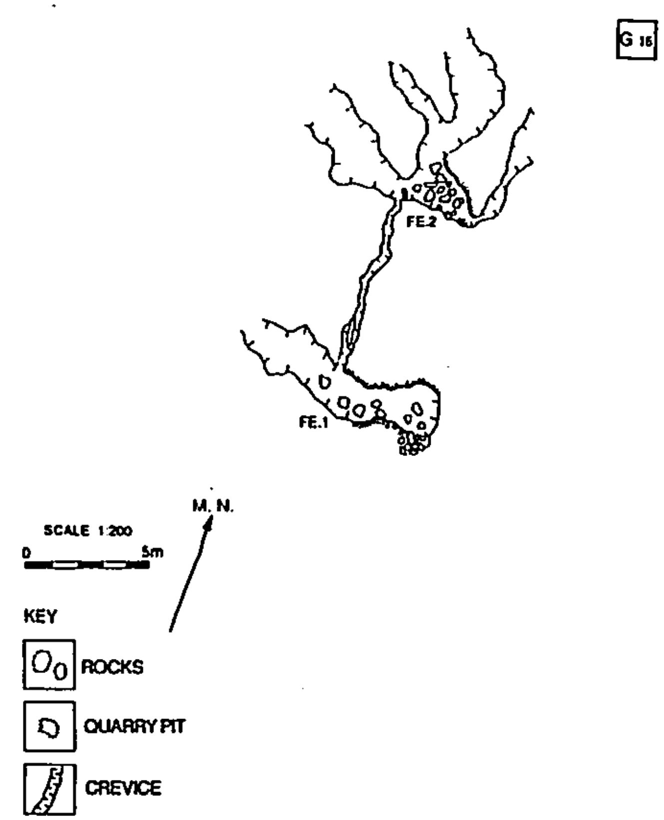


Fig. 33. STATE SITE 50-10-18-5356, PLANVIEW.

State Site 50-10-18-5357 (Site 50-Ha-D21-73)

This site, located on pahoehoe in the southwest portion of the project area, is 198.1 m (650 ft) from the coast, 41.1 m (135 ft) in elevation, and 8.0 m (26 ft) by 8.0 m (26 ft) in size. Two features are present, including one pit and one mound (Fig. 34). No cultural material was recorded.

Feature 2 consisted of piled pahoehoe slabs, measuring 1.0 m by 1.0 m. Vegetation included *kiawe* (rare) and fountain grass (rare).

State Site 50-10-18-5358 (Site 50-Ha-D21-74)

This site is located on pahoehoe in the southwest portion of the project area (Fig. 35). It is 381.0 m (1,250 ft) to 433.2 m (1,437.5 ft) from the coast, 30.5 m (100 ft) to 381.1 m (1,250 ft) in elevation, and measures 38.1 m (125 ft) by 68.6 m (225 ft) in size. Vegetation included fountain grass (occasional), *kiawe* (rare), threadstem carpetweed (rare), *ilima* (rare), *pili* grass (rare), and *Ageratum* (rare).

Five pit features were recorded. One isolated, rounded cobble hammerstone was recorded in the area.

State Site 50-10-18-5359 (Site 50-Ha-D21-75)

This site, located on pahoehoe in the southwest portion of the project area, is 358.1 m (1,175 ft) to 411.5 m (1,350 ft) from the coast, 38.1 m (125 ft) to 45.7 m (150 ft) in elevation, and measures 61.0 m (200 ft) by 30.5 m (100 ft) in size. Nine features were recorded, including eight pits and one lava tube (Fig. 36). Vegetation included fountain grass (occasional), *kiawe* (rare), threadstem carpetweed (rare), *ihi* (rare), lovegrass (rare), *pili* grass (rare), and *Ageratum* (rare).

Feature 1, a lava tube, measured approximately 17 m by 4 m and 1 m to 1.5 m in height. Marine shell was scattered on the surface.

State Site 50-10-18-5360 (State 50-Ha-D21-76)

This site, consisting of two pit features, is located on pahoehoe in the southwest portion of the project area (Fig. 37). It is approximately 342.9 m

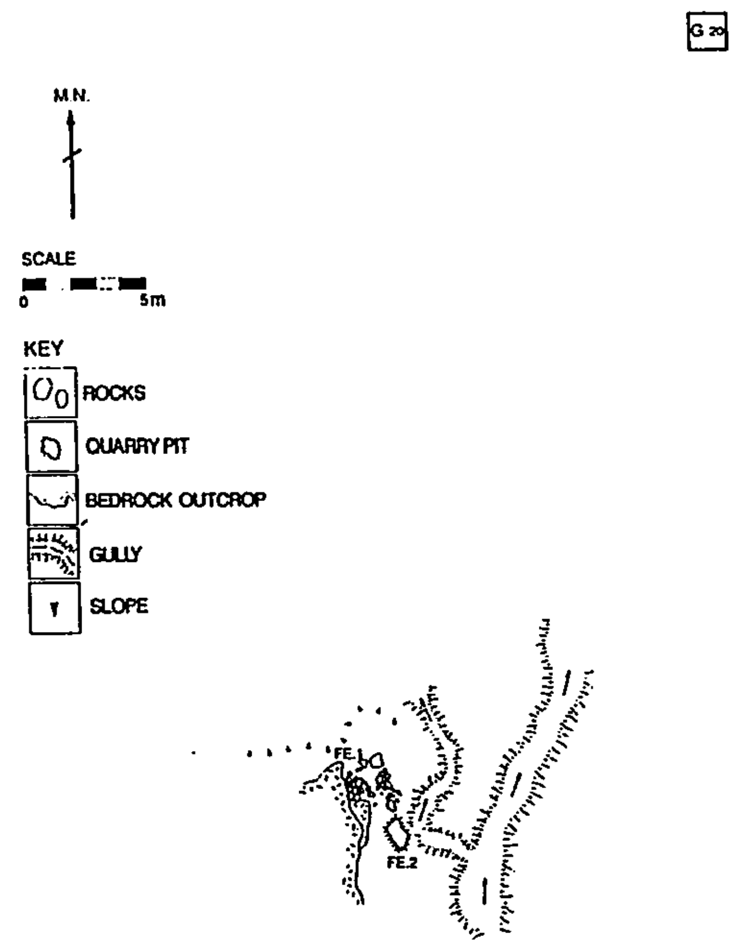


Fig. 34. STATE SITE 50-10-18-5357, PLANVIEW.

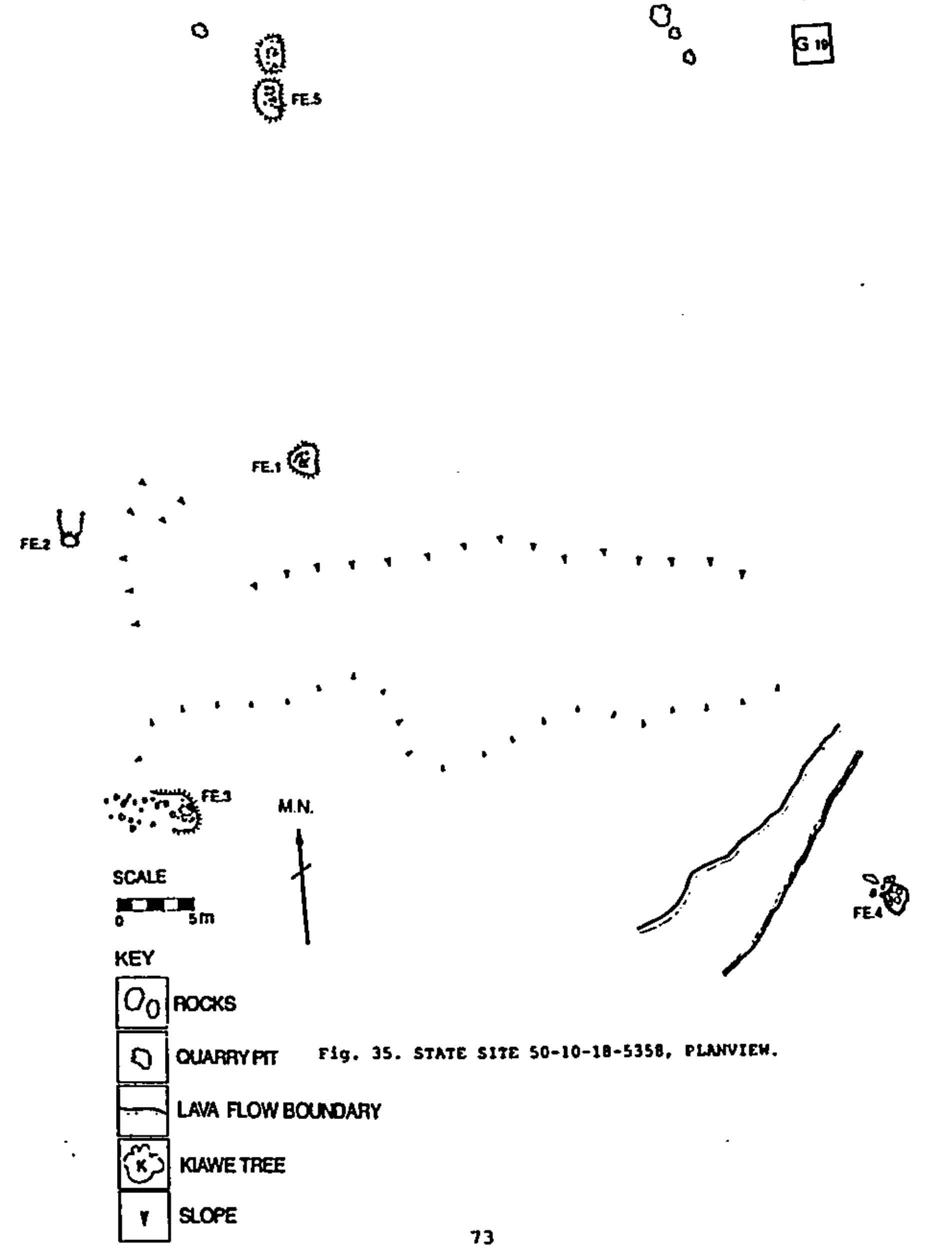


Fig. 35. STATE SITE 50-10-18-5358, PLANVIEW.

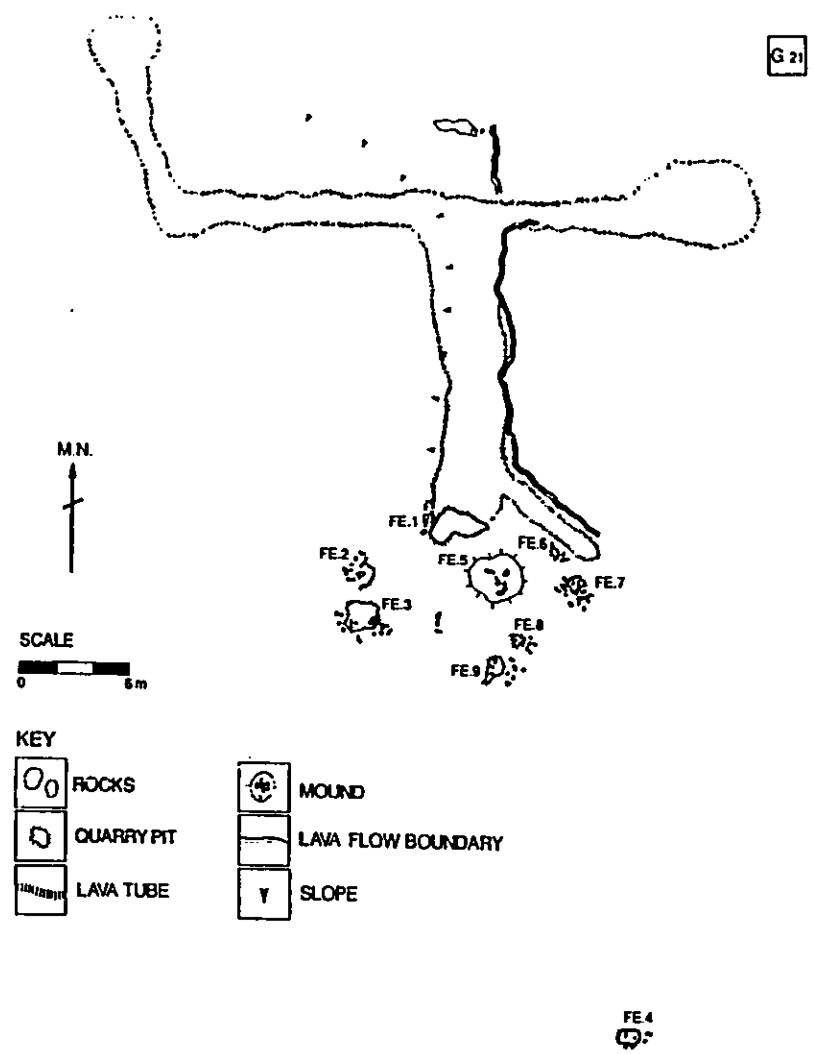


Fig. 36. STATE SITE 50-10-18-5359, PLANVIEW.

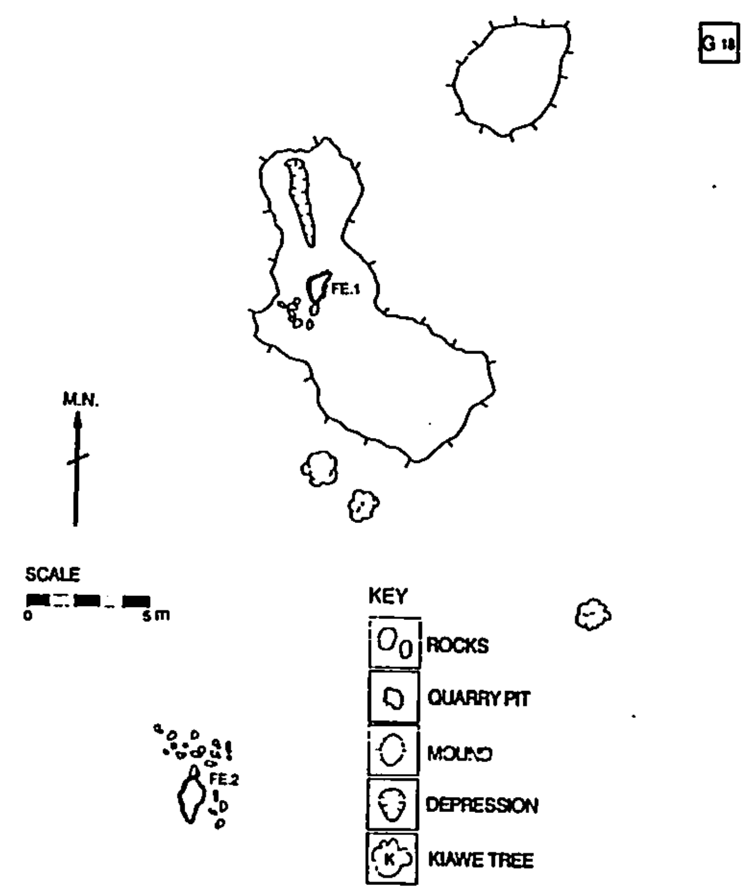


Fig. 37. STATE SITE 50-10-18-5360, PLANVIEW.

(1,125 ft) to 369.6 m (1,212.5 ft) from the coast, 30.5 m (100 ft) to 38.1 m (125 ft) in elevation, and measures 26.7 m (87.5 ft) by 7.6 m (25 ft) in size. No cultural material was present.

Vegetation included fountain grass (occasional), *kiawe* (rare), *ihi* (rare), *uha* (rare), and *pili* grass (rare).

State Site 50-10-18-5361 (50-Ha-D21-77)

This site, consisting of three pit features, is located on pahoehoe in the southwest portion of the project area (Fig. 38). It is approximately 430.5 m (1,412.5 ft) to 464.8 m (1,525 ft) from the coast, 38.1 m (125 ft) to 45.7 m (150 ft) in elevation, and measures 34.3 m (112.5 ft) by 11.4 m (37.5 ft) in size. No cultural material was present.

Vegetation included fountain grass (occasional) and *kiawe* (rare).

RESULTS OF TESTING

Results of test excavations in selected surface features and lava tubes, and findings of further investigations in small lava tube/blister features, are presented in this section.

Testing was conducted by either: (1) exploration of lava tubes and blisters for cultural remains, or (2) subsurface testing in surface structures and caves with observable sediment deposits. Data was collected to aid in interpretation of features and included material for age determination (e.g. charcoal) as well as function (e.g. cultural artifacts and bulk sediment samples).

A total of 150 lava tubes, pits, and crevices were explored with flashlights, of which 58 yielded cultural materials.

Subsurface test excavations accounted for a substantial amount of cultural material collected. Test excavations were conducted at State Site 50-10-18-5341, Fe. 3, State Site 50-10-18-5347, Fe. 4, State Site 50-10-18-5348, Fe. 3.1, State Site 50-10-18-5352, Fe. 4, State Site 50-10-18-5354, Fe. 2, and State Site 50-10-18-5355, Fe. 1. Descriptions of these test units will be summarized below. Due to the sensitive nature of Site 50-10-18-5348, Features 1-3, results of test excavations are presented in an appended report,

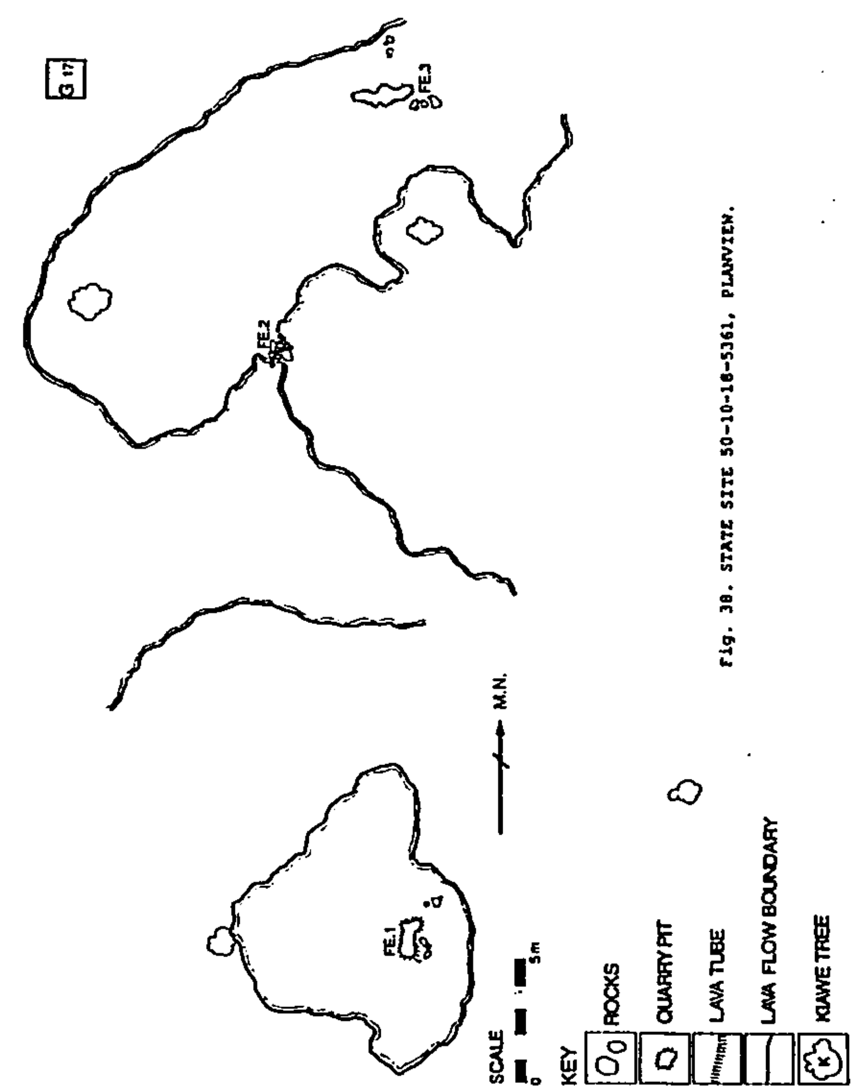


Fig. 38. STATE SITE 50-10-18-5361, PLANVIEW.

which will be available through the State Historic Preservation Division, Department of Land and Natural Resources.

50-10-18-5341, FEATURE 3

A 50 by 50 cm test unit (TU1) was excavated in Feature 4, a rectangular enclosure (see Fig. 11). TU1 was placed in the enclosure where the rock paving was not present. The underlying sediments were excavated in 10 cm levels within stratigraphic layers. The matrix was screened through nested 1/4 and 1/8 in. screens in the field.

Stratigraphy

Two stratigraphic layers were revealed (Fig. 39). Layer I was a very dark grayish brown (10YR 3/2, w.) silt. It was nonsticky and slightly plastic when wet. Sparse, angular basalt cobbles/pebbles and moderate amounts of very fine rootlets were observed. This layer was 16 cm thick. Cultural material recovered included charcoal, fish bone, sea urchin, and marine shell (*Nerita picea* and *Cypraea* spp.). Recovered traditional Hawaiian artifacts included two coral abrader fragments.

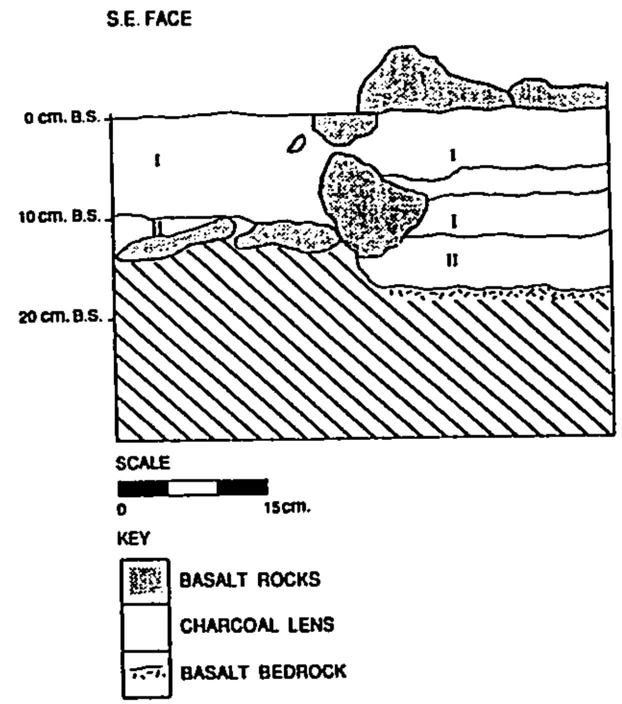
Two charcoal samples were submitted to Beta Analytic. Calibrated age ranges for the upper level (0-11 cm b.s.) of Layer I included two age ranges: A.D. 1480-1690 and A.D. 1729-1808. The age ranges for the lower level (11-16 cm b.s.) of Layer I, include A.D. 1327-1351 and A.D. 1390-1650.

Layer II was a dark yellowish brown (10YR 4/9 w.), silty clay loam, which was nonsticky and slightly plastic. There were few pebbles and a moderate amount of angular basalt cobbles. Few roots were present. This layer was 20 cm thick. Cultural material included sparse midden and charcoal (Table 3).

The test unit was terminated when bedrock was encountered at the base of Layer II, level 2 (36 cm b.s.), and no cultural material was observed (Fig. 40).

50-10-18-5347, FEATURE 4

Test Unit 1, measuring 50 by 50 cm, was excavated in the interior of a large, fragmented, accretionary boulder on an aa flow (see Fig. 22). The



Layer I Very dark grayish brown, silt; contains traditional Hawaiian cultural materials; radiocarbon age ranges include A.D. 1390-1650 (lower portion) and A.D. 1480-1808 (upper portion).

Layer II Dark yellowish brown, silt; contains sparse charcoal and midden in upper portions.

Fig. 39. STATE SITE 50-10-18-5341, FEATURE 3; Southeast Profile, Test Unit 1.

TABLE 3

RADIOCARBON AGE DETERMINATION FOR SITES 50-Ha-D21-57 AND -64

HRC No.	BETA No.	Provenience/ Context	Wt. (gm)	14 c Age B.P.	13 c/12 c Correction	Adjusted 14 c Age B.P.	Calibrated Age**
1354	45056	D21-57/Fe. 3 Enclosure TU1/Layer I/1; 0-11 cm b.s./ Wood charcoal from Layer 1	5.5	230 ± 80	-23.2	260 ± 80	A.D. 1480 - 1690 A.D. 1728 - 1808 A.D. 1931 - 1954
1351	45053	D21-57 Fe. 3 Enclosure TU1/Layer I/2; 11-16 cm b.s.*/ Wood charcoal from Layer 1	5.5	290 ± 80	-18.6	430 ± 80	A.D. 1327 - 1351 A.D. 1390 - 1450
1352	45054	D21-64/Fe. 3.5 Lava tube Surface sample in lava tube by burial 9	18.1	270 ± 50	-25.1	270 ± 50	A.D. 1490 - 1670 A.D. 1743 - 1802 A.D. 1941 - 1954
1355	45057	D21-64/Fe. 3.8 Lava tube TU1/Layer I/2; 8-18 cm b.s./ Wood charcoal from hearth	4.5	840 ± 70	-25.2	830 ± 70	A.D. 1020 - 1280

* Centimeters below surface
** Stuiver and Becker (1986)
Preferred dates based on archeological context are underlined.

Fig. 40. STATE SITE 50-10-18-5341 (SITE 50-Ha-D21-57), FEATURES 3, TEST UNIT 1, BASE OF EXCAVATION. View to Southeast. BH Neg. No. Ha(a) 672-19.

accretionary boulder formed a small shelter, and the floor appeared to be leveled. The underlying sediments initially were excavated by 10 cm levels for Layer I. Since no cultural material was observed, no arbitrary levels were employed for Layer II. Since the excavated matrix consisted mostly of gravel, cobbles, and small boulders, it was sorted by hand.

Stratigraphy

. Three stratigraphic layers were present (Fig. 41). Layer I was an 8 cm thick aa pebble and gravel deposit with sparse silt (Fig. 42). Small bone fragments (probably bird) were collected.

Layer II, 17 cm thick, was an aa gravel deposit with sparse silty sand. Possible cultural material included rounded gravel and pebble-sized pumice and small bone (probably bird) fragments.

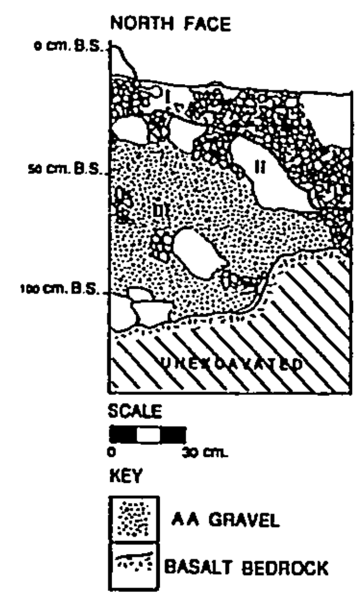
Layer III, 15 cm thick, was an aa gravel deposit with sparse silt in between large aa cobbles and small boulders. A grayish colored silt (probable ash lens) was present in the southwest quadrant. The test unit was terminated at the base of Layer III (40 cm b.s.) when abundant aa cobbles and small boulders were encountered, and cultural material was no longer apparent.

50-10-18-5352, FEATURE 4

A single 0.5 by 0.5 m unit, TU1, was excavated in the east portion of Feature 4, a rectangular-shaped modified (leveled) area in the aa flow (see Fig. 27). It was excavated by removing rocks by hand.

TU1 was excavated to a depth of approximately 50 cm below surface. No soil or fine sediments was observed in the unit. The matrix was a fairly homogeneous deposit of aa cobbles/pebbles. At about 30 cm below surface, a zone of moisture was reached. No cultural materials were observed.

A 50 by 50 cm test unit (TU1) was excavated just inside the west entrance and against the south wall of this lava tube feature. The sediments in the cave were excavated in 5 cm levels within stratigraphic layers. The excavated matrix was screened through nested 1/4 and 1/8 in. screens and sorted in the field.



Layer I Aa pebble and gravel deposit with sparse silt; non-cultural.

Layer II Aa deposit with sparse silty sand; probable cultural material.

Layer III Aa gravel with sparse silt. A greyish colored silt lense present in the southwest quad, probable ash lense.

Fig. 41. STATE SITE 50-10-18-5347, FEATURE 4, NORTH PROFILE, TEST UNIT 1.

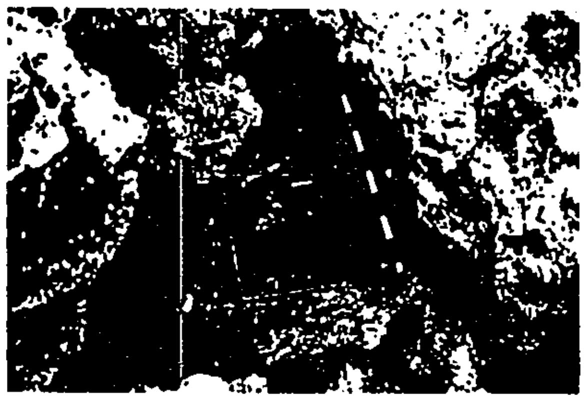


Fig. 42. STATE SITE 50-10-18-5347 (SITE 50-Ha-D21-63) FEATURE 4, SURFACE OF OVERHANG SHELTER, TEST UNIT 1. View to West. BH Neg. No. Ha(a) 672-11.

50-10-18-5354, FEATURE 2

Stratigraphy

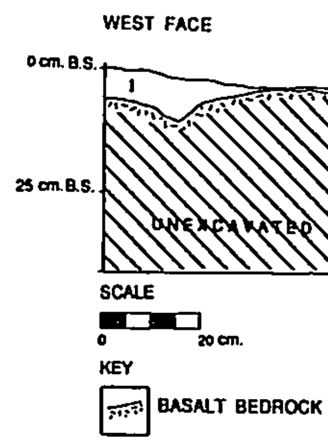
One stratigraphic layer (Layer I) was revealed (Fig. 43). It was a pinkish gray (7.5YR 6/2, d.) silt with few angular, vesicular basalt cobbles and pebbles. Moderate, fine rootlets were present throughout the unit. However, where the rootlets were concentrated, the sediment appeared red (10YR 6/3, d.). A crevice, which was 10 cm deeper than the rest of the floor, extended from the east to the west side of the unit. Layer I, 10 cm thick, contained cultural material including marine shell, bird bones, fish bones, a waterworn cobble, and volcanic glass. An artifact of traditional Hawaiian manufacture collected at an associated feature in tubes situated deeper underground indicates that these areas may have been occupied and used for burial activities sometime after the late fifteenth century.

RADIOCARBON AGE DETERMINATIONS

The primary objective in selecting charcoal samples for radiocarbon assay was to determine the age of various surface and subsurface features. Due to a paucity of charcoal samples from test excavations, only four wood charcoal samples from two sites; 5341 and 5348, were submitted.

The four wood charcoal samples were submitted to the laboratories of Beta Analytic, Coral Gables, Florida, for radiocarbon dating analyses. Each sample was assigned an HRC (Hawaii Radiocarbon) number within the Bishop Museum system as well as a lab number by Beta Analytic. The radiocarbon ages were first adjusted for stable carbon isotope ratios ($^{13}C/^{12}C$) analysis. The adjusted ages were then converted to two standard deviation calibrated age ranges using Stuiver and Becker (1986) and the Calib (Version 2.0) computer program (Stuiver and Reiner 1986).

In the Beta Analytic laboratories, the charcoal samples were first examined for rootlets, then given a hot acid wash to eliminate carbonates. They were then repeatedly rinsed to neutrality and subsequently given a hot alkali soaking to remove humic acids. After rinsing to neutrality, another acid wash was given followed by another rinsing to neutrality. Standard benzene and counting of radiocarbon activities followed the pretreatment.



Layer I Pinkish gray silt with few angular vesicular basalt cobbles and pebbles. Contains traditional Hawaiian cultural material.

Fig. 43. STATE SITE 50-10-18-5354, FEATURE 2: WEST PROFILE, TEST UNIT 1.

The results of the radiocarbon age analyses are presented in Table 3. The first two columns in this table present the HRC and corresponding Beta Lab numbers. The provenience column indicates where the sample was collected and the context it is dating. The weight (wt.) column provides the weight of the sample in grams (gm). The ^{14}C age column shows the sample age in radiocarbon years. The "$^{13}C/^{12}C$" column shows the correction factor applied to the ^{14}C radiocarbon age to derive the adjusted radiocarbon age. The adjacent column provides the adjusted age in radiocarbon years. The final column shows the calendrical, or calibrated ages at ± 2 standard deviations.

Quite often multiple intervals of calendrical conversions exist for some radiocarbon ages less than 1000 B.P. (Schilt 1984). Three of the Manini'ōwali samples (HRC 1351, 1352, and 1354) yielded multiple calendrical conversions. Preferred age ranges, based on archaeological context (primarily stratigraphic and artifactual evidence) are underscored in Table 3.

The two samples (HRC 1351 and 1354) from State Site 50-10-18-5341, Feature 3, provide age estimates for Layer I, the primary cultural deposit in this enclosure. HRC 1351 was collected from lower portions of the layer and yielded multiple age ranges: A.D. 1327-1351 and A.D. 1390-1650. Both dates are in the pre-European Contact period and both can be accepted, based on the presence of traditional Hawaiian cultural materials in the layer. Thus, at the 95% confidence level, the true age of this sample will fall somewhere within these two ranges.

HRC 1354, collected from upper portions of Layer I, also yielded multiple age ranges: A.D. 1480-1690, A.D. 1729-1808, and A.D. 1931-1954. In spite of the overlap with one of the age ranges from HRC 1351, both the A.D. 1480-1690 and A.D. 1729-1808 age ranges can be accepted based on the presence of traditional Hawaiian cultural materials in the layer. Thus, at the 95% confidence level, the true age of this sample will fall somewhere within these two age ranges. The fact that the second age range (A.D. 1729-1808) extends 30 years into the post-Contact period (post A.D. 1778) is not considered to be critical at this time. It is likely that Western cultural influences had not affected traditional lifestyles at this site due to the absence of Historical period artifacts.

The overlap in the A.D. 1390-1650 range of HRC 1351 and the A.D. 1480-1690 range of HRC 1354 can be accounted for by the provenience of the charcoal sample. Because both samples were collected from a layer that appears to have developed over time, some mixing of deposited charcoal can be expected. If the samples contained wood burned at different time periods, overlaps in the calibrated age ranges could result. The third age range, A.D. 1931-1954, can be rejected based on the absence of twentieth century artifacts.

HRC 1352 is from a surface charcoal concentration recovered near Burial 9 on the floor of the lava tube (Feature 3.5, the burial chamber) at State Site 50-10-18-5348. The Calib program yielded multiple age ranges for this sample: A.D. 1490-1650, A.D. 1743-1802, and A.D. 1941-1954. Of these three ranges, the first two can be accepted based on the presence of both traditional Hawaiian and early Historical period artifacts present in the chamber. Unlike State Site 50-10-18-5341, there is evidence of change in traditional Hawaiian lifestyles and culture at Site 5348 (mirrors, wooden tobacco pipes, and wooden boxes). Thus, at the 95% confidence level, the true age of the sample will fall somewhere within these two age ranges.

The last sample (HRC 1355) is charcoal collected from a hearth, Feature 3.8, found in excavations in a lava tube (Feature 3.1) at State Site 50-10-18-5348. The Calib program yielded a fairly early age range: A.D. 1020-1280. At the 95% confidence level, the true age of the sample will fall somewhere within this range.

Discussion

It should be noted that, because of the small sample (four) of radiocarbon dates for these two sites, the results are considered to be preliminary. If possible, more samples should be collected to confirm these results of radiocarbon analyses.

Based on these preliminary results, it appears that occupation at State Site 50-10-18-5341 began sometime between the fourteenth and seventeenth centuries and continued into the early nineteenth century.

The occupation of Site 50-10-18-5348 was established sometime between the eleventh and thirteenth centuries. More charcoal samples from the habitation chamber need to be dated to determine if the A.D. 1020-1280 represents initial occupation of upper portions of this lava tube system. Radiocarbon dates from samples collected in tubes situated deeper underground indicate that these areas may have been occupied and used for burial activities sometime after the late fifteenth century.

MIDDEN

Moderate quantities of midden (non-artifactual cultural debris) were recovered during the current field investigations. General categories of the faunal materials recovered include the remains of *mollusks* (marine shell), *echinoderms* (sea urchin spines, body and mouth parts), *crustaceans* (crab claws and barnacle shells), and bone remains of birds, fish, and mammals. Only a fraction of the bone materials could be identified to species due to the fragmentary nature of the bone and the paucity of diagnostic pieces. Floral materials recovered are represented by *kukui* nut (*Aleurites moluccana*), *wauke* bark fiber (*Broussonetia papyrifera*), *hala* matting (*Pandanus odoratissimus*), and wood charcoal.

Sparse surface scatters of midden are associated with 52 (41%) of the features in the project area (see Appendix A and detailed site descriptions). Only a few specimens from surface scatters were collected for identification purposes. Surface midden components include primarily marine shell with infrequent occurrences of fish and bird bone, sea urchin, and crab. The predominant marine shells observed in surface scatters include *Cypraea caputserpentis*, *Cypraea maculifera*, *Nerita picea*, and *Drupa ricina*, with species from the genera of *Conus*, *Thais*, *Cellana*, and *Isognomon* observed less frequently. *Heterocentrotus mammillatus*, or pencil urchin, was also observed infrequently. The surface midden remains were often quite weathered and bleached.

Tables 4 and 5 present preliminary results of midden analyses from test excavations in two features: Feature 3, Site 50-10-18-5341, and Feature 2, Site 50-10-18-5354. Weight values in Table 5 (Site 50-10-18-5354) reflect values from the one-quarter inch screen only. Midden weights presented in Table 4 (Site 50-10-18-5341) are from both one-quarter and one-eighth-inch screen sizes.

Midden remains recovered from Site 50-10-18-5355, Feature 1, are too sparse to present in tabular form and will be presented in the following discussions. The results of midden analyses for Feature 3.1 in Site 50-10-18-5348, which yielded abundant quantities of midden, will be presented in a separate report.

MOLLUSKS

In the traditional Hawaiian food economy, there was a great dependence upon marine resources, including marine and fresh/brackish water mollusks. It

TABLE 4
ANALYSIS OF MIDDEN MATERIALS

Site # State 50-10-18-5341 (50-Ha-D21-67) Feature/Test unit: Layer/Level:	3/TU1 I/1	3/TU1 I/2	3/TU1 II/1	3/TU1 II/2	TOTAL
	gm	gm	gm	gm	gm
GASTROPODA					
Cellana sp.	0.1	0.1			0.2
Cellana melanostoma		2.2			2.2
Nerita picea	1.0	0.3	0.6		1.9
Cypraea sp.	8.5		3.3		11.8
Conus leopardus	5.0				5.0
Unidentified *gastropoda*	8.3				8.3
Total *Gastropoda*	22.9	2.6	3.9	0.0	29.4
PELECYPODA					
Pinctada galtsoffi	0.5				0.5
Isognomon incisum	0.2				0.2
Total *Pelecypoda*	0.7	0.0	0.0	0.0	0.7
Total Marine Shell	23.6	2.6	3.9	0.0	30.1
ECHINODERMS					
Echinometra mathaei	0.1	0.1			0.2
Echinothrix calamaris	0.1	4.1	0.4		4.6
Sea urchin mouth parts	2.3	3.2	1.6		7.1
Sea urchin body parts	6.4	4.1	0.4		10.9
Total *Echinoderms*	8.9	11.5	2.4	0.0	22.8
CRUSTACEA					
Unidentified *Crustacea*	0.7	0.3			1.0
BONE					
Bird bone		0.2			0.2
Mammal bone-unid charred	0.2			0.2	0.4
Fish bone					
Osteichthyes spp.		1.1			1.1
Total Bone	0.2	1.3	0.0	0.2	1.7
TOTAL MIDDEN	33.4	15.7	6.3	0.2	55.6

TABLE 5
ANALYSIS OF MIDDEN MATERIALS

Site # State 50-10-18-5354 (50-Ha-D21-70) Feature/Test unit: Layer/Level:	2/TU1 I/1	2/TU1 I/2	TOTAL
	gm	gm	gm
GASTROPODA			
Cellana sp.	0.5	0.2	0.7
Cellana melanostoma	3.9	<0.1	3.9
Cellana sandwicensis	24.8		24.8
Cellana exarata	2.7		2.7
Nerita sp.	20.2	8.5	28.7
Nerita picea	597.3	27.6	624.9
Nerita polita	4.7		4.7
Littorina pintado	12.6	1.6	14.2
Cypraea sp.	185.7		185.7
Cypraea caputserpentis	1,023.0		1,023.0
Cypraea maculifera	475.5		475.5
Cypraea mauritiana	5.0		5.0
Cymatium sp.	0.4		0.4
Hues sp.	27.4		27.4
Drupa sp.	66.8	8.5	75.3
Drupa morum	54.4		54.4
Drupa ricina	104.8		104.8
Neothais harpa	8.9		8.9
Thais aperta	39.1		39.1
Purpura aperta	57.1	1.7	58.8
Conus sp.	30.8	1.0	31.8
Conus flavidus	0.5		0.5
Conus leopardus	5.3		5.3
Conus vitulinus	2.1		2.1
Conus catus	2.4		2.4
Unidentified *gastropoda*	20.6	3.2	23.8
Total *Gastropoda*	2,776.5	52.3	2,828.8
PELECYPODA			
Isognomon sp.	21.2	2.4	23.6
Isognomon californicum	5.3	0.3	5.6
Periglypta reticulata	2.8		2.8
Periglypta mathaei	2.5		2.5
Unidentified *pelecypoda*	5.8	0.3	6.1
Total *Pelecypoda*	37.6	3.0	40.6
Total Marine Shell	2814.1	55.3	2869.4

(cont'd)	2/TU1 I/1	2/TU1 I/2	TOTAL
	gm	gm	gm
ECHINODERMS			
Colobocentrotus atratus	1.4	0.6	2.0
Heterocentrotus mammillatus	10.1	2.3	12.4
Echinometra mathaei	0.1	0.1	0.2
Echinothrix calamaris	0.6	0.8	1.4
Sea urchin mouth parts	49.5	3.5	53.0
Sea urchin body parts	73.9	7.1	81.0
Total *Echinoderms*	135.6	14.4	150.0
CRUSTACEA			
Crustacea unid.	6.7	0.3	7.0
Lepas (barnacle)	0.4	0.4	0.8
Chthamalus hembeli	27.8	1.4	29.2
Total *Crustacea*	34.9	2.1	37.0
BONE			
Bird bone	0.1		0.1
Goat	6.8		6.8
Mammal bone unid.	0.4		0.4
Total Bone	7.3	0.0	7.3
FISH			
Bone	7.8	3.6	11.4
Scale	0.2	0.5	0.7
Mandible	1.6		1.6
Carangidae	0.1		0.1
Malichthys vidua	0.4		0.4
Total Fish Bone	10.1	4.1	14.2
BOTANICAL			
Charcoal-wood	1.9	0.3	2.2
Aleurites moluccana	3.8		3.8
Total Botanical	5.7	0.3	6.0
TOTAL MIDDEN	3,007.7	76.2	3,083.9

is not surprising, therefore, that mollusks, including both gastropods (univalve), and pelecypods (bivalve), form the dominant component, by weight, of the midden remains at Sites 5341 and 5354. Five families of gastropods and two families of pelecypods are represented in samples from the two sites. The families (and identified genera) include Patellidae (*Cellana*), Neritidae (*Nerita*), Littorinidae (*Littorina*), Cypraeidae (*Cypraea*), Cymatiidae (*Cymatium*), Thaididae (*Thais*, *Drupa*, *Neothais*, and *Purpura*), Conidae (*Conus*), Pteriidae (*Isognomon*), and Veneridae (*Periglypta*).

At Site 5354, Feature 2, a 0.50 by 0.50 m sample of the shallow (less than 20 cm thick) Layer I deposits in this lava tube yielded 2,869.4 gm of marine shell, representing 93% of the total midden (3,083.9 gm). *Cypraea* is the dominant genera of the marine shell remains. Of the three species of *Cypraea* identified, the snakehead cowrie (*C. caputserpentis*) accounts for 35.5% of the marine shell in the sample while *C. maculifera* accounts for 16.6%. As a genera, *Cypraea* remains comprise almost 59% of the marine shell.

The numerous Hawaiian names for the known varieties of cowries (*leho*) suggest that cowries were quite important in the native economy as food, ornaments, tools, and octopus lures (Titcomb 1978:340). Smaller varieties including *leho maoli* (*C. caputserpentis*) and *leho 'ōpu'upu'u* (*C. granulata*) were collected for consumption, a job normally undertaken by women (Ibid:327). Besides consumption, larger varieties such as *leho ahi* (*C. mauritiana*) and *leho kōlea* (*C. maculifera*) were collected as raw material for tool manufacture. Both varieties were used for octopus lures as well as scrapers for removing the skin from cooked taro and breadfruit, and for grating coconuts (Ibid:341).

Nerita picea (*pipipi*), another dominant component of the midden, accounts for 21.8% of the marine shell. *Pipipi* are commonly found in Hawaiian coastal middens and were enjoyed raw or cooked.

At Site 50-10-18-5341, Feature 3, the 30.1 gm of marine shell recovered in a sample from this enclosure represents 54% of the total midden weight (55.6 gm). *Cypraea* sp. and *Conus leopardus* accounted for 39.2% and 16.6%, respectively, of the total marine shell. *Pinctada galtsoffi*, a pearl oyster present in sparse quantities, was used for the manufacture of fishhooks (Ibid: 349).

ECHINODERMS

Four species of echinoderms were identified in the midden from Sites 5341, Feature 3 and 5354, Feature 2, including *Heterocentotus mammillatus*, *Colobocentrotus atratus*, *Echinometra mathaei*, and *Echinothrix calamaris*. At Site 5354, Feature 2, the remains of these four species of sea urchin account for 4.9% of the total midden weight. Most of the recovered sea urchin in this sample consisted of unidentifiable body and mouth parts. At Site 5341, Feature 3, sea urchin remains comprise 41% of the total midden weight (see Table 4). Two species (*E. mathaei* and *E. calamaris*) were identified at this site.

All the species found in the midden sample are edible and were collected for consumption. *E. mathaei* (*'ina kea* or *'ina 'ula*), *E. calamaris* (*wana hālula*), and *C. atratus* (*hāku 'eku'e* or *hāku'e*), inhabit shallow and deep reef waters and are fairly easy to collect. The pencil urchin, *H. mammillatus* (*hā'ue'ue*), inhabits deeper waters and was also exploited for its abrasive spines, used in bone artifact manufacture.

CRUSTACEA

Sparse quantities of crustacean remains were recovered from excavated midden samples. At Site 5354, Feature 2, 78.9% of the total crustacean weight (37 gm) consists of *Chthamalus hembeli*, the volcano barnacle. Crab remains were too fragmentary for identification.

MAMMALS

Bone remains in this category from Sites 5354, Feature 2, and 5341, Feature 3, were too fragmentary to attempt further identification. Only sparse quantities (less than 1 gm) were recovered from each site.

Bone remains of goat (*Capra hircus*) were recovered from Layer I at site 5354, Feature 2. Articulated and partially articulated skeletons were observed in several lava blisters and tubes. A complete skeleton of a subadult individual was collected from Site 5348, Feature 3.1, and incorporated into the Bishop Museum reference collection. Feral goats are relatively common in the project area. Their skeletal remains are considered not to be part of the archaeological record.

BIRDS

Approximately 0.3 gm of bird bone were recovered from excavated samples (see Tables 4 and 5). The remains were too fragmentary for identification. A surface specimen from Site 5359, Feature 9, was identified as a tibiotarsus belonging to a dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*). This bird is endemic to the Hawaiian Islands and is currently endangered. Dark-rumped petrels, or uau, nest in roots of trees, holes in rocks, and cliffs at elevations of from 1,500 to 5,000 ft (Munro 1982).

FISH

Fish remains recovered from excavated samples include spines, scales, vertebrae, cranial fragments, and mandibular fragments. At Site 5354, Feature 2, only two pieces could be identified: a mandibular fragment probably belonging to a member of the Carangidae family (jacks and mackerels), and a spine belonging to *Melichthys vidua*, the red-tailed triggerfish (*humuhumuhi'ukole*). Members of the Carangidae family usually inhabit reef and shore areas when young and move to deeper waters when mature (Tinker 1978). The red-tailed triggerfish is found in deeper waters on the outer side of reefs (Ibid:473).

Test excavations at Site 5355, Feature 1, yielded a fragment of a dental jaw identified as parrot fish (Scaridae family). The jaw fragment weighed 0.6 gm. Parrot fish inhabit shallow reef waters feeding on marine algae and coral polyps (Ibid:315).

ARTIFACTS

Fifty-six portable artifacts were collected from the surface as well as from excavation in the project area. Of the artifact total, 27 artifacts (48.2%) are traditional, or indigenous Hawaiian forms, 1 (1.8%) is from the historical period, and 28 (50%) are recent (twentieth century) forms. The indigenous forms include artifacts fashioned from basalt, volcanic glass, coral, shell, and bone. The single historical period artifact is a broken glass bottle. Recent artifacts are items fashioned from metal and glass. The artifact distribution, recovered from eight sites, is summarized in Table 6.

Table 6

Distribution of Artifacts

Site # / State 50-10-18- / (50-He-D21-) / Feature/Test Unit / Layer/Level	5339 54 Surf	5343 57 3/TU1 I/1	lava tube 5345 61 3/TU1	5348 64 Fe 37 Surf	5349 65 Fe 22 Surf	5351 67 TU1 Surf	5354 70 2/TU1 Surf	5354 70 2/TU1 I/1	5354 70 2/TU1 I/2	5355 71 Fe 2 Surf	5355 71 2/TU1 Rock fill	TOTAL
	#	#	#	#	#	#	#	#	#	#	#	#
ARTIFACT TYPE												
INDIGENOUS												
Basalt												
Flake					2					8		10
Flake with polish							1					1
Adze				1								1
Manuport	1							1				2
Total Basalt	1	0	0	1	2	0	1	1	0	8	0	14
Volcanic glass												
Core flake												
Flake	1				1			1				3
Frag								2				2
Total Volcanic Glass	1	0	0	0	1	0	0	3	0	0	0	5
Coral												
File tip		2										2
Shell												
Lure	1							1				2
Lure frag											1	1
Total Shell	1	0	0	0	0	0	0	1	0	0	1	3
Bone												
Cut bone		1							1			2
Unid			1									1
Total Bone	0	1	1	0	0	0	0	0	1	0	0	3
TOTAL INDIGENOU	3	3	1	1	3	0	1	5	1	8	1	27
HISTORICAL												
Glass												
Gin bottle						1						1
Metal												
Fishhook	1											1
Marbles												
Glass	26											26
Box axled	1											1
TOTAL HISTORICA	28	0	0	0	0	1	0	0	0	0	0	29
TOTAL ARTIFACT	31	3	1	1	3	1	1	5	1	8	1	56

INDIGENOUS ARTIFACTS

Basalt

The 14 basalt artifacts collected represent 28.6% of the total artifact assemblage and 59.2% of the indigenous assemblage. The basalt artifacts include one adze, ten diagnostic flakes, one polished flake, and two cobble manuports.

The adze (D21-64-1), found on a lava tube (Feature 37) floor at Site 50-10-18-5348, is polished and has an incipient tang. It measures 6.14 by 2.39 cm, averages 1.20 cm thick, with the front edge partially broken. A light reddish brown patina covers the entire adze.

Diagnostic flakes are by-products (debitage) of tool manufacture and core reduction. They have a ventral surface and complete proximal (striking platform) and distal (termination) ends. Based on observations of macroscopic characteristics, the basalt flakes recovered from the project area are from different sources. The eight flakes recovered from the surface at Site 5355, Feature 2, are gray to dark gray, medium-to coarse-grained basalt with sparse vesicles present. They range in size from 2.65 by 4.45 cm to 1.23 by 1.00 cm.

The two flakes from Site 5349, Feature 22, are of a dark gray, medium-to fine-grained basalt with sparse olivine inclusions. The larger flake measures 1.80 by 3.84 cm.

The flake with polish from Site 5354, Feature 2, is of a very dark gray, medium- to fine-grained basalt. It measures 3.04 by 2.37 cm and has a sharp, polished edge with two adjacent highly polished surfaces.

The two manuports were recovered from surface proveniences at Sites 5341 and 5354, Feature 2. Both are smooth, rounded, vesicular cobbles.

Volcanic Glass

The five volcanic glass flakes collected represent 8.9% of the total artifact assemblage and 18.5% of the indigenous assemblage. All but one are small, diagnostic flakes averaging about 1.00 by .08 cm in size. The flake from Site 5349, Feature 22, measures 1.38 by 1.74 cm and has a large bulb of percussion on the ventral surface.

Coral

The two coral artifacts collected represent 3.6% of the total artifact assemblage and 7.4% of the indigenous assemblage. Both are triangular-shaped, coral file tips recovered from Layer I in Site 5341, Feature 3. Both are approximately 1.00 by 0.80 cm in size and have smooth, flat surfaces. Coral files are small tools that were used for shaping, reshaping, and finishing fishhooks (Emory, Bonk, and Sinoto 1968:19).

Shell

Three cowrie shell lures collected represent 5.4% of the total artifact assemblage and 11.1% of the indigenous assemblage. Cowrie shells were used as octopus lures. All three are made from the *Cypraea maculifera* shell and have two perforation on the dorsum of the shell. Although two were found in excavations and one on the surface (see Table 6), all are quite weathered.

Bone

The three bone artifacts recovered include two pieces of cut bone detritus and a long bone fragment modified to a point on one end. The two cut pieces (see Table 6) are both small (about 1.20 by 1.0 cm) and have visible cut marks. Both appear to be long bone fragments of mammal, probably dog or pig.

The third bone artifact (D21-61-1) has been cut and modified to a point on one end. It measures 14.40 cm long and averages 1.3 cm wide. The bone from which this point was made has been tentatively identified as a human tibia. It is not certain whether or not this is a completed tool. Possible functional interpretations include an awl or an incomplete shark hook.

HISTORICAL ARTIFACTS

The single Historical Period artifact and 28 recent artifacts found in the project area all have surface proveniences. The Historical Period artifact is a broken, glass gin bottle, found just adjacent to (south) the *mauka-makai* trail (Site 5351) that cross the aa flow on the south side of the project area. Most of the 47 fragments found had turned purple due to exposure to the sun; several fragments found under rocks had retained their original clear color.

An embossed shoulder seal contained a palm tree and read: "Palmboom G. Meyer & Co./Scheidam". Based on this seal, it is known that this bottle was imported to Hawaii Island by the W.C. Peacock and Company, a Hilo based company, between 1899 and 1918 (Gwen Hurst, personal communication). The bottle was made with clear manganese glass in a chilled iron mold and has a tapered square shape with a tooled, tapered lip.

The 28 recent artifacts were found on the surface approximately 20 m northeast of Feature 394 of Site 5338 and include a rusted box containing a metal fishhook and 26 glass playing marbles.

Twenty-five of the marbles are clear with ribbon spirals and one was opaque with ribbon spirals. All are hand-made and cut and ground at one end. These clear marble types were manufactured between 1901 and 1926, while the opaque marble was manufactured sometime after 1905 (Randall 1971:102-105).

ARTIFACTS LEFT *IN SITU*

An additional 44 indigenous Hawaiian artifacts and manuports were recorded but, due to the large size of many of these and the need for further field work, they were not collected. These artifacts include 18 rounded, smooth, basalt boulder/cobble hammerstones, 2 basalt grindstones, 14 rounded, coral cobble manuports, and 10 basalt cobble manuports.

Fifteen of the hammerstones were associated with pit features, one was found in a lava tube, and one was situated near an enclosure. Seven of the basalt cobble manuports were associated with pit features. The remaining three were associated with a lava tube, a modified outcrop, and a platform.

Nine of the coral manuports were associated with pit features. Other feature types with associated coral manuports include a crevice feature, an enclosure, an overhang, a lava tube, and a modified outcrop. Branch coral occurred at only one site, 5355, Feature 1, a modified outcrop.

DISCUSSION

The results of the current archaeological inventory survey provided significant contributions to the prehistory of the North Kona region. A total of 25 archaeological sites, comprised of 1,313 features, have been recorded, mapped, and their spatial relationships determined. Test excavations in six features provided important information on the function and chronology of the sites. Charcoal samples obtained from the excavations have produced chronometric data for the archaeological features. Sufficient information has been generated to evaluate the significance of all the archaeological features and for the development of a cultural resource management plan.

The environmental setting of the North Kona region is characterized by a narrow, arid coastal habitation zone associated with the exploitation of various marine resources, a sloping, barren middle zone characterized by exposed aa and pahoehoe rocklands, and largely devoid of soil or vegetation other than grasses, and an upland habitation zone associated with agricultural exploitation (Rosendahl 1973). The subject project area is located in the barren middle zone.

PITS

The results of the archaeological survey demonstrated that more cultural activity occurred in the middle zone than anticipated. The identification of 1,191 of pit features throughout the project area, especially along the *mauka-makai* trail, suggests that several activities occurred inland from the coast. Results from previous archaeological surveys along the coast in the North Kona/South Kohala area identified over 3,500 pit features (referred to as pahoehoe clearings, pahoehoe holes, and pits).

Numerous interpretations have been discussed for these pit features (Barrera 1971; Bevacqua and Moore 1972; Carter 1985). Barrera (1971) suggested an agricultural function and provided ethnohistoric documentation from Puna, Hawai'i, where Hawaiians grew sweet potatoes in rocky environments. Chester A. Lyman, while visiting the Kamoamoa area of Puna in 1846, observed the following:

> We passed a potato patch in the broken lava which exceeded anything I had seen. Not a particle of soil was anywhere to be seen, and the holes dug among the stones to receive the

> potatoes were some of them 6 feet in depth - thus securing a degree of moisture and shelter from the sun- though no more soil than on the surface (Emory et al. 1959: 24).

However, after conferring with Dr. Douglas Yen, then ethnobotanist for Bishop Museum, Barerra expressed Yen's doubts regarding this technique of sweet potato production. Yen did not dismiss the possibility entirely and Barrera suggested that this activity needs further research (Barrera 1971).

Bevacqua and Moore (1972) presented a fairly in-depth discussion of pahoehoe holes in the Waikoloa project area and considered both natural and cultural explanations. They rejected a natural explanation because, according to geologists who visited the area, they are not naturally occurring phenomena (Ibid.).

Cultural explanations considered include agriculture, burial, storage, shelter, abrader quarries, and a source for construction stone. They rejected an agricultural function for the pahoehoe holes based on 1) the absence of vegetable/organic remains within the pahoehoe holes, and 2) on conversations with Dr. Douglas Yen. Bevacqua and Moore (1972) had earlier found preserved organic remains within a cairn in Waikoloa and argued that if organic remains can survive the hot, dry environment in a cairn, then such remains should be present in the pahoehoe holes if they were used for agriculture (Ibid.).

Of the other cultural explanations examined, Bevacqua and Moore rejected burial (no skeletal remains were found within the holes), storage (no artifact or other caches were found within the holes), and shelter (the resulting holes were usually too small and had surfaces that were too rough and jagged for comfortable shelter). The two preferred cultural explanations were abrader quarries and a source for construction stone.

The abrader quarry explanation was preferred because several pahoehoe holes were found in close association with abrader grinding surfaces. Three abraders in various stages of manufacture were found adjacent to two abrader grinding surfaces in Survey Area B, suggesting that the quarries were a source for raw material to manufacture scoria abraders.

Bevacqua and Moore (1972) also stated that "one definite function of the holes was a source of stone for the construction of shelters and for the curbstone Kiholo-Puako trail" (Ibid: 18). Shelters in Survey Areas A and B, and the curbstone trail are believed to be constructed of the denser rock found below the scoriaceous upper 2 to 5 cm layer of the pahoehoe flow.

In formulating a hypothesis for the function of the pahoehoe holes, Bevacqua and Moore (1972: 18) suggested that no single function can explain the observed phenomena. Their hypothesis states that the pahoehoe holes were used 1) primarily as abrader quarry sites, and 2) incidently as a source of building stone. The criteria provided to test this hypothesis included:

1. The pahoehoe holes have a random distribution, which follows the natural landscape.

2. The pahoehoe holes are found in association with shelters constructed from extracted stone, or with abrader quarries, or both.

3. The pahoehoe holes do not contain cultural or obviously intrusive material.

Carter's (1985) discussion of these features (pahoehoe clearings) incorporated a review of Barrera's (1971) and Bevacqua and Moore's (1972) research and interpretation of these features. Although she concedes that Bevacqua and Moore presented a good argument for the use of pahoehoe holes as abrader quarries and for a source of construction stone, she did not observe abrader grinding surfaces associated with the pahoehoe clearings in the Ka'ūpūlehu project area where over 2,100 clearings were found. Instead, Carter argued for an agricultural interpretation, evident from ethnohistoric sources, primarily, Lyman's 1846 observations mentioned earlier. Lyman's observation, according to Carter (1985: 21) is substantial evidence for the use of pahoehoe clearings for agriculture. She also pointed out that Handy and Handy (1972: 127-129) describe sweet potato planting methods in rocky environs. Handy and Handy (Ibid.) explained that sweet potatoes grown in the semi-disintegrated lava were fertilized by heaping rubbish and fine gravel and stones around the vines, which also facilitated the holding of moisture in arid areas. Sweet potatoes grown in this manner were considered inferior and tasteless. Carter further supported her argument by bringing attention to the Hawaiian word, *makaili*, meaning the planting of sweet potatoes in rocky places (Fornander (1919-1920, VI: 164).

Resulting from field investigations, previous archaeological studies, and historical research, the following observations concerning pahoehoe clearings (or pits as they are referred to in this report) in the Manini'ōwali/Kūkio 2 project area are presented.

1. The pits recorded in Manini'ōwali/Kūkio 2 are similar to the feature types described as "pahoehoe clearings"

by Carter (1985) and Walker and Donham (1986), and as "pahoehoe holes" by Barrera (1971) and Bevacqua and Moore (1972).

2. A majority of the pits were apparently formed by breaking the pahoehoe surface with hammerstones and removing the resulting boulders. Others pits were formed by breaking into the side of pahoehoe cliffs and large accretionary boulders. It was observed that both methods occasionally exposed lava tubes and blisters of varying sizes. These pits ranged from 9.6 to 0.2 m in length, 9.0 to 0.1 m in width, and from 0.1 to 1.9 m in depth.

3. The pit features in Manini'ōwali/Kūkio 2 seem to be associated with rock shelters and habitation caves, as indicated by Carter for pits in Ka'ūpūlehu (1985). Also, many of the pits (all pit features in Site 5338) appear to be in association with the *mauka-makai* trail (Site 5337).

4. Cultural materials were found in 76 pit features in Manini'ōwali. An infant burial was found in one pit (Site 5338, Feature 810); marine shell (primarily *Cypraea* sp.) was found in 19 pits; rounded, smooth basalt boulder and cobble hammerstones were found in 23 pits; coral manuports were found in 9 pits; artifact caches were found in 27 pits; and small pebble to coarse gravel-sized pumice was found in 17 pits.

5. Only one pit (Site 5352, Features 1,2), quarried into a large accretionary boulder, exposed scoriaceous lava. No abrader grinding surfaces were found in association with pits.

6. Some structures observed may have been constructed with extracted boulders/blocks of pahoehoe from quarried pits.

Based on results of the current archaeological investigations and observations from previous researchers, the pit features in the Manini'ōwali/Kūkio 2 project area are interpreted primarily as quarry and agricultural features. Use as storage (cache) features, burial cysts, and other cultural uses are considered secondary.

The presence of over 3,500 pit features along the North Kona coast from Awake'e to Anaehoomalu in South Kohala needs further examination. Documented scoria abrader manufacturing areas and quarries in areas from Lalamilo to Puuanahulu (Rosendahl 1972) and in Kalahuipua'a (Kirch 1979) lends substantial support to the possibility that Hawaiians discovered a raw material (scoria

lava) for the manufacture of abrading tools. One of the determining factors for the presence of this feature type seems to be the geological composition of pahoehoe flows. In light of these possibilities, Bevacqua and Moore's hypothesis that the pit features functioned as abrader quarries certainly merits further testing.

However, Carter's hypothesis of agricultural use of these features also merits further research and discussion. The ethnohistoric information regarding the cultivation of sweet potato in rocky areas, without soil, is fairly convincing and the presence of gravel to pebble-sized pumice in 17 of the pits provides probable evidence of agricultural use of the pits.

HABITATION FEATURES

Forty-four habitation features were identified in the Manini'ōwali/Kūkio 2 project area. Habitation features were identified on the basis of structural type and presence of surface/subsurface cultural deposits (midden/artifacts/manuports). Feature types identified as habitation included lava tubes, overhang shelters, C-shapes, enclosures, modified outcrops, lava sinks, and platforms. All of these features are considered temporary habitation features. None of the features exhibited characteristics (architectural complexity, associated permanent structures, thick midden deposits) of permanent habitation comparable to permanent household structures identified on the coast at Kua and Kakapa Bays (see Cordy 1978, 1981; Ladefoged 1989; Sinoto and Pantaleo 1990). Table 7 summarizes the 44 temporary habitation features, by site, within the project area. Three features, including two lava tubes (Site 5348, Feature 3.1 and Site 5354, Feature 3) and an enclosure (Site 5341, Feature 3), show evidence of recurrent use.

Of the 15 lava tubes, six are only large enough for one or two individuals (see Appendix A). These range from 1.26 to 2.8 m in length, 0.45 to 1.85 m in width, and 0.75 to 1.65 m in interior height. All but Feature 53 of Site 5348 contained very sparse surface midden (marine shell and/or sea urchin) and are usually situated near pit features (see Appendix C). Site 5348, feature 53, contained a complete adze and a cobble manuport, but no surface midden. The sparse quantity of materials in these six lava tubes indicates that they were used for temporary shelter.

TABLE 7
SUMMARY OF HABITATION FEATURES IN THE MANINI'OWALI/KUKIO 2 PROJECT AREA

Site/Feature No. 50-10-18 (50-He-D21-)	Feature Type	Comments	Map Reference
5338/ (D21-54)			
110	Lava Tube	Partially collapsed tube with sea urchin remains on surface; no sediments in tube	B17
135	Overhang Shelter	Shallow soil deposits with sparse, surface marine shell and bird bone	B16
297	Overhang Shelter	Adjacent to trail, contains sea urchin remains on cobble floor.	B13
559	C Shape	Wall is tumbled and has two uprights; contains sparse, surface marine shell, no soil deposits	F21
619	Enclosure	Rectangular in shape with second, associated enclosure, no soil deposits, contains sparse, surface marine shell and a coral manuport	F23
620	Enclosure	Circular in shape with piled pahoehoe slabs, no soil deposits, coral manuport on surface	F23
733	Modified Outcrop	Stacked boulders/cobbles forms low wall on outcrop; contains sparse marine shell and coral	B4
734	Modified Outcrop	Low, stacked cobble wall connecting accretionary boulders; contains sparse marine shell, coral and basalt manuports	A5
735	Overhang Shelter	Adjacent to steppingstone trail, large accretionary boulder used as shelter; contains sparse, surface marine shell and sea urchin remains.	A5
738	Modified Outcrop	Adjacent to stepping stone trail; contains sparse, surface marine shell	B6
739	Overhang Shelter	Adjacent to three pit features; contains sparse, surface marine shell and red cinder pebbles	B6
808	C-Shape	Three uprights incorporated into wall, no soil deposits; contains sparse, surface marine shell.	C11
5339/ (D21-55)			
137	Overhang Shelter	Adjacent to pits and trail, low wall fronts shelter; contains gravel floor with sparse, surface marine shell	G6

TABLE 7 (CONT'D)

Site/Feature No.	Feature Type	Comments	Map Reference
5341/ (D21-57)			
1	Lava Tube	Shallow sediment deposits with surface marine shell, volcanic glass flake, basalt hammerstone fragment, and smooth, rounded, basalt pebbles.	G8
3	Enclosure	Low stacked walls basalt boulders/ cobbles on outcrop; two subsurface cultural layers (I, II) with sparse midden and artifacts; Layer I charcoal provided two age ranges: A.D. 1327-1650 and D.D. 1480-1808	G8
5343/ (D21-59)			
1	C-Shape	Basalt boulder alignment abutting aa flow, contains sparse marine shell	G2
2	Overhang Shelter	Contains basalt aa pebble/gravel floor with sparse marine shell, adjacent to pit containing bird bone	G2
13	Overhang Shelter	Contains leveled, basalt aa gravel floor with sparse marine shell, adjacent to pit and cupboard features.	G2
15	C-Shape	Basalt boulder alignment on red cinder hill, contains sparse marine shell.	G2
5345/ (D21-61)			
5	Lava Tube	Low wall fronting entrance; pebbly, gravelly, cave sediments contain sparse marine shell.	G26
6	Lava Tube	Leveled floor of basalt pebbles and gravel, contains sparse surface marine shell.	G26
7	Lava Tube	Sparse sediment deposits; contains sparse marine shell and bone artifact	G26
10	C-Shape	Stacked cobbles and boulders, contains sparse marine shell	G26
5346/ (D21-62)			
1	Lava Tube	No sediment deposits; contains sparse marine shell	G10
8	C-Shape	Contructed of upright pahoehoe slabs; sparse, surface marine shell; no soil deposits	G10

TABLE 7 (CONT'D)

Site/Feature No.	Feature Type	Comments	Map Reference
5347/ (D21-63)	Overhang Shelter	Modified accretionary boulder with leveled, cobble floor, contains bird bone	G13
5348/ (D21-64)			
1	Lava Sink	Collapsed lava tube containing surface marine shell, sea urchin, volcanic glass flakes, cowrie lure, and surface hearth; adjacent to Features 2 and 3.1	G9
2	Lava Sink	Collapsed lava tube contains surface marine shell, sea urchin, basalt boulder manuports and cupboard, adjacent to Features 1 and 3	G9
3.1	Lava Tube	Area of concentrated surface cultural materials (midden and artifacts) within Feature 3.2 (lava tube). Feature 3.2, 3.3, and 3.4 are associated tubes with surface midden	G9
34	Enclosure	Roughly rectangular shape with low, piled, basalt boulder/cobble walls; basalt hammerstone outside structure; sparse, surface marine shell	G9
42	Modified Outcrop	Basalt boulders/cobbles piled on outcrop; soil deposit with sparse, surface marine shell	G9
50	Lava Tube	Shallow sediment deposits with surface marine shell, sea urchin, and fish bone; low walls fronts entrance	G9
51	C-Shape	Piled pahoehoe slab construction; sparse, surface marine shell and cobble manuport; no soil deposits	G9
52	Overhang Shelter	Shallow soil deposits with sparse, surface marine shell	G9
53	Lava Tube	No sediment deposits; contained basalt adze and cobble manuport	G9

TABLE 7 (CONT'D)

Site/Feature No.	Feature Type	Comments	Map Reference
5349/ (D21-65)			
39	Lava Tube	Contains sediment deposit with surface marine shell, bird bone, and coral manuport, vandalized	G7
40	Lava Tube	Sediment deposits with very sparse surface marine shell	G7
41	Lava Tube	Contains sediment deposits with surface marine shell, basalt hammerstone and flake, volcanic glass flake, and coral manuport; vandalized	G7
5350/ (D21-66)			
1	Enclosure	Roughly square shape with stacked pahoehoe slabs and boulder walls; sparse, surface marine shell and coral manuport	G25
2	Lava Tube	Collapsed tube with sparse sediment deposits, sparse marine shell and coral manuport	G25
5354/ (D21-70)			
1	Lava Tube	Rough floor with sparse sediments; sparse marine shell, sea urchin and coral manuport	G15
2	Lava Tube	Sediment deposits with abundant midden remains and artifacts; four entrances.	G15
5355/ (D21-71)			
1	Modified Outcrop	Stacked basalt boulders/cobbles against elevated outcrop; contained surface branch coral, 2 basalt manuports, and grindstone; possible shrine.	G14
2	Platform	Roughly rectangular with outcrop boulders and stacked pahoehoe slabs; sparse, surface marine shell and coral manuports; adjacent to Feature 1.	G14

The other nine lava tube shelters are larger, ranging from 4.0 to 40.0 m in length, 2.0 to 3.9 m in width, and 0.50 to 3.1 m in interior height. Sparse to moderate quantities of surface cultural materials present in two of the larger lava tubes (Sites 50-10-18-5348, 5354) suggest that they were used more often than the smaller tubes, possibly for short-term occupation. Two lava tube shelters, Site 5348, Feature 3.1 and Site 5354, Feature 2, contain large enough quantities of surface and subsurface cultural materials to indicate recurrent use of these lava tubes for habitation. At this time, this use is considered to reflect temporary habitation. Artifacts from Feature 2, Site 5354 (a basalt flake with polish from an adze, one volcanic glass flake and two volcanic glass fragments, and a cowrie shell lure) suggest that the Hawaiians living here were engaging in fishing activities (cowrie lure), food preparation (volcanic glass), and possibly wood working (basalt flake with polish). Site 5348, Feature 3.1, is discussed further in the appended burial report.

The nine overhang shelters identified as habitation features range in size from 1.10 by 0.93 m to 4.3 by 1.7 m. All contained very sparse to sparse, surface cultural materials, primarily marine shell, sea urchin remains, and occasional bird bone. Most of the overhang shelters are associated with pit features.

C-shaped shelters identified as temporary habitation features are small, ranging in size from 0.66 by 0.61 m to 3.25 by 2.65 m. None of the C-shapes contained soil/sediment deposits, but all contained very sparse to sparse, surface cultural materials, primarily marine shell.

Enclosures ranged in size from 1.3 by 1.3 m to 5.4 by 4.1 m and are poorly constructed with piled or stacked pahoehoe slabs, boulders, and cobbles. Sparse, surface cultural materials were present in the enclosures, but soil/sediment deposits were present in only one of the enclosures (Site 5341, Feature 3). Test excavations in this enclosure revealed two layers (I and II) containing cultural materials. Dated charcoal samples from lower portions of Layer I (HRC 1351) indicate that this feature was occupied between A.D. 1327 to 1650. Dated charcoal from upper portions of Layer I (HRC 1354) suggests that this occupation possibly continued as late as A.D. 1808. The date of initial occupation of this feature, represented by Layer II deposits, is not known at this time. The presence of two cultural layers in this feature suggests recurrent use of this site for habitation.

Two coral file tips and a piece of cut bone found in the enclosure suggest that Hawaiians living here were engaging in fishhook manufacture. Although no subsurface cooking features (an *imu* or a hearth) were found during testing, the presence of charcoal and food refuse suggests that cooking activities were occurring.

Two lava sinks, Features 1 and 2 at Site 5348, are adjacent habitation features that are associated with a lava tube (Feature 3), portions of which (Features 3.1) were used for habitation. These sinks contain moderate quantities of surface midden (primarily marine shell and sea urchin) and artifacts (volcanic glass, cowrie lure, and basalt manuports). These features are discussed further in the appended burial report.

Five modified outcrops identified as habitation features range in size from 2.60 by 1.65 m to 7.30 by 4.50 m and were identified by stacked or piled pahoehoe slabs, boulders, and cobbles against bedrock outcrops. All but one (Site 5355, Feature 1) contained sparse, surface marine shell. Although no surface midden was observed at Site 5355, Feature 1, it contained branch coral, a basalt grindstone, and coral manuports on the surface. Test excavations in Feature 1 yielded several more pieces of branch coral and two coral cobbles. Based on the presence of branch coral, this feature is interpreted as a possible *ko'a* (shrine). Branch coral offerings are often observed on such shrines (Kirch 1985: 261).

The habitation platform, Site 5355, Feature 2, is associated with Feature 1 and contained surface marine shell and coral manuports.

CHRONOLOGY

Radiocarbon dates were obtained to estimate initial occupation in the Manini'ōwali/Kūkio 2 area, which could be compared with dates from previous studies in the West Hawaii region; determine extent of site contemporaneity, which could achieve local settlement patterns; and determine site abandonment.

Results from available radiocarbon dates, together with previous archaeological research, ethnohistorical review, hydration-rind dates from volcanic glass, and artifacts, indicate that site ages range between A.D. 1020-1280 to A.D. 1729-1808. According to Apple (1965), the *mauka-makai* and coastal trails are prehistoric. The radiocarbon date recovered from a hearth in Site 50-10-18-5348 (A.D. 1020-1280) may indicate early occupation in Manini'ōwali in order to exploit marine resources. A similar, early radiocarbon date (A.D. 1030 to 1290) from Site 10959 in adjacent Ka'ūpūlehu (Walker and Rosendahl 1988) supports early occupation in the general region. The presence of historical artifacts associated with burials in feature 3.5 (lava tube) at Site 5348, suggests use into the historical period. Further testing at this site, especially in the hearth, may determine the association between the habitation and burials. Based on the available dates from radiocarbon and basaltic glass, minimal midden deposits, and the presence of historical artifacts, the Manini'ōwali/Kūkio 2 area was initially occupied A.D. 1020-1280, with the main occupation occurring between A.D. 1500-1700, and abandonment in the early 1800's. This settlement pattern in leeward Hawaii correlates with Kirch's Expansion Period, which is settlements springing up on leeward coasts of Hawaii to exploit the available marine resources.

Due to the lack of soil deposits within the project area, only five test excavations were conducted. The remainder of the testing consisted of sight observations in pit/lava tube features.

The results of the archaeological inventory survey suggest early expansion into the middle, barren zone in order to exploit the marine resources as well as scoria and stone for construction. Expansion into this middle zone probably served for specialized activities, evidenced by the amount of pit features throughout the project area. Temporary habitation features were located primarily along *mauka-makai* trails.

RECOMMENDATIONS

All of the recorded sites are considered significant under National Register Significance Criterion D, which states that a site has yielded or has the potential to yield information significant for the understanding of traditional culture and history of the area. Several sites are also significant under other criteria (A-C,E). Table 8 provides a list of sites and their significance evaluations.

Permanent *in-situ* preservation is recommended for sites 50-10-18-5337 (segments of the *mauka-makai* trail), 50-10-18-5348 (burials), 50-10-18-5338, Feature 402, 50-10-18-5339, Feature 102, 50-10-18-5352, Feature 2, and the cinder cone located in the northern end of the project area (Table 9). The cinder cone and trail would be suitable for incorporation into a public interpretation program. The criteria for in-situ preservation are:

1) Integrity of surface structural components,
2) Representative examples of site/feature types,
3) Educational and/or interpretive potential,
4) Religious or ceremonial function, and
5) Presence of human burials.

A detailed Cultural Resource Management Plan will be submitted at a future date. The CRMP will include two components, a preservation plan and a data recovery plan. The preservation plan will include representative samples of middle zone site-types, trails, and burial treatment plans. Sites recommended for *in-situ* preservation will be placed either in active or passive preservation. Active preservation may entail stabilization and restoration for public interpretation. Passive preservation involves data banking of sites for future research and/or interpretive purposes.

The data recovery plan will address some of the sites not recommended for preservation. These sites will provide information concerning research questions on the settlement and use of the North Kona region as well as specific questions on the prehistory of Manini'ōwali and Kūkio 2 ahupua'a. Data recovery will be conducted primarily at sites located in areas to be impacted. Sites will be selected based on their research potential and frequency of occurrence.

TABLE 8

SIGNIFICANCE EVALUATIONS

Site #	Interpretation	Significance Evaluation
D21-53 (5337)	trail	C,D,E
D21-54 (5338)	burial, temporary habitation, quarry, agriculture, storage	C,D,E
D21-55 (5339)	burial, temporary habitation, agriculture, quarry	D,E
D21-56 (5340)	temporary habitation	D
D21-57 (5341)	temporary habitation, quarry, agriculture	D
D21-58 (5342)	agriculture	D
D21-59 (5343)	temporary habitation, quarry	D
D21-60 (5344)	quarry, agriculture	D
D21-61 (5345)	temporary habitation, quarry, agriculture	D
D21-62 (5346)	temporary habitation, quarry, agriculture, storage	D
D21-63 (5347)	temporary habitation, quarry, agriculture	D
D21-64 (5348)	burial, habitation, quarry, agriculture	D,E
D21-65 (5349)	temporary habitation, quarry	D
D21-66 (5350)	habitation	D
D21-67 (5351)	trail	D
D21-68 (5352)	burial, agriculture, quarry	D,E
D21-69 (5353)	agriculture, storage	D
D21-70 (5354)	temporary habitation	D
D21-71 (5355)	agriculture, habitation, possible shrine	D,E
D21-72 (5356)	quarry	D
D21-73 (5357)	quarry, agriculture	D
D21-74 (5358)	quarry	D
D21-75 (5359)	temporary habitation, quarry,	D
D21-76 (5360)	quarry	D
D21-77 (5361)	quarry	D

TABLE 9

SITES RECOMMENDED FOR PERMANENT *IN-SITU* PRESERVATION

Site #	Feature #	Description
50-10-18-5337	1	*mauka-makai* trail
50-10-18-5338	402	burial
50-10-18-5338 (portions)	--	pits, overhang shelters, lava tubes, cupboards
50-10-18-5339	146	burial
50-10-18-5348	1	habitation
	2	habitation
	3.1	habitation
	3.2	habitation
	3.3	habitation
	3.4	habitation
	3.5	burial chamber
	3.6	burial platform
	3.7	burial
	4-37	habitation, quarry, exploratory, agriculture
50-10-18-5352	2	burial
50-10-18-5355*	1	possible shrine
	2	possible shrine

*Features 1 and 2 of Site 5355 require further testing to confirm function.

REFERENCES

Apple, Russell A.
1965 *Trails: From Steppingstones to Kerbstones*. Honolulu, HI: Bishop Museum Press.

Armstrong, R. W.
1979 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. Ph.D. dissertation, Univ. Hawaii.

1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. New York, NY: Academic Press.

1985 *Archaeological Data Recovery at C22-27 in Kalamakapala Ahupu'a in the Kealakekua Bay Region (South Kona, Hawaii Island)*. Honolulu: Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

1986 *Field Inspection, Kua Bay: Possible Grading Violations, Manini'ōwali, North Kona, Hawaii*. On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

Cordy, Ross, and M. Kaschko
1980 Prehistoric Archaeology in the Hawaiian Islands: Land Units Associated with Social Groups. *Journal of Field Archaeology* 7:403-415.

Donham, Theresa
1986 *Archaeological Reconnaissance Makalawena Coastal Development*. On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

1987 *Archaeological Reconnaissance Survey Proposed Awakee Resort Development Project Area*. On file Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

Emory, Kenneth P., William J. Bonk, and Yosihiko H. Sinoto
1968 *Hawaiian Archaeology: Fishhooks*. Bishop Museum Spec. Publ. 47. Honolulu: Bishop Museum Press.

Kirch, Patrick V.
1973 *Archaeological Excavations at Kahalu'u, North Kona, Island of Hawaii*. Departmental Report Series 73-1. Honolulu: Dept. Anthropology, Bishop Museum.

1979 *Marine Exploitation in Prehistoric Hawaii: Archaeological Excavations At Kalahuipua'a, Hawaii Island*. Pacific Anthropological Records 29. Honolulu: Dept. Anthropology, Bishop Museum.

Munro, George C.
1982 *Birds of Hawaii*. Rutland, VT, and Tokyo, Japan: Charles E. Tuttle Co., Inc..

Randall, Mark E.
1971 Early Marbles. *Historical Archaeology* 5:102-105.

Reinecke, J.
Ms. Archaeology of Kona, Hawaii. Typescript in Bishop Museum Library.

Renger, R. C.
1970 *Archaeological Reconnaissance of Coastal Kaloko and Kukio I, North Kona, Hawaii*. Departmental Report Series 70-10. Honolulu: Dept. Anthropology, Bishop Museum.

Rosendahl, Paul
1973 *Archaeological Salvage of the Keahole to Anaehoomalu Section of the Kailua-Kawaihae Road, Island of Hawaii*. Departmental Report Series 73-3. Honolulu: Dept. Anthropology, Bishop Museum.

Rosendahl, Paul and Richard Sullivan
1989 *Interim Report: Background, Summary of Methodology and Findings, and Additional Tasks Performed, Archaeological Mitigation Project, Kaupulehu Makai Resort, Land of Kaupulehu, North Kona District, Island of Hawaii*. On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

Rosendahl, Paul and Alan Walker
1988 *Archaeological Survey and Test Excavations, Kaupulehu Makai Resort Project Area, Lands of Kaupulehu and Kukio 1st, North Kona, Island of Hawaii*. (TMK 3-7-2-03:1). On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

Sato, Harry H., Warren Ikeda, Robert Paeth, Richard Smythe, and Minoru Takehiro
1973 *Soil Survey of the Island of Hawaii, State of Hawaii*. U.S.D.A. Soil Conservation Service, and University of Hawaii Agricultural Experiment Station Washington DC: U.S. Government Printing Office.

Sinoto, Aki and Jeffrey Pantaleo
1990 Initial Cultural Resources Management Plan, Awake'e-Manini'ōwali/Kuki'o 2 Land Exchange, North Kona, Hawai'i Island. MS in Dept. Anthropology, Bishop Museum, Honolulu.

Schilt, Rose
1984 *Subsistence and Conflict in Kona, Hawaii: An Archaeological Study of the Kuakini Highway Realignment Corridor*. Departmental Report Series 84-1. Honolulu: Dept. Anthropology, Bishop Museum.

Smith, Henry W.
1963 *Handbook for Soil Descriptions*. Dept. of Soils and Agronomy. Pullman, WA: Washington State University.

Soehren, Lloyd
1982a Letter Report. Archaeological Reconnaissance Survey Along the Proposed Road and Utility Corridor at Manini'ōwali (TMK 7-2-04:4 and 17). On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

1982b Letter Report. Archaeological Reconnaissance Survey of Parcels TMK 7-2-04:8, 9, 10, 12, at Manini'ōwali, North Kona. On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

Stuiver, Minze, and B. Becker
1986 High-Precision Decadal Calibration of the Radiocarbon Time Scale, A.D. 1959-2500 B.C. *Radiocarbon* 28 (2B):863-910.

Stuiver, Minze, and P. J. Reimer
1986 A Computer Program for Radiocarbon Age Calibration. *Radiocarbon* 28:1022-1030.

Tinker, Spencer W.
1978 *Fishes of Hawaii: A Handbook of the Marine Fish of Hawaii and the Central Pacific Ocean*. Honolulu, HI: Hawaiian Services, Inc..

Titcomb, Margaret, with collaboration of Mary Kawena Pukui
1972 *Native Use of Fish in Hawaii*. Honolulu: Univ. Hawaii Press.

Walker, Alan, and Paul Rosendahl
1985 *Full Archaeological Reconnaissance Survey Kukio Resort Development Project Area*. On file, Historic Sites Section, Dept. Land and Natural Resources, State of Hawaii.

APPENDIX A

SUMMARY OF ARCHAEOLOGICAL SITES AND FEATURES

APPENDIX A

SUMMARY OF ARCHEOLOGICAL SITES AND FEATURES

Permanent
NPBM (50-Ma-)
(State 50-10-18-)

Site/Feat.#	Type	Functional Interpretation	Plan	Tested	Dimensions (m)
5337 (D21-53)					
1	trail	transportation	D		1900 m.

TOTAL 1					
5338 (D21-54)					
1	pit	quarry, agriculture	D		1.8 x 1.3 x 0.4
2	pit	quarry, agriculture	D		2.8 x 1.7 x 0.35
3	pit	quarry, agriculture	D	x	1.3 x 0.9 x 0.5
4	pit	quarry, agriculture	D	x	1.9 x 1.5 x 0.5
5	pit	quarry, agriculture	D	x	0.8 x 0.3 x 0.35
6	pit	storage	D	x	1.1 x 0.8 x 0.75
7	pit	quarry	D		2.0 x 1.2 x 1.35
8	pit	quarry, agriculture	D	x	1.8 x 0.9 x 1.6
9	pit	quarry	D	x	4.0 x 3.4 x 0.45
10	pit	quarry	D		1.5 x 1.3 x 0.45
11	pit	quarry, agriculture	D		1.5 x 1.3 x 0.35
12	pit	quarry, agriculture	D		1.2 x 0.4 x 0.2
13	pit	quarry, agriculture	D		0.7 x 0.5 x 0.35
14	pit	quarry, agriculture	D		1.4 x 0.6
15	pit	quarry, agriculture	D	x	0.3 x 0.15 x 0.5
16	pit	quarry, agriculture	D	x	0.5 x 0.3 x 0.5
17	pit	quarry, agriculture	D	x	0.3 x 0.2 x 0.4
18	pit	quarry	D	x	4.1 x 2.2 x 0.4
19	pit	quarry, agriculture	D		3.54 x 1.67 x 0.35
20	pit	quarry, agriculture	D		1.24 x 1.12 x 0.2
21	pit	quarry, agriculture	D		0.87 x 0.25 x 0.25
22	pit	quarry, agriculture	D		1.5 x 1.6 x 0.47
23	pit	quarry, agriculture	D		2.54 x 1.28 x 0.49
24	pit	quarry, agriculture	D		3.3 x 1.46 x 0.3
25	pit	quarry, agriculture	D		1.47 x 0.95 x 0.35
26	pit	quarry, agriculture	D	x	3.8 x 2.1 x 0.45
27	pit	quarry, agriculture	D	x	1.8 x 1.2 x 0.4
28	pit	quarry, agriculture	D		1.7 x 1.3 x 0.34
29	pit	quarry, agriculture	D		0.9 x 0.8 x 0.22
30	pit	quarry, agriculture	D		1.7 x 0.45 x 0.27
31	pit	quarry, agriculture	D		0.7 x 0.4 x 0.3
32	pit	quarry, agriculture	D		0.9 x 0.35 x 0.35
33	pit	quarry, agriculture	D		0.8 x 0.55 x 0.3
34	pit	quarry, agriculture	D		1.6 x 0.95 x 0.5
35	pit	quarry, agriculture	D		1.8 x 0.8 x 0.5
36	pit	quarry, agriculture	D	x	1.1 x 1.5 x 0.57
37	pit	quarry	D		2.7 x 0.55 x 0.5
38	pit	quarry	D		2.48 x 0.85 x 0.3

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Plan	Tested	Dimensions (m)
5338 (D21-54)					
39	pit	quarry	D		1.7 x 0.75 x 0.7
40	pit	quarry	D		1.55 x 0.85 x 0.28
41	pit	quarry	D		3.6 x 1.1 x 0.2
42	pit	quarry	D		1.9 x 0.25 x 0.5
43	pit	quarry	D		1.9 x 1.0 x 0.52
44	pit	quarry, agriculture	D		3.8 x 1.9 x 0.5
45	pit	quarry, agriculture	D		1.1 x 1.0 x 0.3
46	pit	quarry, agriculture	D		1.5 x 1.4 x 0.52
47	pit	quarry, agriculture	D		3.9 x 2.7 x 0.4
48	pit	quarry, agriculture	D		2.5 x 1.9 x 0.23
49	pit	quarry	D		0.6 x 0.45 x 0.7
50	pit	agriculture	D	x	3.7 x 2.5 x 0.6
51	pit	agriculture	D	x	2.7 x 2.5 x 0.43
52	pit	agriculture	D	x	4.8 x 1.4 x 0.45
53	pit	quarry	D		1.2 x 0.8 x 0.4
54	pit	quarry	D		0.6 x 0.55 x 0.35
55	pit	quarry	D		1.4 x 0.7 x 0.75
56	pit	quarry	D		4.7 x 2.2 x 0.55
57	pit	quarry	D		0.6 x 0.5 x 0.45
58	pit	quarry	D		5.5 x 1.8 x 0.8
59	pit	quarry	D		0.11 x 0.12
60	pit	quarry	D		2.7 x 2.3 x 0.8
61	pit	quarry	D		0.32 x 0.23 x 0.2
62	pit	quarry	D		1.0 x 0.61 x 0.20
63	pit	quarry	D		0.88 x 0.65 x 0.28
64	pit	quarry	D		2.4 x 1.7 x 0.5
65	pit	quarry, agriculture	D		1.0 x 0.5 x 0.3
66	pit	quarry, agriculture	D		0.7 x 0.6 x 0.25
67	pit	quarry, agriculture	D		3.7 x 1.0 x 0.6
68	pit	quarry	D	x	9.6 x 3.0 x 0.4
69	pit	quarry	D		1.1 x 0.5 x 0.37
70	pit	quarry	D	x	2.7 x 1.7 x 0.3
71	pit	quarry	D		4.0 x 2.2 x 1.2
72	pit	quarry	D	x	2.5 x 1.1 x 0.4
73	pit	quarry	D		1.7 x 0.75 x 0.4
74	pit	quarry, agriculture	D		2.1 x 2.1 x 0.5
75	pit	quarry, agriculture	D		0.85 x 0.8 x 0.15
76	pit	quarry, agriculture	D		0.3 x 0.25 x 0.15
77	pit	quarry, agriculture	D		1.3 x 0.8 x 0.42
78	crevice	quarry	D	x	4.0 x 1.15
79	pit	quarry, agriculture	D	x	9.5 x 4.2 x 0.35
80	pit	quarry, agriculture	D		2.5 x 2.0 x 0.4
81	pit	storage	D	x	4.5 x 2.0 x 0.6
82	crevice	quarry	D		1.94 x 1.26 x 0.42
83	pit	quarry	D		4.13 x 2.89 x 0.32
84	pit	quarry	D		1.67 x 0.78 x 0.18
85	pit	quarry	D		1.5 x 1.0 x 0.6
86	pit	quarry	D		2.66 x 1.65 x 0.4
87	pit	agriculture	D		3.0 x 2.2 x 0.25
88	pit	quarry, agriculture	D	x	1.1 x 0.8

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5318 (D21-56)					
89	pit	quarry, agriculture	D	x	0.5 x 0.4 x 0.2
90	pit	quarry	D		3.32 x 1.92 x 0.24
91	pit	quarry, agriculture	D		1.5 x 1.0 x 0.5
92	pit	quarry, agriculture	D		0.55 x 0.5 x 0.6
93	pit	quarry, agriculture	D		1.2 x 1.2 x 0.55
94	pit	quarry	D		3.23 x 1.6 x 0.28
95	pit	quarry	D		2.9 x 0.65 x 0.26
96	pit	quarry	D		1.13 x 1.01 x 0.15
97	pit	quarry	D		3.04 x 1.68 x 0.24
98	pit	quarry	D		2.92 x 2.77 x 0.35
99	pit	quarry, agriculture	D		3.0 x 1.5 x 0.45
100	pit	quarry	D		1.6 x 1.16 x 0.32
101	pit	quarry	D		1.07 x 0.8 x 0.16
102	pit	quarry	D		1.6 x 0.85 x 0.57
103	pit	quarry	D		2.5 x 1.5 x 0.23
104	pit	quarry, agriculture	D		1.3 x 0.9 x 0.36
105	cupboard	storage	D		1.10 x 0.48
106	pit	quarry	D		1.83 x 1.63 x 0.12
107	pit	quarry, agriculture	D		1.0 x 0.9 x 0.2
108	pit	quarry, agriculture	D		1.9 x 0.9 x 0.2
109	pit	quarry	D		2.25 x 0.95 x 0.75
110	lava tube	temporary habitation	D	x	1.26 x 0.45 x 1.20
111	pit	quarry	D		1.1 x 0.8 x 0.4
112	overhang shelter	temporary habitation	D	x	2.1 x 1.1 x 0.6
113	pit	quarry	D		0.8 x 0.5 x 0.36
114	pit	quarry	D		1.75 x 0.8 x 1.3
115	pit	quarry	D		0.9 x 0.7 x 0.5
116	pit	quarry, agriculture	D		0.5 x 0.2 x 0.65
117	pit	quarry	D		4.8 x 0.7 x 0.65
118	pit	quarry, agriculture	D		1.68 x 1.56 x 0.49
119	pit	quarry, agriculture	D		2.56 x 0.82 x 0.43
120	pit	quarry, agriculture	D		0.66 x 0.34 x 0.33
121	pit	quarry, agriculture	D		0.43 x 0.33 x 0.39
122	pit	quarry, agriculture	D		1.04 x 0.63 x 0.29
123	pit	quarry, agriculture	D		1.65 x 1.44 x 0.32
124	pit	quarry, agriculture	D		1.7 x 1.63 x 0.25
125	pit	quarry, agriculture	D		0.82 x 0.79 x 0.22
126	pit	quarry	D		1.2 x 0.75 x 0.36
127	pit	quarry	D		1.5 x 0.7 x 0.15
128	cairn	trail marker	D		2.6 x 1.4 x 0.33
129	crevice	quarry	D	x	4.4 x 3.5 x 0.98
130	pit	quarry	D	x	2.10 x 0.4 x 0.4
131	pit	quarry	D	x	1.3 x 0.65 x 0.35
132	pit	quarry	D	x	1.15 x 0.6 x 0.4
133	pit	quarry	D	x	2.3 x 1.2 x 0.15
134	pit	quarry	D		1.7 x 1.6 x 0.14
135	overhang shelter	temporary shelter	D	x	2.3 x 2.1 x 1.0
136	pit	quarry	D		1.8 x 0.2 x 0.28
137	crevice	quarry	D		1.3 x 0.8 x 0.5
138	pit	quarry	D		1.9 x 0.8 x 1.0

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5318 (D21-56)					
139	pit	quarry	D		1.3 x 1.0 x 1.0
140	pit	agriculture, quarry	D	x	0.9 x 0.7 x 0.35
141	pit	agriculture, quarry	D	x	2.0 x 1.4 x 0.29
142	pit	agriculture, quarry	D	x	1.0 x 0.55 x 0.54
143	pit	agriculture, quarry	D	x	1.0 x 0.8 x 0.3
144	pit	agriculture, quarry	D	x	1.5 x 0.8 x 0.25
145	pit	agriculture, quarry	D	x	0.5 x 0.3 x 0.45
146	pit	agriculture, quarry	D	x	2.0 x 1.0 x 0.25
147	pit	quarry, agriculture	D		0.9 x 0.4 x 0.7
148	pit	agriculture	D	x	5.5 x 1.0 x 0.25
149	pit	agriculture	D	x	1.5 x 0.8 x 0.25
150	pit	quarry	D		0.8 x 0.4 x 0.25
151	pit	agriculture	D		2.5 x 1.0 x 0.3
152	pit	agriculture, quarry	D		0.9 x 0.5 x 0.25
153	pit	agriculture, quarry	D		2.3 x 2.2 x 0.3
154	pit	agriculture, quarry	D		1.1 x 0.7 x 0.25
155	cupboard	storage	D	x	1.0 x 0.45
156	cupboard	storage	D	x	0.8 x 0.3
157	pit	quarry	D		1.0 x 0.6 x 0.5
158	pit	quarry	D		0.5 x 0.5 x 0.45
159	pit	quarry	D		2.6 x 1.2 x 0.54
160	pit	quarry	D		2.45 x 1.4 x 0.35
161	pit	storage	D	x	3.3 x 2.3
162	pit	quarry, agriculture	D	x	1.0 x 1.0 x 0.45
163	pit	quarry, agriculture	D		2.75 x 1.65 x 0.24
164	pit	quarry, agriculture	D		1.7 x 1.45 x 0.4
165	pit	quarry, agriculture	D		1.45 x 0.6 x 0.5
166	pit	quarry	D		2.7 x 1.0 x 1.1
167	pit	quarry	D		0.9 x 0.6 x 0.34
168	pit	quarry	D		1.0 x 0.9 x 0.35
169	pit	quarry	D		0.7 x 0.5 x 0.12
170	pit	quarry	D		1.0 x 0.7 x 0.2
171	pit	quarry	D		1.4 x 0.8 x 0.26
172	pit	quarry	D	x	1.3 x 0.6 x 0.3
173	pit	quarry	D		2.3 x 1.5 x 0.39
174	pit	quarry	D		1.1 x 0.8 x 0.6
175	pit	quarry	D		1.6 x 1.3
176	pit	quarry	D		1.3 x 0.7 x 0.5
177	pit	quarry	D		0.7 x 0.5 x 0.5
178	pit	quarry	D		1.5 x 1.1 x 0.5
179	pit	quarry	D		1.4 x 1.1 x 0.45
180	crevice	quarry	D		2.8 x 1.4 x 1.5
181	pit	quarry	D	x	1.25 x 0.6 x 0.16
182	pit	quarry	D	x	1.5 x 1.2 x 0.3
183	pit	quarry	D	x	2.0 x 0.5 x 0.23
184	pit	quarry	D	x	1.7 x 1.3 x 0.18
185	pit	quarry	D		3.0 x 2.0 x 0.55
186	crevice	quarry	D	x	1.25 x 0.3 x 0.3
187	pit	quarry	D		1.3 x 1.0 x 0.3
188	pit	quarry	D		1.1 x 0.6 x 0.8

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5318 (U71-54)					
189	pit	quarry	D		1.0 x 0.55 x 0.38
190	pit	quarry	D		0.8 x 0.7 x 0.25
191	pit	quarry	D		2.7 x 1.6 x 0.18
192	pit	quarry	D		1.25 x 0.9 x 0.3
193	pit	quarry	D	x	0.5 x 0.45 x 0.5
194	pit	quarry, agriculture	D		1.6 x 1.1 x 0.4
195	pit	quarry, agriculture	D		1.0 x 0.6 x 0.28
196	pit	quarry, agriculture	D		2.0 x 1.5 x 0.35
197	pit	quarry, agriculture	D		1.3 x 0.7 x 0.2
198	pit	quarry, agriculture	D		1.5 x 1.2 x 0.7
199	pit	quarry, agriculture	D		1.0 x 0.6 x 0.15
200	pit	quarry, agriculture	D		1.0 x 1.0 x 0.35
201	pit	quarry, agriculture	D		0.3 x 0.4 x 0.3
202	pit	quarry, agriculture	D		4.5 x 1.2 x 0.2
203	pit	quarry, agriculture	D		0.7 x 0.6 x 0.3
204	pit	quarry, agriculture	D		1.3 x 0.5 x 0.15
205	pit	quarry, agriculture	D		0.3 x 0.15 x 0.2
206	pit	quarry, agriculture	D		1.2 x 0.7 x 0.2
207	pit	quarry, agriculture	D		2.0 x 1.3 x 0.2
208	pit	quarry, agriculture	D		1.2 x 0.8 x 0.15
209	pit	quarry, agriculture	D		1.0 x 1.0 x 0.6
210	pit	quarry, agriculture	D		2.1 x 0.4 x 0.3
211	pit	quarry	D		1.9 x 1.5 x 0.4
212	pit	quarry	D		1.15 x 0.65 x 0.4
213	pit	quarry	D		0.65 x 0.55 x 0.3
214	pit	quarry	D		2.4 x 0.95 x 0.4
215	pit	quarry	D		2.7 x 0.9 x 0.12
216	pit	quarry	D		2.4 x 1.5 x 0.5
217	pit	agriculture	D		3.0 x 0.6 x 0.25
218	pit	quarry, agriculture	D		2.7 x 0.75 x 0.5
219	pit	quarry, agriculture	D		1.8 x 0.7 x 0.56
220	pit	quarry, agriculture	D	x	0.4 x 0.25 x 0.5
221	pit	quarry, agriculture	D		1.3 x 0.6 x 0.5
222	pit	quarry, agriculture	D		1.1 x 0.7 x 0.5
223	pit	quarry, agriculture	D		2.3 x 1.2 x 0.3
224	pit	quarry, agriculture	D		1.75 x 0.75 x 0.3
225	pit	quarry, agriculture	D	x	2.8 x 1.1 x 0.3
226	pit	quarry	D		2.85 x 2.85 x 0.25
227	pit	quarry, agriculture	D		2.0 x 1.2 x 0.4
228	pit	quarry, agriculture	D		0.9 x 0.6 x 0.3
229	pit	quarry, agriculture	D		1.8 x 1.0 x 0.25
230	pit	quarry, agriculture	D		1.8 x 0.9 x 0.2
231	pit	quarry	D		4.0 x 2.1 x 0.9
232	pit	quarry	D		1.2 x 0.85 x 0.25
233	pit	agriculture, quarry	D		6.2 x 0.9 x 0.24
234	pit	agriculture, quarry	D		1.25 x 0.5 x 0.21
235	pit	agriculture, quarry	D		1.45 x 1.45 x 0.24
236	pit	agriculture, quarry	D		1.8 x 1.3 x 0.93
237	pit	quarry	D		6.65 x 6.2 x 0.3
238	pit	quarry	D		0.9 x 0.75 x 0.19

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5318 (U71-54)					
239	pit	quarry	D		3.4 x 1.7 x 0.6
240	pit	quarry, agriculture	D		1.7 x 0.7 x 0.10
241	pit	quarry, agriculture	D		2.1 x 1.3 x 0.25
242	pit	quarry, agriculture	D		1.2 x 0.6 x 0.2
243	crevice	quarry	D	x	3.5 x 2.5 x 1.7
244	crevice	quarry	D		1.8 x 1.2 x 0.55
245	crevice	quarry	D	x	1.4 x 1.0 x 1.3
246	pit	quarry	D		1.45 x 0.45 x 0.38
247	pit	quarry	D		0.65 x 0.6 x 0.27
248	pit	quarry	D		0.95 x 0.9 x 0.31
249	pit	quarry	D		1.5 x 1.0 x 0.24
250	pit	quarry	D		1.9 x 1.7 x 0.26
251	pit	quarry	D		5.3 x 1.05 x 0.23
252	pit	quarry	D		5.3 x 2.6 x 0.2
253	pit	quarry	D		1.6 x 1.1 x 0.10
254	pit	quarry	D		1.55 x 0.7 x 0.18
255	pit	quarry	D		7.4 x 1.2 x 0.25
256	pit	quarry	D		2.75 x 1.35 x 0.47
257	pit	quarry	D		2.3 x 1.8 x 0.4
258	pit	quarry	D		3.2 x 2.3 x 0.15
259	pit	quarry	D		0.65 x 0.45 x 0.17
260	pit	quarry	D		2.0 x 1.3 x 0.35
261	pit	quarry	D		2.7 x 0.45 x 0.39
262	pit	quarry, agriculture	D		1.3 x 1.0 x 0.11
263	pit	quarry, agriculture	D		0.75 x 0.7 x 0.45
264	pit	quarry, agriculture	D		3.1 x 1.1 x 0.5
265	pit	quarry, agriculture	D		3.2 x 1.4 x 0.37
266	pit	quarry, agriculture	D		1.6 x 1.0 x 0.35
267	pit	quarry	D	x	3.0 x 1.7 x 1.6
268	pit	quarry, agriculture	D	x	2.7 x 2.3 x 0.6
269	pit	quarry, agriculture	D		1.7 x 1.1 x 0.4
270	pit	quarry, agriculture	D		5.0 x 2.6 x 0.2
271	pit	quarry, agriculture	D		1.1 x 0.8 x 0.25
272	pit	quarry	D		1.6 x 1.4 x 0.27
273	pit	quarry	D		1.65 x 0.8 x 0.22
274	pit	quarry, agriculture	D		2.0 x 1.3 x 0.3
275	pit	quarry	D	x	4.9 x 2.5 x 0.65
276	pit	quarry	D		3.0 x 1.7 x 0.8
277	pit	quarry	D		1.7 x 1.2 x 0.35
278	pit	quarry	D		1.5 x 0.65 x 0.3
279	pit	quarry	D		0.55 x 0.5 x 0.5
280	pit	quarry	D		2.9 x 3.2 x 0.5
281	pit	quarry	D	x	1.4 x 0.45 x 0.19
282	pit	quarry	D	x	4.4 x 1.3 x 0.21
283	pit	quarry	D	x	2.05 x 0.85 x 0.2
284	pit	quarry	D	x	2.9 x 0.8 x 0.24
285	pit	quarry	D		2.25 x 1.6 x 0.6
286	pit	quarry	D		2.25 x 1.2 x 0.28
287	pit	quarry	D		3.5 x 3.0 x 0.12
288	pit	quarry	D		4.1 x 1.7 x 0.19

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Size	Tested	Dimensions (m)
5138 (D21-54)					
289	pit	quarry	D		3.2 x 1.05 x 0.33
290	pit	quarry	D		1.3 x 1.2 x 0.31
291	crevice	quarry	D	x	3.7 x 1.3 x 0.14
292	pit	quarry	D		1.9 x 1.6 x 0.27
293	pit	quarry	D		1.8 x 1.5 x 0.2
294	pit	quarry	D		0.7 x 0.4 x 0.26
295	pit	quarry	D		1.05 x 0.45 x 0.16
296	pit	quarry	D		2.2 x 1.6 x 0.33
297	overhang shelter	temp. habitation	D	x	4.5 x 1.5 x 1.8
298	pit	quarry	D		1.5 x 1.5 x 0.25
299	pit	quarry	D		0.6 x 0.4 x 0.1
300	pit	quarry	D		1.2 x 1.0 x 0.12
301	pit	quarry	D		1.5 x 1.1 x 0.14
302	pit	quarry	D		0.6 x 0.27 x 0.38
303	pit	quarry	D		2.6 x 0.85 x 0.14
304	pit	quarry	D		3.0 x 1.15 x 0.18
305	pit	quarry	D		0.95 x 0.55 x 0.15
306	pit	quarry	D		1.3 x 0.7 x 0.28
307	pit	quarry	D		1.75 x 1.4 x 0.22
308	pit	quarry	D		0.45 x 0.2 x 0.27
309	pit	quarry	D		2.1 x 0.7 x 0.3
310	pit	quarry	D		0.8 x 0.55 x 0.2
311	crevice	quarry	D	x	2.3 x 0.2 x 0.17
312	pit	quarry	D	x	0.75 x 0.35 x 0.3
313	pit	quarry	D		1.0 x 0.9 x 0.12
314	pit	quarry	D		0.7 x 0.65 x 0.15
315	pit	quarry	D		2.7 x 1.9 x 0.3
316	pit	quarry	D		3.4 x 2.6 x 0.15
317	pit	quarry	D	x	2.3 x 0.6 x 0.8
318	pit	quarry	D		2.5 x 0.7 x 1.1
319	pit	quarry	D		4.1 x 1.1 x 0.9
320	pit	quarry	D		1.8 x 0.45 x 0.72
321	pit	quarry	D		1.95 x 1.25 x 0.24
322	pit	quarry	D		1.7 x 0.65 x 0.38
323	pit	quarry	D	x	0.65 x 0.35 x 0.6
324	pit	quarry	D	x	0.8 x 0.6 x 0.37
325	pit	quarry, agriculture	D	x	0.8 x 0.7 x 0.2
326	pit	quarry	D		1.2 x 1.0 x 0.45
327	pit	quarry, agriculture	D	x	0.55 x 0.45 x 0.5
328	pit	quarry	D		2.1 x 1.0 x 0.25
329	pit	quarry	D		1.0 x 0.6 x 0.15
330	pit	quarry	D		3.3 x 1.8 x 0.21
331	pit	quarry	D	x	1.4 x 1.2 x 0.15
332	pit	quarry	D		1.4 x 1.0 x 0.35
333	pit	quarry	D		1.0 x 0.9 x 0.5
334	pit	quarry	D		1.4 x 0.85 x 0.6
335	pit	quarry	D		1.1 x 0.6 x 0.46
336	pit	quarry	D		1.25 x 0.55 x 0.15
337	pit	quarry	D		1.15 x 0.4 x 0.19
338	pit	quarry	D		0.95 x 0.55 x 0.16

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Size	Tested	Dimensions (m)
5138 (D21-54)					
339	pit	quarry	D		1.4 x 0.6 x 0.26
340	pit	quarry	D		1.5 x 0.4 x 0.3
341	pit	quarry	D		1.3 x 0.55 x 0.25
342	pit	quarry	D		3.0 x 2.0 x 0.3
343	pit	quarry	D		1.0 x 0.7 x 0.6
344	pit	quarry	D		1.1 x 0.8 x 0.35
345	pit	quarry	D		1.5 x 1.05 x 0.2
346	pit	quarry	D		2.9 x 1.8 x 0.35
347	pit	quarry	D		2.2 x 1.6 x 0.3
348	pit	quarry	D		1.2 x 0.75 x 0.2
349	pit	quarry	D		1.1 x 0.5 x 0.24
350	pit	quarry	D		0.9 x 0.9 x 0.23
351	pit	quarry	D		1.0 x 0.8 x 0.85
352	pit	quarry, agriculture	D	x	2.8 x 1.0 x 0.75
353	pit	quarry, agriculture	D	x	2.3 x 0.6 x 0.9
354	pit	quarry, agriculture	D		2.1 x 0.75 x 0.5
355	pit	quarry, agriculture	D		1.9 x 1.4 x 0.6
356	pit	quarry, agriculture	D	x	1.4 x 0.7 x 0.25
357	pit	quarry, agriculture	D	x	0.95 x 0.85 x 0.63
358	pit	quarry, agriculture	D	x	2.2 x 1.4 x 0.5
359	pit	quarry, agriculture, storage	D	x	3.0 x 2.1 x 0.26
360	pit	quarry, agriculture	D		10.7 x 3.6 x 0.3
361	pit	quarry, agriculture	D		3.7 x 1.8 x 0.7
362	cupboard	storage	D		2.0 x 0.75
363	cupboard	storage	D		1.0 x 0.75
364	pit	agriculture, quarry	D	x	1.3 x 0.8 x 0.5
365	pit	agriculture, quarry	D	x	1.0 x 0.5 x 0.8
366	pit	agriculture, quarry	D	x	0.7 x 0.3 x 0.12
367	lava tube	temp. habitation	D	x	2.0 x 1.85 x 1.1
368	pit	quarry	D	x	1.9 x 1.4 x 0.6
369	pit	quarry	D		1.4 x 1.7 x 0.25
370	pit	quarry	D		2.3 x 0.6 x 1.0
371	pit	quarry	D		1.4 x 0.8
372	overhang shelter	temp. habitation	D		2.3 x 1.4 x 1.1
371	pit	quarry, agriculture	D		2.1 x 1.7 x 0.5
372	pit	quarry, agriculture	D		1.0 x 0.6 x 0.5
373	pit	quarry, agriculture	D		2.6 x 1.5 x 0.5
374	pit	quarry, agriculture	D		1.7 x 0.8 x 0.21
375	pit	quarry	D	x	4.3 x 0.75 x 0.8
376	pit	quarry, agriculture	D	x	1.1 x 1.0 x 0.45
377	pit	quarry, agriculture	D	x	1.4 x 1.3 x 0.3
378	pit	quarry, agriculture	D		1.1 x 0.8 x 0.4
379	pit	quarry	D	x	1.2 x 1.0 x 0.7
380	pit	agriculture, quarry	D		6.4 x 2.3 x 0.4
381	pit	agriculture, quarry	D		0.95 x 0.9 x 0.2
382	pit	agriculture, quarry	D	x	2.6 x 0.8 x 0.25
383	pit	agriculture, quarry	D	x	1.1 x 1.0 x 0.14
384	pit	agriculture, quarry	D	x	3.9 x 0.9 x 0.2
385	pit	agriculture, quarry	D	x	0.9 x 0.7 x 0.17
386	pit	agriculture, quarry	D	x	0.9 x 0.8 x 0.2

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Size	Tested	Dimensions (m)
5330 (D21-54)					
387	pit	agriculture, quarry	D	x	1.9 x 0.9 x 0.2
388	pit	agriculture, quarry	D	x	1.8 x 1.3 x 0.21
389	pit	agriculture, quarry	D	x	2.4 x 2.3 x 0.2
390	pit	agriculture, quarry	D	x	3.6 x 2.3 x 0.26
391	pit	agriculture, quarry	D		2.5 x 2.0 x 0.5
392	pit	agriculture, quarry	D		1.7 x 1.0 x 0.3
393	pit	agriculture, quarry	D		2.9 x 1.3 x 0.17
394	pit	agriculture, quarry	D		3.0 x 1.1 x 0.3
395	pit	agriculture, quarry	D		2.5 x 1.2 x 0.15
396	pit	agriculture, quarry	D		4.3 x 3.4 x 0.7
397	pit	agriculture, quarry	D		1.9 x 0.95 x 0.15
398	pit	agriculture, quarry	D		1.6 x 0.6 x 0.5
399	pit	agriculture, quarry	D		0.65 x 0.45 x 0.6
400	pit	agriculture, quarry	D		3.1 x 1.4 x 0.5
401	pit	agriculture, quarry	D		0.9 x 0.46 x 0.44
402	pit	agriculture, quarry	D		1.4 x 1.0 x 0.56
403	pit	agriculture, quarry	D		1.7 x 1.2 x 0.4
404	pit	agriculture, quarry	D		2.7 x 1.4 x 0.1
405	pit	agriculture, quarry	D		2.5 x 0.98 x 0.53
406	crevice	quarry	D		3.15 x 1.1 x 0.35
407	pit	quarry, agriculture	D		2.45 x 1.3 x 0.3
408	pit	quarry, agriculture	D		1.75 x 1.05 x 0.43
409	pit	quarry, agriculture	D		1.6 x 1.3 x 0.7
410	pit	quarry, agriculture	D		2.5 x 1.9 x 0.27
411	pit	quarry, agriculture	D		1.85 x 1.45 x 0.18
412	pit	quarry, agriculture	D		1.7 x 0.65 x 0.75
413	pit	quarry, agriculture	D		4.0 x 3.0 x 0.35
414	pit	quarry, agriculture	D		1.7 x 1.4 x 0.2
415	pit	quarry, agriculture	D		1.3 x 1.2 x 0.21
416	pit	quarry, agriculture	D		2.5 x 2.7 x 0.9
417	pit	quarry, agriculture	D		3.6 x 2.7 x 0.4
418	pit	quarry, agriculture	D		2.7 x 2.4 x 0.6
419	pit	quarry, agriculture	D		6.0 x 4.8 x 0.6
420	pit	quarry, agriculture	D		2.7 x 1.6 x 0.29
421	pit	quarry, agriculture	D		5.2 x 4.6 x 0.45
422	pit	quarry, agriculture	D		3.0 x 2.2 x 0.2
423	pit	quarry, agriculture	D		7.0 x 4.0 x 0.4
424	pit	quarry, agriculture	D		1.5 x 1.1 x 0.4
425	pit	quarry, agriculture	D		1.2 x 1.0 x 0.43
426	pit	quarry, agriculture	D		1.3 x 1.2 x 0.3
427	pit	quarry, agriculture	D		2.4 x 2.3 x 0.3
428	pit	quarry, agriculture	D		0.75 x 0.5 x 0.3
429	pit	quarry, agriculture	D		1.0 x 1.0 x 0.3
430	pit	quarry, agriculture	D		3.2 x 2.1 x 0.3
431	pit	quarry, agriculture	D		1.5 x 1.1 x 0.17
432	mod. outcrop	agriculture	D		2.3 x 1.5 x 0.16
433	pit	quarry, agriculture	D		1.4 x 1.2 x 0.28
434	pit	quarry, agriculture	D		2.0 x 1.1 x 0.28
435	pit	quarry, agriculture	D		0.94 x 0.44 x 0.3
436	pit	quarry, agriculture	D		7.9 x 7.5 x 0.3

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Size	Tested	Dimensions (m)
5330 (D21-54)					
437	pit	quarry, agriculture	D		1.3 x 1.0 x 0.31
438	pit	quarry, agriculture	D	x	3.7 x 1.3 x 0.34
439	pit	quarry, agriculture	D	x	3.6 x 2.1 x 0.34
440	mod. outcrop	agriculture	D	x	2.2 x 1.3
441	pit	quarry, agriculture	D	x	1.0 x 0.86 x 0.48
442	pit	quarry, agriculture	D		1.7 x 0.3 x 0.27
443	pit	quarry, agriculture	D		3.3 x 1.3 x 0.4
444	pit	quarry, agriculture	D		3.4 x 0.8 x 0.21
445	pit	quarry, agriculture	D		3.3 x 1.6 x 0.4
446	pit	quarry, agriculture	D		1.6 x 0.6 x 0.2
447	pit	quarry, agriculture	D		3.3 x 1.6 x 0.27
448	pit	quarry, agriculture	D		2.5 x 1.6 x 0.36
449	pit	quarry, agriculture	D		2.9 x 1.3 x 0.36
450	pit	quarry, agriculture	D		2.2 x 1.5 x 0.65
451	pit	agriculture	D		2.0 x 1.0 x 0.25
452	pit	quarry	D		2.2 x 0.87 x 0.3
453	pit	quarry, agriculture	D	x	1.1 x 1.0 x 1.0
454	pit	quarry, agriculture	D	x	2.7 x 2.5 x 0.3
455	pit	quarry, agriculture	D	x	0.33 x 0.26 x 0.34
456	pit	agriculture	D		6.7 x 3.6 x 0.4
457	pit	agriculture	D		0.9 x 0.4 x 0.32
458	pit	agriculture	D		0.88 x 0.47 x 0.12
459	pit	agriculture	D		3.0 x 1.7 x 0.18
460	pit	agriculture	D		2.4 x 1.2 x 0.07
461	pit	agriculture	D		1.24 x 0.88 x 0.22
462	pit	agriculture	D		5.0 x 4.9 x 0.4
463	pit	agriculture	D		4.3 x 1.9 x 0.35
464	pit	agriculture	D		0.86 x 0.64 x 0.35
465	pit	quarry, agriculture	D		0.9 x 0.87 x 0.3
466	pit	quarry, agriculture	D		6.0 x 3.0 x 0.2
467	pit	quarry, agriculture	D		1.2 x 1.3 x 0.5
468	pit	quarry, agriculture	D		3.6 x 3.3 x 0.35
469	pit	quarry, agriculture	D		1.6 x 0.9 x 0.4
470	pit	quarry, agriculture	D		3.1 x 0.8 x 0.6
471	pit	quarry, agriculture	D		0.8 x 0.55 x 0.19
472	pit	quarry, agriculture	D		4.5 x 3.3 x 0.2
473	pit	quarry, agriculture	D		3.0 x 2.0 x 0.23
474	pit	quarry, agriculture	D		1.35 x 0.3 x 0.27
475	pit	quarry, agriculture	D		0.7 x 0.6 x 0.34
476	pit	quarry, agriculture	D		2.0 x 1.0 x 1.1
477	pit	quarry, agriculture	D		1.9 x 1.8 x 0.5
478	pit	quarry, agriculture	D		2.1 x 1.0 x 0.5
479	pit	quarry, agriculture	D		1.2 x 0.5 x 0.4
480	pit	quarry, agriculture	D		2.0 x 1.6 x 0.3
481	pit	quarry, agriculture	D		6.4 x 1.5 x 0.6
482	pit	quarry, agriculture	D		4.4 x 1.8 x 0.45
483	pit	quarry, agriculture	D		1.5 x 0.6 x 0.38
484	pit	quarry, agriculture	D		3.3 x 1.5 x 0.45
485	pit	quarry	D		2.7 x 1.1 x 0.25
486	pit	quarry, agriculture	D		3.0 x 1.1 x 0.24

Appendix A (cont'd)

Site/Feat.#	Type	Functional interpretation	Sign	Tested	Dimensions (m)
5138 (D21-54)					
487	pit	quarry, agriculture	D	x	3.0 x 1.3 x 0.4
488	pit	quarry, agriculture	D	x	3.3 x 1.3 x 0.8
489	pit	quarry, agriculture	D	x	2.6 x 1.2 x 0.4
490	pit	quarry, agriculture	D		3.4 x 1.9 x 0.4
491	pit	quarry, agriculture	D		4.5 x 2.8 x 0.4
492	pit	quarry, agriculture	D		0.5 x 0.5 x 0.4
493	pit	quarry, agriculture	D		---------------
494	pit	quarry	D	x	0.8 x 0.5 x 0.15
495	pit	quarry	D	x	0.8 x 0.45 x 0.47
496	pit	quarry, agriculture, storage.	D	x	2.2 x 1.1 x 0.5
497	pit	quarry, agriculture, storage	D		0.8 x 0.65 x 0.25
498	pit	quarry, agriculture, storage	D		0.9 x 0.8 x 0.44
499	pit	quarry, agriculture, storage	D		1.8 x 1.4 x 0.23
500	pit	quarry, agriculture	D		6.0 x 2.3 x 0.52
501	pit	quarry, agriculture	D		0.9 x 0.9 x 0.21
502	pit	quarry, agriculture	D		0.8 x 0.7 x 0.4
503	pit	quarry, agriculture	D		1.4 x 1.3 x 0.35
504	pit	quarry, agriculture	D		1.7 x 1.3 x 0.25
505	pit	quarry, agriculture	D		2.0 x 1.1 x 0.5
506	pit	quarry, agriculture	D	x	1.9 x 1.0 x 0.33
507	pit	quarry, agriculture	D		1.3 x 0.9 x 0.14
508	pit	quarry, agriculture	D		4.8 x 2.1 x 0.23
509	pit	quarry, agriculture	D		1.5 x 0.7 x 0.4
510	pit	quarry, agriculture	D		2.3 x 0.5 x 0.4
511	pit	quarry, agriculture	D		6.3 x 1.7 x 0.4
512	pit	quarry, agriculture.	D		2.3 x 2.0 x 0.7
513	pit	quarry, agriculture	D		1.1 x 0.77 x 0.23
514	pit	quarry, agriculture	D		3.9 x 2.1 x 0.39
515	pit	quarry, agriculture	D		3.64 x 2.5 x 0.4
516	pit	quarry	D		0.55 x 0.4 x 0.6
517	pit	quarry, agriculture	D		1.4 x 9 x 0.4
518	pit	quarry, agriculture	D		5.3 x 1.9 x 0.65
519	pit	quarry, agriculture	D		2.7 x 0.85 x 0.14
520	pit	quarry, agriculture	D		1.3 x 1.0 x 0.27
521	pit	quarry, agriculture	D		0.85 x 0.57 x 0.26
522	pit	quarry, agriculture	D	x	3.6 x 0.9 x 0.4
523	pit	quarry, agriculture	D	x	3.6 x 1.8 x 0.3
524	pit	quarry, agriculture	D	x	1.6 x 1.0 x 0.3
525	pit	quarry, agriculture	D	x	0.7 x 0.37 x 0.25
526	pit	quarry	D		0.35 x 0.2 x 0.21
527	pit	quarry	D		1.0 x 0.55 x 0.38
528	pit	quarry	D		1.1 x 0.35 x 0.36
529	pit	quarry	D		1.3 x 1.25 x 0.39
530	pit	quarry	D		2.15 x 1.1 x 0.43
531	pit	quarry	D		1.35 x 1.0 x 0.32
532	pit	quarry	D		1.45 x 0.9 x 0.23
533	pit	quarry	D		5.65 x 1.85 x 0.4
534	pit	quarry	D		0.75 x 0.55 x 0.35
535	pit	quarry	D		5.80 x 1.95 x 0.37
536	pit	quarry	D		8.50 x 2.25 x 0.36

Appendix A (cont'd)

Site/Feat.#	Type	Functional interpretation	Sign	Tested	Dimensions (m)
5138 (D21-54)					
537	pit	quarry	D		5.50 x 1.75 x 0.14
538	pit	quarry	D		8.50 x 2.65 x 0.18
539	pit	quarry, agriculture	D		4.20 x 1.80 x 0.40
540	pit	quarry, agriculture	D		2.00 x 1.80 x 0.45
541	pit	quarry, agriculture	D		1.10 x 0.75 x 0.40
542	pit	quarry	D		3.20 x 1.10
543	pit	quarry, agriculture	D		1.50 x 0.70
544	pit	quarry	D		0.90 x 0.70
545	pit	quarry	D		3.55 x 1.60 x 0.45
546	pit	quarry	D		1.50 x 0.45 x 0.37
547	pit	quarry	D		1.55 x 0.30 x 0.35
548	pit	quarry	D		0.95 x 0.60 x 0.30
549	pit	quarry	D		0.85 x 0.25 x 0.90
550	pit	quarry	D		2.40 x 1.30 x 0.25
551	pit	quarry	D		1.20 x 0.45 x 0.05
552	pit	quarry	D		2.60 x 1.40 x 0.25
553	pit	quarry	D		2.40 x 1.70 x 0.35
554	pit	quarry	D		1.10 x 0.90 x 0.40
555	pit	quarry	D	x	1.30 x 0.70 x 0.10
556	pit	quarry	D		6.45 x 4.15 x 0.40
557	pit	quarry	D		1.30 x 1.00 x 0.23
558	pit	quarry	D		0.85 x 0.72 x 0.23
559	C-shape	temporary habitation	D		3.25 x 2.65
560	lava tube	temporary habitation	D	x	11.75 x 0.85 x 0.78
561	pit	quarry	D		2.50 x 1.40 x 0.15
562	pit	quarry	D		2.50 x 1.60 x 0.30
563	pit	quarry	D		0.55 x 0.55 x 0.23
564	pit	quarry	D		2.35 x 0.75 x 0.17
565	pit	quarry	D		3.45 x 0.80 x 0.55
566	pit	quarry	D		7.15 x 4.45 x 0.41
567	pit	quarry	D		1.65 x 0.75 x 0.39
568	pit	quarry	D		1.35 x 0.65 x 0.29
569	pit	quarry	D		3.35 x 1.55 x 0.72
570	pit	quarry	D		0.85 x 0.40 x 0.50
571	pit	quarry	D		0.70 x 0.40
572	pit	quarry	D		0.90 x 0.70 x 0.40
573	pit	quarry	D		0.90 x 0.70 x 0.40
574	pit	quarry	D		0.50 x 0.40 x 0.30
575	pit	quarry	D		2.10 x 0.60 x 0.45
576	pit	quarry	D		0.40 x 0.40
577	pit	quarry	D		1.70 x 0.40
578	pit	quarry	D		0.80 x 0.60 x 0.7
579	pit	quarry	D		1.60 x 1.50 x 0.40
580	pit	quarry	D		1.50 x 0.70 x 0.30
581	pit	quarry	D		2.40 x 0.90
582	pit	quarry	D		2.50 x 1.80
583	pit	quarry	D		5.00 x 1.60 x 0.16
584	pit	quarry	D		5.00 x 1.40 x 0.60
585	pit	quarry	D		1.20 x 1.20 x 0.30
586	pit	quarry	D		2.75 x 1.05 x 0.25

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5338 (U21-54)					
587	pit	quarry	D		2.6 x 0.55 x 0.41
588	pit	quarry	D		0.9 x 0.25 x 0.33
589	pit	quarry	D		0.55 x 0.4 x 0.31
590	pit	quarry	D		0.85 x 0.7 x 0.27
591	pit	quarry	D		0.35 x 0.3 x 0.4
592	pit	quarry	D		2.3 x 1.5 x 0.57
593	pit	quarry	D		4.5 x 1.5 x 0.28
594	pit	quarry	D		2.7 x 1.9 x 0.35
595	pit	quarry	D		1.95 x 0.85 x 0.35
596	pit	quarry	D		1.45 x 1.45 x 0.19
597	pit	quarry	D		2.05 x 1.85 x 0.14
598	pit	quarry	D		3.65 x 2.05 x 0.85
599	pit	quarry	D		3.25 x 1.8 x 0.21
600	pit	quarry	D		4.6 x 2.0 x 0.35
601	pit	quarry	D		1.4 x 1.0 x 0.75
602	pit	quarry	D		2.0 x 1.8 x 0.7
603	pit	quarry	D		0.7 x 0.4 x 0.45
604	pit	quarry	D		2.1 x 1.2 x 0.7
605	pit	quarry	D		2.3 x 1.9 x 0.75
606	pit	quarry	D		1.2 x 1.2 x 0.3
607	pit	quarry	D		0.95 x 0.45 x 0.27
608	pit	quarry	D		1.0 x 0.5 x 0.42
609	pit	quarry	D		1.65 x 1.55 x 0.13
610	pit	quarry	D		3.5 x 0.85 x 0.4
611	pit	quarry	D		1.9 x 0.95 x 0.55
612	pit	quarry	D		1.3 x 0.7 x 0.3
613	pit	quarry	D		2.4 x 1.9 x 0.3
614	pit	quarry	D		1.0 x 0.6 x 0.5
615	pit	quarry	D		1.5 x 1.2 x 0.4
616	pit	quarry	D		1.0 x 0.9 x 0.15
617	pit	quarry	D		1.5 x 0.7 x 0.15
618	pit	quarry	D		0.7 x 0.5 x 0.15
619	rectangular enclosure	temporary habitation	D	x	5.5 x 2.5
620	enclosure	temporary habitation	D	x	3.65 x 0.9 x 0.57
621	pit	quarry, agriculture	D		5.44 x 1.2 x 0.51
622	pit	quarry, agriculture	D		0.8 x 0.3 x 0.24
623	pit	quarry	D		3.81 x 1.73 x 0.55
624	pit	quarry	D		0.95 x 0.4 x 0.55
625	pit	quarry	D		0.52 x 0.45 x 0.5
626	pit	quarry	D		1.0 x 0.33 x 0.5
627	pit	quarry, agriculture	D		0.84 x 0.73 x 0.49
628	pit	quarry, agriculture	D		3.09 x 0.95 x 0.27
629	pit	quarry, agriculture	D		1.27 x 1.0 x 0.25
630	pit	quarry, agriculture	D		2.18 x 1.79 x 0.40
631	pit	quarry, agriculture	D		0.48 x 0.35 x 0.19
632	pit	quarry, agriculture	D		2.0 x 0.72 x 0.32
633	pit	quarry, agriculture	D		3.96 x 0.36 x 0.81
634	pit	quarry, agriculture	D		1.98 x 1.81 x 0.78
635	pit	quarry, agriculture	D		1.86 x 1.02 x 0.8
636	pit	agriculture	D		1.18 x 1.05 x 0.25

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5338 (D21-54)					
637	pit	quarry	D		1.4 x 1.0 x 0.7
638	pit	quarry	D		1.6 x 1.0 x 0.25
639	pit	quarry	D		2.9 x 1.1 x 0.25
640	pit	quarry	D		2.32 x 1.53 x 0.8
641	pit	quarry	D		1.86 x 0.68 x 0.78
642	pit	quarry	D		3.45 x 1.1 x 0.6
643	pit	quarry	D		0.9 x 0.7 x 0.4
644	pit	quarry	D		1.1 x 0.8 x 0.8
645	pit	quarry	D		3.7 x 1.6 x 0.55
646	pit	quarry	D		0.9 x 0.85 x 0.4
647	pit	quarry	D		1.8 x 1.4 x 0.45
648	pit	quarry	D		1.8 x 1.65 x 0.7
649	pit	quarry	D		3.06 x 1.99 x 0.45
650	pit	quarry	D		0.86 x 0.34 x 0.34
651	pit	quarry	D		3.0 x 1.0 x 0.3
652	pit	quarry	D		2.5 x 0.9 x 0.6
653	pit	quarry	D		2.8 x 1.6 x 0.35
654	pit	quarry	D		1.5 x 0.7 x 0.3
655	pit	quarry	D		4.3 x 2.6 x 0.33
656	pit	quarry	D		1.5 x 1.0 x 0.4
657	pit	quarry	D		2.1 x 1.8 x 0.25
658	pit	quarry	D		2.2 x 1.2 x 0.18
659	pit	quarry	D		1.2 x 1.0 x 0.2
660	pit	quarry	D		2.0 x 0.9 x 0.25
661	pit	quarry	D		1.5 x 1.0 x 0.6
662	pit	quarry	D	x	1.1 x 0.6 x 0.3
663	pit	quarry	D		1.5 x 1.1 x 0.4
664	pit	quarry	D		1.4 x 0.9 x 0.4
665	pit	quarry	D		2.8 x 1.9 x 0.3
666	pit	quarry	D	x	3.3 x 2.0 x 0.8
667	pit	quarry	D		1.5 x 0.7 x 0.6
668	pit	quarry	D		1.6 x 1.3 x 0.23
669	pit	quarry	D		1.3 x 1.2 x 0.23
670	pit	quarry	D		2.4 x 0.7 x 0.19
671	pit	quarry	D		0.8 x 0.6 x 0.14
672	pit	quarry	D		1.5 x 0.85 x 0.29
673	pit	quarry	D		0.8 x 0.7 x 0.33
674	pit	quarry	D		1.0 x 0.35 x 0.26
675	pit	quarry	D		1.4 x 1.0 x 0.26
676	pit	quarry	D		0.9 x 0.4 x 0.21
677	pit	quarry	D		2.55 x 2.0 x 0.32
678	pit	quarry	D		0.9 x 0.8 x 0.29
679	pit	quarry	D	x	0.9 x 0.8 x 0.4
680	pit	quarry	D	x	1.4 x 1.1 x 0.27
681	pit	quarry	D	x	1.3 x 0.8 x 0.6
682	pit	quarry	D	x	0.56 x 0.4 x 0.28
683	pit	quarry, agriculture	D	x	2.3 x 1.3 x 0.35
684	pit	quarry, agriculture	D	x	3.1 x 1.3 x 0.5
685	pit	quarry, agriculture	D	x	3.5 x 1.4 x 0.6
686	pit	quarry, agriculture	D		3.4 x 1.4 x 0.9

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Slope	Tested	Dimensions (m)
5318 (D21-54)					
687	pit	quarry	D		2.1 x 1.3 x 0.55
688	pit	quarry	D		1.4 x 0.5 x 0.8
689	pit	quarry	D		0.7 x 0.3 x 0.3
690	pit	quarry	D		2.8 x 1.8 x 0.35
691	pit	quarry	D		3.0 x 1.8 x 0.4
692	pit	quarry	D		1.5 x 1.1 x 0.25
693	pit	quarry	D		1.6 x 1.5 x 0.3
694	pit	quarry	D		2.3 x 0.6 x 1.1
695	pit	quarry	D		1.8 x 1.2 x 0.3
696	pit	quarry	D		1.8 x 0.9 x 0.17
697	pit	quarry, agriculture	D		1.4 x 0.8 x 0.4
698	pit	quarry, agriculture	D		5.0 x 3.5 x 1.1
699	pit	quarry, agriculture	D		3.8 x 1.8 x 0.5
700	pit	quarry, agriculture	D	x	1.7 x 1.0 x 0.2
701	crevice	quarry	D	x	3.9 x 0.9 x 0.1
702	pit	quarry	D	x	2.5 x 2.5 x 0.6
703	pit	quarry	D		1.0 x 0.8 x 0.3
704	pit	quarry	D		3.7 x 1.1 x 0.5
705	pit	quarry	D		2.6 x 1.0 x 0.5
706	pit	quarry, agriculture	D		3.3 x 2.5 x 0.3
707	pit	quarry	D		0.9 x 0.6 x 0.5
708	pit	quarry	D		1.5 x 1.4 x 0.2
709	pit	quarry	D		0.5 x 0.4 x 0.3
710	pit	quarry, agriculture	D		0.8 x 0.5 x 0.18
711	pit	quarry, agriculture	D		2.3 x 0.7 x 0.28
712	pit	quarry, agriculture	D		5.0 x 2.3 x 0.23
713	pit	quarry	D		2.2 x 1.4 x 0.7
714	pit	quarry, agriculture	D		3.8 x 2.5 x 0.52
715	pit	quarry, agriculture	D		1.7 x 0.7 x 0.4
716	pit	quarry, agriculture	D		5.2 x 3.8 x 0.3
717	pit	quarry, agriculture	D		1.1 x 1.0 x 0.4
718	pit	quarry	D		0.8 x 0.7 x 0.6
719	pit	quarry	D		1.9 x 1.4 x 0.6
720	pit	quarry	D		0.65 x 0.45 x 0.35
721	pit	quarry	D		1.1 x 0.8 x 0.35
722	pit	quarry	D		4.6 x 2.3 x 0.25
723	pit	quarry	D		4.6 x 1.0 x 0.55
724	pit	quarry	D		4.0 x 1.6 x 0.55
725	pit	quarry	D		1.3 x 1.3 x 0.26
726	pit	quarry	D		1.3 x 0.8 x 0.4
727	pit	quarry	D		2.2 x 1.1 x 0.7
728	pit	quarry	D		2.1 x 1.7 x 0.55
729	pit	quarry	D		2.0 x 1.6 x 1.2
730	pit	quarry	D		2.2 x 0.9 x 0.45
731	pit	quarry	D		1.5 x 1.4 x 0.35
732	pit	quarry	D		1.0 x 0.5 x 1.5
733	mod. outcrop	temporary habitation	D		2.6 x 1.65
734	mod. outcrop	temporary habitation	D	x	4.0 x 2.5 x 0.5
735	mod. outcrop	temporary habitation	D	x	3.1 x 1.1
736	pit	agriculture	D		2.0 x 1.1 x 1.65

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Slope	Tested	Dimensions (m)
5318 (D21-54)					
737	pit	quarry, agriculture	D	x	2.0 x 0.5 x 1.0
738	pit	temporary habitation, quarry	D	x	1.2 x 0.7
739	overhang shelter	temporary habitation	D	x	2.0 x 1.0
740	pit	quarry, agriculture	D	x	2.0 x 1.5 x 1.0
741	pit	quarry, agriculture	D	x	2.7 x 0.6 x 0.75
742	pit	quarry, agriculture	D	x	0.75 x 0.6 x 0.6
743	pit	quarry, agriculture	D	x	1.1 x 0.75 x 0.75
744	pit	quarry, agriculture	D		2.5 x 0.84 x 0.28
745	pit	quarry	D		2.8 x 1.4 x 0.5
746	pit	quarry, agriculture	D		1.2 x 0.7 x 0.28
747	pit	quarry, agriculture	D		1.5 x 1.4 x 0.2
748	pit	quarry, agriculture	D		1.0 x 0.9 x 0.2
749	pit	quarry, agriculture	D		3.9 x 3.0 x 0.25
750	pit	quarry, agriculture	D		1.2 x 1.0 x 0.25
751	pit	quarry, agriculture	D		2.0 x 0.7 x 0.25
752	pit	quarry, agriculture	D		5.4 x 1.4 x 0.35
753	pit	quarry, agriculture	D		1.75 x 0.75 x 0.35
754	pit	quarry, agriculture	D		1.55 x 0.75 x 0.35
755	pit	quarry, agriculture	D	x	0.7 x 0.5 x 0.34
756	pit	quarry, agriculture	D	x	4.1 x 0.8 x 0.35
757	pit	quarry, agriculture	D		1.6 x 0.7 x 0.3
758	pit	quarry, agriculture	D		1.9 x 0.7 x 0.3
759	pit	quarry, agriculture	D		3.1 x 0.7 x 0.3
760	pit	quarry, agriculture	D		2.6 x 2.1 x 0.7
761	pit	quarry, agriculture	D		3.7 x 2.3 x 0.28
762	pit	quarry, agriculture	D		1.3 x 0.80 x 0.55
763	pit	quarry, agriculture	D		0.9 x 0.5 x 0.18
764	pit	quarry, agriculture	D		0.65 x 0.45 x 0.28
765	pit	quarry, agriculture	D		1.2 x 0.9 x 0.18
766	pit	quarry, agriculture	D		1.8 x 1.6 x 0.37
767	pit	quarry, agriculture	D		1.4 x 0.7 x 0.4
768	pit	quarry, agriculture	D		0.7 x 0.56 x 0.14
769	pit	quarry, agriculture	D	x	1.5 x 1.3 x 0.15
770	pit	quarry, agriculture	D	x	1.8 x 1.3 x 0.13
771	pit	quarry, agriculture	D		1.5 x 0.8 x 0.3
772	pit	quarry, agriculture	D		1.0 x 0.8 x 0.23
773	pit	quarry, agriculture	D		1.0 x 0.4 x 0.3
774	pit	quarry, agriculture	D		2.3 x 1.5 x 0.4
775	pit	quarry, agriculture	D		2.7 x 1.4 x 0.36
776	pit	quarry, agriculture	D		2.0 x 1.0 x 0.37
777	pit	quarry, agriculture	D		2.3 x 1.2 x 0.2
778	pit	quarry, agriculture	D		1.9 x 1.1 x 0.2
779	pit	quarry, agriculture	D		2.12 x 1.3 x 0.75
780	pit	quarry, agriculture	D		0.56 x 0.42 x 0.65
781	pit	quarry, agriculture	D		0.65 x 0.6 x 0.18
782	pit	quarry, agriculture	D		1.2 x 0.47 x 0.35
783	pit	quarry, agriculture	D		0.64 x 0.6 x 0.53
784	pit	quarry, agriculture	D		1.5 x 1.0 x 0.4
785	pit	quarry, agriculture	D		1.2 x 0.9 x 0.27
786	pit	quarry, agriculture	D		1.3 x 1.1 x 0.3

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5338 (D21-54)					
787	pit	quarry, agriculture	D		1.6 x 0.67 x 0.4
788	pit	quarry, agriculture	D		1.4 x 0.55 x 0.23
789	crevice	quarry, agriculture	D		3.1 x 1.2 x 0.5
790	pit	quarry, agriculture	D		1.15 x 0.9 x 0.15
791	pit	quarry, agriculture	D		3.6 x 2.5 x 0.5
792	pit	quarry, agriculture	D		1.3 x 0.9 x 0.21
793	pit	quarry, agriculture	D		2.4 x 1.0 x 0.31
794	pit	quarry, agriculture	D		1.0 x 0.5 x 0.4
795	pit	quarry, agriculture	D		5.0 x 1.1 x 0.23
796	pit	quarry, agriculture	D		2.1 x 1.0 x 0.3
797	pit	quarry, agriculture	D		0.85 x 0.65 x 0.26
798	pit	quarry, agriculture	D		1.4 x 0.9 x 0.2
799	pit	quarry, agriculture	D		0.8 x 0.6 x 0.35
800	pit	quarry, agriculture	D		1.8 x 1.0 x 0.8
801	pit	quarry, agriculture	D		4.5 x 4.3 x 0.26
802	pit	quarry, agriculture	D		2.3 x 0.7 x 0.6
803	pit	quarry, agriculture	D		4.6 x 1.3 x 0.35
804	pit	quarry, agriculture	D		2.3 x 2.8 x 0.45
805	pit	quarry, agriculture	D		4.7 x 1.0 x 0.38
806	pit	quarry, agriculture	D		0.96 x 0.6 x 0.4
807	pit	quarry, agriculture	D		1.5 x 1.5 x 0.43
808	C-shape	temporary habitation	D		1.5 x 1.4
809	pit	quarry	D	x	4.7 x 1.4
810	pit	burial	D,E	x	5.7 x 2.8 x 1.5
811	pit	quarry, agriculture	D		1.5 x 0.6 x 0.3
812	pit	quarry, agriculture	D		4.6 x 3.1 x 0.4
813	pit	quarry, agriculture	D		1.1 x 0.8 x 0.3
814	pit	quarry, agriculture	D		5.5 x 4.9 x 0.27
815	pit	quarry, agriculture	D		4.2 x 2.9 x 0.4
816	pit	quarry, agriculture	D		1.3 x 0.9 x 0.45
817	pit	quarry, agriculture	D		1.6 x 1.2 x 0.8
818	pit	quarry, agriculture	D	x	1.0 x 0.8 x 0.4
819	pit	quarry, agriculture	D	x	1.5 x 1.4 x 0.6
820	pit	quarry, agriculture	D	x	0.75 x 0.55 x 0.6
821	pit	quarry, agriculture	D	x	1.2 x 1.0 x 0.35
822	cupboard	storage	D	x	0.5 x 1.3 x 1.0
823	pit	quarry, agriculture	D	x	1.5 x 1.1 x 0.26
824	pit	quarry, agriculture	D	x	5.0 x 1.5 x 0.3
825	pit	quarry, agriculture	D	x	1.5 x 0.9 x 0.26
826	pit	quarry, agriculture	D		1.4 x 0.7 x 0.6
827	pit	quarry, agriculture	D		3.9 x 3.7 x 0.5
828	pit	quarry, agriculture	D	x	2.0 x 1.9 x 0.9
829	pit	quarry, agriculture	D	x	1.5 x 0.8 x 0.25
830	pit	quarry, agriculture	D	x	1.8 x 0.8 x 0.5
831	pit	quarry, agriculture	D	x	1.4 x 0.8 x 0.4
832	pit	quarry, agriculture	D	x	0.9 x 0.8 x 0.3
833	pit	quarry, agriculture	D	x	0.5 x 0.31 x 0.2
834	pit	quarry, agriculture	D	x	0.9 x 0.65 x 0.2
835	pit	quarry, agriculture	D	x	0.9 x 0.75 x 0.23
836	pit	quarry, agriculture	D	x	0.8 x 0.45 x 0.22

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5338 (D21-54)					
837	pit	quarry, agriculture	D		2.5 x 0.55 x 0.3
838	pit	quarry, agriculture	D		1.0 x 0.55 x 0.33
839	pit	quarry, agriculture	D		2.7 x 0.8 x 0.3
840	pit	quarry, agriculture	D		0.9 x 0.7 x 0.4
841	pit	quarry, agriculture	D		0.55 x 0.5 x 0.2
842	pit	quarry, agriculture	D		3.3 x 1.2 x 0.25
843	pit	quarry, agriculture	D		6.4 x 2.5 x 0.35
844	pit	quarry, agriculture	D		1.9 x 0.7 x 0.35
845	pit	quarry, agriculture	D		3.1 x 1.2 x 0.15
846	pit	quarry, agriculture	D		2.2 x 1.8 x 0.28
847	pit	quarry, agriculture	D		1.1 x 0.8 x 0.28
848	pit	quarry, agriculture	D		1.0 x 0.7 x 0.5
849	pit	quarry, agriculture	D		5.3 x 4.6 x 0.7
850	pit	quarry, agriculture	D		3.0 x 1.0 x 0.3
851	pit	quarry, agriculture	D		2.3 x 1.7 x 0.8
852	pit	quarry, agriculture	D		0.95 x 0.9 x 0.33
853	pit	quarry, agriculture	D		3.1 x 1.4 x 0.21
854	pit	quarry, agriculture	D		2.2 x 1.7 x 0.4
855	pit	quarry, agriculture	D	x	1.5 x 1.3 x 0.25
856	pit	quarry, agriculture	D	x	2.1 x 2.1 x 0.25
857	pit	quarry, agriculture	D	x	0.6 x 0.4 x 0.15
858	pit	quarry	D	x	6.6 x 3.2 x 0.4
859	crevice	quarry	D		4.0 x 0.6 x 0.6
860	pit	quarry, agriculture	D		0.9 x 0.7 x 0.3
861	pit	quarry, agriculture	D		0.7 x 0.2 x 0.3
862	pit	quarry, agriculture	D		0.65 x 0.5 x 0.5
863	pit	quarry, agriculture	D		1.6 x 1.0 x 0.5
864	pit	quarry, agriculture	D		1.5 x 0.8 x 0.4
865	pit	quarry, agriculture	D		0.7 x 0.7 x 0.4
866	pit	quarry, agriculture	D		0.4 x 0.4 x 0.4
867	pit	quarry, agriculture	D		2.5 x 0.3 x 0.4
868	pit	quarry	D		0.65 x 0.25 x 0.7
869	pit	quarry	D		0.6 x 0.3 x 0.5
870	crevice	quarry	D	x	1.8 x 1.6 x 0.85
871	pit	quarry	D		0.6 x 0.3 x 0.5
872	pit	quarry, agriculture	D		0.7 x 0.7 x 0.45
873	pit	quarry	D		1.1 x 0.5 x 0.72
874	crevice	quarry	D	x	3.5 x 1.1 x 0.4
875	pit	quarry	D		0.7 x 0.6 x 0.7
876	pit	quarry	D	x	3.0 x 1.0 x 0.4
877	pit	quarry	D		0.84 x 0.46 x 0.3
878	pit	quarry	D		1.05 x 0.7 x 0.43
879	pit	quarry	D	x	0.85 x 0.8 x 0.55
880	pit	quarry	D	x	8.0 x 0.8 x 0.5
881	pit	quarry	D	x	1.4 x 0.5 x 0.5
882	pit	quarry	D	x	0.65 x 0.5 x 0.45
883	pit	quarry	D	x	1.0 x 0.4 x 0.5
884	pit	quarry	D		3.0 x 1.1 x 0.25
885	pit	quarry	D		3.0 x 1.4 x 0.4
886	pit	quarry	D		1.8 x 0.8 x 0.4
TOTAL	886				

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5139 (D21-55)					
1	pit	quarry	D		2.7 x 1.53 x 0.32
2	pit	quarry	D		1.0 x 0.68 x 1.2
3	pit	quarry	D		1.39 x 1.49 x 0.33
4	pit	quarry	D	x	3.0 x 2.72 x 0.4
5	pit	quarry	D		0.75 x 0.45 x 0.23
6	pit	quarry	D		2.3 x 1.6 x 0.35
7	pit	quarry	D		5.3 x 1.7 x 0.29
8	pit	quarry	D		3.2 x 1.7 x 0.35
9	pit	quarry	D	x	1.3 x 1.21 x 0.4
10	pit	quarry	D		2.8 x 1.3 x 0.46
11	pit	quarry	D		1.8 x 0.72 x 0.3
12	pit	quarry	D		4.9 x 2.1 x 0.22
13	pit	quarry	D		2.0 x 0.96 x 0.5
14	pit	quarry	D		2.0 x 1.3 x 0.25
15	pit	quarry	D		2.1 x 0.64 x 0.7
16	pit	quarry	D	x	0.98 x 0.57 x 0.18
17	pit	quarry	D	x	2.52 x 1.5 x 0.65
18	pit	quarry	D		2.5 x 1.65 x 1.15
19	pit	quarry	D		2.4 x 1.55 x 0.75
20	pit	quarry	D		1.4 x 1.0 x 0.24
21	pit	quarry	D		2.1 x 1.3 x 0.34
22	pit	quarry	D		1.3 x 1.0 x 0.54
23	pit	quarry	D		4.0 x 3.0 x 0.3
24	pit	quarry	D		3.0 x 2.6 x 0.33
25	pit	quarry	D	x	2.0 x 0.89 x 0.22
26	pit	quarry	D		4.1 x 1.7 x 0.33
27	pit	quarry	D		0.95 x 0.59 x 0.21
28	pit	quarry	D		2.1 x 2.0 x 0.35
29	pit	quarry	D		3.2 x 1.3 x 0.24
30	pit	quarry	D		4.6 x 2.5 x 0.5
31	pit	quarry	D		4.2 x 1.6 x 0.74
32	cairn	trail marker	D		1.1 x .057
33	pit	quarry	D		1.0 x 0.81 x 0.6
34	pit	quarry	D		1.35 x 0.66 x 0.37
35	pit	quarry	D		0.56 x 0.38 x 0.17
36	pit	quarry	D		1.8 x 1.13 x 0.17
37	pit	quarry	D		1.7 x 1.4 x 0.16
38	cairn	trail marker	D		0.52 x 0.38
39	cairn	trail marker	D		0.45 x 0.37
40	pit	quarry	D		0.98 x 0.51 x 0.22
41	pit	quarry	D		3.0 x 2.2 x 0.4
42	pit	quarry	D		0.97 x 0.73 x 0.23
43	pit	quarry	D		2.6 x 3.0 x 0.24
44	pit	quarry	D		5.7 x 4.3 x 0.4
45	pit	quarry	D		0.66 x 0.35 x 0.4
46	steppingstone trail	transportation	D		9.2 x 0.6
47	pit	quarry	D		0.6 x 0.7 x 0.27
48	pit	quarry	D		1.25 x 1.0 x 0.22
49	pit	quarry	D		1.70 x 1.25 x 0.30
50	pit	quarry	D		1.0 x 1.0 x 0.24
51	pit	quarry	D	x	1.69 x 0.65 x 0.52
52	pit	quarry	D		1.7 x 1.25 x 0.2

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5339 (D21-55)					
53	pit	quarry	D		3.4 x 1.29 x 0.3
54	pit	quarry	D		3.7 x 1.2 x 0.6
55	pit	agriculture, quarry	D	x	2.5 x 0.75 x 1.2
56	pit	quarry	D		4.7 x 3.8 x 0.9
57	pit	quarry	D	x	1.7 x 0.7 x 0.74
58	pit	quarry	D		1.2 x 0.7 x 0.25
59	pit	quarry	D		0.75 x 0.75 x 0.4
60	pit	quarry	D		1.0 x 0.6 x 0.45
61	pit	quarry	D		0.4 x 0.4 x 0.45
62	pit	quarry	D		1.1 x 0.9 x 0.45
63	pit	quarry	D		1.98 x 0.8 x 0.45
64	pit	agriculture, quarry	D		2.5 x 1.0 x 1.0
65	pit	quarry	D		2.3 x 0.8 x 0.34
66	pit	quarry	D		0.7 x 0.7 x 1.4
67	pit	quarry	D		0.75 x 0.7 x 0.76
68	pit	quarry	D		1.5 x 1.1 x 0.44
69	pit	quarry	D		0.7 x 0.62 x 0.3
70	pit	quarry	D		2.24 x 0.7 x 0.49
71	pit	quarry	D		1.0 x 0.7 x 0.54
72	pit	quarry	D		1.1 x 1.0 x 0.32
73	lava tube	temporary habitation	D		4.6 x 0.54 x 0.76
74	pit	quarry, agriculture	D		0.9 x 0.9 x 0.5
75	pit	quarry, agriculture	D		0.5 x 0.5 x 0.8
76	pit	quarry, agriculture	D		0.35 x 0.3 x 0.55
77	pit	quarry, agriculture	D		1.28 x 1.2 x 0.5
78	pit	agriculture, quarry	D		0.8 x 0.4 x 0.35
79	pit	agriculture, quarry	D		0.65 x 0.58 x 0.25
80	pit	agriculture, quarry	D	x	0.52 x 0.23 x 0.29
81	pit	agriculture, quarry	D	x	0.97 x 0.54 x 0.28
82	pit	agriculture, quarry	D		8.6 x 1.23 x 0.35
83	pit	quarry	D		1.96 x 1.0 x 0.5
84	pit	quarry	D		4.3 x 1.7 x 0.7
85	pit	quarry	D		1.5 x 1.1 x 0.17
86	pit	agriculture, quarry	D		4.7 x 2.0 x 0.5
87	pit	quarry	D		1.14 x .77 x 0.39
88	pit	agriculture, quarry	D		1.1 x 0.7 x 0.12
89	pit	agriculture, quarry	D		3.8 x 1.2 x 0.15
90	pit	agriculture, quarry	D		4.5 x 2.0 x 0.4
91	pit	quarry, agriculture	D		3.21 x 2.8 x 0.61
92	pit	quarry, agriculture	D		1.04 x 0.39 x 0.7
93	pit	quarry, agriculture	D		1.0 x 0.9 x 0.25
94	pit	quarry	D		0.9 x 0.5 x 0.25
95	pit	quarry	D		0.53 x 0.5 x 0.42
96	pit	quarry	D		1.23 x 1.03 x 0.25
97	pit	quarry	D		1.5 x 0.85 x 0.2
98	pit	quarry	D		0.9 x 0.85 x 0.35
99	pit	quarry	D		1.8 x 1.4 x 0.9
100	pit	quarry	D		2.6 x 1.9 x 0.3
101	pit	agriculture, quarry	D	x	3.0 x 3.0 x 0.14
102	pit	agriculture, quarry	D	x	1.4 x 1.0 x 0.34
103	pit	agriculture, quarry	D	x	2.5 x 1.5 x 0.14
104	pit	quarry	D		1.6 x 1.1 x 0.4

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5339 (D21-55)					
105	pit	quarry	D		1.6 x 1.1 x 0.4
106	pit	quarry	D		1.2 x 0.9 x 0.4
107	pit	quarry	D		1.4 x 0.4
108	pit	quarry	D		1.4 x 1.2
109	pit	quarry	D		1.3 x 0.3
110	pit	quarry, agriculture	D		1.75 x 1.36 x 0.48
111	pit	quarry	D		1.0 x 0.3 x 0.5
112	pit	quarry	D		1.7 x 1.4 x 0.3
113	pit	quarry	D		1.35 x 1.6 x 0.6
114	pit	quarry, agriculture	D		3.05 x 0.39 x 0.38
115	pit	quarry, agriculture	D		0.93 x 0.53 x 0.33
116	pit	quarry, agriculture	D		0.95 x 0.58 x 0.28
117	pit	quarry	D		1.3 x 1.2 x 0.7
118	pit	quarry	D		0.95 x 0.7 x 0.5
119	pit	quarry	D		0.77 x 0.6 x 0.3
120	pit	quarry	D		6.3 x 1.4 x 0.5
121	pit	quarry	D		1.8 x 0.75 x 0.25
122	pit	quarry	D		1.2 x 0.7 x 0.55
123	pit	quarry	D		1.1 x 0.5 x 0.37
124	pit	quarry	D		0.75 x 0.6 x 0.36
125	pit	quarry, storage	D	x	1.01 x 0.65 x 0.4
126	pit	quarry, storage	D	x	1.5 x 1.55 x 0.4
127	pit	quarry, storage	D	x	3.37 x 1.62 x 0.4
128	pit	quarry	D	x	2.7 x 1.5 x 0.35
129	pit	quarry	D		3.6 x 1.1 x 0.4
130	pit	quarry	D		1.1 x 1.1 x 0.6
131	pit	quarry	D		0.82 x 0.44 x 0.54
132	pit	quarry, agriculture	D		1.8 x 0.58 x 0.38
133	pit	quarry	D		5.3 x 1.8
134	pit	quarry	D	x	0.6 x 0.3 x 0.4
135	pit	agriculture	D		2.6 x 2.1 x 0.13
136	pit	quarry	D		0.92 x 0.6 x 0.27
137	overhang shelter	temporary habitation	D	x	1.1 x 0.93
138	pit	quarry	D		2.1 x 1.3 x 0.36
139	pit	quarry	D		1.9 x 0.9 x 0.19
140	pit	quarry	D		1.5 x 0.66 x 0.64
141	pit	agriculture, quarry	D	x	2.3 x 0.8 x 0.26
142	pit	agriculture	D	x	0.31 x 0.31 x 0.36
143	pit	agriculture	D	x	1.5 x 1.4 x 0.4
144	pit	agriculture	D	x	1.43 x 1.35 x 0.36
145	pit	agriculture	D	x	2.1 x 1.8 x 0.4
146	lava tube	burial	D,E	x	9.3 x 7.25 x 0.8
147	pit	quarry	D		1.6 x 1.3 x 0.22
148	pit	quarry	D		3.3 x 2.05 x 0.6
149	lava tube	temporary habitation	D	x	9.0 x 5.4 x 0.95
150	pit	quarry	D		1.46 x 0.7 x 0.45
151	pit	quarry	D		0.7 x 0.6 x 0.4
152	pit	quarry	D		0.61 x 0.4 x 0.54
153	pit	quarry	D		2.9 x 2.9 x 0.5
154	pit	quarry	D		0.75 x 0.5 x 0.46
155	pit	quarry	D		1.1 x 0.99 x 0.36
156	pit	quarry	D		0.51 x 0.1 x 0.65

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5339 (D21-55)					
157	pit	agriculture	D		2.6 x 1.4 x 0.36
158	lava tube	temporary habitation	D	x	5.9 x 3.35 x 1.0
159	pit	quarry, agriculture	D		3.4 x 1.75 x 0.6
160	pit	quarry, agriculture	D		2.5 x 1.6 x 0.32
161	pit	quarry, agriculture	D		1.3 x 1.2 x 0.27
162	pit	quarry, agriculture	D		0.88 x 0.46 x 0.3
163	pit	quarry, agriculture	D		0.76 x 0.46 x 0.21
164	pit	quarry, agriculture	D		1.3 x 0.75 x 0.33
165	pit	quarry	D		2.55 x 1.7 x 0.8
166	pit	quarry	D		6.0 x 1.0 x 0.8
167	pit	quarry	D		2.3 x 0.7 x 0.45
168	pit	quarry	D		0.4 x 0.4 x 0.45
169	pit	quarry	D		1.8 x 0.7 x 0.36
170	pit	quarry	D		1.4 x 0.76 x 0.21
171	pit	quarry	D		1.7 x 1.5 x 0.2
172	pit	quarry	D		1.8 x 1.1 x 0.3
173	pit	quarry	D		0.3 x 0.3 x 0.2
174	pit	quarry	D		0.75 x 0.3 x 0.2
175	pit	quarry	D		0.4 x 0.3 x 0.2
176	pit	quarry	D		1.2 x 1.9 x 0.26
177	pit	quarry	D		0.77 x 0.45 x 0.27
178	pit	quarry	D		1.9 x 0.9 x 0.24
179	pit	quarry	D		0.45 x 0.45 x 0.17
180	pit	quarry	D		0.4 x 0.4 x 0.45
181	pit	quarry	D		0.59 x 0.32 x 0.6
182	pit	quarry	D		0.76 x 0.51 x 0.22
TOTAL 182					
5340 (D21-56)					
1	mod. outcrop	unknown	D		3.75 x 1.6 x 1.05
TOTAL 1					
5341 (D21-57)					
1	lava tube	temporary habitation	D	x	33.6 x 2.0 x 1.35
2	pit	quarry	D		2.7 x 1.05 x 0.5
3	enclosure	temporary habitation	D	x	5.4 x 4.1 x 0.7
4	cupboard	storage	D		1.75 x 0.75 x 0.1
5	pit	quarry, agriculture	D		1.1 x 0.64 x 0.3
6	pit	quarry, agriculture	D		3.1 x 1.0 x 0.25
7	pit	quarry, agriculture	D		6.0 x 1.0 x 0.75
TOTAL 7					

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5342 (D21-58)					
1	mod. outcrop	agriculture	D	x	--------------
2	terrace	agriculture	D		1.0 x 1.0 x 0.3
TOTAL 2					
5343 (D21-59)					
1	C-shape	temporary habitation	D		1.5 x 1.5 x 0.4
2	overhang shelter	temporary habitation	D	x	4.0 x 0.8 x 0.9
3	cupboard	storage	D	x	1.5 x 1.0 x 0.5
4	cupboard	storage	D	x	1.0 x 0.5 x 0.5
5	pit	quarry, agriculture	D	x	1.0 x 0.75 x 0.6
6	pit	quarry, agriculture	D		--------------
7	pit	quarry	D		0.8 x 0.5 x 0.3
8	pit	quarry	D		0.4 x 0.4 x 0.3
9	trail	transportation	D		4.7 x 0.4
10	wall	agriculture	D		4.7 x 0.4
11	cupboard	storage	D		0.6 x 0.6 x 0.42
12	cupboard	storage	D		1.3 x 1.0 x 0.6
13	overhang shelter	temporary habitation	D		1.5 x 1.4 x 0.65
14	pit	quarry	D		2.5 x 1.9 x 0.9
15	C-shape	temporary habitation	D		3.0 x 3.0 x 0.75
TOTAL 15					
5344 (D21-60)					
1	pit	quarry	D		0.95 x 0.8 x 0.23
2	pit	quarry	D		1.65 x 1.15 x 0.52
3	pit	quarry	D		2.25 x 2.6 x 0.3
4	pit	quarry, agriculture	D	x	1.4 x 0.45 x 0.34
5	pit	quarry	D		2.45 x 1.35 x 1.04
TOTAL 5					
5345 (D21-61)					
1	pit	quarry	D		0.75 x 0.4 x 1.17
2	pit	quarry	D		2.3 x 2.0 x 0.50
3	pit	quarry	D		2.9 x 1.4 x 1.07
4	pit	quarry	D		1.0 x 0.85 x 0.74
5	lava tube	temporary habitation	D	x	2.8 x 1.45 x 1.65
6	lava tube	temporary habitation	D	x	1.8 x 1.7 x 0.8
7	lava tube	temporary habitation	D	x	3.5 x 1.9 x 2.0
8	pit	quarry, agriculture	D		0.9 x 0.55 x 0.39
9	pit	quarry, agriculture	D		1.0 x 0.6 x 1.2
10	C-shape	temporary habitation	D		1.5 x 1.5
11	pit	quarry, agriculture	D		0.8 x 0.5 x 0.8
12	pit	quarry, agriculture	D		0.66 x 0.4 x 0.63
13	cupboard	storage	D		1.2 x 1.5 x 0.7
TOTAL 13					

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5346 (D21-62)					
1	lava tube	temporary habitation	D	x	4.0 x 2.9 x 1.2
2	pit	quarry	D		0.6 x 0.4 x 0.6
3	pit	quarry	D		5.6 x 2.0 x 1.04
4	pit	quarry	D		1.6 x 1.2 x 1.15
5	crevice	quarry	D	x	1.4 x 0.8 x 0.6
6	pit	quarry	D	x	3.0 x 2.0 x 1.6
7	pit	quarry	D		0.8 x 0.4 x 0.5
8	C-shape	temporary habitation	D		2.1 x 1.3 x 0.55
9	pit	quarry	D		1.0 x 0.9 x 0.2
10	pit	agriculture	D		1.3 x 1.0 x 2.8
11	pit	agriculture	D		2.3 x 0.7 x 0.28
12	overhang shelter	temporary habitation	D	x	1.25 x 1.0 x 1.4
13	pit	quarry	D		1.4 x 0.7 x 0.2
14	pit	quarry	D		1.2 x 1.2 x 0.1
15	pit	quarry, agriculture	D		1.0 x 1.0 x 0.5
16	pit	quarry, agriculture	D		1.25 x 0.9 x 0.3
17	pit	quarry, agriculture	D		1.0 x 0.7 x 0.3
18	pit	quarry, agriculture	D		0.8 x 0.55 x 0.3
19	pit	quarry	D		1.95 x 1.6 x 0.15
20	pit	quarry	D		1.7 x 1.3 x 0.45
21	pit	quarry	D		1.6 x 0.9 x 0.3
22	pit	quarry	D	x	2.3 x 1.1 x 0.45
23	pit	quarry	D	x	3.1 x 0.7 x 0.3
24	pit	quarry	D	x	1.1 x 0.7 x 0.3
25	pit	quarry	D	x	0.9 x 0.9 x 0.3
26	pit	quarry	D	x	5.0 x 0.9 x 0.55
27	pit	quarry	D	x	4.5 x 3.4 x 0.55
28	pit	quarry, agriculture	D		1.5 x 1.3 x 0.15
29	pit	quarry, agriculture	D		0.76 x 0.6 x 0.71
30	pit	quarry, agriculture	D		1.45 x 1.55 x 0.7
31	pit	quarry, agriculture	D		0.8 x 0.7 x 0.7
32	pit	quarry	D		7.5 x 1.4 x 0.3
33	pit	quarry, agriculture	D	x	4.5 x 0.75 x 0.4
34	pit	quarry, agriculture	D		2.4 x 1.2 x 0.4
35	pit	quarry, agriculture	D		1.55 x 1.25 x 0.3
36	pit	quarry	D		1.15 x 0.25 x 0.4
37	pit	quarry	D		6.4 x 1.6 x 0.75
TOTAL 37					
5347 (D21-63)					
1	enclosure	agriculture	D		4.7 x 4.1 x 0.8
2	pit	quarry	D		1.4 x 1.3 x 0.8
3	pit	quarry	D		1.0 x 0.75 x 0.35
4	overhang	temporary habitation	D	x	1.5 x 1.8 x 1.2
5	pit	quarry	D		3.5 x 2.1 x 1.4
6	pit	quarry	D		1.8 x 0.6 x 0.2
7	pit	quarry	D		1.1 x 0.6 x 0.36
8	pit	quarry	D		3.0 x 2.55 x 0.4
9	mod. outcrop	agriculture	D		2.0 x 1.7 x 0.4
10	cupboard	storage	D	x	1.6 x 0.35 x 1.2

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5347 (D21-61)					
11	pit	quarry, agriculture	D		1.2 x 0.95 x 0.6
12	mod. outcrop	agriculture, quarry	D		1.6 x 1.2 x 0.8
13	pit	quarry	D		8.2 x 7.6
14	cupboard	storage	D		2.0 x 0.9 x 0.15
15	pit	quarry, agriculture	D	x	2.3 x 1.8 x 0.7
16	mod. outcrop	agriculture, temp. habitation	D		2.2 x 1.6 x 0.5
17	pit	quarry	D		1.3 x 1.2 x 0.5
18	pit	quarry	D	x	1.4 x 0.7 x 1.0
19	pit	agriculture	D	x	1.65 x 1.0 x 1.25
TOTAL 19					
5348 (D21-64)					
1	lava sink	temp. habitation	D		5.6 x 4.7 x 1.3
2	lava sink	temp. habitation	D		5.0 x 2.4 x 0.8
3.1	lava tube	temp. habitation	D	x	5.0 x 4.0
3.2	lava tube	temp. habitation	D	x	16.4 x 1.4 x 1.0
3.3	lava tube	temp. habitation	D	x	8.2 x 1.6
3.4	lava tube	temp. habitation	D	x	4.4 x 1.2 x 0.6
3.5	lava tube	burials	D,E	x	49.9 x 5.0 x 2.8
3.6	platform	burials	D,E	x	3.0 x 2.8 x 0.7
3.7	lava tube	burial	D,E	x	56+ meters
4	pit	quarry	D		0.5 x 0.3 x 0.5
5	pit	quarry	D		5.0 x 0.5
6	pit	quarry	D		2.4 x 1.4 x 0.5
7	pit	quarry	D		3.0 x 2.5 x 0.5
8	pit	quarry	D		6.6 x 1.2 x 0.4
9	pit	quarry	D		1.2 x 0.6 x 0.65
10	pit	quarry	D		2.1 x 1.7 x 0.6
11	pit	quarry	D		1.0 x 0.8 x 0.4
12	pit	quarry	D		1.6 x 1.2 x 0.3
13	pit	quarry	D		1.4 x 1.3 x 0.6
14	pit	quarry	D		1.7 x 0.8 x 0.25
15	pit	quarry	D		0.6 x 0.3 x 0.6
16	pit	quarry	D		0.5 x 0.4 x 0.4
17	pit	quarry	D	x	7.5 x 6.0 x 1.0
18	pit	quarry	D		1.5 x 1.0 x 0.55
19	pit	quarry	D		1.8 x 1.6 x 0.7
20	pit	quarry	D		2.0 x 1.0 x 0.55
21	pit	quarry	D		1.9 x 1.1 x 0.41
22	pit	quarry	D	x	0.9 x 0.6 x 0.56
23	pit	quarry	D	x	0.6 x 0.35 x 0.7
24	pit	agriculture, quarry	D	x	0.7 x 0.6 x 0.5
25	pit	quarry, agriculture	D	x	1.2 x 0.5 x 0.6
26	pit	quarry	D	x	3.8 x 0.65 x 0.55
27	pit	quarry	D	x	0.8 x 0.6 x 0.4
28	crevice	quarry	D	x	15.0 x 2.6 x 0.7
29	pit	quarry, storage	D		3.25 x 2.25 x 0.6
30	pit	quarry, agriculture	D		2.2 x 1.3 x 0.35
31	pit	agriculture, quarry	D		1.8 x 1.3 x 0.36
32	pit	quarry, agriculture, storage	D		3.1 x 1.6 x 0.65

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5348 (D21-64)					
33	pit	quarry, agriculture, storage	D		2.8 x 1.15 x 0.8
34	enclosure	temporary habitation	D		1.3 x 1.3 x 0.4
35	pit	quarry, agriculture	D		1.7 x 1.1 x 0.5
36	pit	quarry, agriculture	D		2.05 x 1.4 x 0.52
37	pit	quarry, agriculture	D		6.0 x 2.55 x 0.53
38	pit	quarry	D		2.6 x 2.25 x 0.6
39	pit	quarry, agriculture	D		3.6 x 2.0 x 0.41
40	pit	quarry, agriculture	D		3.5 x 1.5 x 0.58
41	mound	agriculture	D		0.8 x 0.8
42	mod. outcrop	temporary habitation	D		2.4 x 2.4
43	pit	quarry, agriculture	D		1.8 x 1.7 x 1.9
44	pit	quarry, agriculture	D		1.37 x 0.9 x 0.35
45	pit	quarry, agriculture	D		0.8 x 0.8 x 0.6
46	pit	quarry, agriculture	D		1.6 x 1.33 x 0.78
47	overhang shelter	temporary habitation	D		3.0 x 1.65 x 8.0
48	pit	quarry	D		1.0 x 0.4 x 1.1
49	pit	quarry	D		2.5 x 0.9 x 0.7
50	lava tube	temporary habitation	D		19.8 x 3.1 x 3.1
51	C-shape	temporary habitation	D		0.66 x 0.61 x 0.67
52	overhang shelter	temporary habitation	D		4.3 x 1.7 x 0.5
53	lava tube	temporary habitation	D	x	2.5 x 1.0 x 1.35
54	trail	transportation	D		48 m. length
TOTAL 60					
5349 (D21-65)					
1	pit	quarry	D	x	0.5 x 0.5 x 0.4
2	pit	quarry	D	x	1.0 x 0.6 x 0.3
3	pit	quarry	D	x	1.8 x 0.6 x 0.4
4	pit	quarry	D	x	3.6 x 0.8 x 0.4
5	pit	quarry	D	x	4.3 x 1.6 x 0.7
6	pit	quarry	D		2.1 x 1.2 x 0.4
7	pit	quarry	D		2.6 x 1.2 x 0.2
8	pit	quarry	D		1.9 x 1.2 x 0.3
9	pit	quarry	D		1.9 x 0.7 x 0.45
10	pit	quarry	D		0.6 x 0.35 x 0.4
11	pit	quarry	D		1.30 x 0.6 x 0.52
12	pit	quarry	D		1.45 x 0.35 x 0.38
13	pit	quarry	D		3.4 x 0.9 x 0.35
14	pit	quarry	D		4.05 x 1.05 x 0.44
15	pit	quarry	D	x	0.9 x 0.7 x 0.3
16	pit	quarry	D	x	1.5 x 1.1 x 0.5
17	pit	quarry	D		3.7 x 2.5 x 0.6
18	pit	quarry	D		2.95 x 1.5 x 0.24
19	pit	quarry	D		0.75 x 0.4 x 0.47
20	pit	quarry	D		1.9 x 1.5 x 0.41
21	pit	quarry	D		2.7 x 0.3 x 0.48
22	pit	quarry	D		2.05 x 1.05 x 0.27
23	pit	quarry	D	x	1.9 x 1.5 x 0.2
24	pit	quarry	D	x	2.1 x 1.0 x 0.25
25	pit	quarry	D	x	0.9 x 0.6 x 0.25

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5349 (D21-63)					
26	pit	quarry	D	x	1.7 x 1.0 x 0.3
27	pit	quarry	D	x	2.4 x 1.0 x 0.25
28	pit	quarry	D	x	1.5 x 1.1 x 0.25
29	pit	quarry	D		1.8 x 0.9 x 0.15
30	pit	quarry	D		3.8 x 1.6 x 0.55
31	pit	quarry	D		1.5 x 1.1
32	pit	quarry	D		2.1 x 0.9 x 0.2
33	pit	quarry	D		2.0 x 0.75 x 0.7
34	pit	quarry	D		1.5 x 1.0 x 0.4
35	pit	quarry, agriculture	D		0.5 x 0.4 x 0.5
36	pit	quarry	D		1.9 x 0.9 x 0.8
37	pit	quarry	D		1.3 x 1.2 x 0.3
38	pit	quarry	D		1.9 x 0.75 x 0.38
39	lava tube	temporary habitation	D	x	40.0 x 1.8 x 1.43
40	lava tube	temporary habitation	D	x	2.30 x 1.5 x 1.5
41	lava tube	temporary habitation	D	x	1.5 x 1.0 x 1.1
42	pit	quarry	D		0.7 x 0.5 x 0.9
43	lava tube	temporary habitation	D	x	1.8 x 0.8
44	pit	quarry	D		0.85 x 0.7 x 0.6
45	pit	quarry	D		2.65 x 2.15 x 0.67
46	lava tube	temporary habitation	D	x	1.2 x 1.1
TOTAL 46					
5350 (D21-66)					
1	enclosure	habitation	D		3.0 x 2.7 x 0.45
2	lava tube	temporary habitation	D	x	8.2 x 6.0 x 0.2
TOTAL 2					
5351 (D21-67)					
1	trail	transportation	D		655.1 m.
TOTAL 1					
5352 (D21-68)					
1	mod. outcrop	quarry	D		1.30 x 1.20 x .80
2	cupboard	burial	D,E	x	1.0 x 0.5 x 0.8
3	pit	agriculture, quarry	D		5.0 x 4.5 x 1.5
4	mod. outcrop	agriculture	D	x	5.0 x 3.3
TOTAL 4					
5353 (D21-69)					
1	terrace	agriculture	D		3.0 x 1.8
2	terrace	agriculture	D		2.4 x 1.4
3	cupboard	storage	D	x	1.0 x 0.8 x 0.8
4	cupboard	storage	D	x	8.5 x 2.0
TOTAL 4					

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5354 (D21-70)					
1	lava tube	temporary habitation	D	x	6.0 x 4.0 x 1.4
2	lava tube	temporary habitation	D	x	7.3 x 2.85 x 1.9
TOTAL 2					
5355 (D21-71)					
1	mod. outcrop	possible shrine, temporary habitation	D	x	7.3 x 4.5 x 0.7
2	platform	possible shrine, temporary habitation	D	x	4.55 x 4.35
TOTAL 2					
5356 (D21-72)					
1	pit	quarry	D		4.0 x 1.6 x 1.3
2	pit	quarry	D		1.6 x 1.4 x 0.8
TOTAL 2					
5357 (D21-73)					
1	pit	quarry, agriculture	D		0.6 x 0.4 x 0.5
2	mound	agriculture			1.0 x 1.0
TOTAL 2					
5358 (D21-74)					
1	pit	quarry	D		1.4 x 1.4
2	pit	quarry	D		0.7 x 0.5 x 0.3
3	pit	quarry	D		3.0 x 1.8 x 0.5
4	pit	quarry	D		1.6 x 1.4
5	pit	quarry	D		5.0 x 3.0
TOTAL 5					
5359 (D21-75)					
1	lava tube	temporary habitation	D	x	37.0 x 4.0 x 1.5
2	pit	quarry	D		0.95 x 0.6
3	pit	quarry	D		1.5 x 1.4
4	pit	quarry	D		0.9 x 0.6

Appendix A (cont'd)

Site/Feat.#	Type	Functional Interpretation	Sign	Tested	Dimensions (m)
5359 (D21-75)					
5	pit	quarry	D		2.6 x 2.6
6	pit	quarry	D		0.9 x 0.35
7	pit	quarry	D		0.8 x 0.6
8	pit	quarry	D		0.75 x 0.5
9	pit	quarry	D		1.6 x 0.8
TOTAL 9					
5360 (D21-76)					
1	pit	quarry	D		1.3 x 0.6
2	pit	quarry	D		1.75 x 1.0
TOTAL 2					
5361 (D21-77)					
1	pit	quarry	D		1.5 x 0.6 x 0.5
2	pit	quarry	D		0.7 x 0.3 x 0.5
3	pit	quarry	D		0.5 x 0.3 x 0.5
TOTAL 3					

SITE TOTAL: 25 FEATURE TOTAL: 1313

APPENDIX B

REGIONAL NOTES FROM KEKAHA: MANINI'ŌWALI/KŪKIO 2

by

HANNAH KIHALANI SPRINGER

ACKNOWLEDGEMENT

Mahalo to Holly Kunewa Dunaway, Karin Haleama'u, Coco Hind, Robert Keakealani, Thomas Lindsey, Keoki Magoon, Richard Moore, Agnes Haleama'u Ohira, and Michael Tomich for the thoughts and aloha shared.

INTRODUCTION

Under contract to the North Kona Development Corporation, the Applied Research Group, Bishop Museum, conducted a preliminary archival research to identify and examine available sources for information related to the Manini'ōwali/Kūkio 2 project area. This work was conducted by Hannah Kihalani Springer. A sampling of specific mythological, cultural, and historical information has been assembled from the writings of native historians, descriptive accounts, and land records. Cartographic sources and personal communications have also been included.

The information contained in the archival study shall be an important component for interpretation of archaeological sites in the project area. Formulation of an interpretive plan early in the project planning process shall be useful in shaping the vision of the project. Proper interpretation shall assure the consistency of the project with the continuum of human activity in Kūki'o 2 and Manini'ōwali *ahupua'a*.

In addition to data recovered from TMK: 7-2-04: por. 17 in Kūki'o 2 and Manini'ōwali, North Kona, cursory information will be presented of the larger region, Kekaha, in which the Kūki'o 2 and Manini'ōwali lands are located. This information will define the setting and provide information to past lifeways of the residents.

KEKAHA - A TRADITIONAL PERSPECTIVE

Eliza Davis Low Maguire, a resident of Hu'ehu'e at the turn of the century, translated a selection of stories relating to Kekaha under the title *Kona Legends(1926)*. These stories had originally been submitted to *Hoku O Hawaii*, a Hawaiian language newspaper edited in Hilo by Reverend Stephen Desha and Isaac W. H. Kihe, a Hawaiian school teacher in Kekaha during the latter years of the Monarchy. In her introduction to *Kona Legends*, Mrs. Maguire offered the description of Kekaha:

> ...Kekaha (barren, desolate) was the name given to that section of North Kona from Honokohau, North of Kailua to Napuu (The Hills), meaning Puuwaawaa and Puuanahulu, and along the coast to Anaehoomalu, the boundary of South Kohala.

It is often spoken of as Kekaha-Wai-Ole (The desolate land without water). Pele, the Volcano has literally eaten the heart out of this section (Maguire) 926: 5).

As noted by its residents and those familiar with the region, the water source was scarce. In no way has this scarcity diminished the love that *kama'aina* had for their homeland, as indicated by the following:

Kekaha wai 'ole o na Kona. Waterless Kekaha of the Kona district.

Kekaha in Kona, Hawai'i, is known for the scarcity of water but is dearly loved by its inhabitants (Pukui 1983:185).

ENVIRONMENTAL SETTING

Geology

The principal rift zone of Hualalai, which runs through Kekaha, trends approximately 50 degrees NW, and is defined by cinder and spatter cones. A trachyte pumice cindor cone, Pu'uwa'awa'a, and the flow which issued from it, called Pu'uanahulu, is located on a secondary rift zone with a general north-south trend (Macdonald, Abbott, and Peterson 1983:364).

The cinder and spatter cones of the northwest rift of Hualalai, Pu'uwa'awa'a and Pu'uanahulu, are evident from the view plane of the project area.

It is probable that Nahaha on the northwest rift was the source of some of the surface lava of the Kūki'o/Manini'ōwali coastal area. The hill, Akahipu'u (2232 ft), is the upper terminus of the *ahupua'a* of Kūki'o and Manini'ōwali, while another hill, Kuili (342 feet), is a prominent landmark of the southern coastal boundary of Manini'ōwali.

The last eruption of Hualalai occurred in 1801 and formed the spatter cone known as Puhiapele (1637 ft above sea level). The flow from Puhiapele moved down the western flank of Hualalai and entered the sea over a front approximately four miles wide.

This flow destroyed "the tabu breadfruit grove of Kameha'ikana which grew in the uplands of Hu'ehu'e where the flow started" (Kamakau 1961:185) and the fishpond of Pa'aiea, which extended from "Kaelehuluhulu, adjoining the

little fishing hamlet of Mahaiula, and as far as Wawaloli on the boundary of Ooma" (Maguire 1926:14). The impact of this flow upon the traditional economy of the region was certainly evident.

Volcanic events such as this created deltas and bays, which make up the coastline of Kekaha. "Sea sand is buried for 1/4 mile from shore" (Stearns and Macdonald 1946:147). There are remnant beaches along the coast at various bays, most notably at Mahai'ula, Makalawena, Manini'ōwali, Kūki'o, and Ka'upulehu. These beaches change in size and/or profile with seasonal ocean swells and currents.

Though there has been no eruption of Hualalai since 1801, seismic activity continues. In 1929 the Stillman family evacuated their home at Kūki'ohiwai in Ka'upulehu at c. 2000 feet above sea level when "a series of several thousand earthquakes câme from beneath its [Hualalai's] northern flank" (Macdonald, et al., 1983:348). According to geologist Richard Moore, "There are a few earthquakes each year, from Hu'ehu'e Ranch on out to sea... but we do not see swarms of earthquakes, nor do we see harmonic tremor [indicating the movement of magma]" (Moore, personal communication, 1982).

Climate

Located on the leeward side of Hawai'i, Kekaha is less affected by the northwest tradewinds (which are distorted, if not blocked by the masses of Mauna Kea, Mauna Loa, and Hualalai) than are the windward regions of the island. The land-sea breezes and other regional winds are important to determining the climate of Kekaha.

Robert Keakealani, who was born at Ka'upulehu Beach and lived his adult life at Pu'uanahulu, described the winds of Kekaha as he learned them, "the 'Eka is the Waimea wind, the prevailing wind; the Kaumoku is the wind from Kona; the wind from Maui is called Ho'olua; and the Kuhonua is the wind from ma uka..." (Keakelani, personal communication, 1985).

Three poems referring to the 'Eka wind were presented in *'Olelo No'eau:*

1. *Ka makani kukolu pe'a nui, he 'Eka*

   The 'Eka, the wind that sets up the big sails.
   When the 'Eka wind blew in Kona, Hawai'i, the fishermen sailed out to the fishing grounds (Pukui 1983:159).

2. *Ke 'Eka makani ho'olale wa'a o na Kona.*

The 'Eka breeze of Kona that calls to the canoemen to sally forth. Refers to Kona, Hawai'i (Pukui 1983:182).

3. *Makani 'Eka aheahe o Makalawena.*

The gentle breeze of Makalawena (Pukui 1983:228).

In *Fragments of Hawaiian History* (Ii, J.Papa 1973) the winds of Kailua and environs are described:

> The only strong wind that blew along these beaches was the one that came from the upland occasionally, called the Kuhonua. Although coconut leaves were bent over sometimes and *'i'iwi* and *apapane* birds blown by the wind were seen perching on coconut and *noni* trees and on stone walls, no house was ever damaged. The Kuhonua winds blew for only a few hours at a time, after which the customary calm of the land returned. A little more frequent was a cold wind from Kekaha, the Hoolua (I'i 1973:122).

The Ho'olua is the "Maui wind" blowing across Kekaha to reach Kailua.

An affect of the breezes of the region was described by Keoki Hagoon of Mahai'ula, "Johnny Hano used to tell me about their sailing...they would go up the coast [from Kailua] during the morning and come back in the afternoon after the wind had changed" (Hagoon, personal communication, 1986).

Water

In Kekaha, the value of water cannot be underestimated. Wooden troughs, calabashes, and gourds were placed in lava tubes to catch water percolating from the surface into the tube during times of rain. Makalei, a lava tube located at Hu'ehu'e on the slope of 'Akahipu'u, was used in this manner until the 1920's (*Hoku O Hawaii*, May 29, 1924, and Maguire 1926:3, 27-30).

Along the coast, springs were important resources for the *kama'aina* in Kekaha. Such bodies of water vary from extensive pond systems at Makalawena and Awake'e to small ponds such as at Kua Bay in Manini'ōwali.

Whether these ponds are extensive or simple, their value is indicated by evidence of modification, place names, or contemporary use.

At their home at Mahai'ula Beach, the Hagoon family utilizes such a spring for domestic needs.

According to Norman Keana'aina, the numerous brackish ponds at Makalawena were used for specified purposes, the ones furthest inland being designated for collecting drinking and cooking water. Users of these ponds were ordered not to *kapulu* or foul them (Keana'aina, personal communication, 1986).

Modifications to ponds included partitioning walls. Accumulations of material apparently dredged from the ponds were piled on some of the walls, perhaps the result of pond management efforts. The ponds at Kūki'o I have pond material accumulations on some of the partitioning walls. Vegetation and sediment material were probably periodically removed from the ponds to create an environment more attractive to the *'opae 'ula*, those endemic red shrimp which were preferred for *'opelu* during times of old (use continued after Contact).

The water from the spring at Laekikaua, Kūki'o, "...is probably the most potable water on the coast of Hualalai" (Stearns and Macdonald 1946:270). This spring continues to be used to meet some of the water needs of the Hu'ehu'e Ranch cottage situated on the point.

From coastal Ka'upulehu, a *mo'olelo* of a drought is recounted, and where the deity Kane came to aid of the people by creating bubbling springs, which issue from the rock reef along the edge of Kahuwai Bay (Maguire 1926:36). These springs were tapped by positioning empty water gourds over the spring source and filling gourds with fresh water.

At Waiulu brackish waters of coastal Ka'upulehu are found within the hollows of some of the lava blisters. Similarly, a feature noted at Kiholo, Pu'uwa'awa'a on the U.S.G.S. topographic map for the Kiholo quadrant as "Keanalele Waterhole", was a body of water found in a lava tube and accessible through the ceiling of the tube.

Flora

The leeward climatic conditions and the harsh volcanic terrain of Kekaha have determined the vegetative communities of the region. The botanic zones of Kekaha are the coastal zone, which includes the sandy-beach mat communities, the *kiawe* thicket communities, and the marsh communities found in conjunction with naturally occurring and man-modified bodies of brackish water; the leeward savannah, which extends to about 1200 feet above sea level; the dry and cloud forests, which extend to approximately 6000 feet above sea level; and the sub-alpine region, which extends up to the summit area of Hualalai at an elevation of 8271 feet.

The coastal areas were first settled approximately 1000 years ago. As the population expanded, agricultural activity increased, up to an elevation of about 1800 feet.

From the native coastal community, the *loulu* palm (*Pritchardia*) yielded fronds suitable for weaving and thatching.

The native savannah and dry and cloud forests were exploited by the traditional residents of Kekaha for a variety of resources including grass for thatching (*pili, Heteropogon contortus*), wood for building material (*'a'ali'i, Dodonea eriocarpa* and *lama, Diospyros ferrea*), wood for fashioning implements (*kauila, Colubrina oppositifolia* and *Alphitonia ponderosa*), bark for treating cordage (*koki'o, Kokia drynarioides*), foliage for dressing certain altars (*halapepe, Pleomele aurea*), rootlets for basket making (*'ie'ie, Freycinetia arborea*), foliage for *lei* (*maile, Alyxia olivarformis*), and wood for canoes (*koa, Acacia koa*).

Species introduced by Polynesian settlers included coconut (*niu, Cocos nucifera*), pandanus (*pu hala, Pandanus odoratissimus*), bread fruit (*'ulu, Artocarpus communis*), ti (*ki, Cordyline terminalis*), taro (*kalo, Colocasia esculenta*), and sweet potato (*'uala, Ipomoea batatas*).

Post 1778, a wide variety of plants were introduced including (*mohi Passifloraceae*), which is a food plant; silver oak (*Grevillea robusta*), which was introduced experimentally to form wind breaks; *kiawe* (*Prosopis pallida*), which was introduced as food for livestock, fuel, fencing, and shade; and fountain grass (*Pennisetum setaceum*), which was introduced as an ornamental.

These plants are generally more aggressive and competitive than native plants or Polynesian introductions, and have greatly modified the landscape of Kekaha. In the cloud forests, *mohi*, a climbing vine, forms a dense mat in the canopy of the native forest, reducing light to the understory as well as

strangling emerging trees. In the dry forest, the silver oak with its quick growth rate competes tenaciously with native species, as does the *kiawe* at lower elevations.

Fountain grass is the most ubiquitous ground cover of the region. It is perhaps the greatest competitive threat to native species in the dry forest and savannah.

Avifauna

From the coastal sandy-beach mat and marshland communities up to the summit area of Hualalai, Kekaha has played host to a wide variety of native and avian birds.

The endangered Hawaiian stilt (*kukuluae'o, Himantopus mexicanus knudseni*), the Hawaiian coot (*'alae ke'oke'o, Fulica americana alai*), the black crowned night heron (*auku'u, Nycticorax nycticorax hoactli*), and the seasonally present Pacific golden plover (*kolea, Pluvialis dominica fulva*), among others, may be found at Kapo'ikai Wetlands in Makalawena.

Until recently, the ponds and wetland area behind the beach at Kua Bay in Manini'ōwali have provided a habitat for the *kukuluae'o*. Irresponsible degradation of this wet area has reduced appropriate habitat for the activities of this native, federally listed endangered species (1980 listing).

At Kūki'o 1, introduction of small bait-fish such as *Poecilia mexicana*, which prey upon the native *'opae 'ula* (*Halocaridina rubra* and *Metabetaeus lohena*), a favored food of the *kukuluae'o*, may have altered avian activity patterns at the ponds and wetlands behind the beach. *Kukuluae'o*, which formerly frequented the ponds, have been joined, if not displaced by *auku'u*, which may have a preference for the bait-fish.

Native birds of the plains and uplands included the Hawaiian goose (*Branta sandwichensis*), the Hawaiian crow (*Corvus tropicus*), the Hawaiian hawk (*Buteo solitarius*), and the Hawaiian owl (*Asio flammeus sandwichensis*).

All of these species were hunted during times of old (use continued after Contact) for their feathers, which were highly valued for adornment including *kahili* making. According to Malo, the *nene* and the *'alala* were also utilized for food. The *'io* continues to be used for a person of rank or deserving of recognition and respect. The *pueo* is considered to be the embodiment (*kinolau*) of some families' revered ancestor(s) (*'aumakua*) and "is regarded as a deity and is worshiped by many" (Malo, 1976:38).

Another bird of the region, which was of great importance to the Hawaiian people, is the *ua'u* (*Pterodroma phaeopygia sandwichensis*). This ocean-going hunter nests in the uplands and was stalked by bird hunters. According to Malo, "It is delicious eating" (Malo 1976:39).

Testimony regarding the boundaries of nearby Ka'upulehu, made before the Commission of Boundaries on June 8, 1874, by Keli'ihanapule, include the following reference: "Thence along Kau to Kaimuki, a place where they used to catch uwau." Similarly in the story of "*Na Kaikamahine Pulehu Ulu,*" (*Hoku O Hawaii*, May 8, 1924) and the translation of it "The Two Girls Roasting Breadfruit" (Maguire 1926:20), the place Kawahapele is associated with *ua'u* hunters.

Native forest birds include the *'amakihi* (*Loxops virens*), *'akepa* (*Loxops coccinea*), *'apapane* (*Himatione sanguinea*), and *'i'iwi* (*Vestiara coccinea*). According to Malo, many of the native forest birds such as the *'amakihi* and *'i'iwi* were hunted for both their feathers, which were used in the fashioning of adornments and for food (Malo 1976:38-9).

TRADITIONAL FOOD RESOURCE

Fishing

The Hawaiians exploited both in-shore and off-shore ocean resources extensively. Management of these resources corresponded to observed natural cycles and where conditions permitted, included modified environments.

Regional conditions necessitated variations of management techniques, the following account, given by Mary Pukui (1983), provides useful insight to the traditional attitude toward resources management:

> There was never a time when all fishing was tabu. When inshore fishing was tabu, deep sea fishing (*lawai'a-o-kai-uli*) was permitted, and vice versa. Summer was the time when fish were the most abundant and therefore the permitted time for inshore fishing. Salt was gathered at this time also, and large quantities of fish were dried. Inland crops were tilled, and supplies from the higher lands procured. In winter, deep sea fishing was permitted, and the sweet potatoes that grew in large patches near the shore were cultivated. A tabu for the inshore fishing covered also all the growths in that area, the seaweeds, and shellfish, as well as the fish. When the *kahuna* had examined the inshore area, and noted the condition of the animal and plant growths, and decided that they were ready for use, that is, that the new growth had a chance to mature and become established, he so reported to the chief of the area, and the chief ended the tabu. For several days it remained the right of the chief to have all the sea foods that were gathered, according to his orders, reserved for his use, and that of his household and retinue. After this, a lesser number of days were the privilege of the *konohiki*. Following this period the area was declared open (*noa*) to the use of all (Titcomb 1977:14).

Kekaha is famous for its off-shore fishing resources. The native historian, Kamakau, notes the High Chief 'Umialiloa fishing for aku (*Katsuwonus pelamis*) off of Maka'ula (Kamakau 1961:20).

Another native historian, 'I'i, in his description of Kamehameha's return to Hawai'i, notes:

> The next day the ship arrived outside of Kaelehuluhulu where the fleet for *aku* fishing had been since the early morning hours. The sustenance of those lands was fish...Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma drew close to the ship to trade for *pa'i'ai* (hard *poi*) carried on board, and shortly a great quantity of *aku* lay silvery-hued on the deck ('I'i 1973:109).

During the Great Mahele in 1848, Haleohiu, in Kekaha, reserved one of the *ahupua'a* for himself. Much of the *ahupua'a* had been rendered barren by the Puhiapele flow of 1801. Perhaps Kauikea'ouli desired the *ahupua'a*, not for its on-shore resources, but rather for its off-shore fishing resources.

Off-shore fishing grounds, *ko'a*, were identified by sighting and lining up with land marks on-shore.

People living in upland Kekaha recall the "old folks" who lived at Makalawena and Ka'upulehu beach who caught and dried *'opelu* (*Decapterus pinnulatus*) for domestic, trade, and sale at the stores in upland Kekaha.

To further supplement their protein needs, Hawaiians innovated systematic breeding and nurturing networks (fishponds) for certain fish. Fish frequently propagated included *'anae* (*Mugil cephalus*), *'o'io* (*Albula velpes*), and *awa* (*Chanos chanos*), as well as various *'opae* (shrimp). Some open water fish such as *ulua* (*Carangidae*), *kumu* (*Parupeneus porphyreus*), *weke* (*Hulloidichthys spp.*), *manini* (*Acanthurus sandvicensis*) and *kupipi* (*Abudefduf sordidus*) may have entered ponds built in the open sea.

Kekaha was also noted for its fishponds. As described previously, the lava flows of Ka'upulehu and Puhiapele destroyed ponds at Kiholo and Ka'upulehu and also the large pond of Pa'aiea.

The impact of these losses to the traditional economy of Kekaha cannot be underestimated. At the time that the losses were incurred, however, the traditional social and political systems were sufficiently intact and healthy. Under the direction of Kamehameha I, a large pond was built at Kiholo in 1810:

> A small bay, perhaps half a mile across, runs inland a considerable distance. From one side to the other of this bay, Tamehameha built a strong stone wall, six feet high in some places and twenty feet wide, by which he had an excellent fish-pond not less than two miles in circumference.
>
> There were several arches in the wall, which were guarded by strong stakes driven into the ground so far apart as to admit the water of the sea, yet sufficiently close to prevent the fish from escaping. It was well stocked with fish, and water fowl were seen swimming on its surface (Ellis 1963:294-296).

This pond was destroyed by the great Mauna Loa flow of 1859. By this time, the traditional social, political, and economic systems were less intact and no pond building effort was enacted to replace the loss.

Until the middle part of this century, the *loko pu'e'one* at Honokohau and the *loko kuapa* at Kaloko were used to raise *'anae* and *awa*. The *'opae 'ula* from the *wai 'opae* at Makalawena, Kūki'o and Ka'upulehu were harvested as chum for *'opelu* fishing.

While most fishermen have abandoned much of the traditional fishing lore, it is known that the Pai *'ohana* from Honokohau still follow many of the older traditions including use of *'opae 'ula* as chum and fishing *ko'a* that have been taught from one generation to the next.

AGRICULTURE

William Ellis, on his tour of Hawai'i 1823, described Kailua, Kona and environs as follows:

> The houses, which are neat, are generally erected on the seashore, shaded with coconut and *kou* trees, which greatly enliven the scene. The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses are built, where ever soil could be found sufficient to nourish the sweet potato, the water melon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava collected in small heaps around their roots.
>
> The next morning, Messrs. Thurston, Goodrich, and Harwood visited the high and cultivated part of the district. After traveling over the lava for about a mile, the hollows in the rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by the decayed vegetation and decomposed lava. Here they enjoyed the agreeable shade of breadfruit and ohia trees...The path now lay through a beautiful part of the country, quite a garden compared with that through which they had passed, on first leaving town. It was generally divided into small fields, about fifteen rods square, fenced with low stone walls, made of fragments of lava which had been gathered from the surface of the enclosures. These fields were planted bananas, sweet potatoes, mountain taro, paper mulberry plants, melons, and sugar cane, which flourished in every direction (Ellis 1969:0-1).

Additionally, Handy described areas of taro and sweet potato planting in North Kona:

> In North Kona dry taro flourishes only in the uplands, which are now largely given over to ranching, though some Hawaiians still have taro plantations above Kalaoa...
>
> Wherever a little soil could be heaped together along the dry lava coast of North Kona, a few sweet potatoes were planted by fishermen at such places as Honokohau, Mahai'ula, Makalawena, Kaupulehu, Kiholo, Keawaiki, and Kapalaoa. Doubtless potatoes were planted on the upland of North Kona, on the lower slopes of Hualalai toward Pu'u Wa'awa'a, up to a considerable altitude in rainy seasons. In recent times the flatlands of Pu'u Anahulu, having an elevation of 2,300 feet, have supported a number of patches planted by Hawaiian cowboys (Handy, Handy and Pukui, 1972:5278).

From the May 29, 1924, article in the *Hoku O Hawaii*, "He Ana O Makalei", and the translation from *Kona Legends*, "The Cave Of Makalei", it is noted that when Ko'amokumokuoheeia settled at Akahipu'u, "he began to cultivate taro, sweet potatoes, bananas, sugar cane and awa" (Maguire, 1926:27).

We also know of the breadfruit grove destroyed by the Puhiapele eruption in 1801, and so may infer that Ellis' description of the landscape above Kailua may probably be applied to parts of upland Kekaha.

Up until the 1920's, residents of Kahuwai Bay, Ka'upulehu, tended *'uala* as well as *niu*, *puhala*, and *loulu*. The *lau* of the latter two were woven into mats, hats, and bags, which were taken *ma uka* by trail, to be sold at either of the two stores then operating in upper Kalaoa (Robert Keakealani, 1985, personal communication).

Livestock

Traditional animal husbandry was limited to three species including *pua'a* (pig), *'ilio* (dog), and *moa* (chicken). Clearly "it was the sea that yielded the greatest variety and abundance of animal food" (Kirch, 1985:2), which "provided the main source of protein in the Hawaiian diet" (Kirch, 1985:199). Further, the *pua'a* and the *'ilio* were not everyday fare, but were status and ritual foods.

The *pua'a* is the largest and the most ritualistically important of the domestic animals. It was used ceremonially both at personal and state levels.

Hawaiian historian David Malo proposed examples when *pua'a* was offered to the appropriate deity; weaning of a boy child (Malo, 1976:87); "circumcision" of a boy child (ibid:93); petition for the health of a beloved family member or friend (ibid:95); festival food during the time of *Makahiki* (ibid:150); and offered by *ali'i* and *kanaka* single and in multiples of forty, according to ability, at the various stages of construction and dedication of *luakini heiau* (ibid:159-87).

'Ilio were used by the "*ali'i* for general use, and were regarded as a special luxury for great feasts" (Handy, Handy, and Pukui, 1972:244). Contributions of *'ilio* were made during the time of *makahiki* (Malo, 1976:143). In general, they were less important as a ceremonial food than the *pua'a*, but its teeth were used as adornments.

Kirch suggests that "a steady increase in the frequency of dog and pig bone", implies "a corresponding expansion of the agricultural system, as pigs and dogs were both fed on agricultural produce" (Kirch, 1985:303). Though the breadfruit grove at Kameha'ikana, located upslope of the project area, was renown, any evidence of extensive animal husbandry, which may have been associated within, was destroyed by the Puhiapele flow in 1801.

The *moa* was a a less prized food resource, but since it was brought across the ocean along with the *pua'a* and *'ilio*, it may indicate recognized utility. The *moa* was known to be both domestic and feral, and associated with various mythical traditions.

A traditional account concerning *moa* that comes from the region and is associated with Kuili has been recounted today musically by the song "Na Menehune Ekolu", written by Keli'i Taua. The account was presented in the May 22, 1924, *Hoku O Hawaii* as "Ka Puu O Akahipuu" and in *Kona Legends* as "Akahipuu".

According to the story, a group of *menehune* tried to work some mischief upon the hill in the uplands of Hu'ehu'e, known as Akahipu'u. Their efforts to remove the top of Akahipu'u and fill in the hollow of Kuili are repeatedly thwarted by a rooster named Moanuiahea with supernatural powers.

Moanuiahea lived on a hill of the same name in a cave with a pool of water in it. The rooster was the guardian of the pool for "Kane, who was the greatest God of the forests and the waters" (Maguire 1926:12). This place is also referred to in the Boundary Commission testimony of Keli'ihanapule, given on June 8, 1874, as "a hill where they used to worship".

Within the project area there are no apparent remains of extensive animal husbandry. Coastal dwellers of Kekaha such as Annie Punihaole Una of Makalawena and "Kahiko" of Ka'upulehu kept domestic pigs for home use, and upland households continue to do the same. The attraction of coastal Kekaha, an arid leeward region with no streams and relatively limited agricultural potential, is clearly rich with near-shore and adjacent deep-sea fishing resources.

Tomich (1986) indicates that English pigs and domestic goats were introduced to the islands of Hawai'i in 1778 by Captain James Cook (Tomich, 1986:121,151). Domestic cattle were introduced in 1793 by Captain George Vancouver (ibid:141), the domestic horse in 1803 (ibid:110), and the donkey probably in 1825 (ibid:114).

Cattle and horses have continued to play a major role in the upland ranching activities of the region until the present time.

The Hawaiian Kingdom Statistical and Commercial Directory and Tourists' Guide describes three individuals living on the "Kawaihae Road", within Kona District, as goat ranchers: Hopula'au on 130 acres of land in Kaulana (pp. 211, 337), Makahaikuli also in Kaulana (p. 241), and Punihaole on 105 acres at Kiholo (pp. 259, 349). Further, Frank Spencer of Pu'uanahulu is noted as a sheep rancher who also ran 12-14,000 goats on 80,000 acres of leased and 20 acres of owned land.

Tomich (1986:152-153) notes that by the early 20th century a concerted effort was being made to control the burgeoning goat population on the government lease lands of Pu'uwa'awa'a and Pu'uanahulu.

The feral donkey population of the region is clearly indicated by the donkey crossing signs on the Ka'ahumanu Highway and documented by Tomich (1986:117). These animals are no doubt descended from the stock raised by Keaka Punihaole (Robert Keakealani, 1985, personal communication), which were used by residents of Kekaha at the turn of the century.

LIFEWAYS

Mythic Past

From Maguire's collection, *Kona Legends*, comes "The Waters Of Kane" (Maguire, 1926:36-39), which describes certain events of the time when a chiefess controlled "the great division of the land of Ka'upulehu, and the adjoining lands of Kūki'o and Manini'ōwali. She was ruler over thousands of people and the land around was well cultivated." The events occurred "during the time when the ancient Gods had their way, long before Pele, the Goddess of Fire, had come and taken possession of the country."

From the same collection, the story "Manini'ōwali" (1926:31-35) includes many characters who's names are known as place names of the project area and environs. "Manini'ōwali" is the name of one of the principal female characters, a rock formation, a bay, and one of the land divisions within the project. "Uluweuweu" is the name of the principal male character, a rock formation, and the bay off of Kūki'o 1 *ahupua'a*. "Kikaua" is the name of a *kahuna*, the point on the southwestern side of Uluweuweu Bay. "Po'opo'omino" is a chiefly parent in the story, and also the name of a small cinder cone on

the Kūki'o 1, Ka'upulehu boundary, just above the Ka'ahumanu highway. "Kahawaliwali" is the name of the other principal female character, and a rock formation that is part of Kikaua Point. The events of this story clearly occurred after the coming of Pele to the region.

In this story, Manini'ōwali and Uluweuweu were born upon the same day and immediately betrothed. When the time of the marriage drew near, Uluweuweu became ill and the *kahuna*, Kikaua, was called to diagnose the illness. Over time it was revealed that Uluweuweu had become enamored to Kahawaliwali and did not desire to be married to Manini'ōwali, where upon she fell ill. The diagnosis of Kikaua was that she was heart broken and her parents were presented with two options, either to immediately follow through with the wedding or "do away with them all". The parents chose the latter and Kikaua invoked his deities, including Pele, to do the deed. The rock formations bearing the names of the three principal characters of the story reflect the intervention of Pele in the history of Kekaha.

RITUAL REFERENCE

Na Pule Kahiko (*Ancient Hawaiian Prayers*) by June Gutmanis (1983) includes references to prayers that address a representative sample of concerns of the people of old. In the chapter "Aloha" ("Love"), there is a section entitled "Ho'iho'i Hou I Ke Kulana Hua: Restoring Sexual Potency". The final prayer to complete the treatment for restoration of sexual potency includes recitation of these place names of the Kekaha coastline including Kiholo, Ka'upulehu, and Manini'ōwali (p. 47-48).

NA ALI'I (THE CHIEFS)

Kekaha was a region valued by ruling chiefs, inhabited by attendant chiefs, and upon occasion, abused by warring chiefs.

Lonoikamakahiki

During the reign of the chief, Lonoikamakahiki, A. D. 1565-1595 (Kalakaua, 1972:31), Kekaha was the object of scrutiny, as Kamalalawalu, ruling chief of Maui prepared to invade Hawai'i (Kamakau, 1961:56-61).

Keakealani

During the reign of the chiefess, Keakealani, over Kona and Kohala A.D. 1655-1685 (Kalakaua, 1972:31), the Mahi clan provided her war leaders. During times of war between the chiefs of Kona and the chiefs of Hilo, the chiefs of Hilo were dominant and the following reference refers to Kekaha specifically. "After they won the battle of Hu'ehu'e the secret places and burial caves in Kona were broken open." (Kamakau, 1961:63)

Alapa'inui

During the reign of Alapa'inui, 1720-1754 (Kalakaua, 1972:31), Kekaulike of Maui made war against Hawai'i and cut down "the trees throughout the land of Kona...abused the country people of Kekaha," and at "Kawaihae he cut down all the coconut trees" (Kamakau, 1961:66). These acts of war were of great consequence for "to fell trees of such usefulness (to the ancients) was considered truly inhuman" (Silva 1986:109).

Kame'eiamoku and Kamanawa

"...the land of Kekaha was held by the kahuna class of Ka-uahi and Nahulu" (Kamakau, 1961:231). The chiefly twins, Kame'eiamoku and Kamanawa, were of the Nahulu line. Kamanawa is associated with Kiholo in Pu'uwa'awa'a and Kame'eiamoku with Ka'upulehu.

The twins served as aides and counselors to Kalaniopu'u, Kiwala'o, and Kamehameha. While not ruling chiefs, they and their half brother Ke'eaumoku were of sufficient rank to move among ruling chiefs. These three began their influential careers before the arrival of Captain Cook and exerted influence into the nineteenth century.

Kame'eiamoku gained infamy as the captor of the Fair American, a sloop, in 1790, while he was living at Ka'upulehu. "Among the men who joined him in the raid were Nauki, Kuaiwa, Mano-hili, Na-luhi, 'Ahu-'ole, Pe'e, and some relatives of the chief, Ka-lau-koa, Hanu-hoa, Ka-nuha, and Ke-aka-o-ka-lani" (Kamakau 1961:147).

Upon gaining dominion of O'ahu, "According to Kamanawa's counsel, Kamehameha had divided the large *ahupua'a* tracts and the smaller *'ili'aina*

tracts of land all over O'ahu among his chiefs...Kapunahou and Moanalua for his *ahupua'a* to Kame'eiamoku" ('I'i, 1973:69-70).

Together, they are associated with secreting the bones of Kalola Pupuka and Ka-hekili-nui'Ahu-manu in a cave at Kaloko in Kekaha.

These men and their contributions to Hawai'i were so highly regarded that when a coat of arms was adopted by Hawai'i in May of 1845, they were depicted upon it. Kame'eiamoku is depicted on the right, holding a *kahili*, and Kamanawa on the left, with an *'ihe*.

Ulumaheihei

It is the son of Kame'eiamoku, Ulumaheihei, that is associated with the burial of the bones of Kamehameha.

> Ulumaheihei was a learned man, skilled in debate and in the history of the old chiefs and the way in which they had governed. He belonged to the priesthood of Nahulu and was an expert in priestly knowledge. He had been taught astronomy and all ancient lore...He was proficient in the genealogies of chiefs even where they were obscure (Kamakau, 1961:354).

Ulumaheihei was sought both by native historians and missionaries when insight and clarification of the traditional ways were desired.

An early Christian convert, he "often traveled about the islands preaching the doctrine of the Trinity...Ulumaheihei welcomed the missionaries to the island(s) and gave them land for churches and enclosed yards for their houses without taking any payment" (Kamakau, 1961:354). For example, Reverend Bingham was given a house lot at Kawaiha'o and the land at Punahou (Ibid:355).

Na Kamehameha

The lands of Kūki'o 1 and 2 and Manini'ōwali were all included in Interior Department Document 374 (not dated), a list of Kamehameha's lands. They were later set apart as Government land, with no *kuleana* claims.

Kauikeaouli chose Haleohiu and Pu'uwa'awa'a Likekalu at the time of the Mahele.

During the Mahele, Kamehameha V chose Ka'upulehu, which is rich in off shore and forest resources, including the summit area of Hualalai, and Kaloko, which is also rich in forest resources and the site of the *loko kuapa*.

Kalakaua

Kalakaua leased lands in North Kona, including Kūki'o 2, Hanini'ōwali, and nearby Mahai'ula. According to genealogy presented in *Hawaiian Genealogies* (McKinzie 1983), Kalakaua was born to Kapa'akea (m) and Keohokalole (f); Keohokalole was born to 'Aikanaka (m) and Kamae (f); 'Aikanaka was born to Kepo'okalani (m) and Keohohiwa (f); and Kepo'okalani was born to Kame'eiamoku (m) and Kamakaeheikuli (f). Thus, Kalakaua was a great-great-grandchild of Kame'eiamoku, the before mentioned prominent chief of the region (McKinzie 1983:20-21).

KA PO'E (THE PEOPLE)

C. 1790

The earliest documentary reference to the occupation of the Hanini'ōwali and Kūki'o comes from the following excerpt from Marion Kelly's work in *Kekaha, 'Aina Malo'o*:

> One informant stated that Kūki'o was once owned by his great-grandfather, Kinolau, who obtained it from Hulikoa. Presumably, Kinolau would have had Kūkio in the late 1790s, long before written records were kept. It was his daughter who was married at the time that Pele filled Kamehameha's pond in 1801. Kinolau and his wife, Ha'ilauwahine, lived at Kūkio and were buried there (Kelly, 1971:10).
>
> ...Kinolau and Ha'ilau...raised their family at Kūki'o and all their children except Ka'ahu'ula were buried there. She was buried at Makalawena because, it was explained, by the time she died, there was no one left to take her remains back to the family burial grounds at Kūki'o (Kelly, 1971:42).

It has been said by an elder who passed on, Molly Kunewa Dunnaway (Personal communication, 1985), that there is a "regular" graveyard behind Kakapa Bay in Kūki'o 2. It is known that there are cave burials at Kūki'o 1.

Which of these is occupied by Kinolau and Ha'ilau and their children has not yet been discerned from documentary research or through personal communications.

1835

In *The Missionary Censuses of Hawaii* (1973), Robert C. Schmitt cites a 1836 article from *Ke Kumu Hawaii*, which notes North Kona populations for 1835, including the following numbers for Kekaha and Kailua (indicated as from Keahualuu (perhaps Keahuolu) to Puaa):

	Kekaha	Kailua
Na Kane	426	511
Na Wahine	435	572
Na Keikikane	200	283
Na Kaikamahine	183	250
Pauloa	1,244	1,616

The article further notes that the total population of North Kona was 6,649 in 1831 and 5,957 in 1835, a loss of 692 persons (Schmitt, 1973:31).

1855-1875

On May 28, 1855, J. Fuller reported that land sales in Kona, Hawai'i, included the sale of 690 acres at Kūki'o 1 to Pupule for $86.25. He further notes:

> ...that none of these lands are paid for, but after the sales are confirmed I shall proceed to collect the balance as soon as possible. Yet it is necessary to give the purchasers considerable time, as they are mostly poor and have little which they can turn into cash. To encourage them, I have agreed to take goat skins, pulu, and wood and pay cash for them.
>
> Your excellency will perceive that I have sold this land in large tracts for goat runs and pastures as in small lots it would be perfectly worthless (Interior Department, 5-28-1855).

On November 11, 1856, Grant 2121 was awarded to Pupule. "690 acres excepting the rights of the tenants for $86.25" (Grant Award Book).

From the above, "excepting the rights of the tenants" is an intriguing phrase. From the constitution of 1841, signed by Kauikeaouli at Lahaina, comes the following statement on tenants rights:

> Landlords, oppress not your tenants; condemn them not without a cause while they continue to do well. If a land agent do thus to his tenants, and disposes them without a crime on their part, he shall pay a fathom swine to his tenant, and the tenant shall not be dispossessed. Wherefore, ye landlords, land agents, and sub-landlords, do not thus to your sub-tenants - take not causelessly from them the products of their lands, nor their domestic animals, nor any other article which is not given you. All the avails of your own working days are yours. There is no penalty for the landlords who confine themselves to that right.

Pupule paid $20 toward the purchase of land at Kūki'o 1 on March 25, 1861 (Interior Department, 3-25-61).

On March 23, 1864, Pupule's son Kahaunaele paid $9 towards the purchase of land at Kūki'o 1 (Interior Department, 3-23-64).

On June 30, 1873, $33 was collected from Hueu for a lease on Kūki'o (Interior Department, 6-30-1873).

On April 12, 1875, a request was made by John Broad of Ka'upulehu to lease Pu'ukala, Ohiki, Awalua, Kaulana, Mahai'ula, Awake'e, Manini'ōwali, and the two Kūki'o. "...However, a portion here ma kai has been acquired by a native named Kahaunaele, who bought from his father, Pupule, and the places conveyed to the natives should be reserved out of this leasing" (Interior Department, 4-12-75).

In April of 1875, two letters of request were received from A. S. Cleghorn for leases on North Kona Lands including Kūki'o 1 and 2 and Manini'ōwali (Interior Department, 4-75).

1887-1895

On April 7, 1887, a letter from E. Kahulanui to Luther Ahlo inquired about land of North Kona including Kūki'o 2 and Manini'ōwali and indicated his determination "to bid for the land until it is sold" (Interior Department, 4-7-87).

On June 8, 1888, a letter from J. W. H. I. Kihe notes a delay in instructions from Interior Minister Lorrin A. Thurston regarding the division of Government lands in North Kona. Kihe further writes of his desire to go and live on Government lands, which he has picked out at Kūki'o 1 and 2 and Manini'ōwali (Interior Department 6-8-88).

In 1889, according to lease 364, Kalakaua was renting North Kona lands, including Kūki'o 2 and Manini'ōwali. He was apparently aware of the desire of *kama'aina* for Government lands in the region to be subdivided and made available to them for homesteading purposes. Kalakaua was willing to give up suitable lands to those properly applying for homestead entitlements and who desired to retain the balance (Interior Department, 1-22-89).

Various petitions were submitted to the Monarchy and the Provisional Government to make homesteads available at various Kekaha *ahupua'a* including Kūki'o 1 and 2 and Manini'ōwali, to *kama'aina* who:

> ...are subject to taxes, and who have the right to vote in the district of Kona, Hawaii, and ones who are really without lands, and who wish to place this application before Your Excellency, that all of these Government lands here in North Kona, be given to the native Hawaiians who are destitute and poor, being the lots which were subdivided by the Government which are lying idle and for which no Agreements have been given out and also the lots which were granted Agreements and issued in the time when Lorrin A. Thurston was Minister of the Interior, and also the lots which still remain undivided. All of these Government lands are what we are now again asking that the dividing and subdividing be continued in these remnants of Government lands, until all of the poor and needy ones are provided for.
>
> Your Excellency, we ask that no consent whatever be given permitting lands to be acquired by the rich through sale at auction, or by lease, and if there is to be any lease, then to be leased to the poor ones (Interior Department, 7-3-1890).

The majority of the signatories of the above cited petition signed and undated Interior Department document Number 184. Document number 184 was sent to Professor W. D. Alexandar, Surveyor General of the Government. The documents had 64 and 70 signatories respectively. An additional petition dated January 10, 1895, was signed by eight persons.

KO LAKOU 'INOA (THEIR NAMES)

In the June 12, 1924, edition of the *Hoku O Hawaii* in the article, "Na Hoomanao O Ka Manawa", the following people are listed as having lived at Makala-wena and Kūki'o:

Kahaialii *ma*, Mamae *ma*, Kapehe *ma*, Kauaonuuanu *ma*, Hopulaau *ma*, Kaihemakawalu *ma*, Kaomi, Keoni Aihaole *ma*, and Pahukula *ma* resided at Makala-wena.

D. P. Keoahu *ma* Kaolelo *ma*, Luahine *ma*, Paapu *ma*, and J. K. Pu'ipu'i Kaailuwale *ma* resided at Kūkio.

And further, *"Ua pau loa na kanaka koe na hunona a Kauaonuuanu, oia o J. H. Mahiko ame Jack Punihaole a me na leili o lakou wale noia e noho nei i pani hakahaka na KauaanuuanuameAhu."* (*Hoku O Hawaii*, "Na Hoomano o Ka Manawa", June 12, 1924).

All people are gone except the sons-in-law* of Kauaonuuanu, J.H. Mahiko and Jack Punihaole and their children who are living there as successors of Kauaonuuanu and Ahu.

Of the names mentioned in the article Keoahu, Kapehe, Pahukula, and Punihaole appear as signatories of the Interior Department document dated July 3, 1890. Keoahu, Kapehe, and Pahukula are again signatories of the January 10, 1895, petition and Pahukula and Keaka and J. W. Punihaole appear as signatories of Document Number 184.

"Kaua-i-Nuuanu" is noted in Kekaha: *'Aina Malo'o* as:

> ...a man who was born on Maui but raised at Kohala by foster parents. When the lava flowed at Kiholo...many Kohala people came to Kona to visit and watch the eruption...it was then that he met and married Ka'ahu'ula. They lived at Makalawena where they raised their children (Kelly, 1971:42).

*hūnōna - son or daughter in law; nephew or niece Translation would depend on family relationship

A daughter of Kaua-i-nuuanu and Ka'ahu'ula named Kapahukela was also known as Jack Punihaole. "Jack had been adopted (*hanai*) by his uncle, Joseph Punihaole, who lived near the church at Kohanaiki and who also had a house at Kiholo. He spent time at both places, going from one to the other," (Kelly, 1971:42).

Ka'ahu'ula, as noted previously, was the daughter of Kinolau and Ha'ilau of Kūki'o.

Kulani is noted as "the oldest daughter" of Kinolau and Ha'ilau, and had a second husband named Ehu, who was also a signatory of the Interior Department document dated July 3, 1890:

> The fourth child of Kinolau and Ha'ilau was a daughter Haiha. She was said to have married a man by the name of Kahopulaau, and their son, Kealoha, married Kamaile Ha'ilau-wahine. Kealoha and Kamaile were the parents of Luka, who was the first wife of John A. Maguire and...died in 1898. Her will listed lands valued at $12,855, which went to her husband, John A. Maguire...Among these were lands once owned by Pupule (Gr. 926 and Gr. 2121) in Puaa and Kūki'o, respectively. Maihui Pupule was contracted to be a "retainer of Kūki'o" from July 1, 1898 to June 1, 1899, for the sum of $96.00 and on June 7, 1899, received $25 from John A. Maguire (Probate Estate 388, 3rd Circuit Court, Archives of Hawaii) (Kelly, 1971:44-45).

John Maguire was the son of Charles Maguire and Hi'ilawe, born at Po'okanaka, Hamakua, in 1848. He is listed in the *Directory and Reference Book of the Hawaiian Islands 1896-1897* as proprietor of Kahua Ranch along with J. F. Woods, manager, and further noted as a rancher and coffee planter in Kona and Kohala. In Kona, he started Hu'ehu'e Ranch in 1886. Hu'ehu'e Ranch was owned by his and Luka's descendants until 1966.

John Maguire's second wife was Eliza Davis Low, the sister of Hannah Low Hind, who's husband, Robert, started Pu'uwa'awa'a Ranch in partnership with Hannah and Eliza's brother Eben Low.

KOMO ANA (ACCESS)

There are clear traditions of sailing and paddling associated with Kekaha, some have been noted earlier in this paper and another, which comes to us from the time of Kamehameha, follows:

> Kepaalani, too, was known as a strong man...When his canoe left the harbor of Kailua to go to Kawaihae, he paddled without pausing to rest until he reached shore. Because of this ability he became a favorite of the king, and it was thus that he received the whole of Pu'uwa'awala and the fish ponds Paalea in Makaula and Kaulana in Kekaha ('I'i, 1973:132).

This pond of Pa'aiea served the mariners of Kekaha as a water-course as well as a fishpond.

> This pond was not far from Ka-Lae-O-Keahole...
>
> To mariners of the days of sailing crafts, this point was a test of skillful navigation; the wind and tide and current, all combining to thwart the mariner's effort to round the cape, and make the entrance to Kailua Bay.
>
> This Fish-Pond of Paalea was three miles long, and a mile and a half wide. The fishermen going to Kailua and further South, often took a short cut by taking their canoes into the pond and going across, thus saving time and the hard labor of paddling...(Maguire, 1926:14).

Following transition, Robert Keakealani, born at Ka'upulehu in 1917, recalled sailing with the prevailing winds and paddling as needed, in plank canoes, to go shopping at Kawaihae.

The family would also walk to Kawaihae and other destinations using donkeys as beasts of burden.

Robert Keakealani's mother attended school at Makalawena. By the time Robert Keakealani was born, the school at Makalawena was closed. Kaikala'ia church at Makala-wena was still a site for Sunday services and the family would walk over on Saturday to visit with family and friends.

In addition to visiting at Makalawena, the folks at Ka'upulehu were visited by those from Makalawena when they went to Kalaemano for the gathering of salt. Mahiko and 'Una would come over to Ka'upulehu and be joined by Keakealani, Maka'ainui, and Puhi, they would go to Kalaemano (Robert Keakealani, personal communication, 1986).

Mrs. R. L. Hind, Jr., the daughter of ranch manager Theodore Vreedenberg, who grew up at Hu'ehu'e, recalls that after all of the other coastal residents had passed on or moved away, Annie Una would make the trek

to Kalaemano from Makala-wena "early in the year, after the winter storms and before the March rains, to gather salt" (personal communication, 1986).

Karin Haleama'u, a *kama'aina* and Hu'ehu'e employee, recalled that he never fished at Manini'ōwali. When he was young he would carry nets for "Uncle Kino" (Kino Ako, a.k.a. Kinolu Kahananui) who was the only one who ever threw net at this place (personal communication, 1991).

Thomas Lindsey, a *kama'aina* and Hu'ehu'e employee, told Michael Tomich about going with George Punihaole and Kino Ako to throw net. They would ride from Hu'ehu'e down to Kūki'o 1 and work their way down the coast towards Makalawena where they would go back *ma uka* following sections of the Makala-wena - Hu'ehu'e Trail.

These travels crossed both the seas and the lands of Kūki'o 2 and Manini'ōwali. Both of these *ahupua'a* have sites identified as canoe landings and trails, which run parallel to the sea as well *ma uka* - *ma kai*.

> Trails, where not obliterated by modern tracts or roads, form an important component of settlement landscapes, and their study provides important data on the linkages between individual communities. In certain areas, particularly along the leeward coasts of Hawai'i Island and in the Kahikinui District of Maui, prehistoric trails are readily discernible and some are still in use today, by fishermen, hunters, and campers (Kirch, 1985:267).

<u>**NA WAHI (THE PLACES)**</u>

A number of place names and traditions have already been discussed. The following are additional references to places of the region:

> HE PUU O KUILI
>
> Aia keia puu kokoke loa i kahawai mawaena o Makalawena, Awakee, a me na Kūkio.
>
> This hill is very near the stream between Makalawena, Awake'e, and Manini'ōwali and the Kūki'o.
>
> He ui keia puu ke nana ia aku a nona keia lei onaona.
>
> This hill is beautiful when gazed upon and this fragrant lei is [written] for it.

Ala i Kuili o ka naueue. E nana kaua i ka ai hoopau.

There at Kuili is Kanāueue. We gaze at Ka'aihu'opau.

Ina oo i ka moana a huli mai oe e nana ia Kuili, e ike mai ana oe, i ke lele aku me he manu ala, a hoomanao ae ia ka mea kakau i koia lei ahihi.

If you are at sea and turn to look at Kuili, you will see [Kuili] looking as flying bird, and be reminded of what is written in this "lei ahihi".

He aloha no Kauiki,
Au ana i ke kai,
Me he manu ala,
E lele ana.

Love for Kauiki,
Floating on the sea,
As a bird,
Flying.

NUHEENUI

He puu pili keia aia mauka aku o Kuili a ua olelo ia he wahine keia, a he kane o Kanakaloa, he pohaku loihi e pili ana no m aka aoao o ka puu o Nuheenui.

This is a hill on the mountainside of Kuili and it is said that it is a woman, and Kanakaloa is a man, a long/tall stone alongside the hill of Nuheeni.

O keia pohaku he maka ia no kekahi ko'a lawaia o Kahoowaha ka inoa, a hiki i keia la, Puunahaha, a me Puumauu, o Kapuhiapele kahi o na kaikamahine pulehu iho he puu pohaku pele kiekie ia e ku nei malalo mai kahi o Mr. Maguire. (*Hoku O Hawaii*, May 22, 1924)

This stone is the beginning of the fishing shrine named Kaho'owaha, until today, Pu'unāhāhā and Pu'umau'u, Kapuhiapele, the place where the girls roasted, is a high mound of volcanic rock standing below Mr. Maguire's place.

[Reference to Puhiapele, a spatter cone, and a story of two girls roasting breadfruit new there. Only one offered her breadfruit to Pele and her house was then spared with the next eruption of Hualalai.]

Kuili has been referred to earlier in this report as a landmark and in the context of the story of "Akahipu'u". In *Place Names Of Hawaii* (1974), "Kuili" is translated as "memorized temple prayer" (Pukui, Elbert, and

Mo'okini, 1974:120). *Hawaiian Antiquities* (1950) includes a "Pule Kuili" as part of the notes on chapter 37 "Concerning the Luakini" (Malo, 1976:184-185).

It is of interest to note that while in the field on August 30, 1991, with members of the Hawai'i Island Burial Ccuncil, Ulu Gorman was struck by the name Kuili and began a spontaneous recitation of "the prayer, Kuili". Mrs. Gorman commented that she considered Kuili to be the *ahu* of the region (Gorman, Personal communication, 1991).

Muhe'enui is the large cinder cone ma uka of the Ka'ahumanu Highway and is called by some the sister to Kuili. On Registered Map 1449, it is identified as Kaho'owaha, a name which is mentioned in the above *Hoku O Hawaii* article, which references Kaho'owaha as a "*koa lawai'a*".

Another place name collected from Registered Map 1280, is Kapuahimanini, a rock in the water off shore of Manini'ōwali. There are various prominent rocks off shore here, the specific reference is yet to be verified.

A significant feature of the project area is the cinder cone on the Kūki'o side of the project area. No name has yet been learned for this cone from cartographic, archival, or human resources.

CONCLUSION

Eliza D. Maguire described reasons for compiling *Kona Legends* (1926):

> ...when Isaac W. H. Kihe...began writing...for "Ka Hoku O Hawaii"...I began to realize that I ought to gather and translate these stories for the future knowledge of our young children who some day may want to know about the history and legends of their own section of country (Maguire, 1926:3-4).

As one of the children who grew up hearing the stories and visiting the places about which they told, I am so grateful for Mr. Kihe and Mrs. Maguire for their wisdom. As an adult I am so grateful for inspiration they continue to offer me in my turn to tell the history of our own section of country.

<u>BIBLIOGRAPHY</u>

Cordy, Ross H.
1978 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. Ph.D. dissertation (Anthropology), University of Hawai'i.

Ellis, William
1963 *Journal of William Ellis*. Honolulu: Advertiser Publishing Company Ltd.

Emerson, Nathaniel B.
1978 *Pele and Hiiaka*. Vermont and Japan: Charles E. Tuttle Company Ltd.

Gutmanis, June
1983 *Na Pule Kahiko*. Honolulu: Editions Limited.

Handy, E.S. Craighill, and Elizabeth Green Handy, with Mary Kawena Pukui
1972 *Native Planters in Old Hawaii*. Bishop Museum Bul. 233. Honolulu: Bishop Museum Press.

Hawai'i State Archives
Boundary Commission Books
Interior Department Correspondence
Land File

Hoku O Hawaii
1924 May 8, May 15, May 22, May 29, articles entitled "*Na Hoonanea O Ka Manawa*" and June 12 an article entitled "*Na Manao O Ka Manawa*" concerning various aspects of life in Kekaha.

Ii, Jonh Papa
1973 *Fragments of Hawaiian History*. Honolulu: Bishop Museum Press.

Kalakaua
1972 *The Legends and Myths of Hawaii*. Vermont and Japan: Charles E. Tuttle Company, Inc.

Kamakau, Samuel M.
1961 *Ruling Chiefs of Hawaii*. Honolulu: Kamehameha School Press.

Kelly, Marion
1971 *Kekaha: 'Aina Malo'o. A Survey of the Background and History of Kaloko and Kuki'o Ahupua'a, North Kona, Hawai'i*. Department Report Series 71-2. Dept. Anthro., Bishop Museum.

Kirch, Patrick Vinton
1985 *Feathered Gods and Fishooks*. Honolulu: University of Hawaii Press.

Macdonald, Gordon A., Agatin T. Abbott, and Franklin L . Peterson
1983 *Volcanoes in the Sea*. (Second edition) Honolulu: University of Hawaii Press.

Maguire, Eliza D.
1926 *Kona Legends*. Honolulu: The Paradise of the Pacific.

Malo, David
1951 *Hawaiian Antiquities (Moolelo Hawaii)*. Bishop Museum Special Publication 2, Honolulu.

McKinzie, Edith Kawelohea
1983 *Hawaiian Genealogies Volume I*. Edited by Ishmael W. Stagner, II. The Institute for Polynesian Studies, Brigham Young University-Hawaii Campus, Funded by the Polynesian Cultural Center. Distributed by University of Hawaii Press.

Pukui, Mary Kawena, Samuel H. Elbert and Esther T. Mookini
1974 *Place Names of Hawaii*. (Second edition) Honolulu: University of Press of Hawaii.

Pukui, Mary Kawena
1983 *'Olelo Noeau*. Bishop Museum Special Publications 71. Honolulu: Bishop Museum.

Schmitt, Robert C.
1973 *The Missionary Censuses of Hawaii*. Pacific Anthropology Records, Number 20. Department of Anthropology, Bishop Museum, Honolulu.

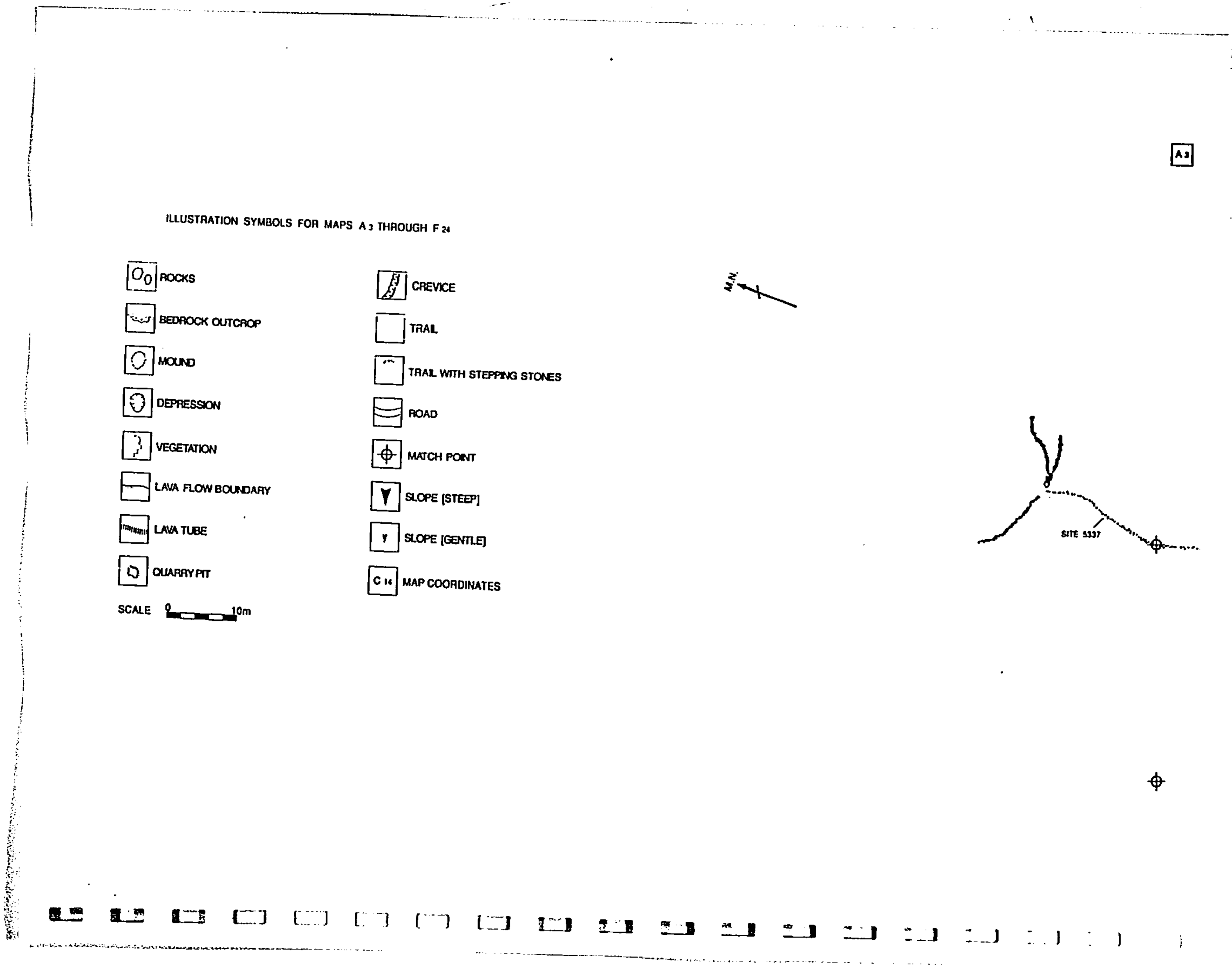
Stearns, Harold T., and Gordon A. Macdonald
1946 *Geology and Ground-Water Resources of the Island of Hawaii*. Hawaii Division of Hydrology Bulletin 9. Honolulu: Territory of Hawaii.

Titcomb, Margaret
1972 *Native Uses of Fish in Hawaii.* (Second Edition) Honolulu: University Press of Hawaii.

Tomich, P. Quentin
1986 *Mammals in Hawai'i.* (Second edition) Honolulu: Bishop Museum Press.

APPENDIX C

ILLUSTRATION FOR MAPS A3 THROUGH F24


A3
ILLUSTRATION SYMBOLS FOR MAPS A3 THROUGH F24
ROCKS
BEDROCK OUTCROP
MOUND
DEPRESSION
VEGETATION
LAVA FLOW BOUNDARY
LAVA TUBE
QUARRY PIT
SCALE 0 10m
CREVICE
TRAIL
TRAIL WITH STEPPING STONES
ROAD
MATCH POINT
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SLOPE [GENTLE]
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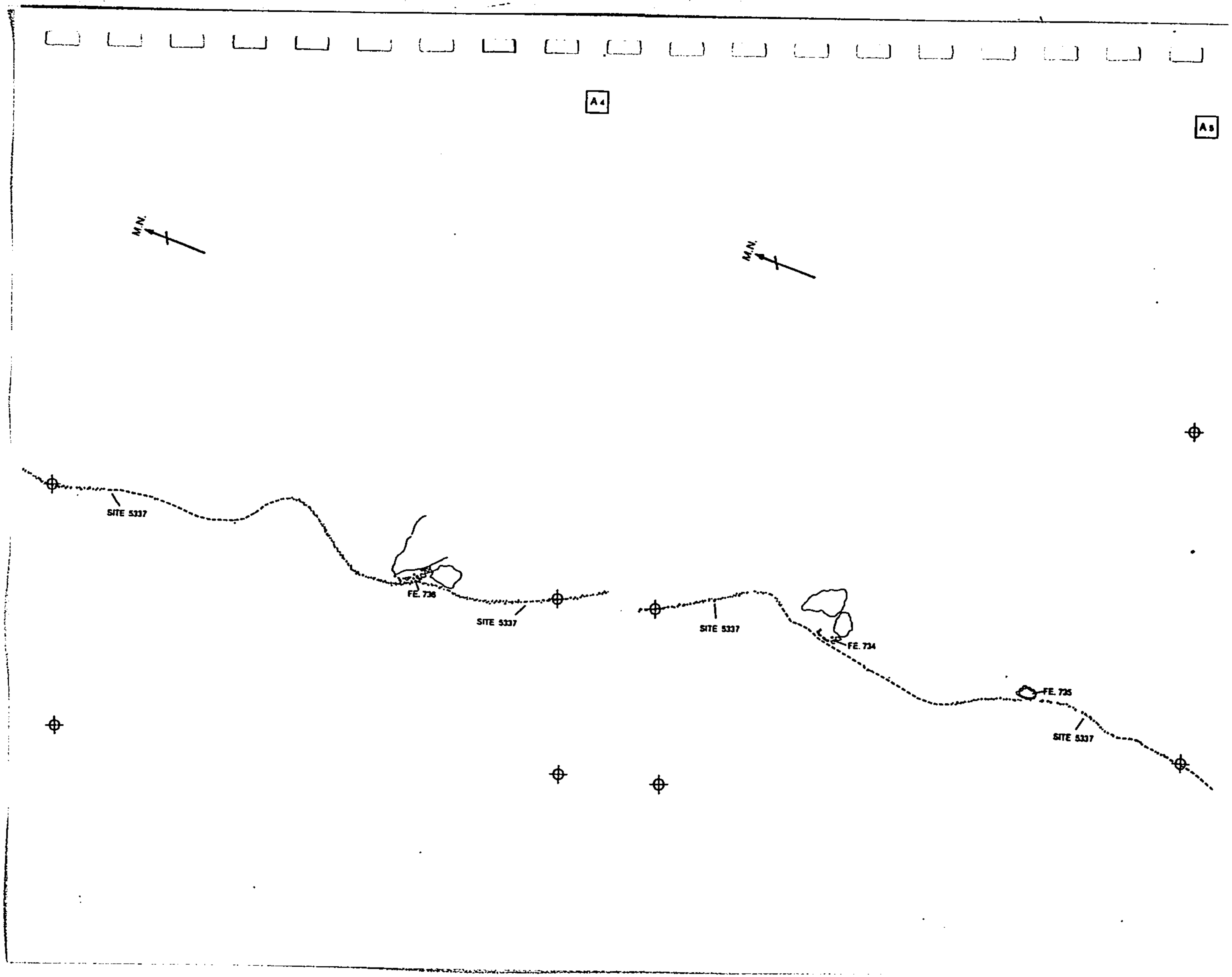

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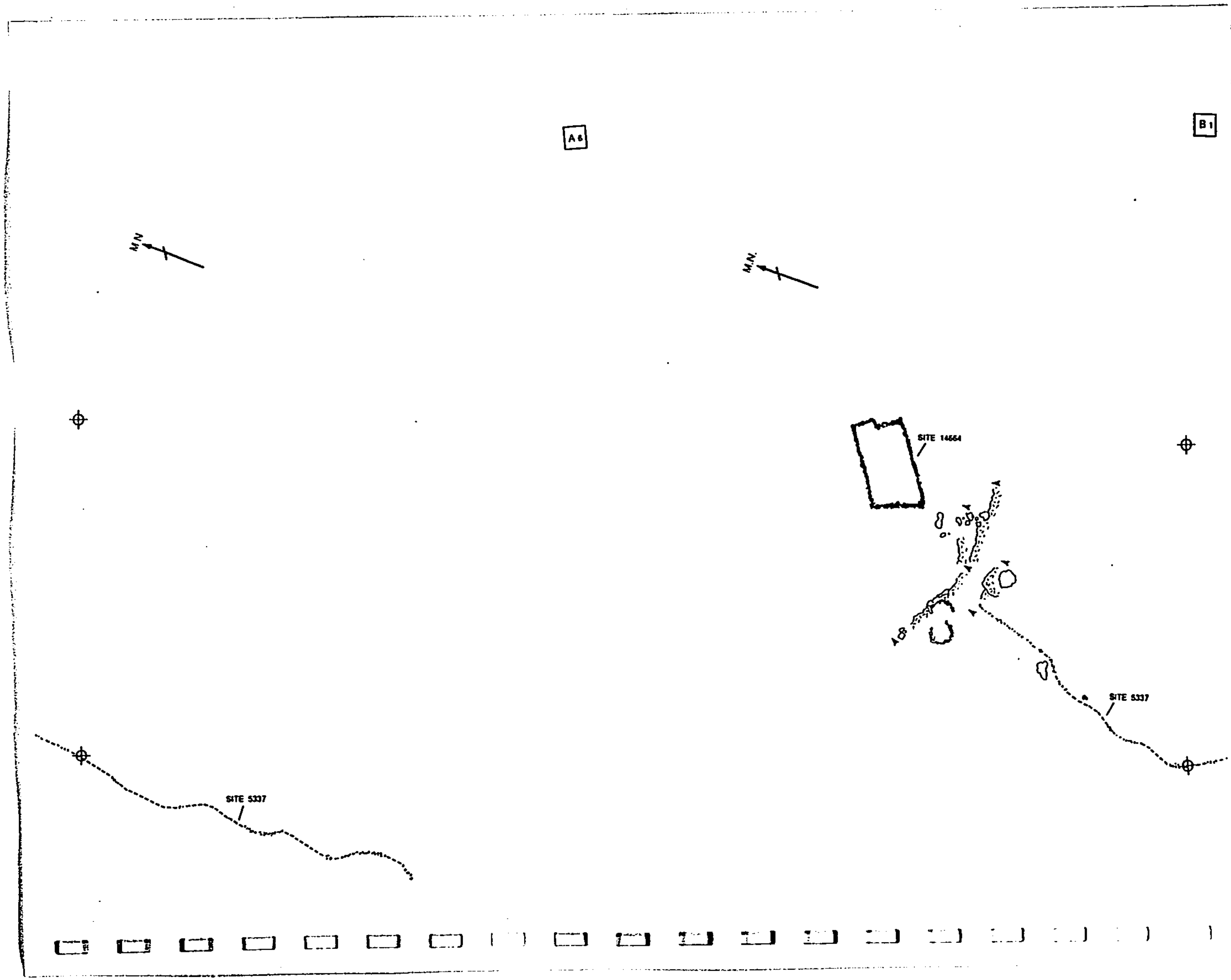
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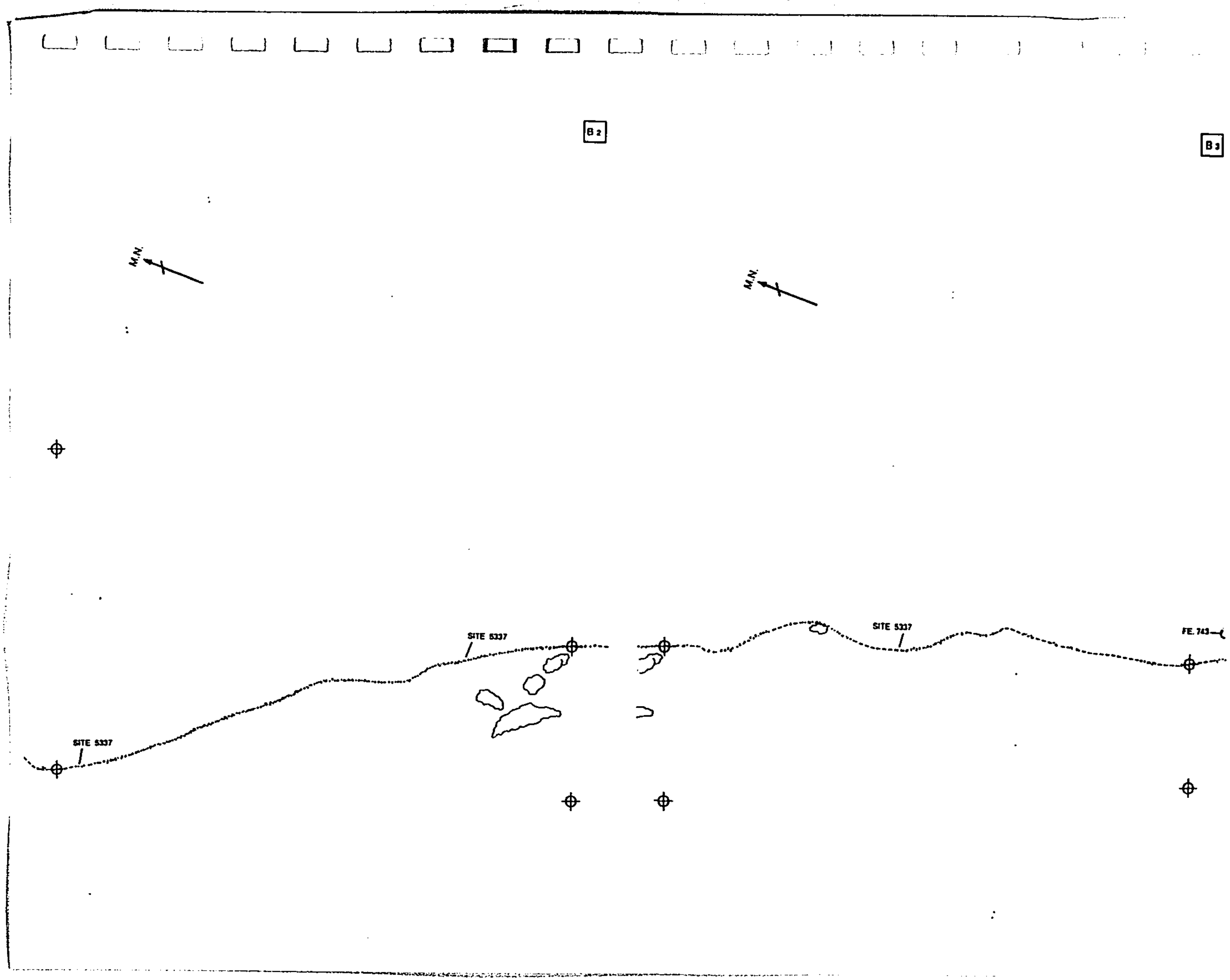
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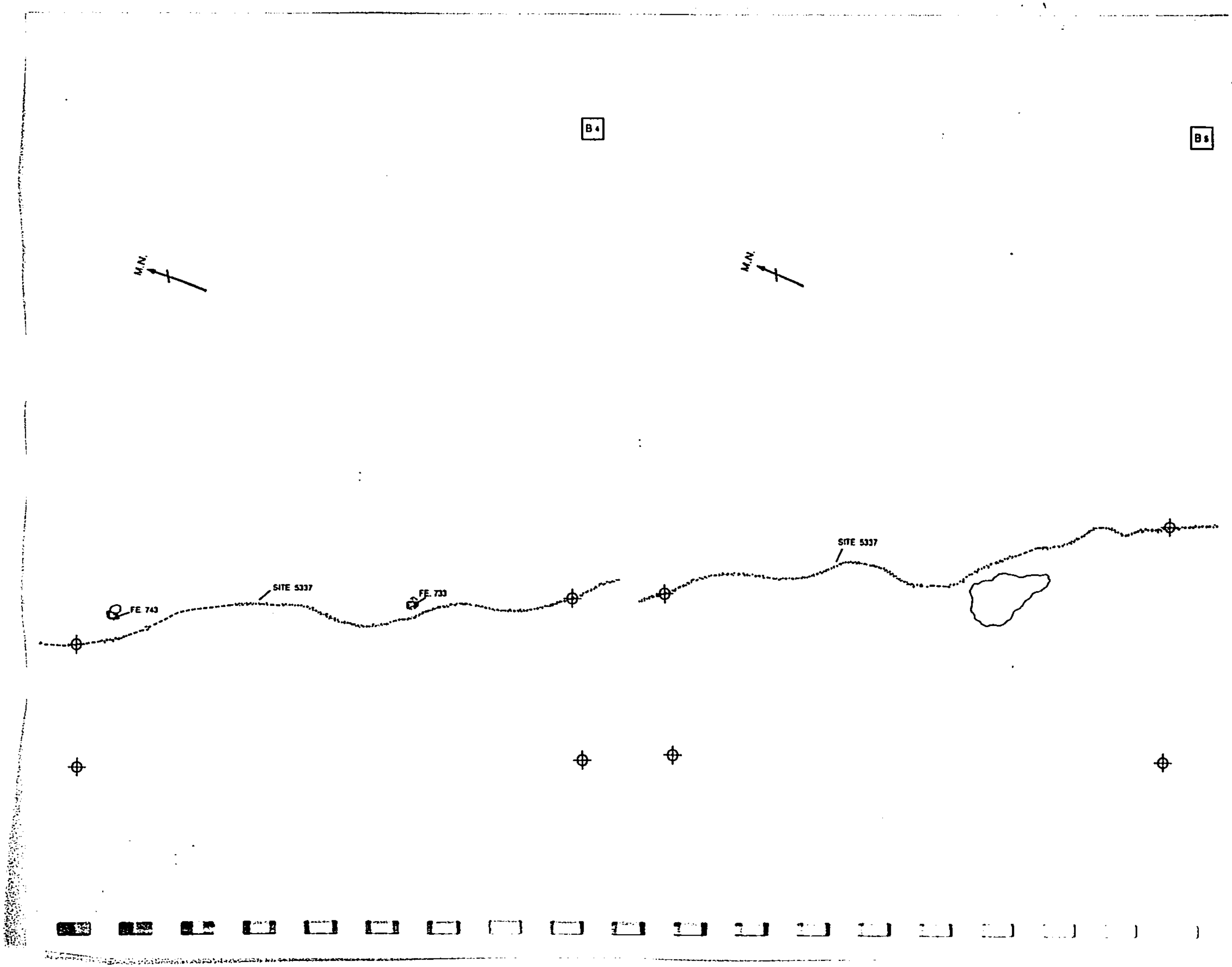
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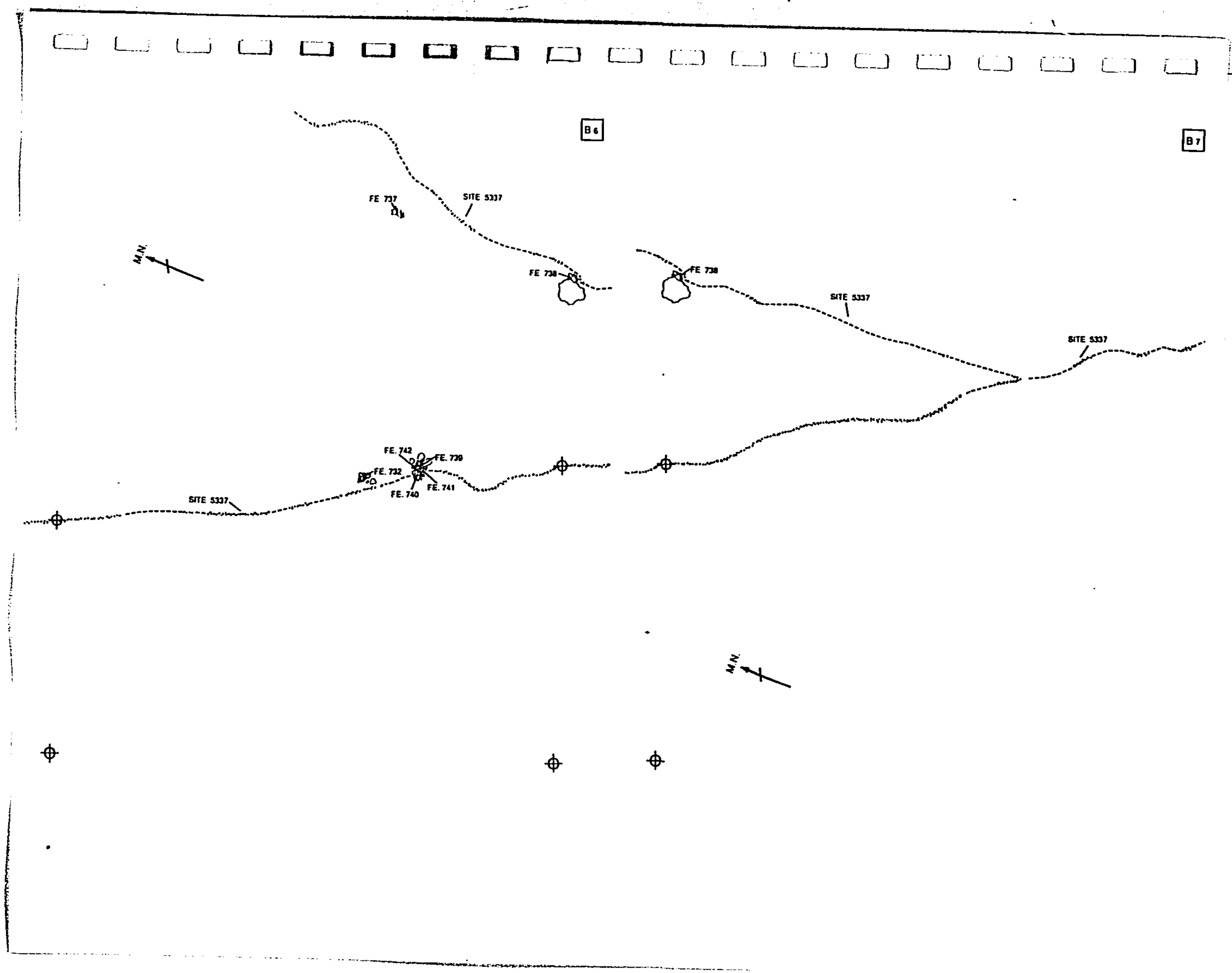
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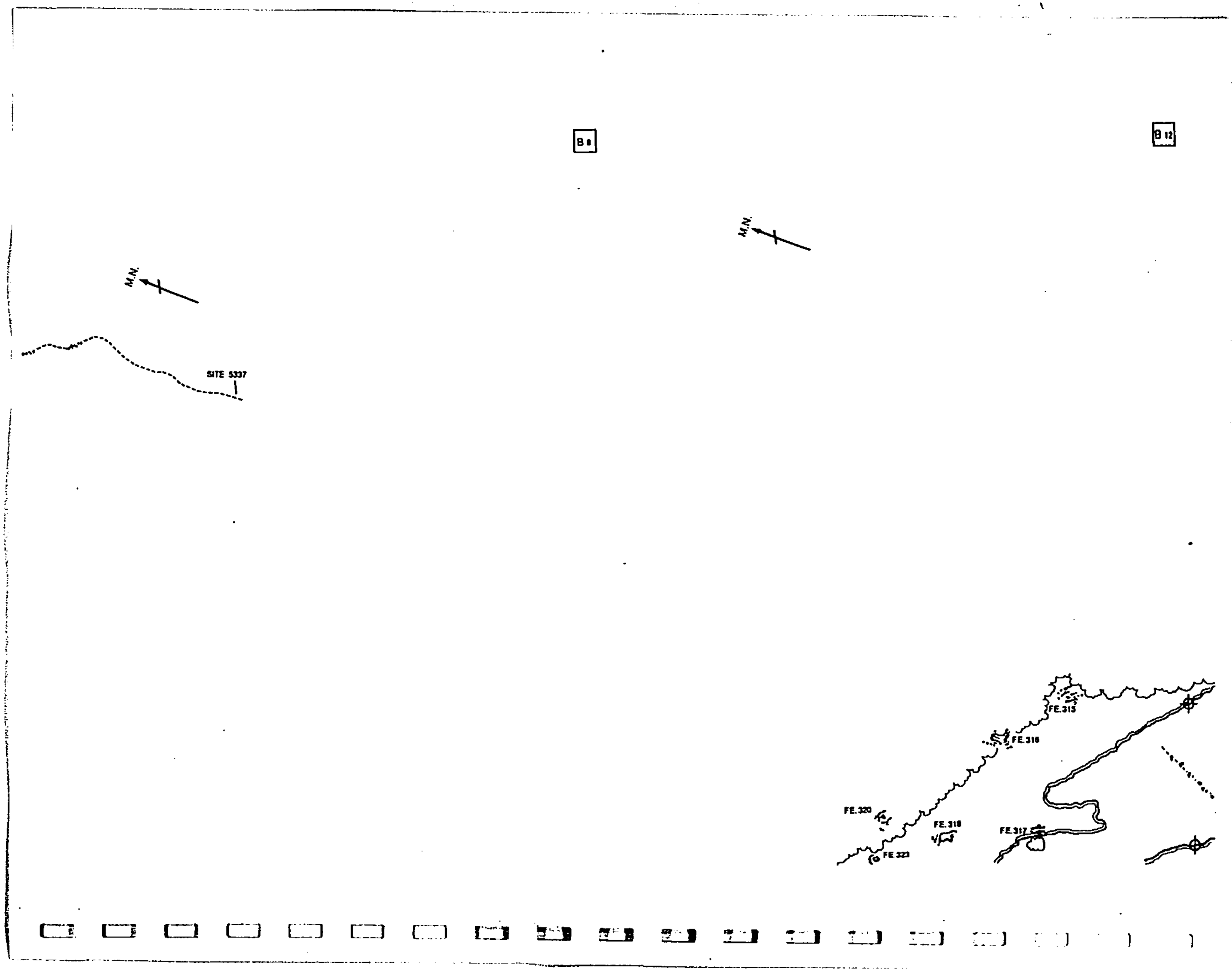

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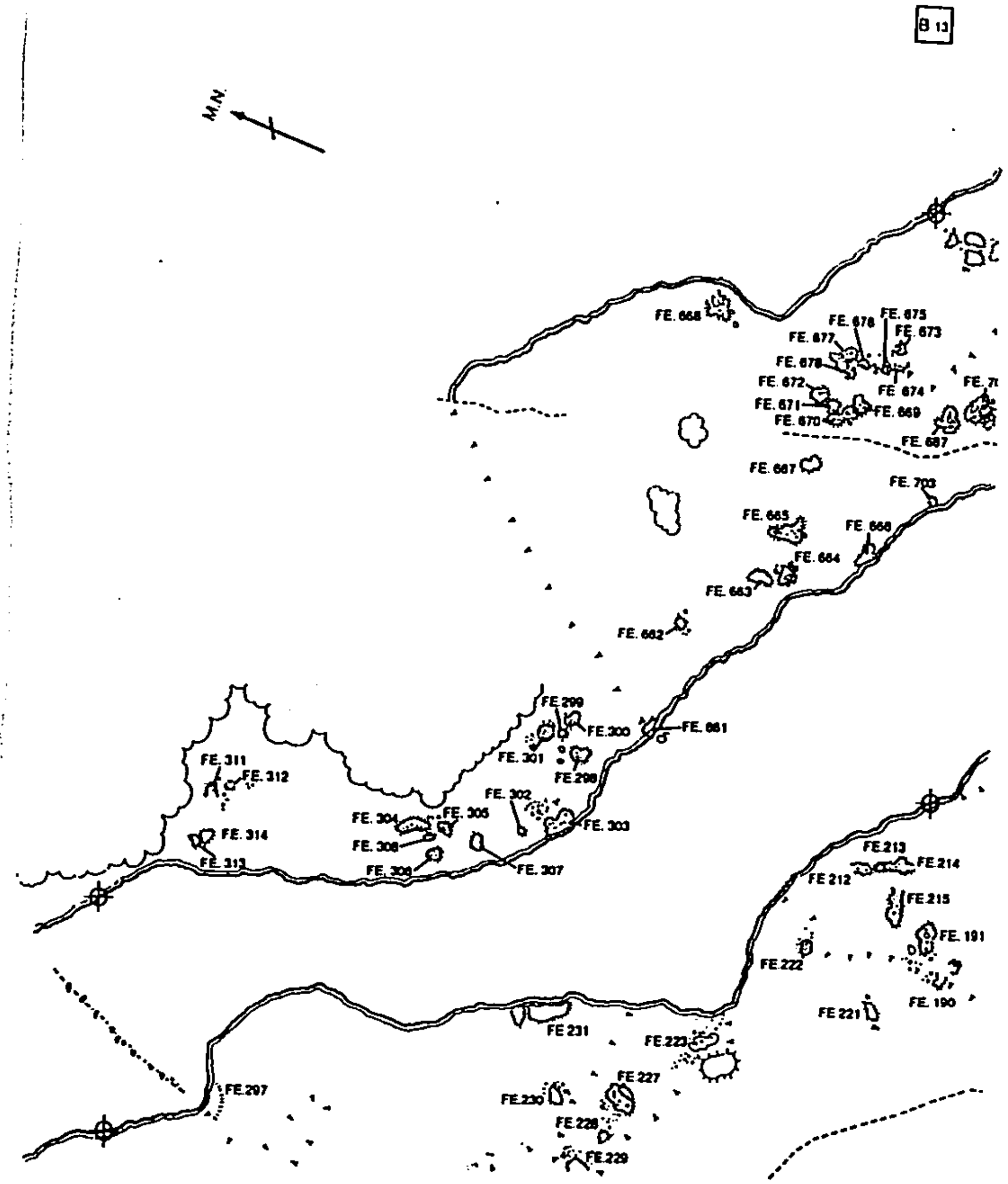
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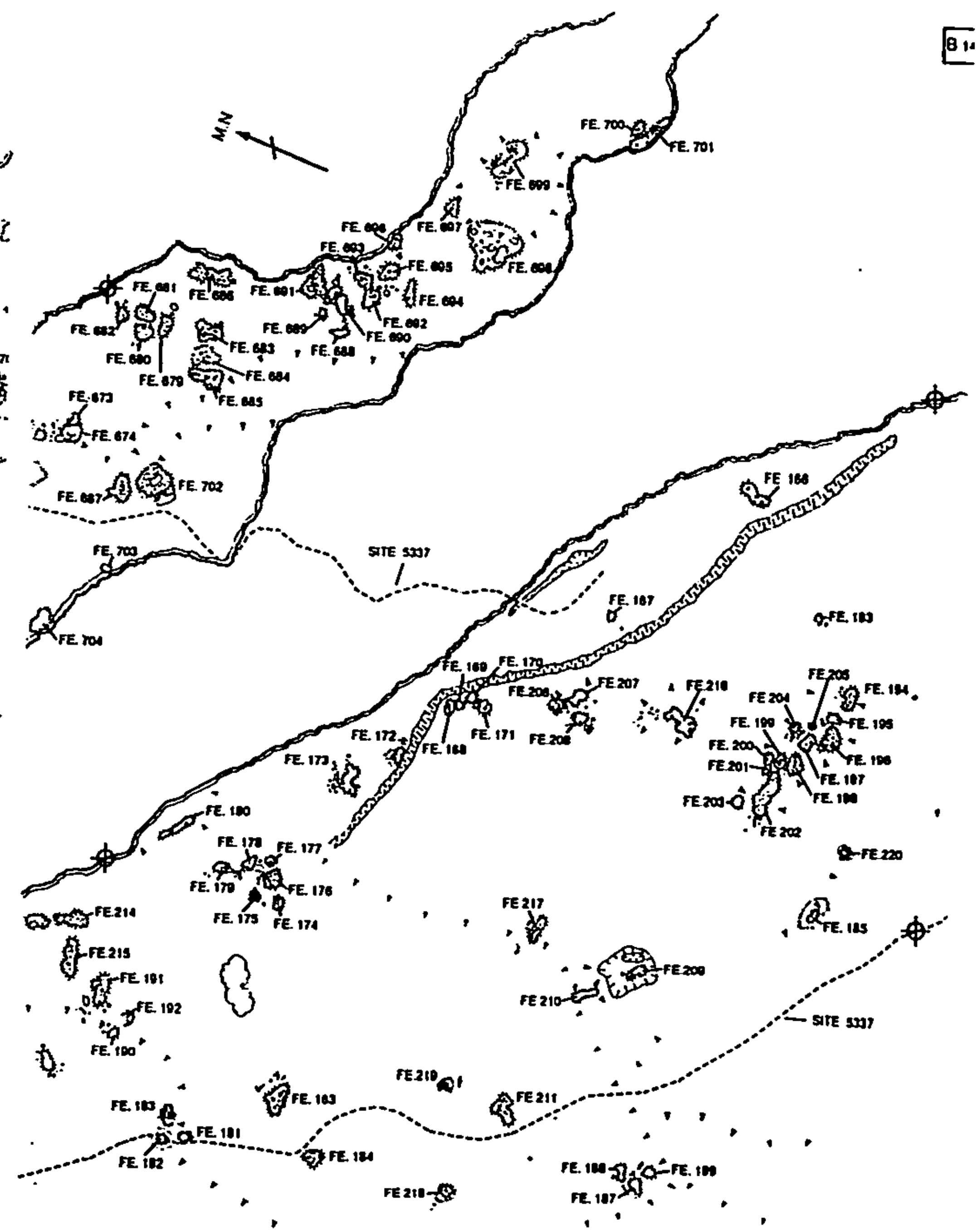
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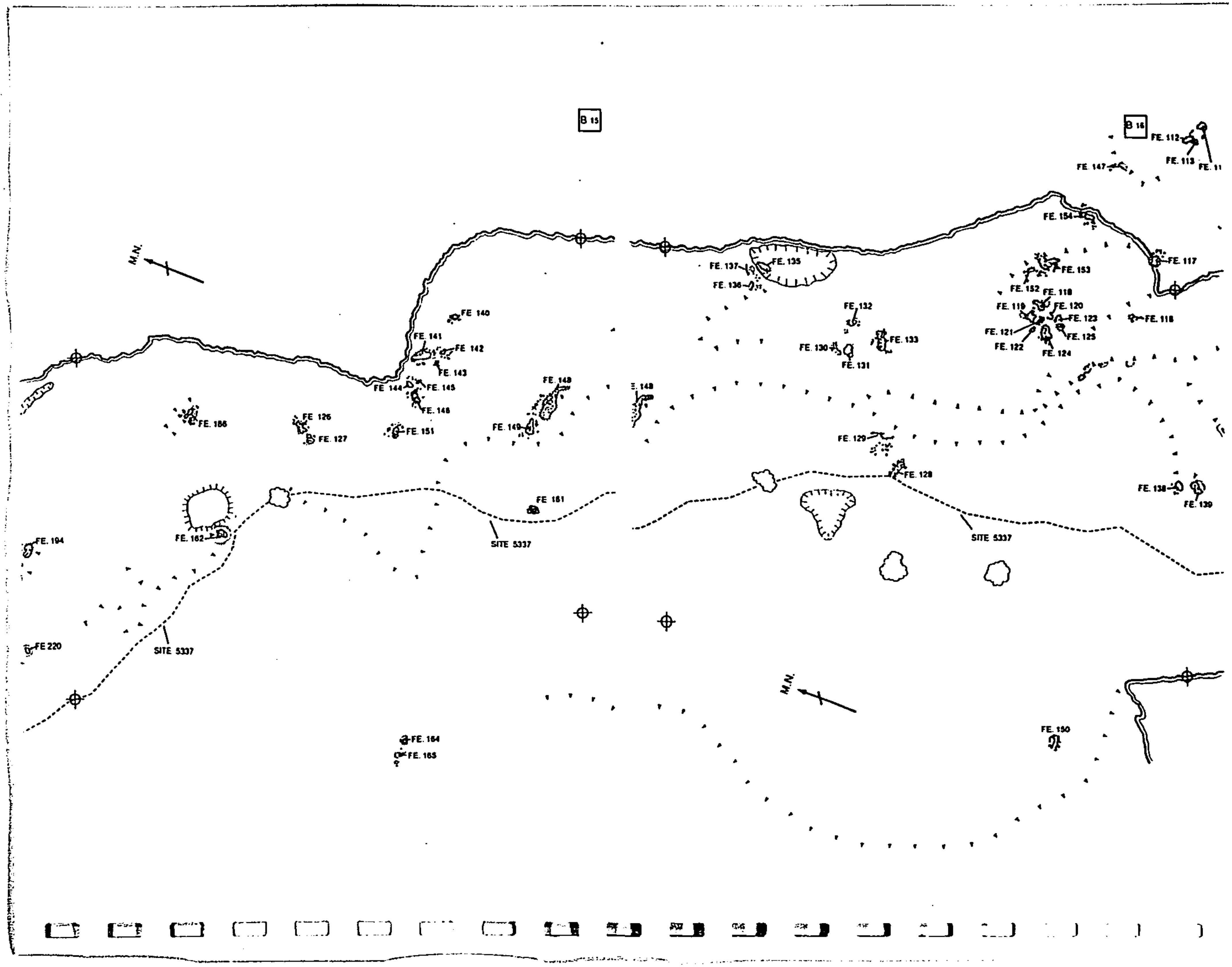
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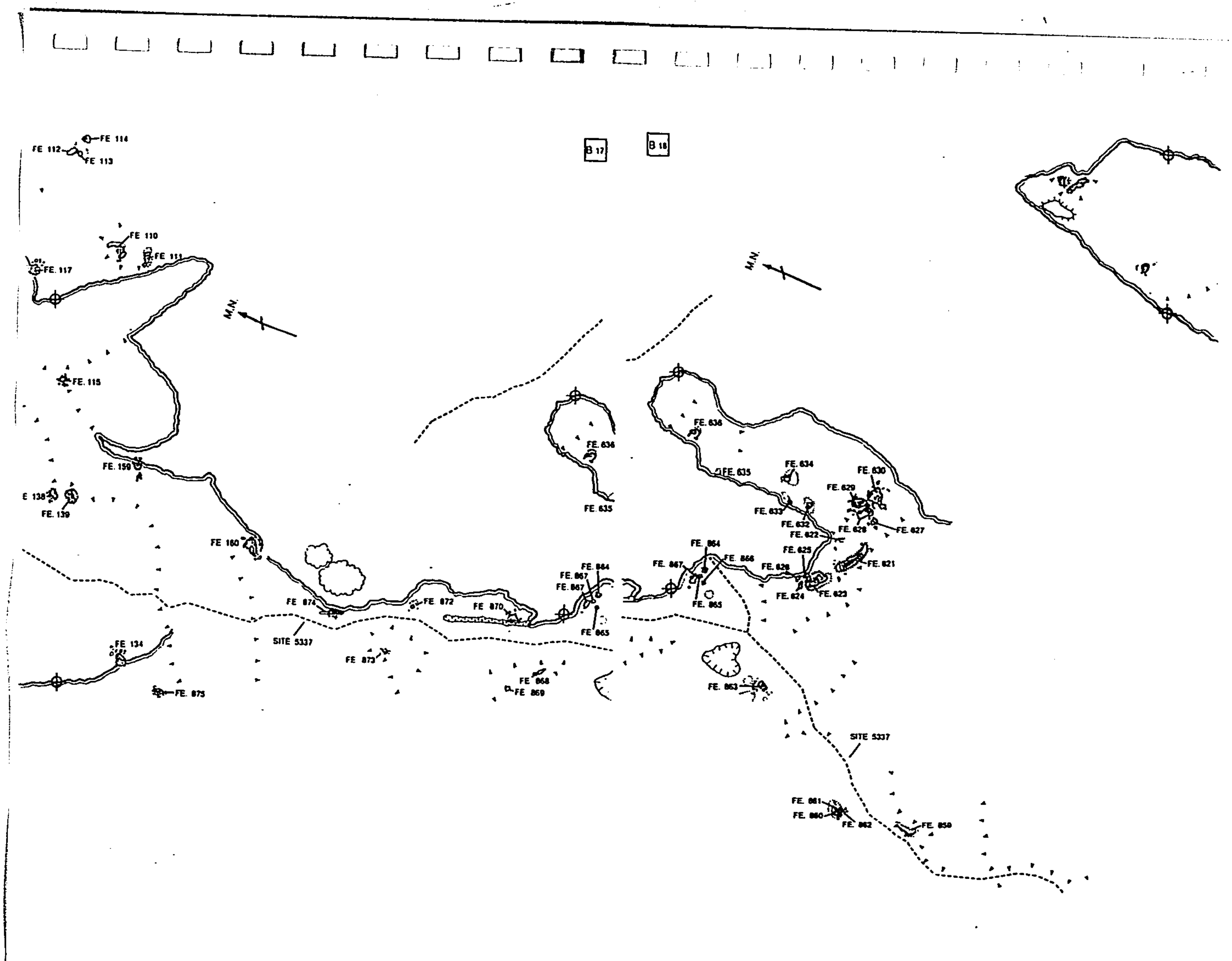
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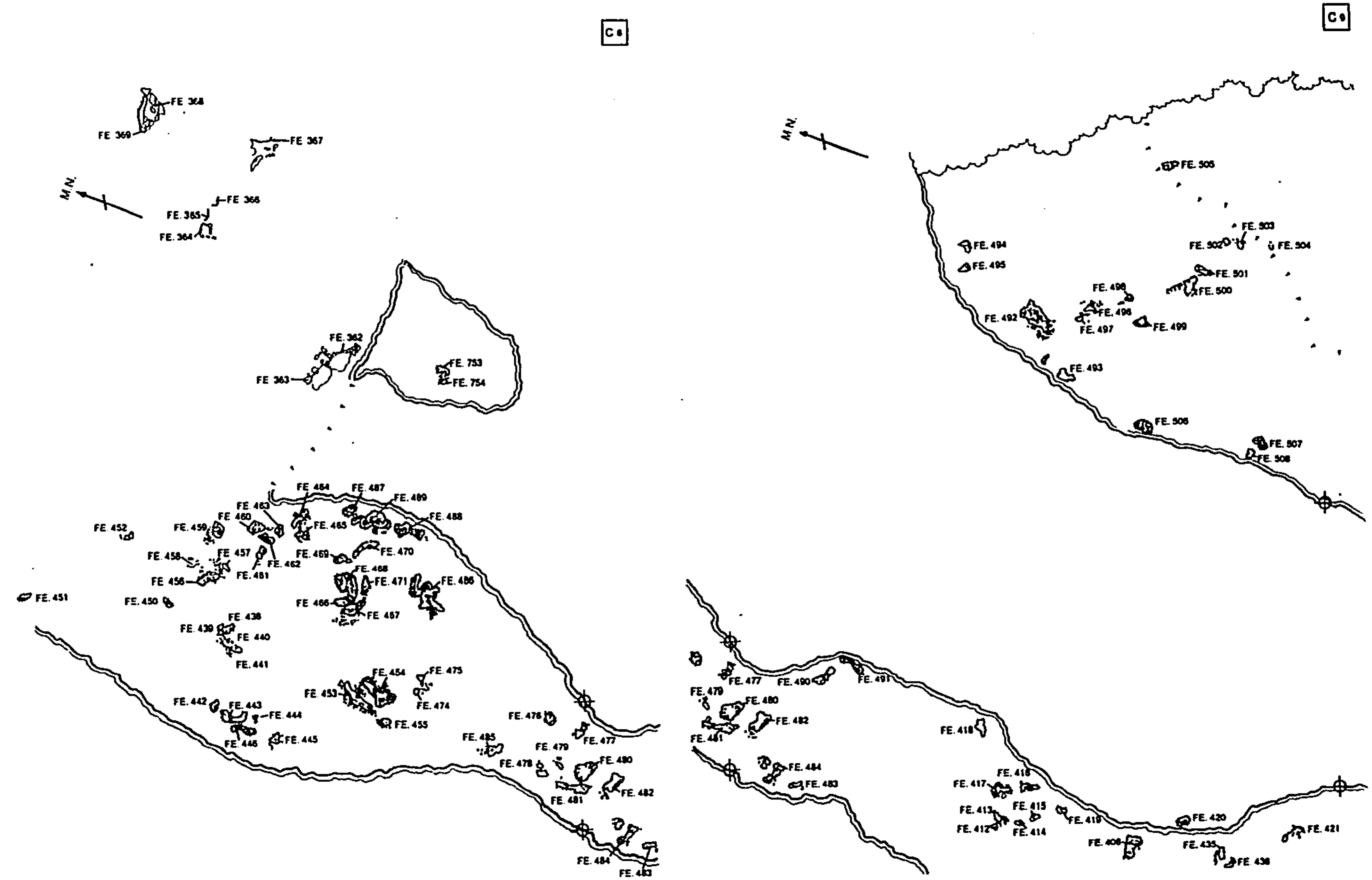
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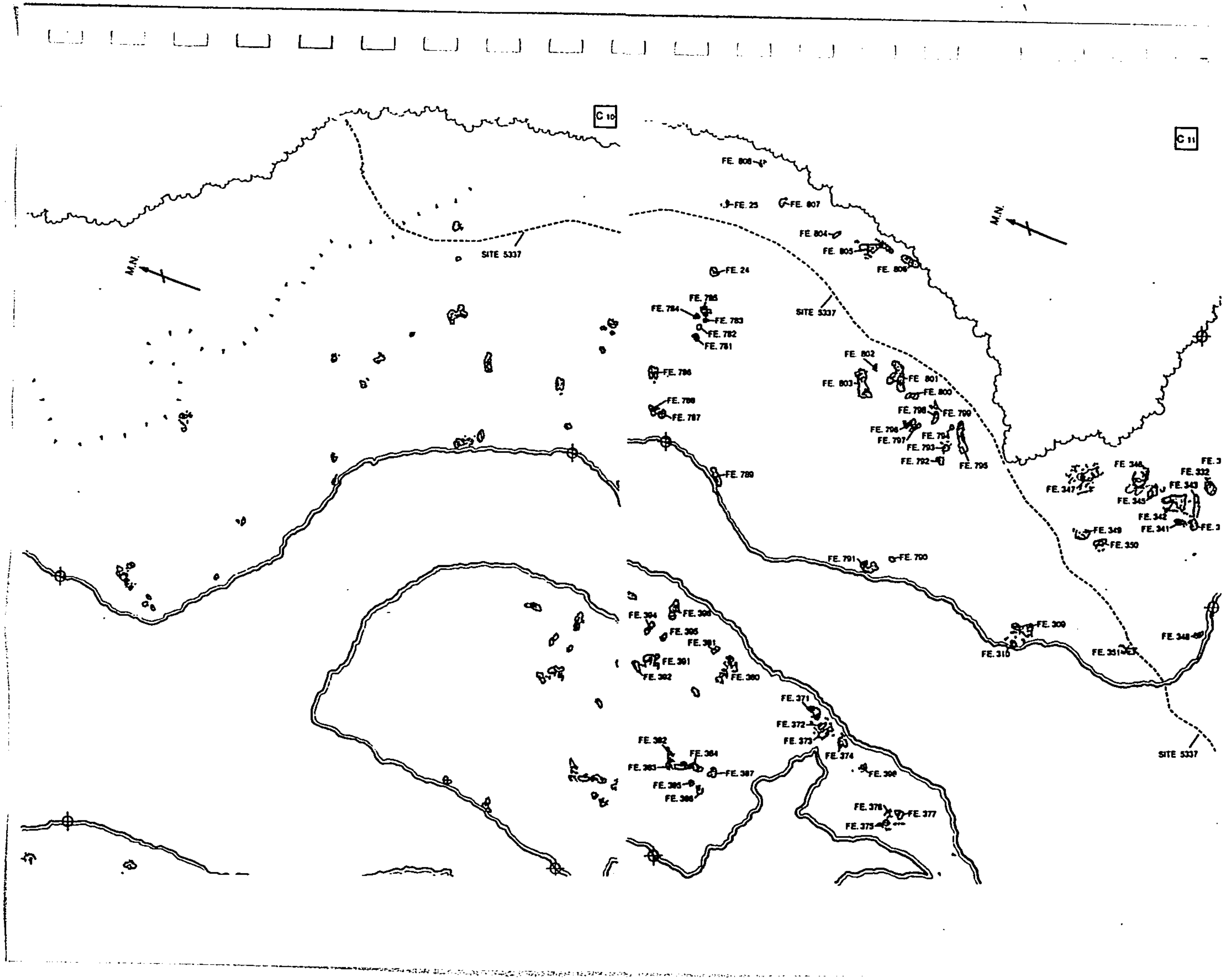
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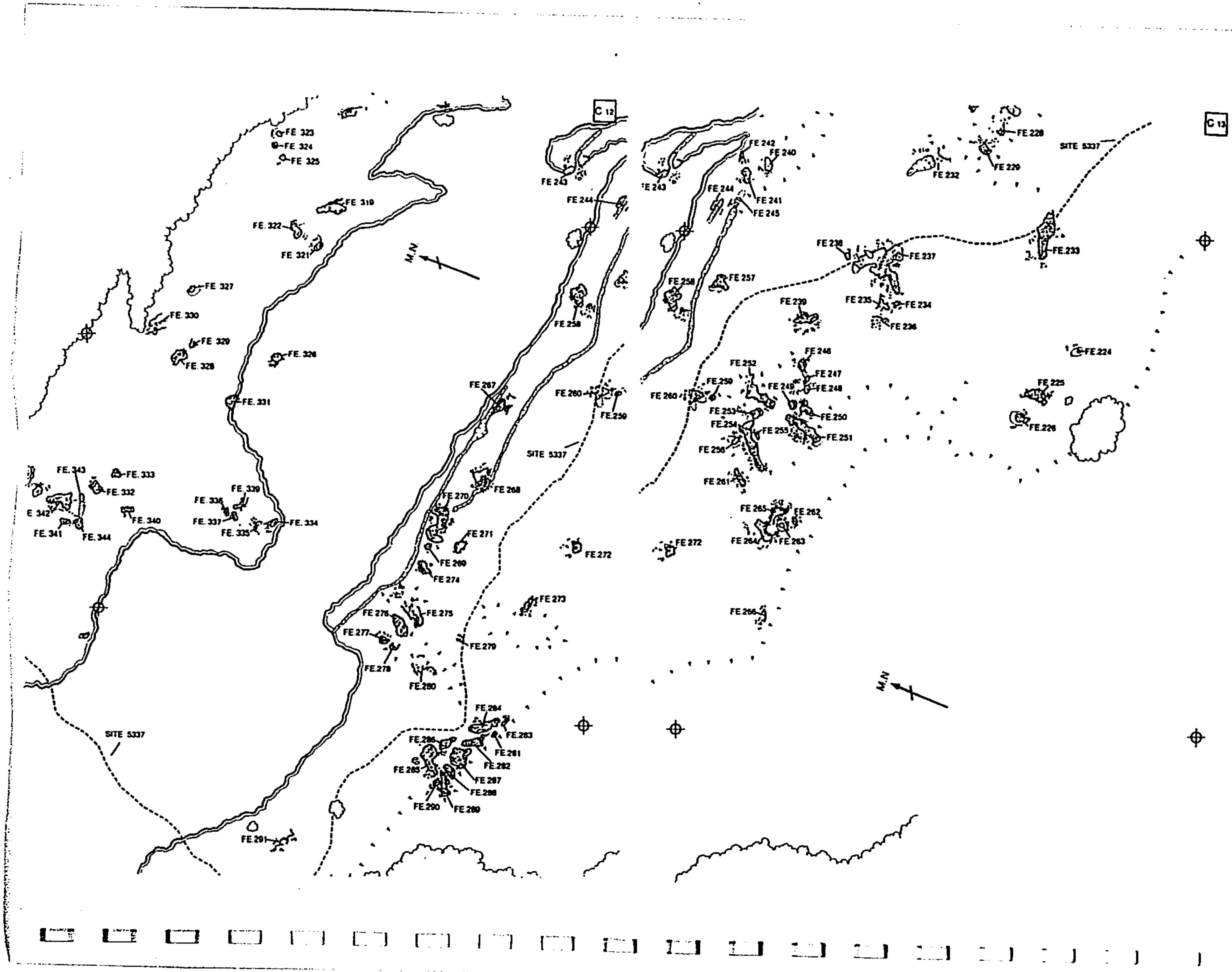
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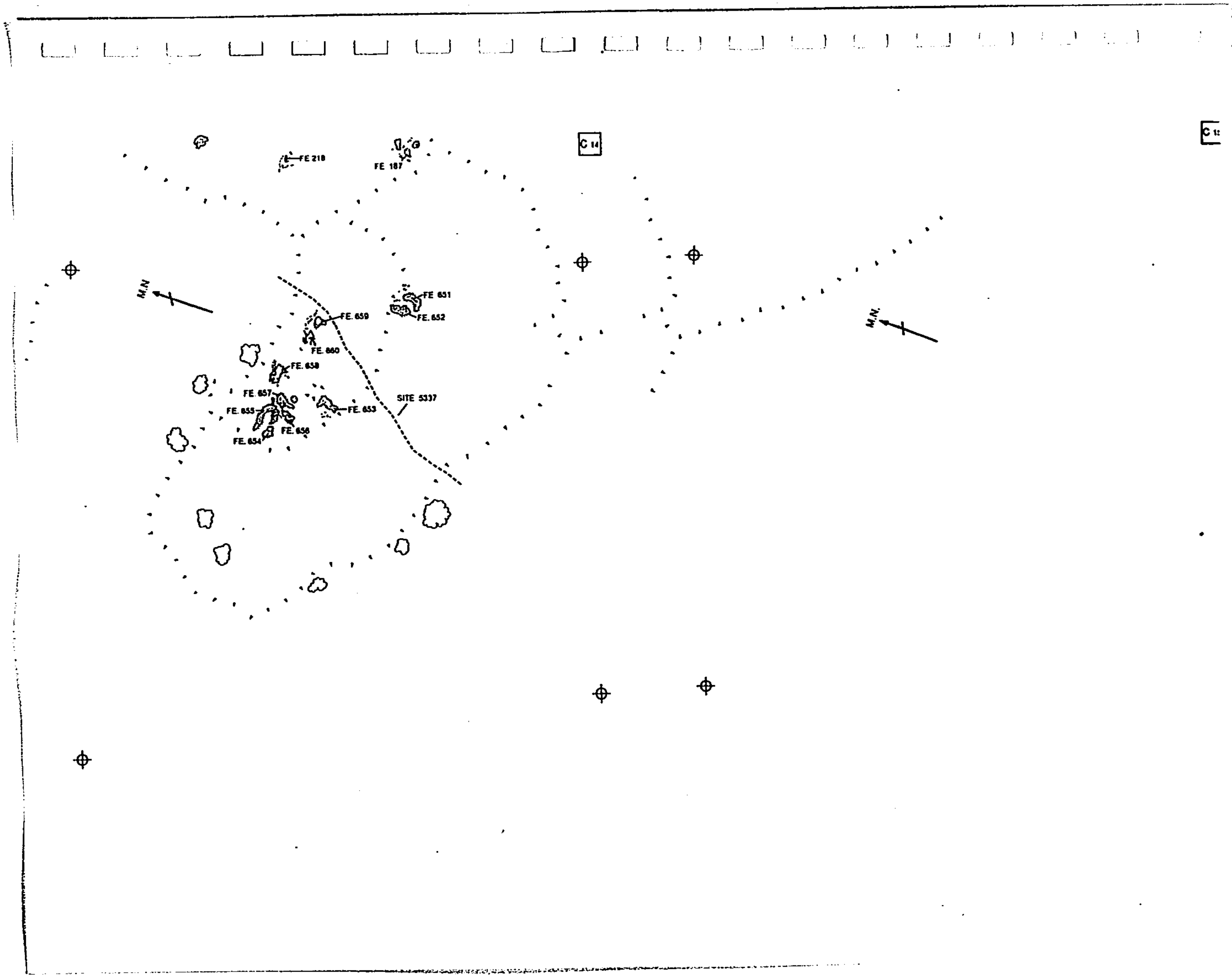
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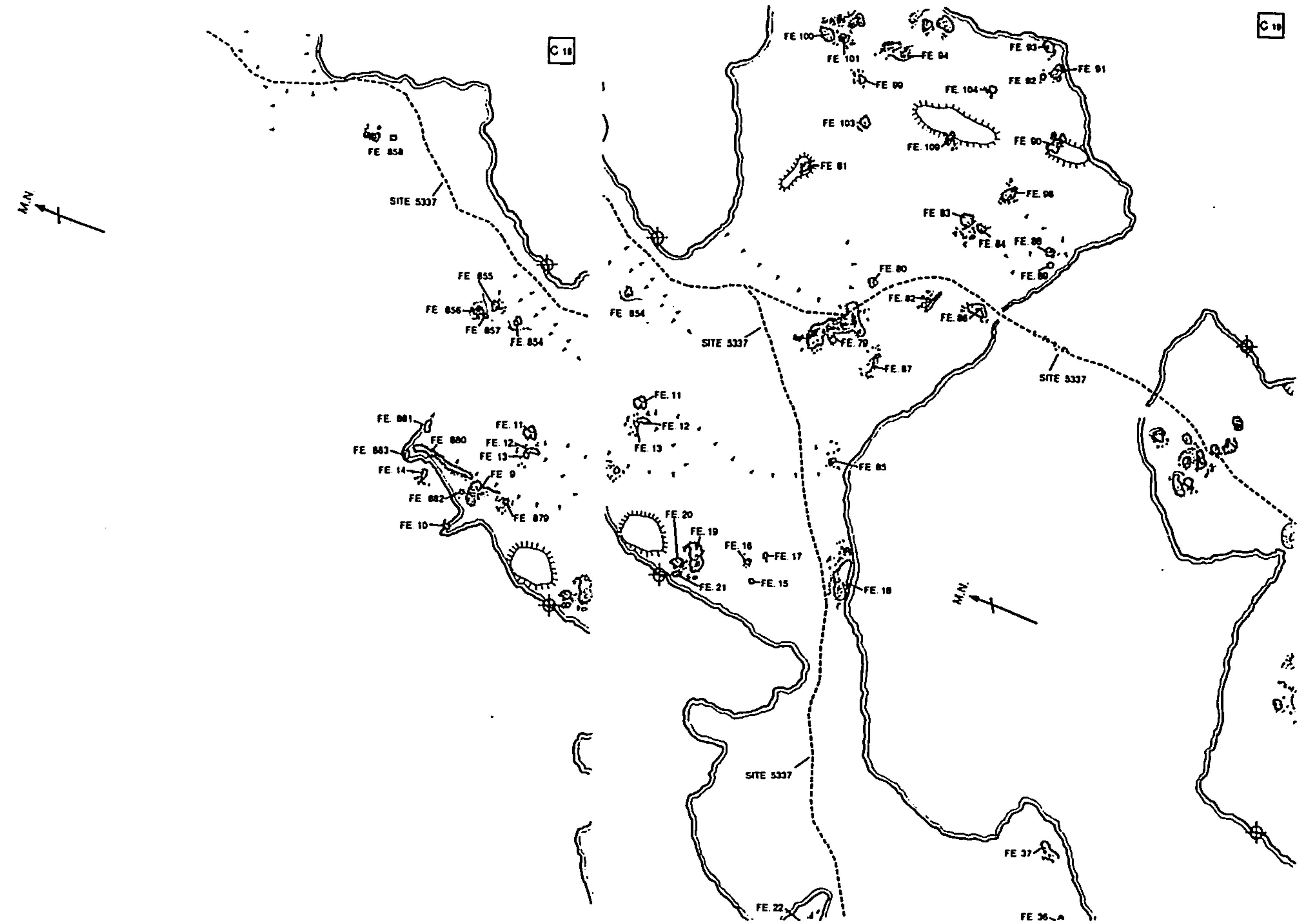

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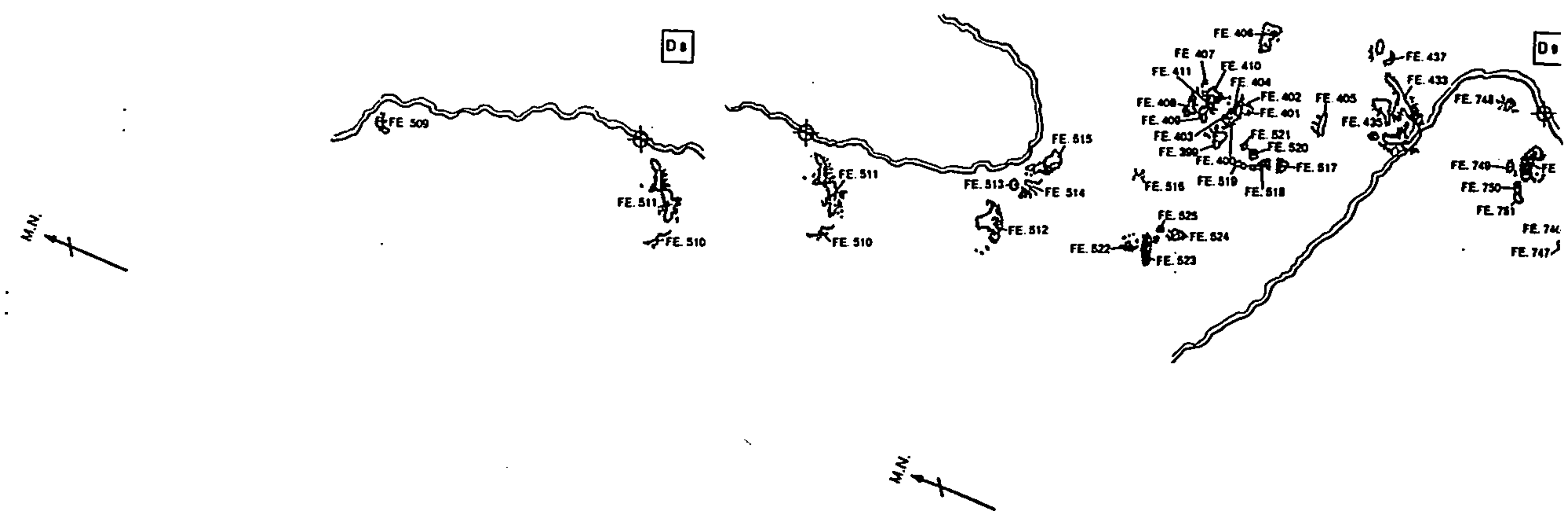
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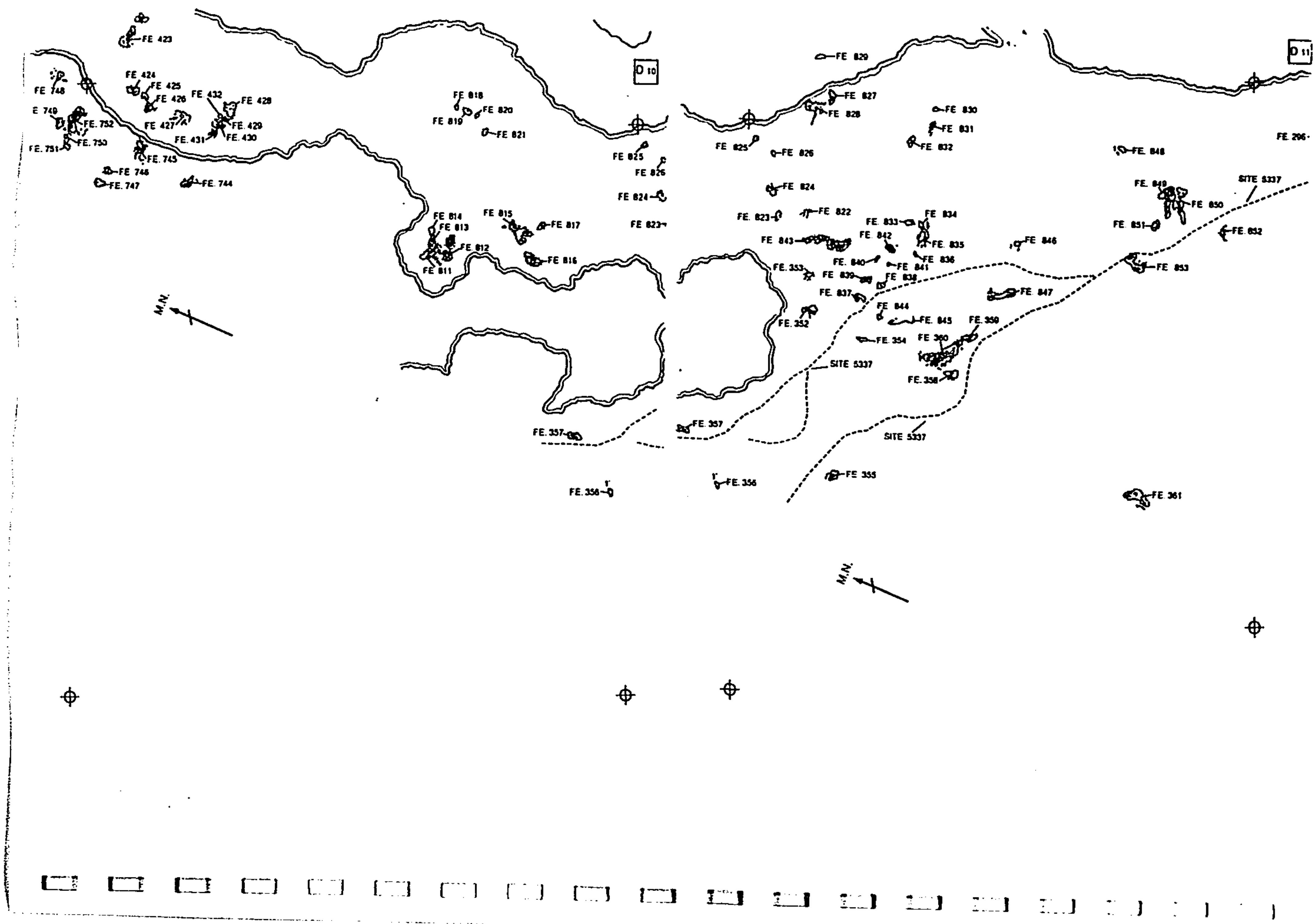

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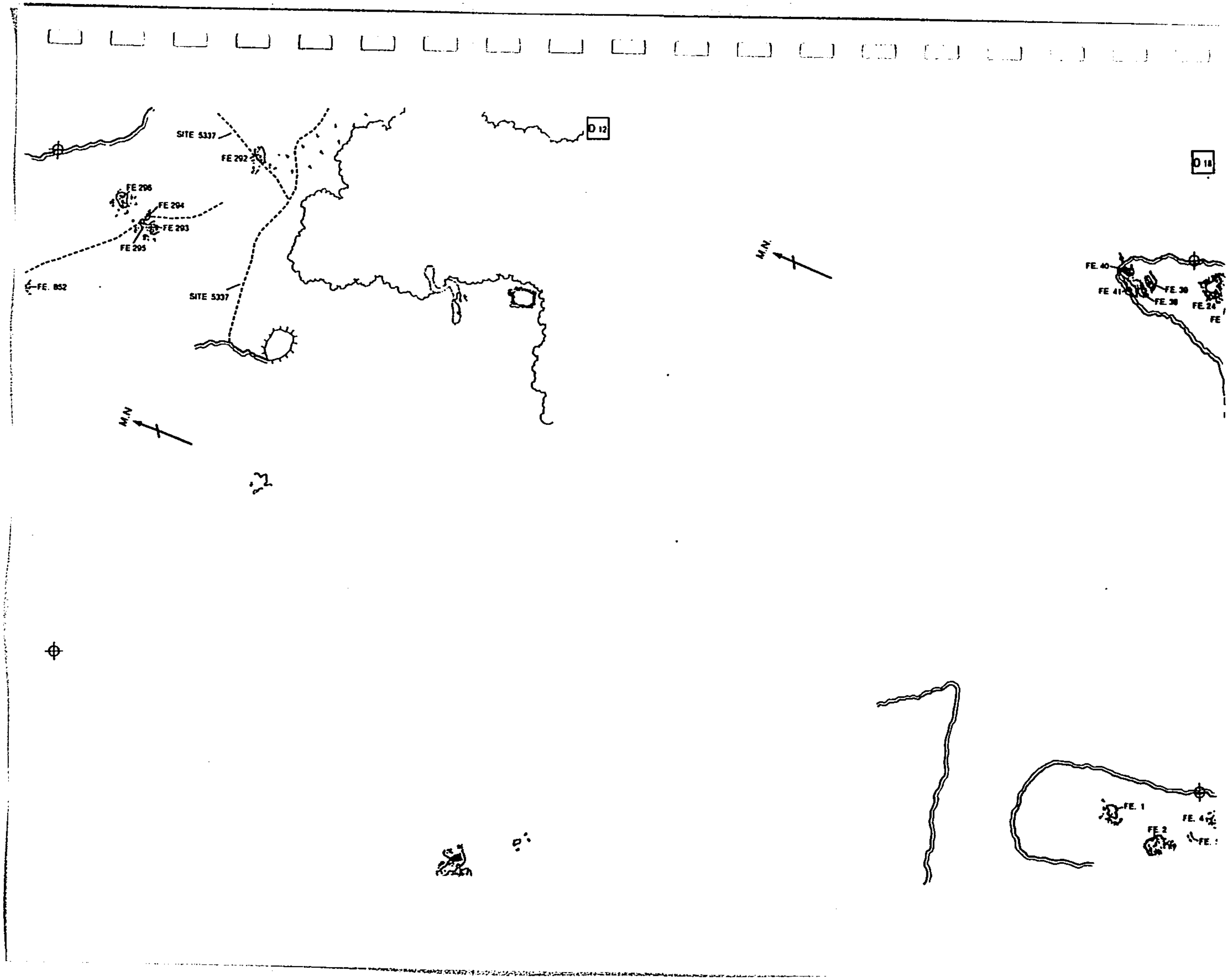
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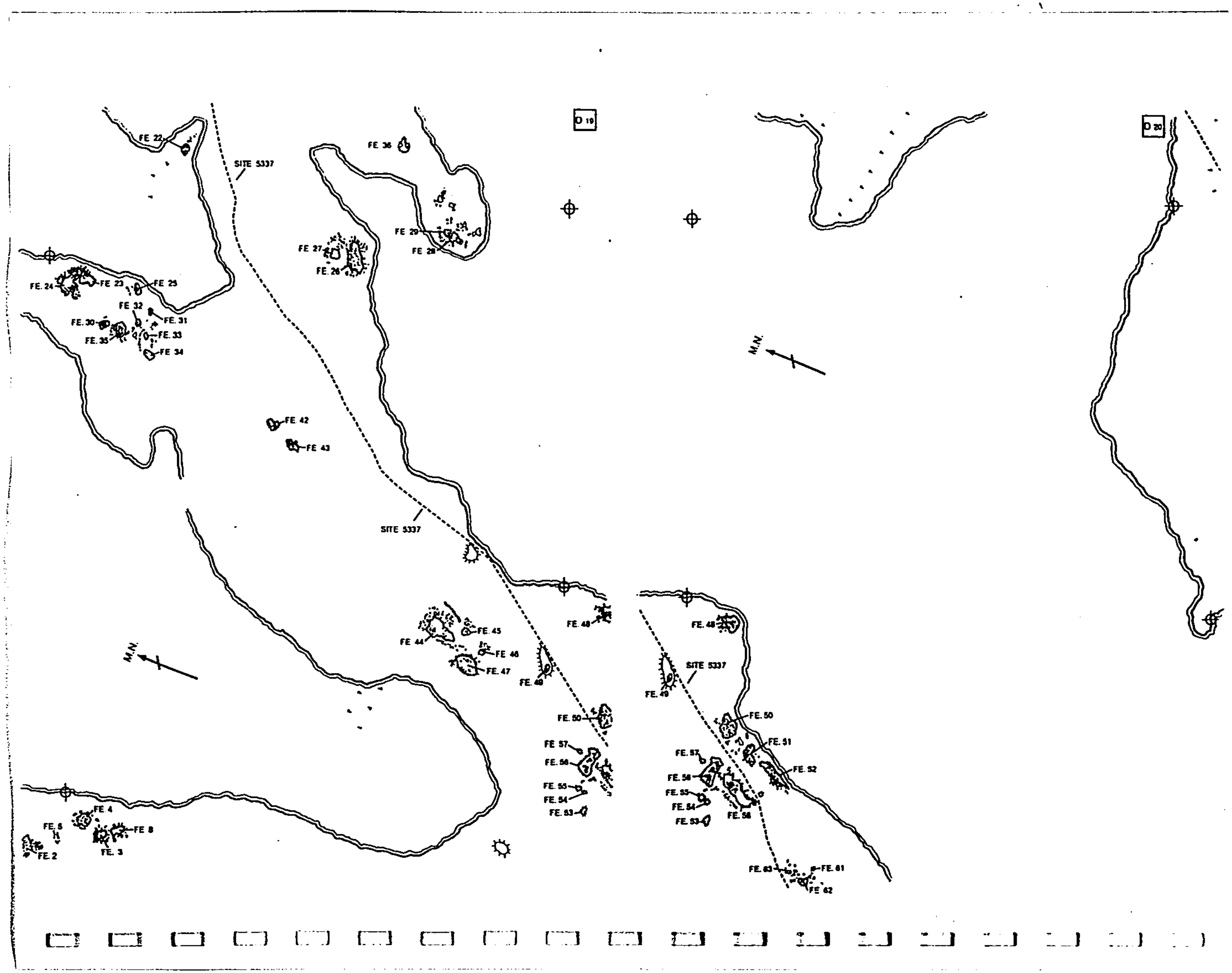
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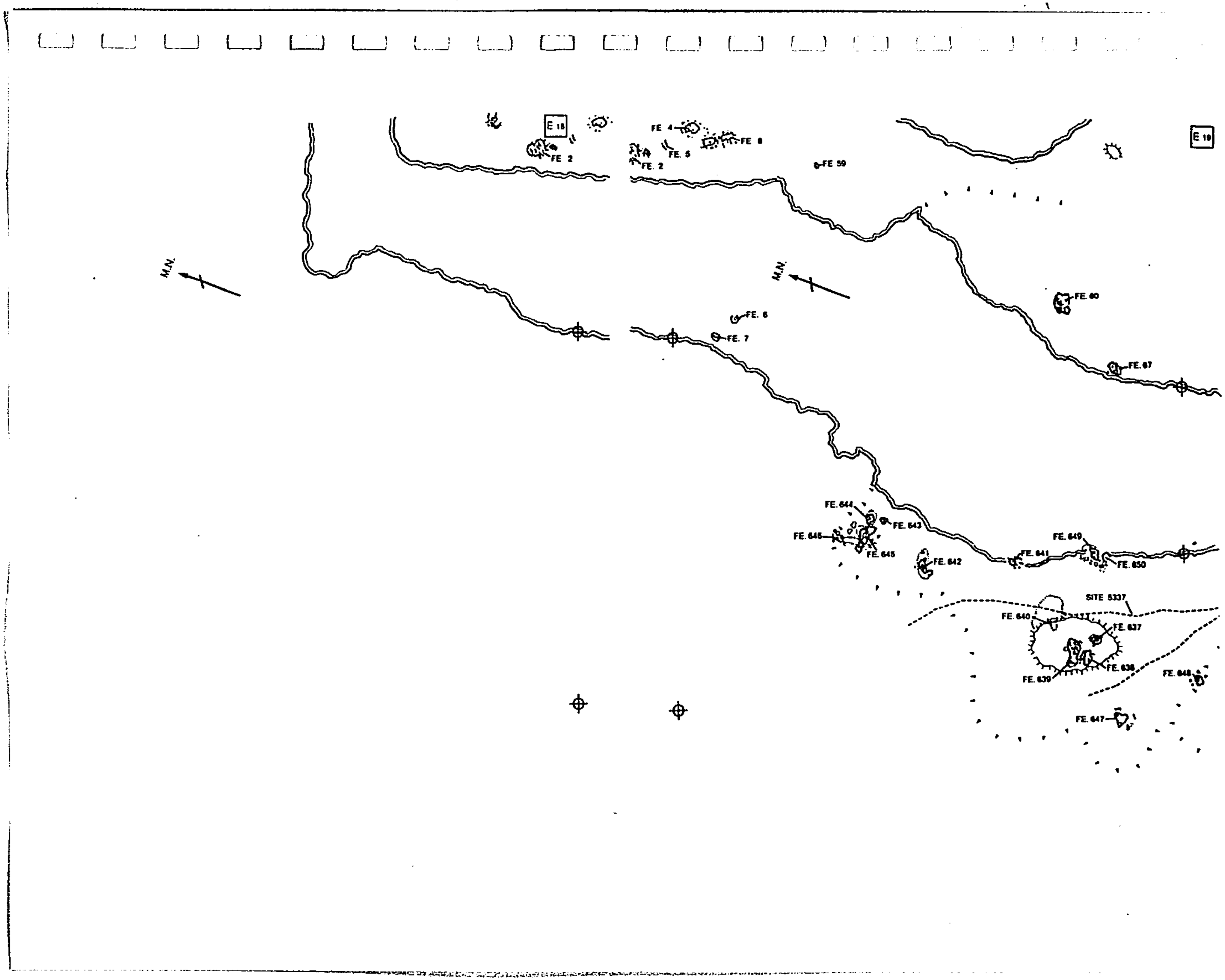

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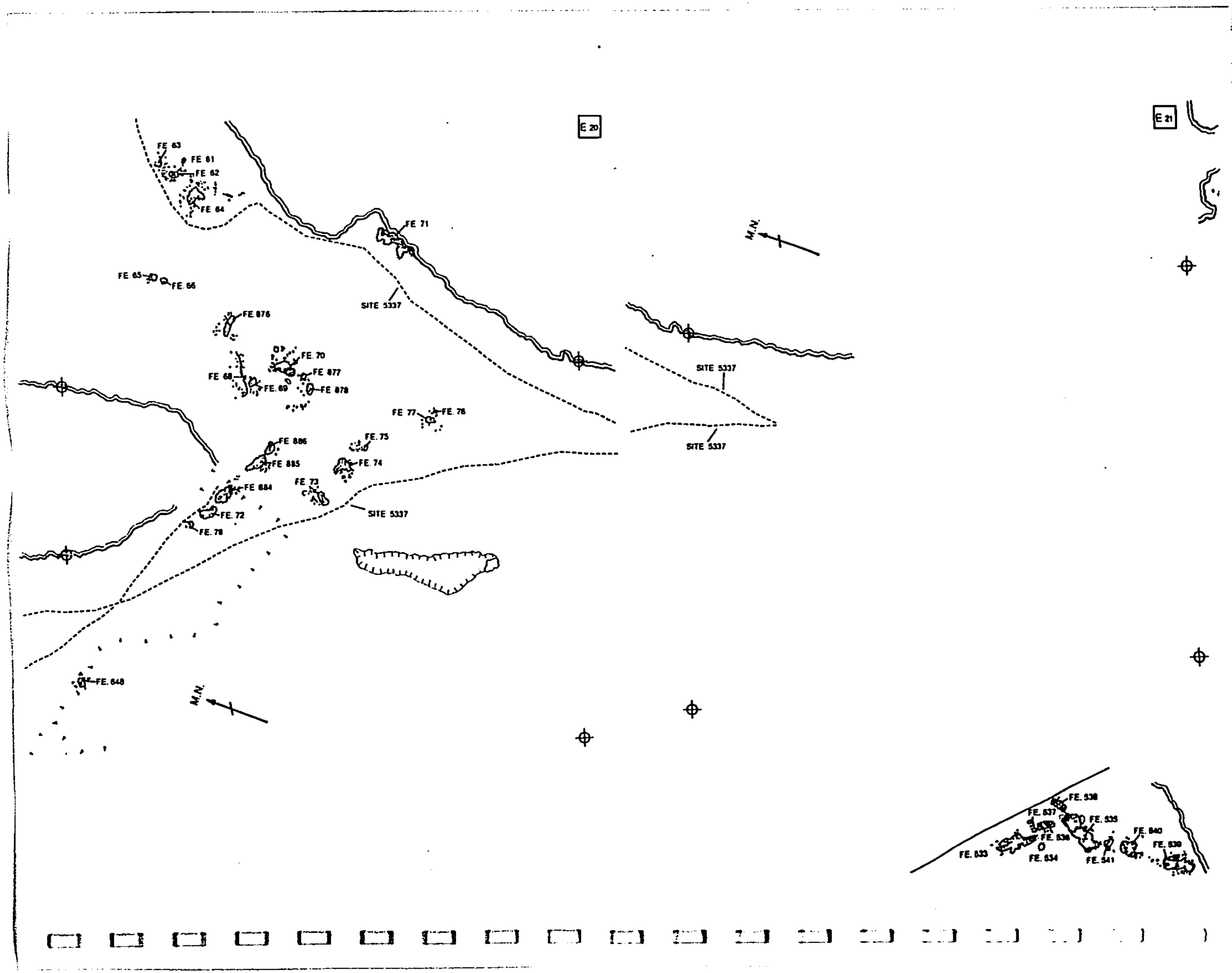
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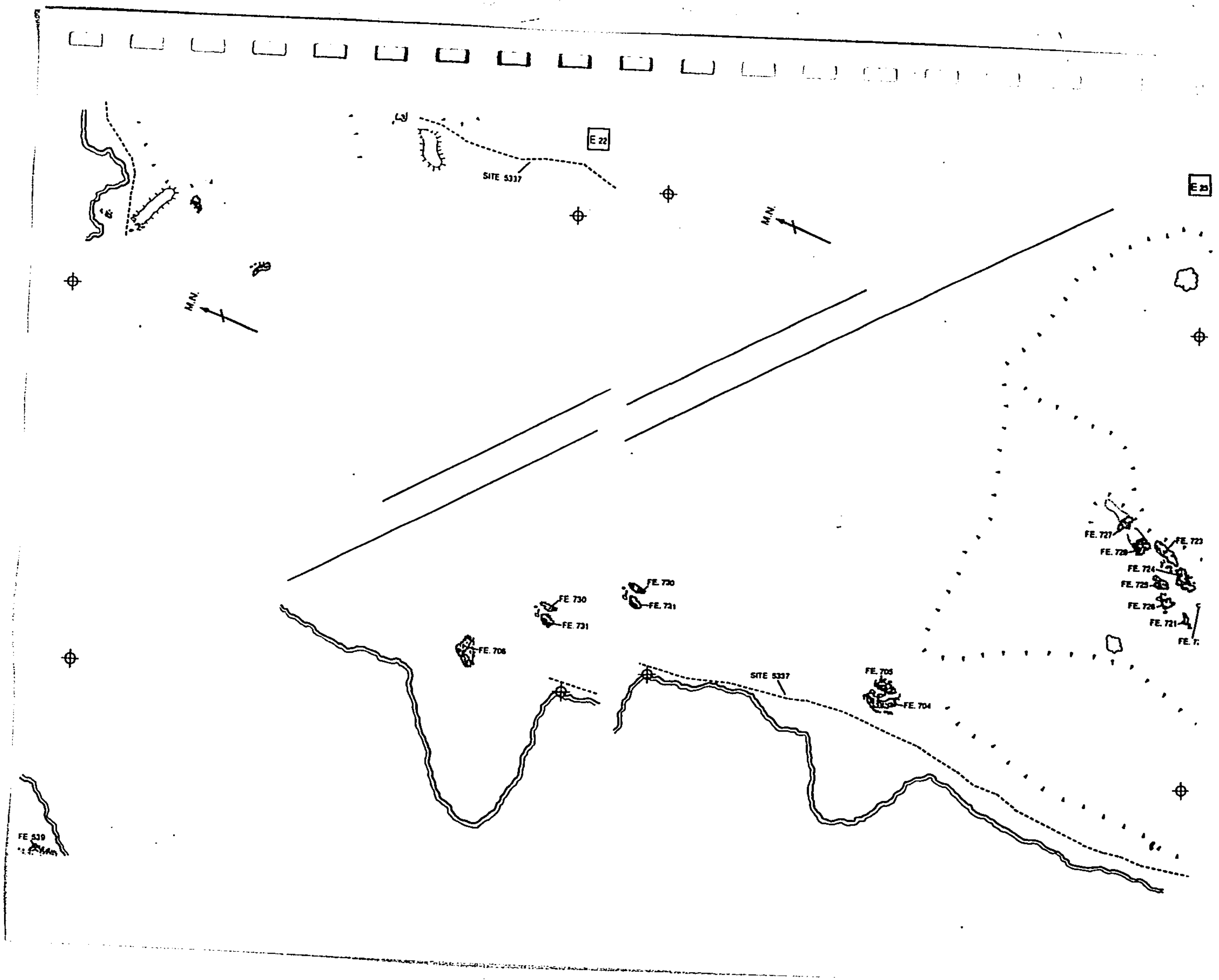
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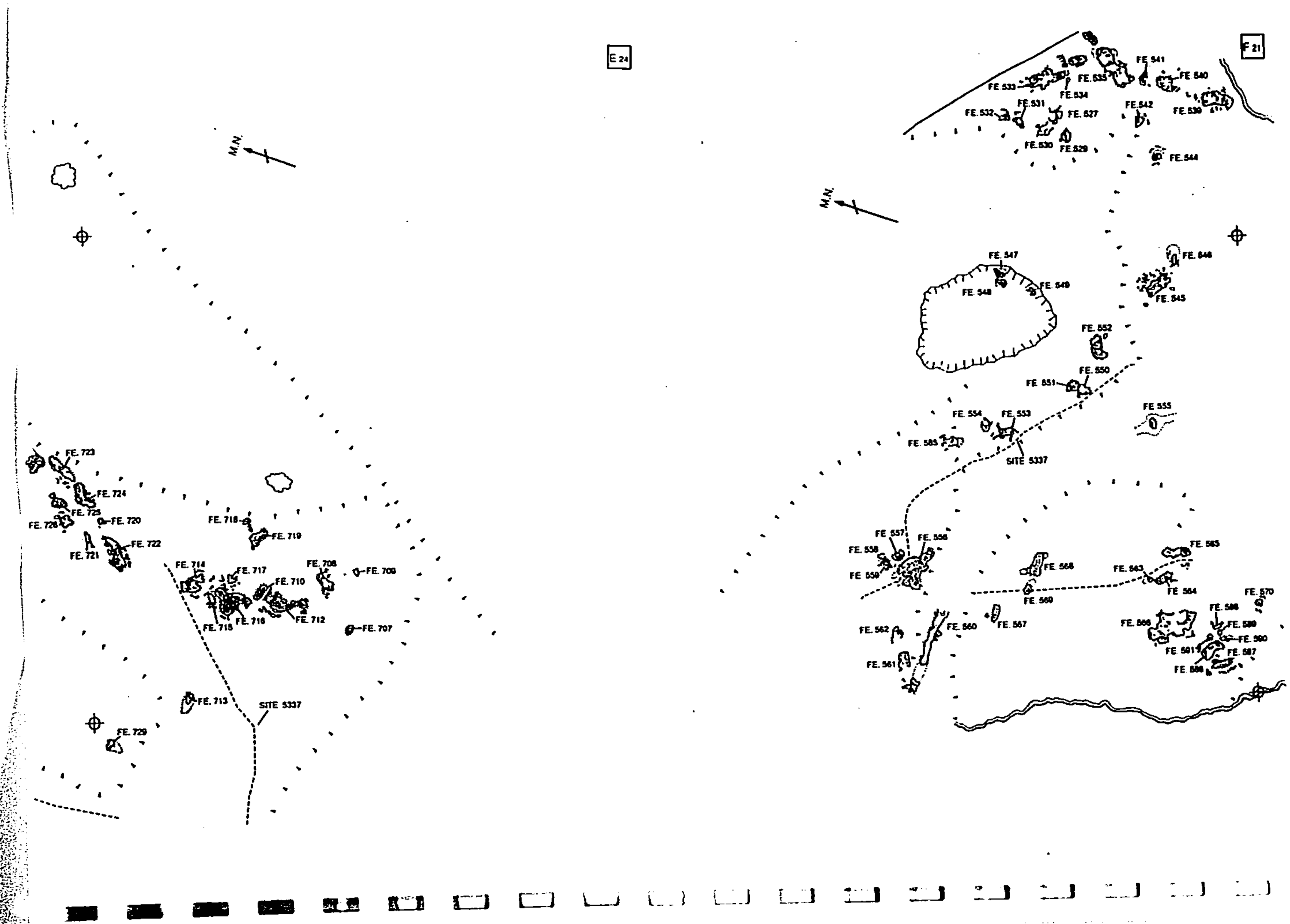
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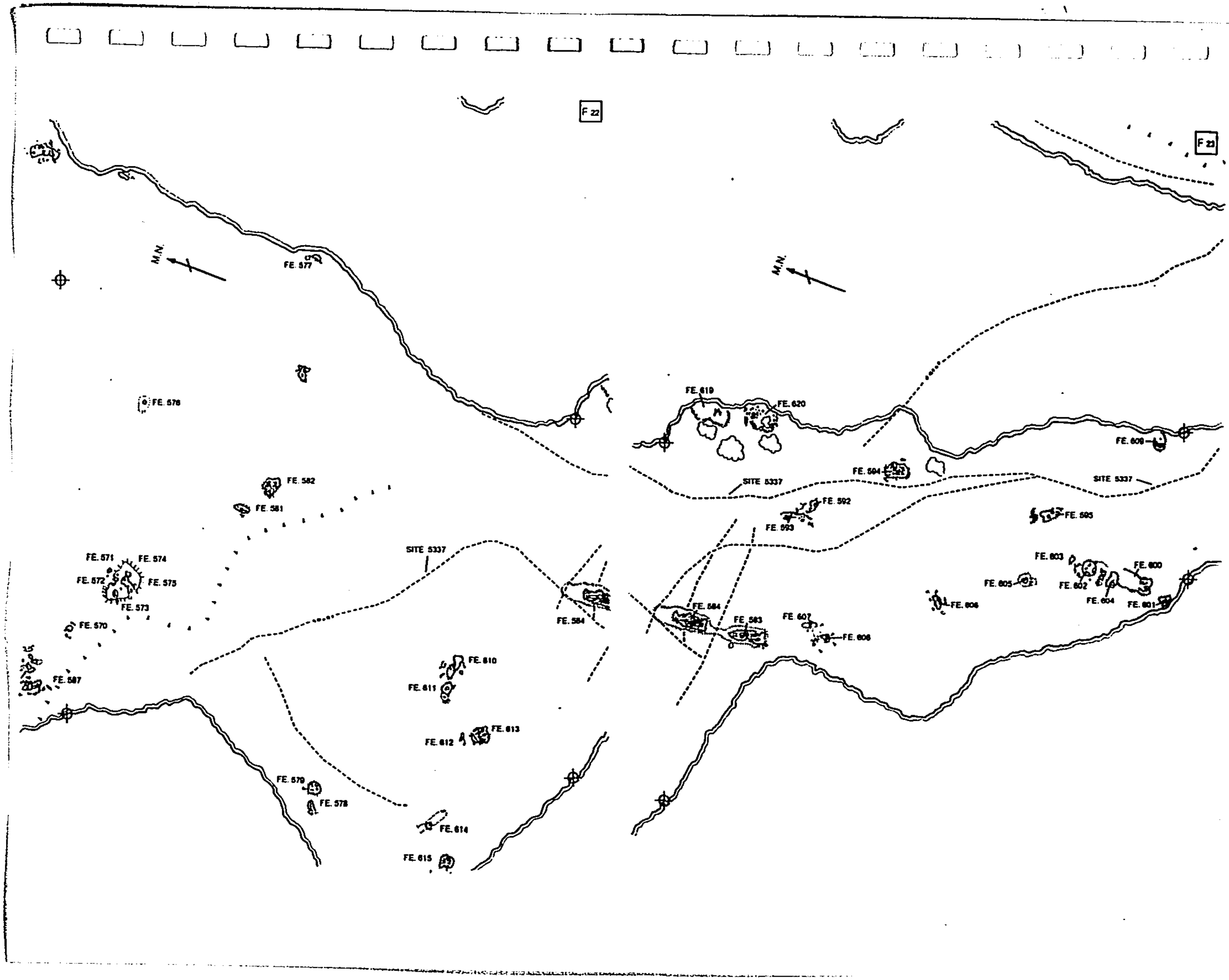

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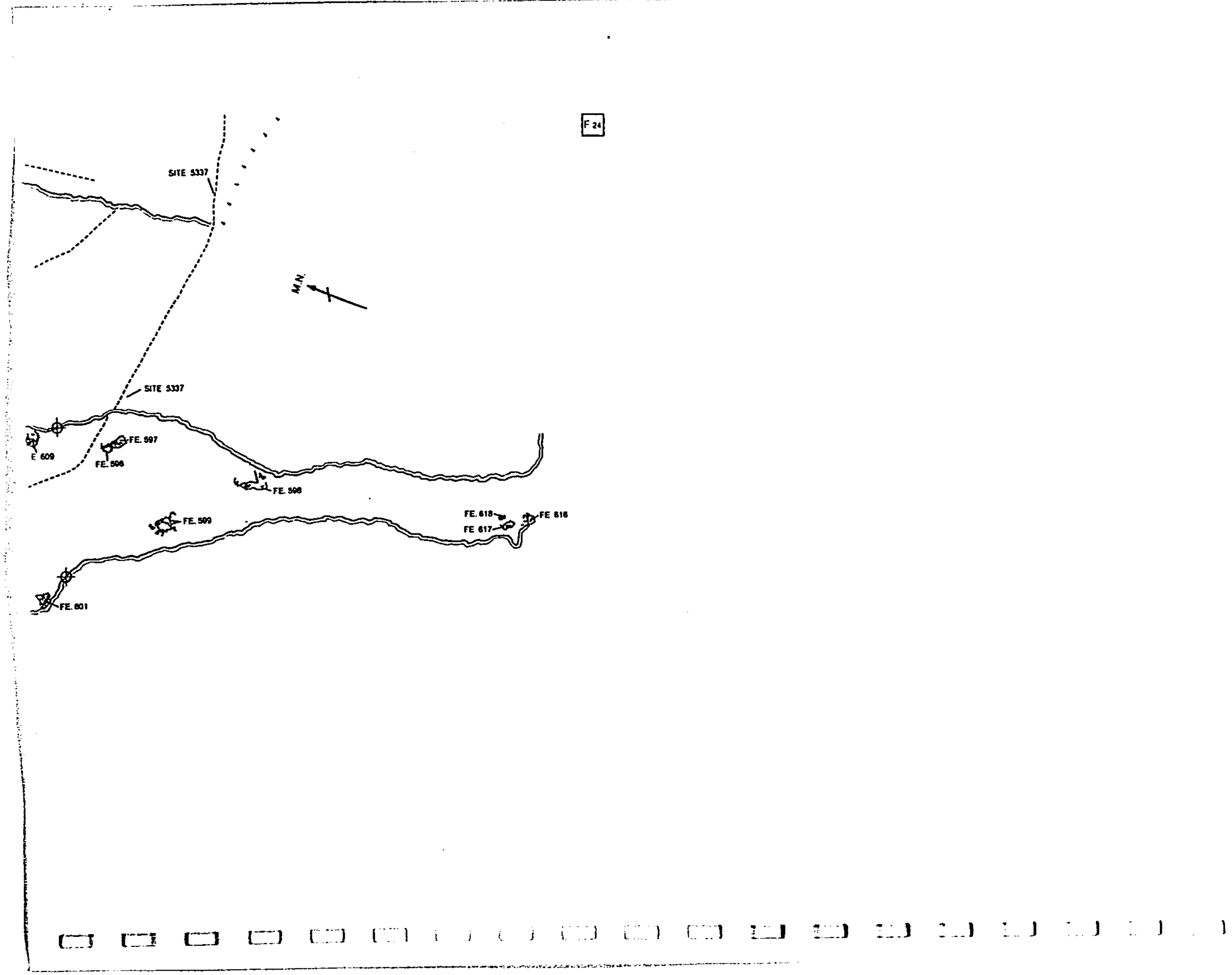
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APPENDIX K

TRAFFIC IMPACT ANALYSIS REPORT
FOR THE PROPOSED

MANINI'OWALI RESIDENTIAL COMMUNITY

PREPARED FOR

GROUP 70

OCTOBER 11, 1991

PREPARED BY

THE TRAFFIC MANAGEMENT CONSULTANT
RANDALL S. OKANEKU, P. E., PRINCIPAL • 1188 BISHOP STREET • SUITE 1907 • HONOLULU, HAWAII 96813

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FOR THE PROPOSED
MANINI'OWALI RESIDENTIAL COMMUNITY

I. INTRODUCTION

A. Purpose of Study

The purpose of this study is to analyze the traffic impacts resulting from the proposed Manini'owali Residential Community in North Kona, Hawaii. This report presents the findings and recommendations of the study.

B. Scope of Study

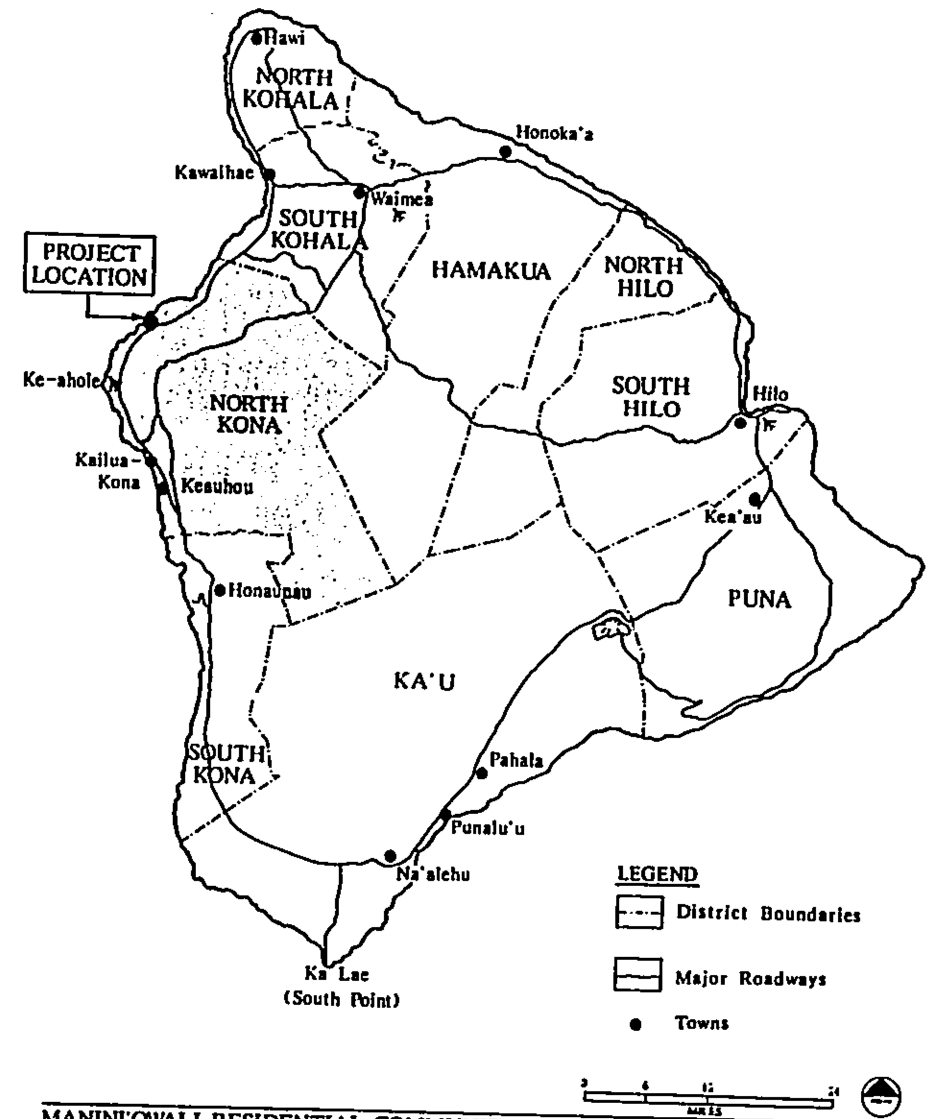
The scope of this study includes:

1. Description of the proposed project.
2. Evaluation of existing roadway and traffic conditions.
3. Analysis of future roadway and traffic conditions without the proposed project.
4. Development of trip generation characteristics for the proposed project.
5. Superimposing the site-generated traffic over future traffic conditions.
6. The identification and analysis of traffic impacts resulting from the proposed project.
7. Recommendation of improvements that would mitigate the traffic impacts resulting from the development of the proposed project.

II. PROJECT DESCRIPTION

A. Location

Manini'owali is located on the makai (west) side of Queen Kaahumanu Highway, approximately 4 miles north of the Keahole Airport in North Kona, Hawaii. The 388 acre site is located immediately to the south of the Kaupulehu and Kukio Projects. The vicinity of the project is shown on Exhibit 1.



MANINI'OWALI RESIDENTIAL COMMUNITY

EXHIBIT 1 - LOCATION MAP

B. Site Characteristics

1. Project Site

The proposed Manini'owali project will be primarily a residential community surrounding a golf course. The internal road system consists of three loop roads connecting to a single access point on Queen Kaahumanu Highway near the midpoint of the property frontage. For the purpose of this traffic impact analysis, site access is assumed to be provided by a single at-grade intersection on Queen Kaahumanu Highway. The site plan is shown in Exhibit 2.

2. Proposed Land Use Intensity

Manini'owali consists of 1,000 dwelling units; 700 single family dwelling units and 300 multi-family dwelling units. The average household size for the residential project is estimated at 2.23 persons per household. The project also includes an 18-hole golf course and a four-court tennis center.

For the purpose of this study, the project is analyzed at full build out condition by the Year 2006.

C. Study Area

The study area is defined on Queen Kaahumanu Highway at the project access road. The State Department of Transportation's (DOT) long range plan for Queen Kaahumanu Highway is to develop a controlled-access four lane highway. It includes approved interchanges at Keahole Airport Access Road and at Waikoloa, and a system of frontage roads to provide access to properties along the highway. It is assumed that primary access, under this long range plan, would be provided at one or more yet to be determined interchange(s) located between Waikoloa and the airport.

The State DOT is currently undertaking a planning study for the widening of Queen Kaahumanu Highway that would determine the location of additional interchanges and the functional aspects of the frontage road system. The ultimate access configuration for Manini'owali cannot be determined at this writing. In any case, it is assumed that initial access to the project would be provided at a channelized at-grade intersection shown on Exhibit 2. Ultimately, project access would be provided along the proposed frontage road system or at an interchange located at the project access.

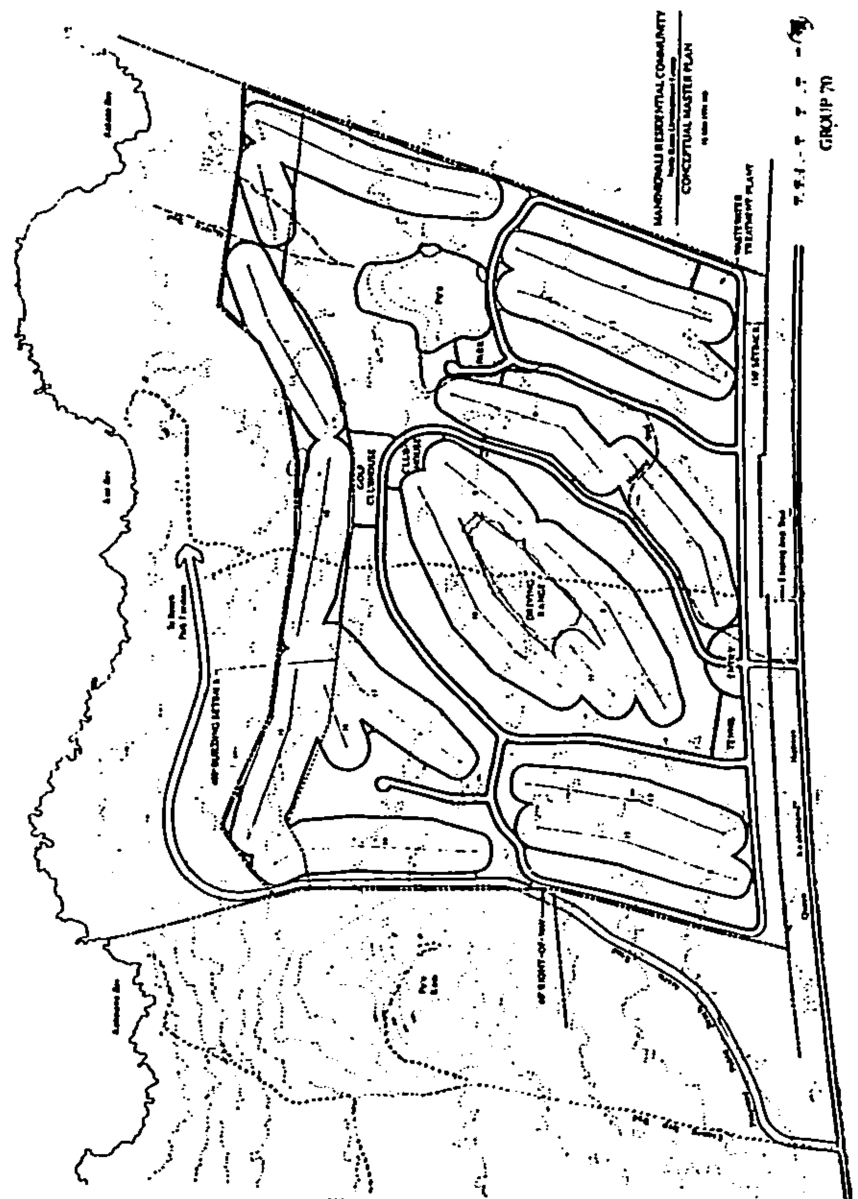


EXHIBIT 2 - SITE PLAN

III. EXISTING TRAFFIC CONDITIONS

A. Area Roadway System

Queen Kaahumanu Highway is the primary arterial highway in the region. Queen Kaahumanu Highway is a high quality, two lane, two way State highway between Kawaihae and Kailua. The posted speed on Queen Kaahumanu Highway is 55 miles per hour. The highway right-of-way, fronting the project, varies between 330 feet and 390 feet wide.

Mamalahoa Highway is a two lane, two way County highway, located mauka of Queen Kaahumanu Highway. The only existing mauka-makai connector roadways between the two highways are located at Waikoloa and Keahole. For the purpose of this analysis, it is assumed that Mamalahoa Highway would not be significantly affected by the proposed project.

B. Traffic Volumes and Conditions

1. General

a. Field Investigation

The site investigation was conducted in May, 1991. The State DOT 1990 traffic data, taken in over several week days in October, is used to establish the existing traffic conditions.

b. Capacity Analysis Methodology

The highway capacity analysis performed for this study is based upon procedures presented in the "Highway Capacity Manual", Special Report 209, Transportation Research Board, 1985 and the "Highway Capacity Software", Federal Highways Administration.

Level of Service (LOS) is a quantitative and qualitative assessment of traffic operations. Levels of Service are defined by LOS "A" through "F", LOS "A" being the best operating condition and LOS "F" the worst operating condition.

"Volume-to-capacity" (v/c) ratio is another measure that shows the relative traffic demand to the road carrying capacity. A v/c ratio of 1.00 indicates that the roadway is operating at 100% of its capacity. A v/c ratio greater than one (1.00) means that the projected traffic demand exceeds the road's traffic handling capacity.

Intersection operation under a signalized condition is defined in general terms as "under capacity", "near capacity", and "over capacity".

2. Existing AM Peak Hour Traffic Analysis

The AM peak hour of traffic in the study area occurs between 6:30 AM and 7:30 AM. The existing AM peak hour traffic volumes and capacity analysis are shown on Exhibit 3.

Queen Kaahumanu Highway, south of Waikoloa Road, carries 770 vehicles per hour (vph) during the existing AM peak hour, 333 vph north bound and 437 vph southbound. Queen Kaahumanu Highway, operates at LOS "D" and at a v/c ratio of 0.37 during the AM peak hour of traffic.

Queen Kaahumanu Highway, north of the Keahole Airport Access Road, carries 563 vehicles per hour (vph) during the existing AM peak hour, 329 vph north bound and 234 vph southbound. Queen Kaahumanu Highway, operates at LOS "C" and at a v/c ratio of 0.27 during the AM peak hour of traffic.

3. Existing PM Peak Hour Traffic Analysis

The PM peak hour of traffic in the study area occurs between 3:15 PM and 4:15 PM. The existing PM peak hour traffic volumes and capacity analysis are shown on Exhibit 4.

Queen Kaahumanu Highway, south of Waikoloa Road, carries 909 vehicles per hour (vph) during the existing PM peak hour, 427 vph north bound and 482 vph southbound. Queen Kaahumanu Highway, operates at LOS "D" and at a v/c ratio of 0.43 during the PM peak hour of traffic.

Queen Kaahumanu Highway, north of the Keahole Airport Access Road, carries 783 vehicles per hour (vph) during the existing PM peak hour, 284 vph north bound and 499 vph southbound. Queen Kaahumanu Highway, operates at LOS "D" and at a v/c ratio of 0.39 during the PM peak hour of traffic.

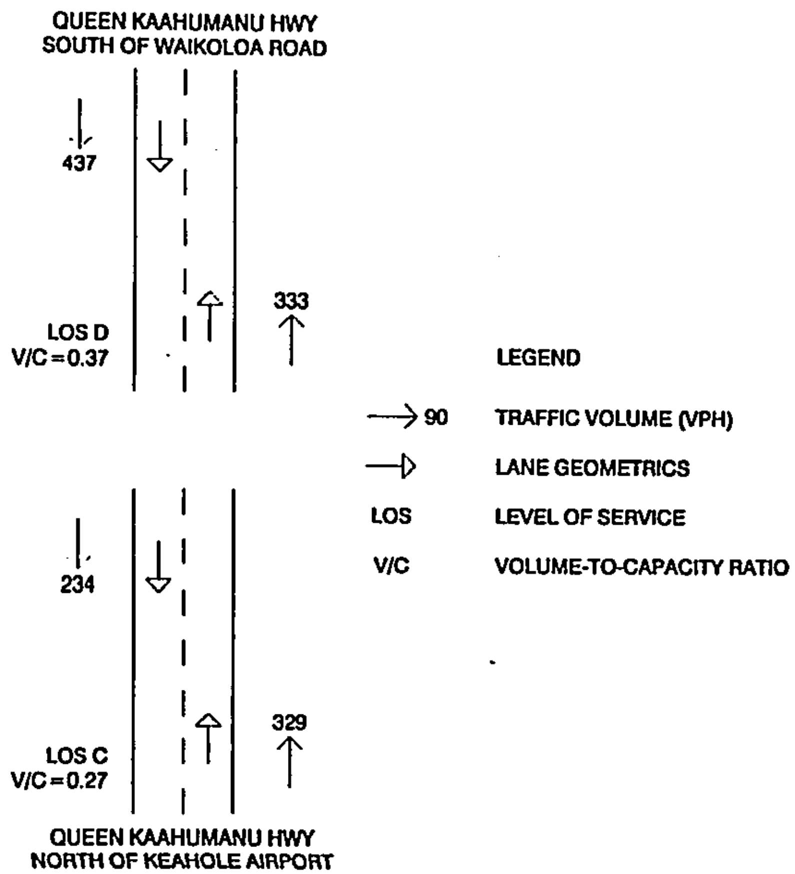


EXHIBIT 3 - EXISTING AM PEAK HOUR TRAFFIC

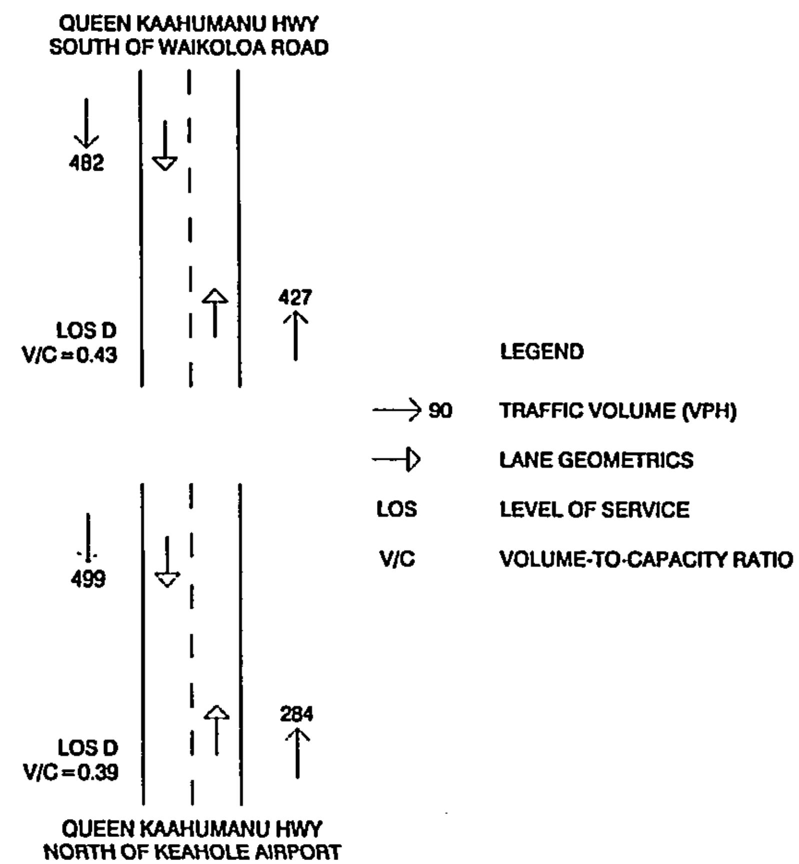


EXHIBIT 4 - EXISTING PM PEAK HOUR TRAFFIC

IV. PROJECTED TRAFFIC

A. Site-Generated Traffic

1. Trip Generation Methodology

The trip generation methodology used in this study is based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in "Trip Generation, 5th Edition", 1991. The ITE trip rates for residential and commercial projects are developed empirically, by correlating the vehicle trip generation data with various land use characteristics, such as vehicle trips per dwelling unit.

2. Trip Generation Characteristics

The trip generation characteristics are based upon 1,000 dwelling units, an 18-hole golf course, and a four-court tennis center. The trip rates for the single family residential dwelling units were adjusted for the 2.23 persons per household size. ITE recommends a reduction of approximately 20% in the standard trip rates for household sizes between 2 to 3 persons per household. The marketing analysis indicates that about 25% of the residential dwelling units will be purchased as recreational or "second" homes. The trip generation rates for recreational homes are lower than "full-time" residential units during the peak hours of adjacent street traffic. However, applying the rule of conservatism, it is assumed that the 100% of the dwelling units will be occupied by full-time residents, thereby analyzing the traffic impacts based upon a worst case scenario. The trip generation characteristics are summarized in Table 1.

TABLE 1. TRIP GENERATION SUMMARY

Land Use	Land Use Intensity	AM Peak Hour (Vph)			PM Peak Hour (Vph)		
		Enter	Exit	Total	Enter	Exit	Total
Single - Family Residential	700 DU	90	257	347	323	174	497
Multi - Family Residential	300 DU	21	102	123	102	53	155
Golf Course	18 Holes	41	8	49	31	29	60
Tennis Center	4 Courts	3	3	6	6	6	12
PROJECT TOTAL		155	370	525	443	281	724

B. External Traffic

1. Anticipated Future Development

West Hawaii is experiencing rapid growth, as several major projects are presently in the plan approval process. To the north, these include the Waikoloa Village and Resort, Kaupulehu Resort, and Kukio Project. Several residential and resort developments are also located to the south. These include the Lands of Ka'u residential project, the State housing project at Kealekehe, and the Queen Liliuokalani Trust project.

The State DOT and the County of Hawaii have completed the "Island of Hawaii Long Range Highway Plan". This Highway Plan included a travel forecast for the Year 2010, based upon a land use forecast developed by the County of Hawaii. In the project vicinity, the land use forecast for the proposed Kaupulehu and Kukio Resorts include 1200+ hotel rooms and 500+ resort condominiums. This travel forecast is adopted for the purpose of establishing future baseline traffic conditions from which to analyze the traffic impacts resulting from the proposed project.

Based upon an analysis of the "Island of Hawaii Long Range Highway Plan", a growth factor of 1.81 was used in projecting Year 2006 traffic demands over the existing Year 1990 conditions.

2. **Total Traffic Volumes Without Project**

The Year 2006 traffic projections without the proposed project are shown on Exhibit 5. South of Waikoloa Road, the two lane Queen Kaahumanu Highway would operate at LOS "E" during both peak periods. During the AM peak hour of traffic, Queen Kaahumanu Highway would operate at a v/c ratio of 0.67. During the PM peak hour of traffic, Queen Kaahumanu Highway would operate at a v/c ratio of 0.77.

C. Total Traffic With Project

Exhibit 6 shows the AM and PM peak hour traffic with the site-generated traffic. The capacity analysis is shown for an at-grade intersection under signalized conditions. The traffic impact analysis of the site-generated traffic is discussed in the next section.

V. TRAFFIC IMPACT ANALYSIS

A. AM Peak Hour Traffic With Project

During the AM peak hour with the site-generated traffic, the project access road intersection on Queen Kaahumanu Highway would operate "under capacity" under signalized conditions. Queen Kaahumanu Highway, south of the project access road, would operate at LOS "E" and a v/c ratio of 0.85.

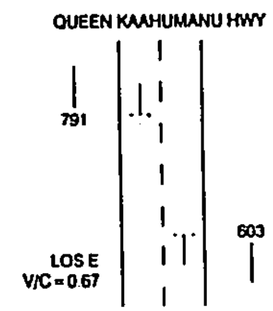
B. PM Peak Hour Traffic With Project

The project access road intersection on Queen Kaahumanu Highway would operate "near capacity" under signalized conditions, during the PM peak hour with the site-generated traffic. Queen Kaahumanu Highway, south of the project access road, would operate at LOS "E" and a v/c ratio of 0.97.

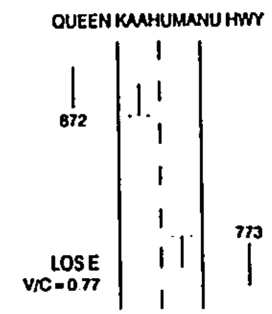
VI. PROPOSED HIGHWAY IMPROVEMENTS

A. Improvements to Accommodate the Year 2006 Highway Deficiencies Without Project

Based upon evaluation criteria for highway deficiencies established in the State DOT Long Range Highway Plan, Queen Kaahumanu Highway would require widening to four lanes. Until the proposed interchange and frontage road system is constructed, at-grade access should be provided at channelized intersections under traffic signal control.



PROJECTED AM PEAK HR TRAFFIC

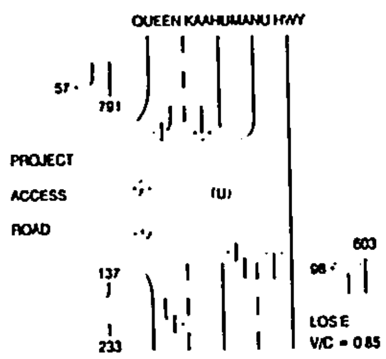


PROJECTED PM PEAK HR TRAFFIC

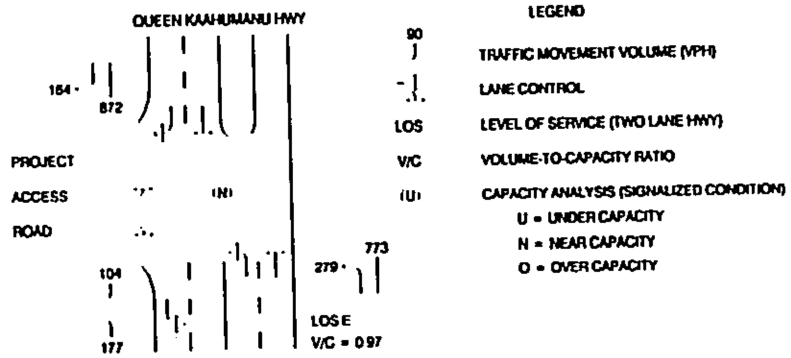
LEGEND

· 90	TRAFFIC VOLUME (VPH)
|	LANE GEOMETRICS
LOS	LEVEL OF SERVICE
V/C	VOLUME-TO-CAPACITY RATIO

EXHIBIT 5 - 2006 PEAK HOUR TRAFFIC W/O PROJECT



CUMULATIVE AM PEAK HR TRAFFIC



CUMULATIVE PM PEAK HR TRAFFIC

EXHIBIT 6 - CUMULATIVE PEAK HOUR TRAFFIC W/PROJECT

B. Site Access Improvements

The proposed access road intersection for Manini'owali should provide for an exclusive left turn lane (northbound), a right turn deceleration lane (southbound), and a right turn acceleration lane (southbound) on Queen Kaahumanu Highway. Traffic signals should be installed at this channelized intersection. These improvements would be implemented on an interim basis, with the understanding that at-grade access on Queen Kaahumanu Highway would eventually be eliminated and replaced with access to a system of frontage roads leading to the proposed interchanges, to be determined by State DOT.

VII. CONCLUSIONS

With the implementation of the road improvements recommended in this study, the proposed Manini'owali Residential Community should not have any significant impacts on traffic within the time frame of this study. The proposed channelized intersection should accommodate the project access needs until the State DOT's long range plan for Queen Kaahumanu Highway is implemented.

It is anticipated that, initially, Queen Kaahumanu Highway would be widened to a four lane, divided highway with at-grade signalized intersections at warranted locations. As traffic continues to increase and the at-grade intersections reach capacity, grade-separated interchange facilities would be constructed. Access to Manini'owali would then be relocated to a frontage road system leading to interchanges, located to north and south. The preliminary engineering study for Queen Kaahumanu Highway, conducted by State DOT, is expected to determine the access requirements for each of the proposed projects on Queen Kaahumanu Highway that would either access the frontage road system. The study also should determine how the frontage road system would collect and distribute traffic to and from the interchanges.

THE TRAFFIC MANAGEMENT CONSULTANT

Randall S. Okaneku, P. E., Principal • 1188 Bishop Street • Suite 1907 • Honolulu, Hawaii 96813
Telephone: (808) [illegible] • Facsimile: (808) [illegible]

February 3, 1992
Job No. 9104

FEB 04 1992

Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Jeff Overton

Gentlemen and Ladies:

Subject: Draft Environmental Impact Statement (DEIS) Manini'owali Residential Community

The Traffic Report in the DEIS proposes that project access be provided by traffic signals on an interim basis, with the understanding the ultimate access would be allowed only at grade-separated interchanges or onto a frontage road system. Comments on the DEIS from the State Department of Transportation (Comment No. 1 of the January 7, 1992 letter from Mr. Rex Johnson, Director of the State DOT, to Mr. Norman Hayashi, Director of the Planning Department, County of Hawaii) note that traffic signals will not be permitted on Queen Kaahumanu Highway. DOT has requested that a revised capacity analysis be prepared for the unsignalized project access intersection, the results of which are included herein.

The results of the capacity analysis at the intersection of Queen Kaahumanu Highway and the project access road (Year 2006 unsignalized condition) is shown on the attached Exhibit S-1. During the both the AM and PM peak hours of traffic, the right turn movement from the project access road to south bound Queen Kaahumanu Highway is expected to operate near capacity. The projected traffic demand would exceed the capacity on the left turn movement from the project access road to north bound Queen Kaahumanu Highway, during both the AM and PM peak hours of traffic. During the PM peak hour of traffic, the projected traffic demand would exceed the capacity on the left turn movement from north bound Queen Kaahumanu Highway to the project access road. In general, through traffic on Queen Kaahumanu Highway would not be affected by the project access, except for the potential for traffic safety problems, as the project traffic attempts to enter Queen Kaahumanu Highway during less than acceptable gaps in traffic.

The State DOT's on-going Queen Kaahumanu Highway Master Plan would determine future interchange locations and the operation of the frontage road system. The ultimate configuration of the project access can be be determined, once these plans are finalized. Until the final plans are available and the upgrade of the highway system is completed, an interim access to

Group 70 International, Inc.

February 3, 1992
Page 2

this new community will be necessary, such as the scheme presented in the DEIS. Actual design and timing of the interim access connection should be worked out with State DOT over the next few years, as the planning progresses for the Queen Kaahumanu Highway improvements and the Manini'owali Residential Community.

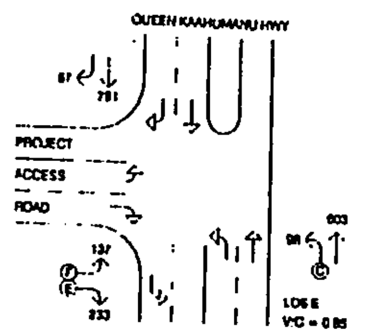
If you have any questions, please do not hesitate to call me.

Very Truly Yours,

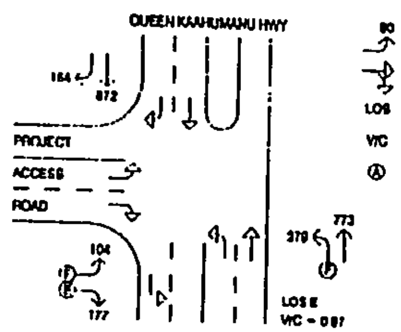
The Traffic Management Consultant

By Randall S. Okaneku

Randall S. Okaneku, P. E.
Principal



CUMULATIVE AM PEAK HR TRAFFIC



CUMULATIVE PM PEAK HR TRAFFIC

LEGEND

90	TRAFFIC MOVEMENT VOLUME (VPH)
	LANE CONTROL
LOS	LEVEL OF SERVICE (TWO LANE HWY)
V/C	VOLUME-TO-CAPACITY RATIO
Ⓐ	LEVEL OF SERVICE (UNSIGNALIZED CONDITIONS)

EXHIBIT S-1 CUMULATIVE PEAK HOUR TRAFFIC (UNSIGNALIZED)

APPENDIX L

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dba
DARBY
& ASSOCIATES
ACOUSTICAL CONSULTANTS

J91-07
July 30, 1991

GROUP 70
924 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Jeff Overton

SUBJECT: ENVIRONMENTAL NOISE IMPACT ASSESSMENT, MANINI'OWALI RESIDENTIAL COMMUNITY, HAWAII COUNTY, HAWAII

Dear Mr. Overton:

A study has been performed to assess the noise impact due to the proposed project. The following is provided as a result of this study:

1. SUMMARY

1.1 The existing acoustical condition in the vicinity of Queen Kaahumanu Highway is dominated by highway traffic noise, with a measured average levels ranging from about 45 to 52 dBA at a distance of about 350 feet. At locations away from the highway, the current conditions are dominated by natural sounds (wind, birds, surf, etc.). The measured average levels at these locations ranged from about 38 to 41 dBA.

Aircraft activities associated with the Keahole Airport can be seen at the project site, but do not increase the ambient levels significantly. The project site lies well outside of the 55 dB Average Day-Night Sound Level (Ldn) contour lines for both the existing (1990) and the future (2005) years. Ldn is a commonly used noise descriptor for land use guideline purposes, and is essentially an average of sound level over a twenty-four hour period, with a 10 dBA nighttime penalty to account for people's increased sensitivity to noise during the nighttime hours. Appendix 1 provides a more detailed explanation of Ldn. A noise exposure of less than 55 dB Ldn is in clear compliance with the State Department of Transportation (DOT), Airports Division's Land Use Compatibility guidelines' 60 dB Ldn limit for residential uses. The existing and the future aircraft generated Ldn's are also below the DOT's "minimal risk level" of 55 dB Ldn.

1.2 The only known existing noise sensitive areas located near the project site are the beach parks where some informal camping activities may occur. These areas are exposed to high sound levels generated by surf and wind. No significant noise impact from the project is expected due to this high masking sound level.

1.3 Queen Kaahumanu traffic noise increase, as a result of the project development, is estimated to be at most 1 dBA. Such an increase is not considered a significant noise impact.

1.4 The nearest proposed residential areas to Queen Kaahumanu Highway are to be located at a distance of about 400 feet. At a such distance, the Ldn level is estimated to be at most 65 dB. Traffic noise due to vehicle movements on the interior road is estimated to generate an Ldn of 65 dB at a distance of about 40 feet from the centerline of the roadway. Therefore, all residential areas within the project site are expected to be in compliance with the U.S. Department of Housing and Urban Development (HUD)'s Site Acceptability Standards, if they have a minimum of 40 feet setback distances from the centerline of the interior roadway.

1.5 Noise due to the activities associated with the proposed golf course, such as clubhouse and ground maintenance operations, could potentially impact the nearby future homes. However, provided that all necessary noise mitigation measures are implemented, noise generated by these activities will be in compliance with the State Department of Health (DOH) noise guidelines.

1.6 Noise generated by tennis match activities could exceed the DOH noise guidelines and cause annoyance to the residents of future homes located adjacent to or near the tennis center. Adequate setback distances and administrative control measures are recommended.

1.7 Implementation of all necessary mitigation measures are recommended so that noise from all stationary equipment do not exceed the DOH guideline and to reduce the possibility of causing annoyance to future nearby residences. Administrative controls should be enforced to reduce the possibility of annoyance caused by other activities, such as trash pickup and delivery vehicles.

1.8 The various construction phases of a development project may generate significant amounts of noise; the actual amounts are dependent upon the methods employed during each stage of the process. It is recommended that construction vehicles using local roadways comply with the noise level guidelines.

2. **PROJECT DESCRIPTION**

The project site is located in the North Kona District of Hawaii County, on the makai side of Queen Kaahumanu Highway, about 6 miles north of the Keahole Airport. It consists of about 388 acres of land and will include the following (see Figure 1):

- o residential areas
- o an 18-hole golf course with a clubhouse, and a driving range
- o a tennis center
- o a wastewater treatment plant
- o a park
- o roadways (40' wide R.O.W. internal roads and a 60' wide R.O.W. park access road)

3. **NOISE STANDARDS**

3.1 **HUD Site Acceptability Standards** -- The U.S. Department of Housing and Urban Development (HUD)'s Site Acceptability Standards specify an exterior Day-Night Average Sound Level (Ldn) of 65 dB as an acceptable level without any special noise mitigation measures (Reference 1). Refer to Appendix I for an explanation of Ldn. For residential developments located within a 65 to 70 dB Ldn zone, the standards require the construction to provide a minimum of 5 dB attenuation in addition to "attenuation provided by buildings as commonly constructed in the area, and requiring open windows for ventilation." A minimum of 10 dB additional attenuation is required for residential projects exposed to an Ldn of 70 to 75 dB.

3.2 **State Department of Transportation, Airports Division (DOT)** -- The local land use compatibility guidelines setforth by DOT specify an aircraft generated 60 dB Ldn as a maximum allowable level for residential use without any special mitigation measures (Reference 2). The guidelines also specify 55 dB Ldn as a "minimal risk level". The DOT guidelines allow golf course uses for an Ldn of up to 65 dB.

3.3 **State Department of Health** -- The State Department of Health (DOH) noise regulations specify allowable levels that shall not be exceeded for more than 10% of any 20-minute period (Reference 3). Although the regulations are currently enforceable only on Oahu, they can serve as

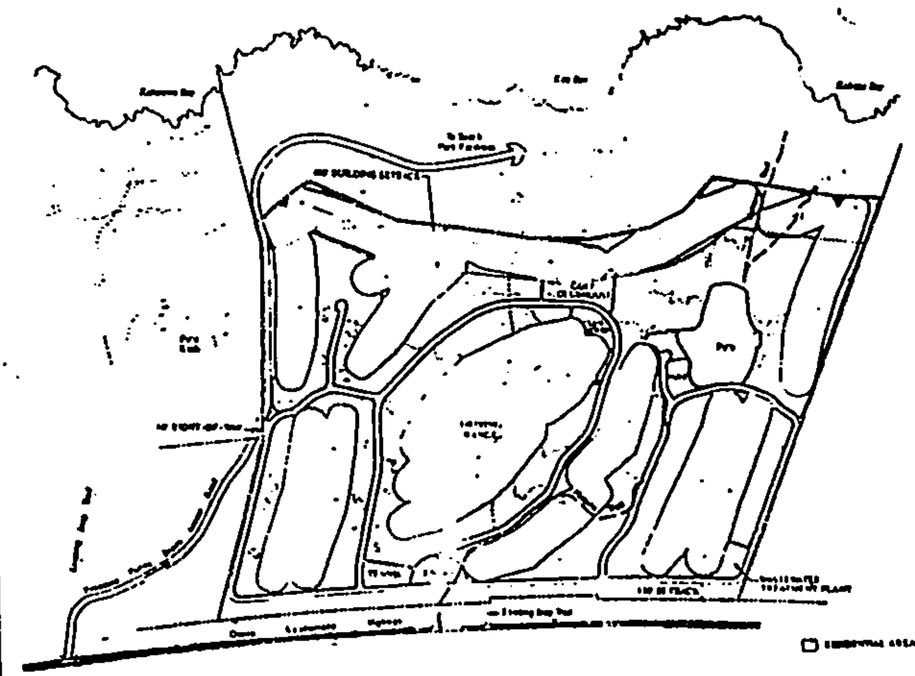

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FIGURE 1. PROJECT SITE PLAN

guidelines in determining if noise generated by such sources as activities within the golf clubhouse, tennis center, wastewater treatment plant, etc., cause excessive intrusion into the nearby future homes. The specified noise limits vary from 55 to 60 dBA for the daytime (7 am to 10 pm) and 45 to 50 dBA for the nighttime (10 pm to 7 am) at the property lines of the areas containing any noise sources such as air conditioning equipment, motors, pumps, etc. The DOH allowable levels are summarized in Appendix II.

4. EXISTING ACOUSTICAL ENVIRONMENT

Ambient noise level measurements were performed during the morning and the afternoon hours of June 3, 1991, in order to assess the existing conditions. The measurements were made at Locations A through D shown in Figure 2.

The existing acoustical environment at locations near Queen Kaahumanu Highway is dominated by noise generated by highway traffic. Noise level measurements made at a distance of about 350 feet from the highway yielded Equivalent Continuous Sound Levels, Leq's (average), ranging from 45 to 52 dBA over twelve separate 15-minute periods. The summary of the measurement results are presented in Table I. At locations away from the highway, natural sound sources such as wind in foliage, bird and surf were dominant. The measured Leq's ranged from about 38 to 41 dBA.

Several aircraft operations associated with the Keahole Airport were observed at the project site. Noise levels generated by approaching airplanes (Runway 17) were barely audible and did not increase the ambient levels. Takeoff (Runway 17) noises were more noticeable, but they also did not cause any significant increase in the ambient levels. Figure 3 shows the location of the project site relative to the Keahole Airport aircraft noise contour lines for the year 1990. As can be seen, the project site is exposed to levels well below 55 dB Ldn.

Although not measured, individual aircraft takeoffs using Runway 35 (towards north) are expected to generate significantly higher noise levels than Runway 17 takeoffs. It should be noted that the Ldn contour lines shown in Figure 3 already take into account the Runway 35 flight operations.

5. ASSESSMENT OF POTENTIAL NOISE IMPACT

5.1 General -- The only known existing noise sensitive areas located near the project site are several beach parks where some camping activities

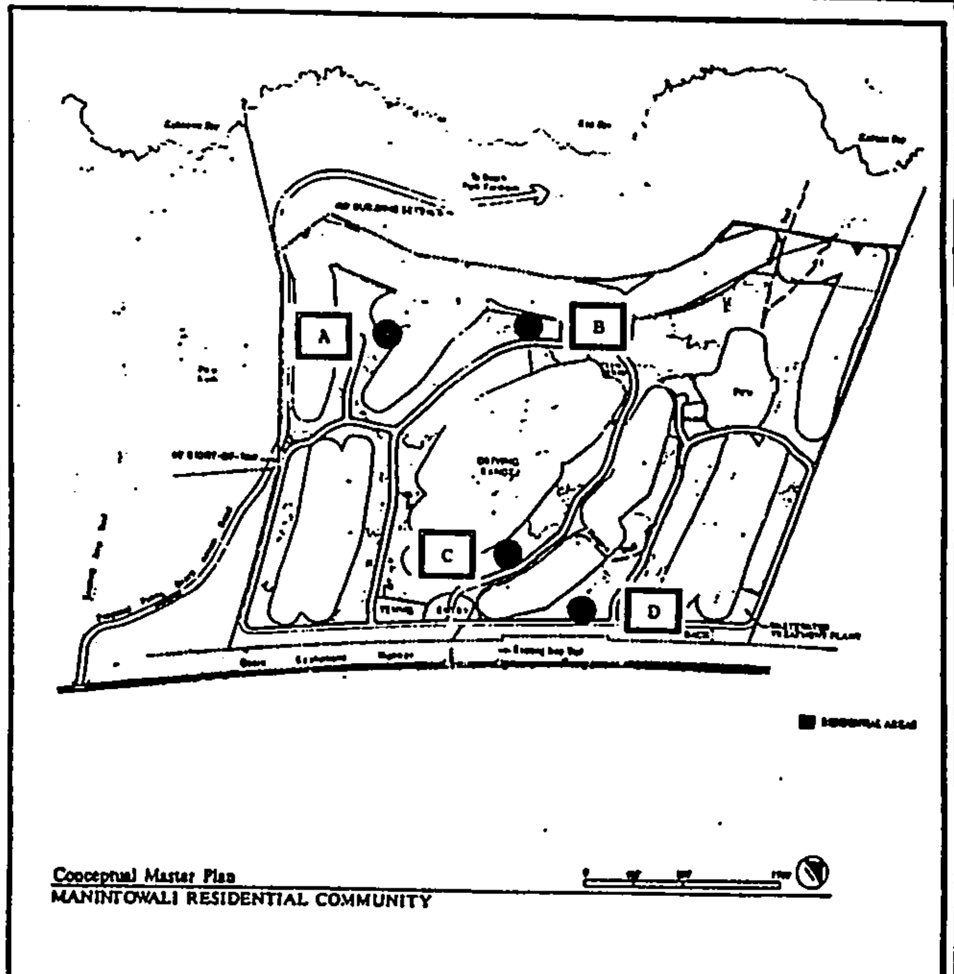

FIGURE 2. NOISE MEASUREMENT POSITIONS

Table 1. Summary of Noise Measurement Results

Pos.	Description/Dominant Source	Time/Period	Leq (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)	L1 (dBA)	Lmax (dBA)	Lmin (dBA)
				Percentile Exceeded * Sound Level					
A	About 1,200' south of the existing jeep trail; wind in foliage, birds	11:05-11:20 am; 15 minutes	38	36	37	40	41	43	35
B	Along the jeep trail, about 500' mauka of the makai property line; wind in foliage, bird, surf	10:23-10:34 am; 15 minutes	38	34	36	41	45	49	33
		3:20-3:30 pm 10 minutes	39	35	37	41	48	62	34
C	Along the jeep trail, about 1,000' from the highway or about 800' from the gate; wind in foliage, bird, one aircraft approaching	10:00-10:15 15 minutes	41	35	38	44	50	54	34
D	About 350' makai of the highway and about 700' north of the jeep trail; highway traffic noise	noon-3:00 pm 3 hours	49	36	41	51	62	68	33
		<u>15-minute intervals:</u>							
		12:00-12:15 pm	48	35	40	48	61	68	33
		12:15-12:30	50	36	41	54	63	65	33
		12:30-12:45	48	35	40	50	61	63	33
		12:45-1:00	49	36	42	51	62	64	34
		1:00-1:15	49	36	42	52	62	64	34
		1:15-1:30	50	35	40	50	64	66	34
		1:30-1:45	48	35	41	51	60	65	34
		1:45-2:00	52	36	43	56	64	66	34
		2:00-2:15	48	35	40	50	60	63	34
		2:15-2:30	45	36	41	48	57	62	34
		2:30-2:45	50	35	40	48	65	68	33
		2:45-3:00	50	37	42	53	62	67	34

* -- Percentile Exceeded Sound Level is defined as the level which was exceeded for a certain percentage of time during the measurement period. For example, an L10 of 60 dBA for a 20-minute measurement period means that during the 20-minute period, 60 dBA was exceeded for a total of 2 minutes (10% of 20 minutes).

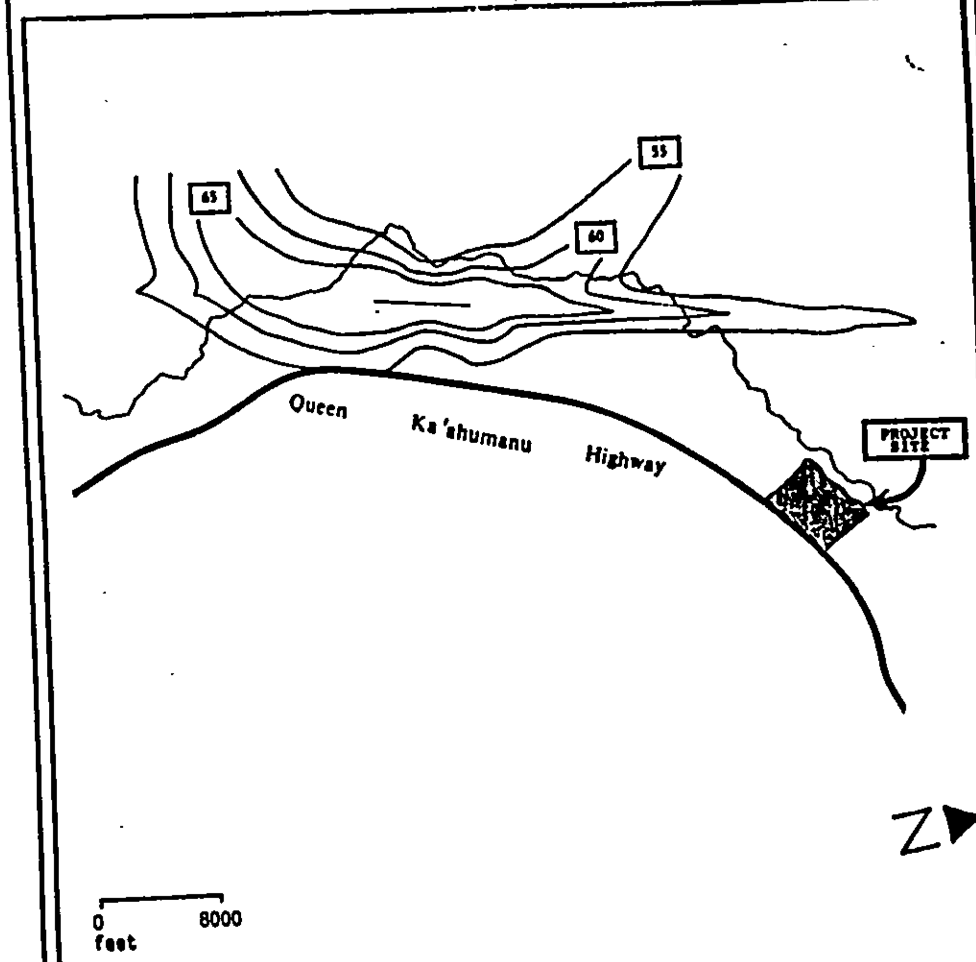

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FIGURE 3. KEAHOLE AIRPORT Ldn NOISE CONTOUR MAP FOR THE YEAR 1990

SOURCE: STATE DEPARTMENT OF TRANSPORTATION, AIRPORTS DIVISION may occur. However, most of these camping areas are exposed to high sound levels of surf and wind noise, with an Ldn levels probably exceeding 70 dB, depending on the weather condition. Due to this natural masking sound, the project-generated noise is not expected to cause any significant impact at these beach parks.

Discussions of potential noise sources that may impact the future noise sensitive areas within the project are provided below.

5.2 Traffic Noise -- Traffic noise field calibration was performed on June 3, 1991 at a site adjacent to Queen Kaahumanu Highway to utilize the Federal Highway Administration (FHWA)'s Traffic Noise Prediction Model (Reference 4). This calibrated model was then used with the traffic data provided in References 5 and 6, in order to estimate the existing and future traffic noise levels. The results of the calculations are summarized in Table 2. Since only comparative analysis is involved, the calculated levels are for an arbitrary distance of 100 feet from the centerline of the highway.

As can be seen from the table, the increases in the future Queen Kaahumanu Highway traffic noise levels due to project-generated traffic are at most 1 dBA. An increase in noise level of 1 dBA is usually not detectable by a person with a normal hearing, and therefore, it is not considered a significant noise impact. The table also shows that about 4 dBA increase in the highway traffic noise is expected due to the overall future growth. However, contribution from the project-generated traffic to this overall increase is considered negligible.

The nearest project residential areas to the Queen Kaahumanu Highway are to be located at a distance of about 400 feet. At a such distance, the Ldn level is estimated to be at most about 65 dB, and is in compliance with the HUD Site Acceptability Standards.

Similar calculations for the interior roads were also performed and the results are presented in Table 2. The results indicate that at a distance of 100 feet from the centerline of the roadway, the traffic noise levels are less than 60 dBA, using the "soft site" (i.e., single-story homes with dirt or grassy intervening grounds; no asphalt or concrete in between). Precise data for the road are not yet available, and therefore, a 35 mph average speed and a 1% heavy truck and 1% medium truck mix were used for the calculations. Analyses also indicate that the 65 dB Ldn contour line for the road is at a distance of about 40 feet from the centerline, regardless of "soft" or "hard"

TABLE 2. EXISTING AND FUTURE TRAFFIC NOISE LEVELS AT SELECTED LOCATIONS; 100' FROM THE CENTERLINE

Condition	QUEEN KAAHUMANU HIGHWAY		
	SOUTH OF THE PROJECT ACCESS ROAD	NORTH OF THE PROJECT ACCESS ROAD	PROJECT ACCESS ROAD
Existing a.m. Peak	70 - 71 dBA	70 - 71 dBA	--
Future a.m. Peak Without Project	74	74	--
Future a.m. Peak With Project	74	74	58
Increase in Future a.m. Peak Due to Project	less than 1	less than 1	--
Increase in a.m. Peak Due to Project and Future Traffic Growth	3 - 4	3 - 4	--
Existing p.m. Peak	69 dBA	69 dBA	--
Future p.m. Peak Without Project	72	72	--
Future p.m. Peak With Project	73	73	59
Increase in Future p.m. Peak Due to Project	1	1	--
Increase in p.m. Peak Due to Project and Future Traffic Growth	4	4	--

site. Therefore, according to the above calculations, if all residential structures are provided with a setback distances of 40 feet or more from the centerline of the interior roadway, the HUD standards of 65 dB Ldn will be satisfied.

5.3 Aircraft Noise -- As stated earlier, the overall existing Ldn due to aircraft activities does not cause any significant noise impact at the project site. The Keahole Airport is planning to extend the runway in the near future. This runway extension will cause an increase in the Ldn level at the project site. However, the site will still be exposed to levels well below 55 dB Ldn. Therefore, the project site will be in clear compliance with the DOT's 60 dB Ldn guideline limit for residential uses. The levels are also below the DOT's "minimal risk level" of 55 dB Ldn (see Figure 4).

5.4 Golf Course Clubhouse Activity Noise -- Noise sources associated with the clubhouse could include kitchen equipment, fans, air-conditioning equipment, refrigeration equipment, pool pumps, as well as sound systems for announcements and music. Noise from the clubhouse could potentially impact the nearby future residential areas. If the appropriate measures are not taken in the design of these facilities, noise generated by the above-mentioned noise sources may cause annoyance to the residents of the closest homes.

5.5 Golf Course Ground Maintenance Noise -- Noise from equipment associated with ground maintenance activities, including lawn mowers and leaf blowers, could have an adverse impact on the proposed residential areas particularly when the equipment is near the housing. However, noisy equipment is also incompatible and disruptive with golf play. Provided that all equipment powered by internal combustion engines is fitted with adequate exhaust mufflers, and that schedules are developed so noisier maintenance operations do not occur near the proposed residences before 7 a.m., the noise from ground maintenance operations should not cause "unreasonable" or "excessive" noise as defined in Reference 3.

5.6 Tennis Center Activity Noise -- The primary sources of noise from the tennis center, during a typical non-spectator tennis match, are racquet-to-ball impact, shoe screech, shouting and yelling. Noise generated by such activities may affect the proposed homes located adjacent to or near the tennis center. For example, based on our file noise data, a typical doubles tennis game could generate an L10 Percentile Exceeded Sound Level (i.e., the level exceeded 10% of the time) of about 58 dBA at a court fence-line. The Percentile Exceeded Sound Level is the level which was exceeded by a stated percentage of time during the measurement period.

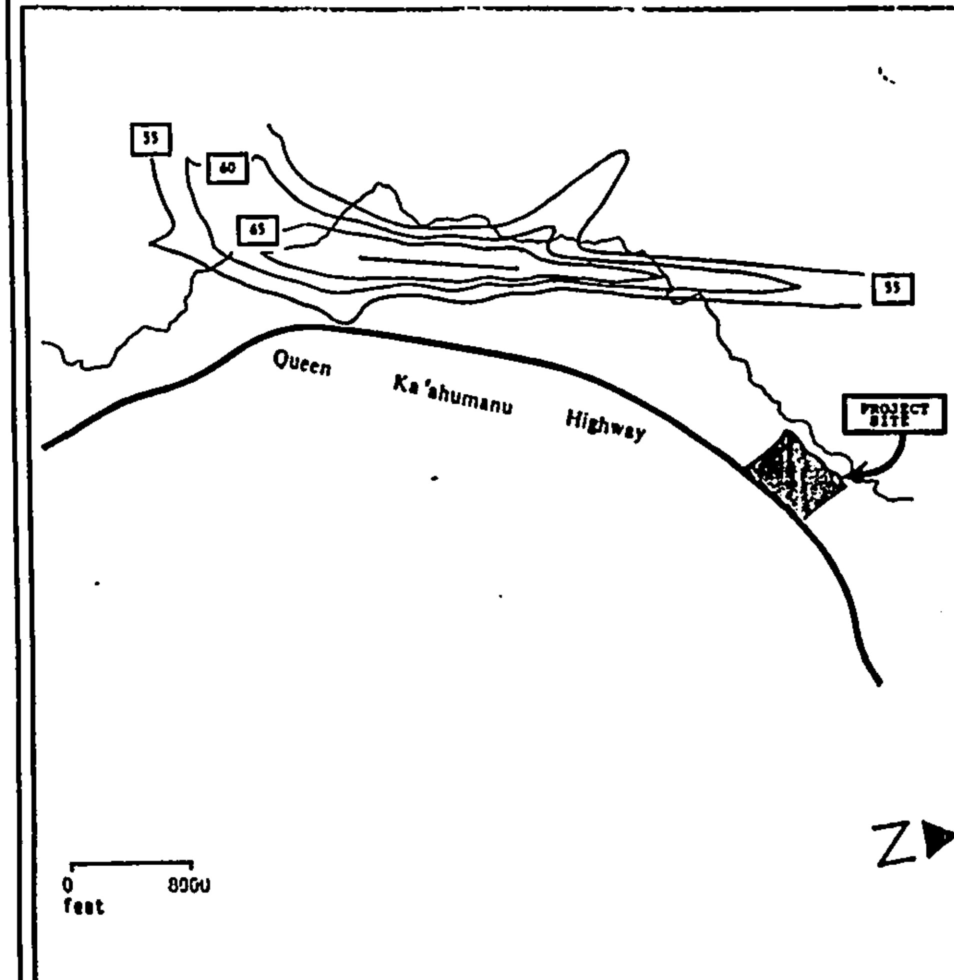

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FIGURE 4. KEAHOLE AIRPORT Ldn NOISE CONTOUR MAP FOR THE YEAR 2005 (WITH THE RUNWAY EXTENSION)

SOURCE: STATE DEPARTMENT OF TRANSPORTATION, AIRPORTS DIVISION

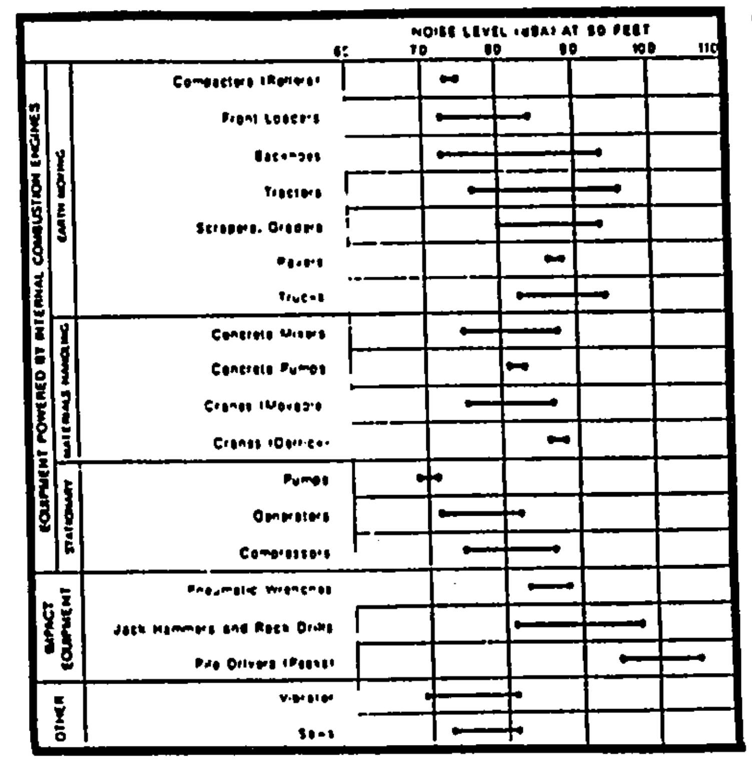
Although not enforceable in Hawaii County, the 58 dBA level exceeds both the DOH's daytime (7 am to 10 pm) and the nighttime (10 pm to 7 am) noise limit of 55 and 45 dBA, respectively. Adequate setback distances between the tennis courts and the common property line (between the tennis center and the adjacent homes) and strict administrative control measures are recommended in order to comply with the guidelines. It is our understanding that spectator-type tennis matches will not be held at the tennis center, and therefore, no crowd cheering or PA sound system noise will occur.

5.7 __Stationary Equipment Noises__ -- Noise from air-conditioning equipment; pool pumps; exhaust fans; trash compactors; and any other stationary equipment at the Clubhouse, Tennis Center, sewage treatment plant and residential complexes should be controlled so that they do not exceed the allowable noise levels specified in Reference 3. Trash pickup and delivery vehicles should be operated and scheduled to cause minimum disturbance to neighboring residential units if complaints arise.

5.8 __Construction Noise__ -- Development of the project site will involve grubbing, grading, and the construction of infrastructure and buildings. The various construction phases of a development project may generate significant amounts of noise; the actual amounts are dependent upon the methods employed during each stage of the process. Typical construction equipment noise ranges in dBA are shown in Figure 5. Earthmoving equipment such as bulldozers and diesel-powered trucks will probably be the loudest equipment used during construction for the majority of the project. However, the construction may involve rock hammers and drills as well as possible blasting. Equipment using impact to break rock is noisy (as seen in Figure 5, where 82 to 98 dBA at 50 feet is indicated as being typical of jack hammers and rock drills). The breaking of rock by explosion is usually accomplished by using numerous small charges detonated with small time delays. Also, the immediate blast area is covered by a blast mat with the purpose of (a) directing the explosive energy into the rock, (b) muffling the airborne pressure pulse, and (c) controlling flying debris.

6. NOISE MITIGATION MEASURES

The design of the project should include noise mitigation measures, including proper location, adequate setback distances, appropriate building design and orientation of the air-conditioning equipment, exhaust fans, pool pumps, amplified speaker sound systems, tennis courts, bleachers, etc., such that the HUD standards and the DOH noise



Note: Based on Limited Available Data Samples

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FIGURE 5. CONSTRUCTION ACTIVITY NOISE LEVELS

SOURCE: U.S. ENVIRONMENTAL PROTECTION AGENCY 1972 guidelines are satisfied. Furthermore, strict administrative controls should be enforced to reduce the possibility of the facility-related activities creating annoyance to the future residents nearby.

Although not required, it is recommended that the construction equipment and on-site vehicles or devices requiring an exhaust of gas or air should be equipped with mufflers. Also, construction vehicles using local roadways should satisfy the noise level requirements defined in Reference 7.

• • •

This concludes our noise impact assessment study of the project. Please feel free to call if you have any questions.

Sincerely,

Mike S. Lee
Senior Consultant

MSL:msl

REFERENCES:

1. "HUD Environmental Criteria and Standards, 24 CFR Part 51, "Federal Register, Volume 44, No. 135, July 12, 1979; amended 49 FR 880, January 6, 1984.
2. State Department of Transportation, Airports Division, Land Use Compatibility Guideline, received 1988
3. "Chapter 43 -- Community Noise Control for Oahu," Department of Health, State of Hawaii, Administrative Rules, Title 11, November 6, 1981.
4. "FHWA Highway Traffic Noise Prediction Model", Federal Highway Administration, December 1978.
5. Traffic Data from The Traffic Management Consultant, dated May 23, 1991
6. Traffic Summary, Island of Hawaii, 1988, State Department of Transportation, Highways Division,
7. "Chapter 42 - Vehicular Noise Control for Oahu", Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.

APPENDIX I

DAY NIGHT AVERAGE SOUND LEVEL, Ldn

The Day Night Average Sound Level, Ldn, is a commonly used noise metric in assessing land-use compatibility, and is used by federal and local agencies and standards organizations (U.S. Environmental Protection Agency, U.S. Department of Housing and Urban Development, Federal Aviation Administration, State Department of Transportation, American National Standards Institute, etc.).

The Ldn is an average, on an energy basis, of 24 consecutive A-weighted hourly Leq sound levels, to which a 10 dBA penalty is applied for the nighttime and early morning hours (10 pm to 7 am), to account for people's higher sensitivity to noise during this period.

Typical outdoor Ldn values are provided in Figure I-1.

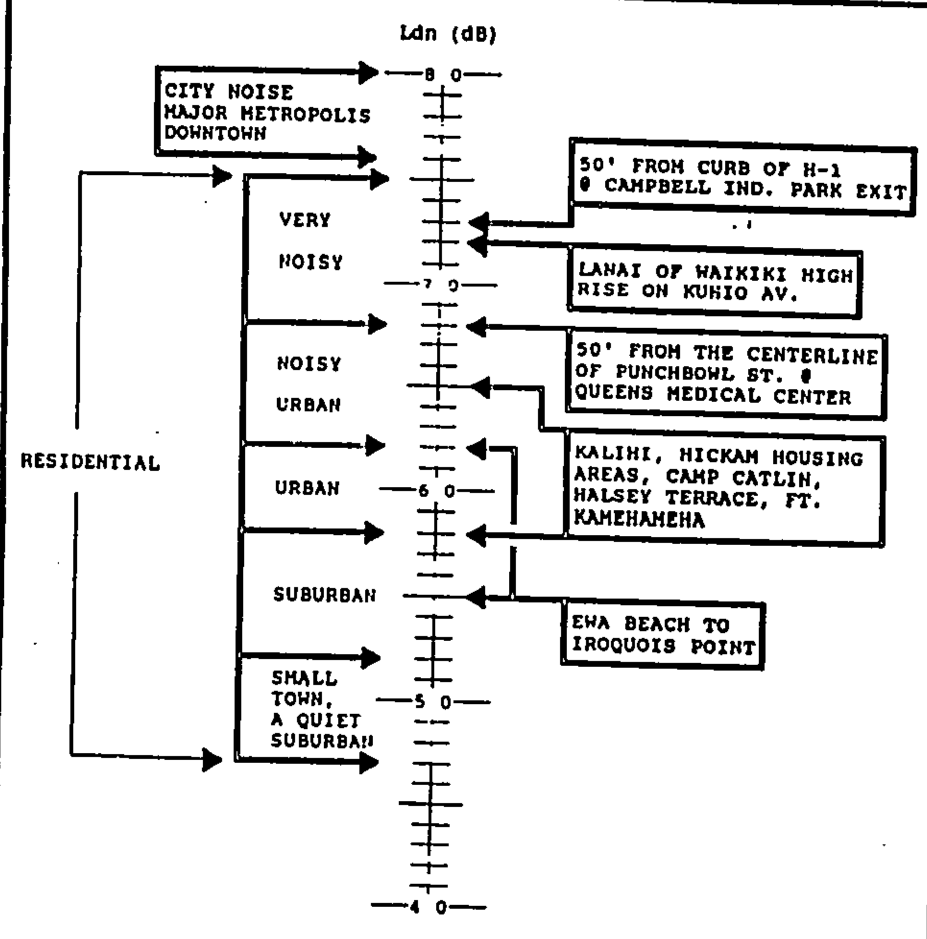

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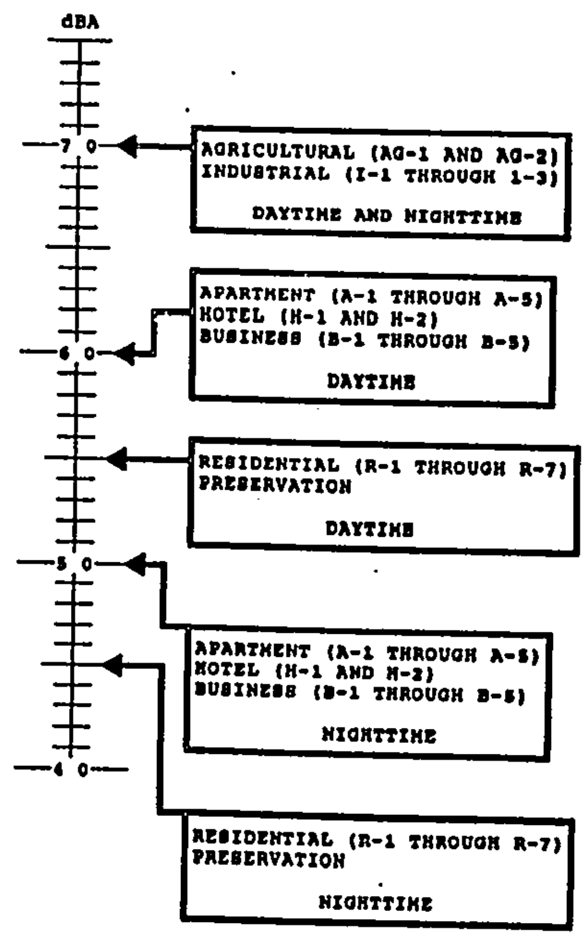
FIGURE 1-1. QUALITATIVE DESCRIPTION OF THE DAY-NIGHT AVERAGE SOUND LEVEL (Ldn) AND SELECTED LOCATIONS ON OAHU EXPOSED TO THE Ldn LEVELS INDICATED

APPENDIX II

ALLOWABLE NOISE LEVELS FOR VARIOUS ZONING DISCTRICTS
COMMUNITY NOISE CONTROL FOR OAHU
STATE OF HAWAII, DEPARTMENT OF HEALTH

NOTE: THE REGULATION STATES THAT THE ALLOWABLE LEVELS SHALL NOT BE EXCEEDED FOR TEN PERCENT OF THE TIME WITHIN ANY TWENTY MINUTE PERIO



APPENDIX M

AIR QUALITY STUDY
FOR THE PROPOSED
MANINIOWALI RESIDENTIAL COMMUNITY PROJECT

NORTH KONA, HAWAII

Prepared for:

Group 70, Limited

October 1991

B. D. NEAL & ASSOCIATES
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P.O. BOX 8239, CAPTAIN COOK, HAWAII 96704-8239
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CONTENTS

FIGURES

TABLES

TABLES (cont.)

Table

1.0 SUMMARY

North Kona Development Group is proposing to develop the Maniniowali Residential Community on about 388 acres of land makai of Queen Kaahumanu Highway near Kua Bay in the North Kona District on the island of Hawaii. Major elements of the project include: 1000 residential units, an 18-hole golf course with clubhouse and driving range and a tennis center. Construction is presently scheduled to begin during 1994 with a full build-out date of 2006. 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 Kua Bay area is very much affected by its leeward and coastal situation. Much of the time the area is sheltered from the tradewinds by the mountains to the east and north. During periods of strong trade winds, however, winds flow through the gap between the Kohala Mountains and Mauna Kea and reach the areas to the lee. Kona storms generate occasional 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 about 5 and 15 miles per hour, although there can be prolonged periods of higher or lower wind speeds. There are no published temperature data specifically for the project area, but based on data from other nearby locations, average daily temperatures probably range from about 70 to 85°F. Average annual rainfall is estimated to amount to about 20 inches.

Air quality in the vicinity of the project is mostly affected by emissions from natural and/or vehicular sources. The dominant factor for the past several years has been the volcanic haze (vog) from Kilauea Volcano which eventually drifts into the Kona and Kohala areas from more than 50 miles away. Other natural sources of air pollution that may affect the air quality of the site include the ocean, plants and wind-blown dust. Queen Kaahumanu Highway, adjacent to the project site, is a major arterial roadway. Depending on the prevailing wind direction, emissions from motor vehicles traversing Queen Kaahumanu Highway may also be carried over the project site.

Virtually no air quality monitoring data are available from the State Department of Health for the North Kona area. Based on what little data are available, it appears likely that both state and national ambient air quality standards are currently being met despite the persistent vog.

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 or chemically stabilizing 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 Queen Kaahumanu Highway. 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 air pollution both with and without the proposed project. 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 2006 without the project, the highest concentrations were predicted to increase slightly mostly due to an expected increase in background concentrations. In the 2006 with project scenario, maximum concentrations within a small area will be substantially higher compared to the without project case due to the creation of a signalized intersection, but concentrations should remain 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 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.

The proposed wastewater treatment plant for the project will be located in the northeast corner of the project site. Areas immediately to the northwest of the facility could occasionally experience nuisance odor, although proper design and operation of the plant should all but eliminate the problem.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not

made, but based on the estimated emission rates involved and the relative changes in demands, the attendant impacts are expected to be small. Adopting energy-saving design features and promoting conservation and recycling programs within the proposed development could serve to reduce any impacts.

2.0 INTRODUCTION AND PROJECT DESCRIPTION

North Kona Development Group is proposing to develop the Maniniowali Residential Community on approximately 388 acres of land in the North Kona District on the island of Hawaii. As indicated in the project location map given in Figure 1, the project site is located immediately makai of Queen Kaahumanu Highway about 6 miles north of Keahole Airport near Kua Bay. The land the project would occupy as well as much of the surrounding areas were inundated by lava flows during the 1800's or before and currently exist as old lava fields. The master plan for the project (see Figure 2) calls for a 1000-unit residential community to be constructed around an 18-hole golf course. Other elements of the proposed development would include a golf clubhouse, a driving range, a tennis center, a park, archeological preserves, roads and a wastewater treatment plant. The first phase of construction is expected to begin during 1994 with the first residential lots being sold during 1996. Full buildout would be completed by 2006.

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 potential 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.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit, and the state 1-hour limit 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 most of the state and 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.

North Kona, the site of the proposed project, is located near the midpoint of the western coast of the island of Hawaii. The topography of this island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes. The site of the proposed project occupies a portion of the lower western slope of Hualalai extending from near sea level up to an elevation of about 200 feet.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach the

areas to the lee. Due to wind shadow effects caused by the terrain, winds in the Kailua-Kona and Keahole areas are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds tend to dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds which move downslope and out to sea. Calms occur about 29 percent of the time at nearby Keahole Point [3]. Wind speeds at the project site are likely somewhat faster on average than at Keahole due to the site's closer proximity to the gap between Mauna Kea and the Kohala Mountains.

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 wind tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location and low-level elevation results in a relatively moderate temperature profile compared to windward locations near sea level. At the Old Kona Airport, located a few miles to the south of the project, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [4]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F.

Temperatures at the project site are probably near this range or possibly slightly warmer.

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. It is oftentimes 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 the best during stability class 1 conditions and the worst when stability class 6 prevails. In the North Kona area, stability class 5 or 6 is generally the highest stability class that occurs, developing 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 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

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 is no mixing height data for the North Kona area, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in North Kona probably tend to be somewhat lower due to the fact that light winds often prevail and also because sea breeze conditions often develop during the daytime.

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. The North Kona area being a leeward location experiences a relatively dry climate, especially at lower elevations. Some of the rainfall occurs in conjunction with winter storms, and some occurs during summer afternoons and evenings as a result of the onshore and upslope movement of moisture laden marine air. At the Old Kona Airport, average annual rainfall amounts to about 24 inches but may vary significantly from one year to the next [4]. Moving north from Kailua, annual rainfall tends to decrease reaching a minimum of about 10 inches or less at Puako. Annual rainfall at the project site is probably somewhere near 20 inches.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural and/or vehicular sources. There are no industrial or agricultural air pollution sources nearby. 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 have chronically plagued the project area since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from Kilauea 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 50 miles east of the project site, the prevailing wind patterns eventually carry the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area. The American Lung Association is currently studying the character and concentrations of volcanic air pollution in the Kona area. Preliminary results indicate that sulfate levels are up to five times higher in the Kona area compared to Hilo. Potential impacts on human health from the vog are still under study.

Queen Kaahumanu Highway, which borders the project site on the east, is the region's major arterial roadway. Some contamination from the exhausts of motor vehicles traversing Queen Kaahumanu Highway and other roadways nearby occurs, although elevated concentrations are likely confined to limited areas near intersections where and when traffic congestion occurs during poor dispersion conditions.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very little data are available for the island of Hawaii, and even less are available for the Kona area specifically. As indicated in Table 2, the only existing monitoring data in the

vicinity of the project site consist of sulfur dioxide and particulate measurements that were made about 20 miles to the south at Kealakekua during 1985 and 1986. During this two-year period, measurements of 24-hour average sulfur dioxide concentration at this location were consistently low with daily mean values ranging from less than 5 to 12 $\mu g/m^3$. No exceedances of the state/national 24-hour AAQS for sulfur dioxide were recorded. Twenty-four hour average particulate concentrations ranged from 4 to 28 $\mu g/m^3$; no violations of the state AAQS were measured.

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 vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present 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, soil excavation and building demolition; 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.

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 [5] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activities of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%) and semiarid climate. Uncontrolled fugitive dust emissions from the proposed project would probably be somewhere near this level. In any case, State of Hawaii Air Pollution Control Regulations [6] 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 the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in

motion if they are transporting materials that could be blown away. In addition to windage, haul trucks tracking dirt onto paved streets from unpaved areas is oftentimes a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule 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. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. 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 by the year 1995 compared to the amounts now emitted due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect 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, whereas nitrogen oxides air pollution most often is a regional issue. This is reflected somewhat in the fact that the AAQS for carbon monoxide are specified on a short-term basis (1-hour and 8-hour averaging times) while the AAQS for nitrogen dioxide is set on an annual basis.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1991 with present conditions, year 2006 without the project, and year 2006 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. Presently, Queen Kaahumanu Highway in the vicinity of the project site is a two-lane roadway with through movements only. Without the project, it was assumed that there would be no roadway improvements. With the project, it was assumed that a project access road would be constructed forming a T-intersection with Queen Kaahumanu Highway and that the intersection would be signalized. It was further assumed that the project access road would be fully channelized providing for separate right and left turn movements and that Queen

Kaahumanu Highway would also have a left and a right turn lane as well as a southbound merge lane at the intersection. 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. The traffic impact assessment report indicates that traffic volumes both are and will be substantially higher during the afternoon than during the morning peak period. Worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations. Thus, even though traffic volumes may be higher in the afternoon than in the morning, worst-case air pollution concentrations may occur during the morning. To ensure that worst-case concentrations were identified, both morning and afternoon peak traffic periods were studied.

The EPA computer model MOBILE4 (8) was used to calculate vehicular carbon monoxide emissions for each of the years studied. One of the key inputs to MOBILE4 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 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 both the present and the future without project scenarios, cold- and hot-start fractions of 5 percent and 1 percent, respectively, were assumed due to the relatively isolated location of the study area. In the future with project case, 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 [9] and taking into consideration the likely origins of traffic operating through the intersection studied. MOBILE4 idle emissions (which pertain to stabilized engines) were adjusted to account for excess cold/hot-start emissions per a recent U.S. EPA memorandum [10].

An ambient temperature of 59 degrees F was used for morning peak-hour emission computations while a temperature of 68 degrees F was used for the afternoon case. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this and emission estimates given by MOBILE4 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4, these data were then input to the latest version of the computer model CALINE4 [11]. 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 'o occur in the area by the year 2006. Traffic queuing estimates were made based on the project traffic study, Transportation Research Board procedures [12] and U.S. EPA guidelines [13]. The speed limit presently on Queen Kaahumanu Highway is 55 mph. After the project is built, vehicles using Queen Kaahumanu Highway were assumed to accelerate to 45 mph, while traffic on the project access roads was assumed to move at 35 mph. Deceleration and acceleration times of 20 and 25 seconds, respectively, were assumed for vehicles traveling at 45 mph, whereas values of 16 and 18 seconds were assumed for those travel , at 35 mph.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Presently, there are no pedestrian walkways along the roadways within the project area and none were assumed to exist when the project is completed in 2006. Thus, model receptor sites were located near the edge of the road right-of-ways at distances of about 10 meters from the traveled portions of the roadways near the intersection studied. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone.

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 6 was assumed for morning scenarios and stability category 4 was assumed for afternoon cases. These are the most conservative stability categories that can be used for

estimating pollutant dispersion at suburban or undeveloped locations. A surface roughness length of 10 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 with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at relatively low levels. 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 the 1991 scenario. Due to the significant development that is predicted to oc--r in the project area within the next several years, a background value of 0.5 ppm was used for all 2006 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 0.6 mg/m^3. This is predicted to occur during either the morning or the afternoon peak traffic hour near the location of the proposed intersection of Queen Kaahumanu Highway and the project access road (as a result of through traffic only on Queen Kaahumanu Highway). In the year 2006 without the proposed project, the worst-case 1-hour concentration is projected to increase somewhat at this location to about 1.2 mg/m^3 during the morning peak traffic hour, mostly due to the anticipated increase in background concentration. With the project, the predicted worst-case 1-hour concentration in 2006 increases to 6.3 mg/m^3 and is predicted to occur during the morning peak traffic period. Predicted with project concentrations are substantially higher than without the project due to the assumed presence of a signalized intersection. However, even though with-project concentrations may increase significantly, 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 monitoring 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 modeling [14] concluded that 1-hour to 8-hour concentration ratios could typically be expected to range from 0.4 to 0.5. EPA guidelines [13] 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 [15] 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 concentrations were 0.3 mg/m^3 for the 1991 scenario and 0.6 mg/m^3 for the without project case in 2006. (Due to through traffic only on Queen Kaahumanu Highway). With the project access road intersection, the worst-case 8-hour concentration is

predicted to increase to 3.2 mg/m^3. Comparing these predicted values to the AAQS, it can be concluded that both the state and the national 8-hour standards will be achieved in the project vicinity both during the present year and during 2006 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 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 Pesticide Usage

Once the project is completed and the golf course is in use, it will be necessary to regularly apply various chemical pesticides to maintain grass quality. Herbicides are applied to greens, tees, fairways and perimeter areas, and insecticides and fungicides are used on greens and tees and for spot treatment of fairways. Golf course pesticides are applied with 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 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.

Murdoch and Green (16) have examined the potential impacts on air quality resulting from sprayer drift and have concluded that, if appropriate application techniques are used, there will be no significant adverse effects. Application during low wind speeds and using low nozzle heights, low spray pressures and coarse nozzle openings are recommended. Use of shrouded spray equipment will also reduce spray drift. Sufficient buffer space with tall vegetation between the golf course and housing sites and other facilities will further reduce the chance of exposure.

7.3 Wastewater Treatment Plant

As indicated in the master plan presented as Figure 2, a wastewater treatment plant will likely be located on the northeastern corner of the project site. Depending on facility size and design, gaseous and/or particulate emissions from wastewater tre· ·ent plants can potentially impact air quality. Even relatively minor emissions can in some cases cause nuisance odor problems if sensitive receptor areas exist at downwind locations near the plant.

Although final design details of the plant are not yet available, wastewater quantities are expected to amount to about 360,000 gallons per day. Wastewater will likely be conveyed to the 1.7-acre facility via gravity sewers and force mains located along the proposed roadway system to the extent that the terrain and site layout will allow. Wastewater entering the plant will receive both primary and secondary treatment; the treated effluent will then be pumped into a storage pond, blended with non-potable water and used

to irrigate the project golf course. Although it has not yet been specified, sludge resulting from the process will likely be dewatered and disposed of off site (avoiding any onsite particulate emissions).

A facility of this size and type will present at most only a minor odor nuisance. The location of the plant in the northeast corner of the project site will provide a buffer distance of several hundred feet to the nearest residences in all directions except to the northwest. Project homes or the immediate adjacent property located along the northern boundary of the site will likely be downwind of the facility early in the morning when drainage winds often prevail and when dispersion conditions are least favorable. Thus, any odors emanating from the plant will have the greatest potential to impact these areas for brief periods of time.

Control of odors emanating from wastewater treatment plants can be achieved by:

1) Controlling the characteristics of the wastes discharged to the sewers (in this case it will be mainly home discharges);

2) Limiting odor production by designing facilities to prevent slow-moving wastewater streams in sewers and by proper handling of the recycle of anaerobic sidestreams from solids processing systems;

3) Treating odors in the liquid phase with chemicals rather than waiting to let them move into the gas phase;

4) Covering, ventilating and treating foul air from process units that are likely to give off odor;

5) Designing and locating ventilation points so as to enhance atmospheric dispersion.

All of the above are general odor control measures that should be considered when designing the proposed facility.

7.4 Electrical Demand

The proposed project would also cause indirect emissions from power generating facilities as a consequence of electrical power usage. Peak project power demand at full build-out is not expected to exceed about 4.2 megawatts. Present generating capacity on the Big Island is 161 megawatts with most of this power provided by oil-burning generating units. Island wide, peak-power demand is currently about 120 megawatts. Average annual electrical demand of the project when fully developed is not expected to exceed about 15 million kilowatt-hours. In the worst case, this power demand would be provided mainly by oil-fired generating facilities located on the island. In order to meet the electrical power needs of the proposed project, power generating facilities would have to be expanded and/or burn more fuel, and hence more air pollution would be emitted at these facilities. Given in Table 3 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at Hawaii's oil-fired power plants. Based on the ratio of peak project power demand to total present peak power demand on Hawaii, the project power demand would result in about a 3 percent increase in emissions from the electric utility if all project power is derived from fuel oil.

7.5 Solid Waste Disposal

Solid waste generated by the project when fully completed is not expected to exceed about 7 tons of refuse (about one 6-ton truckload) per day. Presently, the refuse district handles about 360 tons per day. Most if not all project refuse would likely be hauled away and either landfilled or burned at another location. If all refuse is landfilled, the only air pollution emissions associated with solid waste disposal (assuming problems similar to those which currently exist at the Kailua Landfill are avoided) would be due to exhaust fumes and fugitive dust from trucks and heavy equipment used to place the refuse in the landfill. If, on the other hand, all or part of the refuse is burned at a municipal incinerator, disposal of solid waste from the project would also result in emissions of particulate, carbon monoxide and other contaminants from the incineration facility. Table 4 gives emission factors for municipal refuse incinerators in terms of pounds of air pollution per ton of refuse material charged. Thus, air pollutant emission rates in terms of pounds per year, for example, can be estimated by multiplying the emission factors given in the table by the number of tons per year of refuse that is burned.

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 about 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 chemical 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 Queen Kaahumanu 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 vehicular emissions, maximum carbon monoxide concentrations along roadways in the project vicinity in the year 2006 (at full buildout of the project) will be higher than

existing levels but should remain well within both state and national ambient air quality standards. Without the project, concentrations in 2006 will likely increase only slightly, mostly due to an expected increase in background concentrations.

Options available to mitigate long-term, traffic-related air pollution from increased project motor vehicle traffic are to improve roadways, reduce traffic or reduce individual vehicular emissions. Estimates of carbon monoxide concentrations from emissions emanating from vehicular traffic associated with the completed development include any roadway improvements recommended in the traffic impact study for the project. In this case, traffic entering and exiting the project from Queen Kaahumanu Highway was the primary concern. Construction of a signal-controlled T-intersection at this location with separate lanes for all traffic movements was assumed. With these improvements, maximum projected carbon monoxide concentrations in the project area are well within ambient air quality standards (with an interchange instead of an intersection, air quality impacts would be less). Thus, no further mitigation 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; spraying from low heights during favorable wind conditions; maintaining a safe distance from sensitive receptor sites; and planting vegetation screens around the golf course boundary.

At most, the project's wastewater treatment plant should constitute only a minor odor nuisance at locations to the northwest of the facility. The location of the plant with respect to the surrounding land uses and the prevailing wind pattern is probably optimum insofar as odor impacts are concerned. Proper design and operation of the facility will minimize any air quality impacts.

Any long-term impacts on air quality due to indirect emissions from power generating facilities supplying the project with electricity and from the disposal of waste materials generated by the project will likely be small. Nevertheless, indirect emissions from project electrical demand could be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; movable, controlled openings for ventilation at opportune times; and possibly automated room occupancy sensors. Any air quality impacts from solid waste disposal could be reduced through the promotion of conservation and recycling programs within the proposed development. This would reduce solid waste volumes which would in turn reduce any related air pollution emissions proportionately.

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. R.W. Armstrong, ed., Atlas of Hawaii, Second Edition, University of Hawaii Press, 1983.

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. 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.

6. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

7. The Traffic Management Consultant, Draft Traffic Impact Assessment Report for the Proposed Maniniowali Residential Community Project, June 1991.

8. User's Guide to MOBILE4 (Mobile Source Emission Factor Model), EPA-AA-TEB-89-01, 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, February 1989.

9. Benson, Paul E., "Corrections to Hot and Cold-Start Vehicle Fractions for Microscale Air Quality Modeling", California Department of Transportation, Transportation Laboratory, Sacramento, California.

10. Memorandum from Terry P. Newall, U.S. Environmental Protection Agency, Ann Arbor, Michigan, to MOBILE4 Users concerning "Adjustment of MOBILE4 Idle CO Emission Factors to Non-Standard Operating Conditions", January 4, 1990.

11. 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.

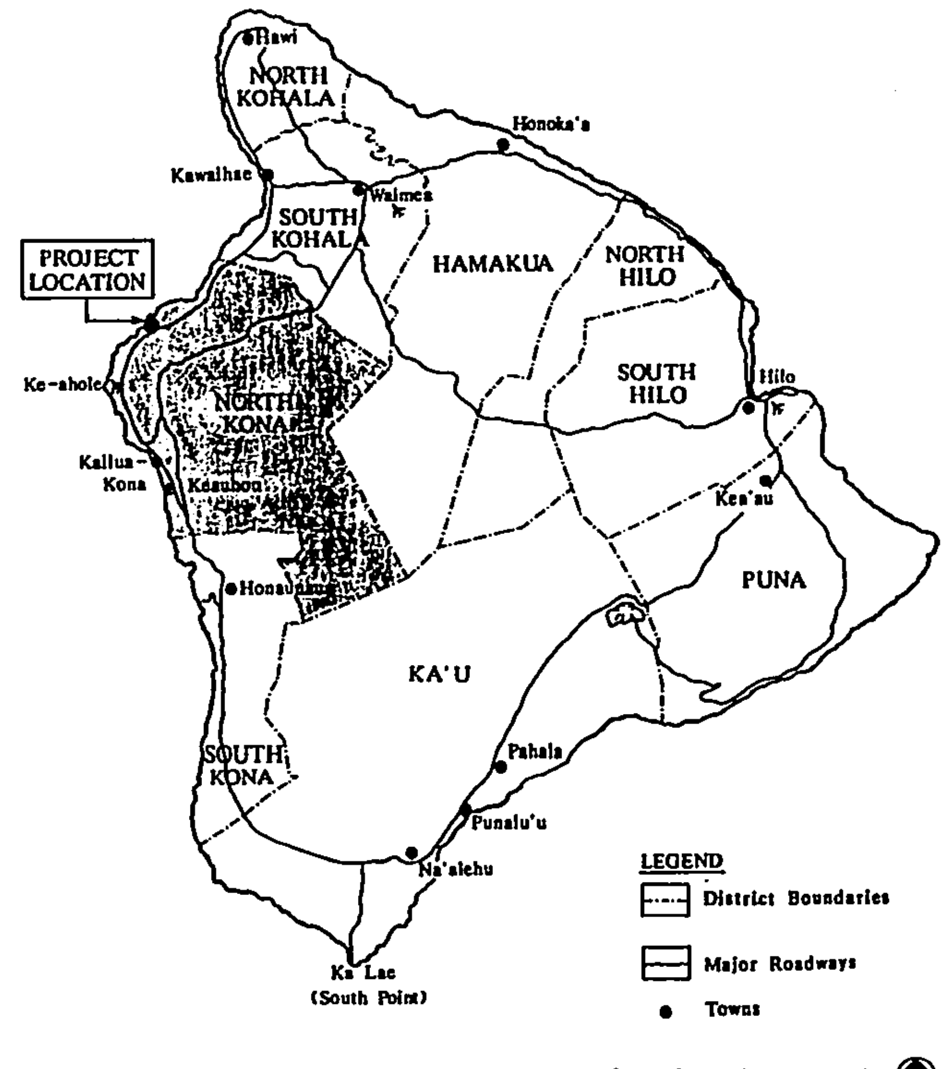
12. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., Special Report 209, 1985.

13. Guidelines for Air Quality Maintenance Planning and Analysis: Indirect Sources, Volume 9 Revised, U.S. Environmental Protection Agency, September 1978.

14. "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.

15. Hawaii Air Quality Data for the Period of January 1985 to December 1987, State of Hawaii Department of Health.

16. "Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Maniniowali Golf Course", Charles L. Murdoch and Richard E. Green, Draft, March 30, 1991.



Hawaii Location Map
MANINI'OWALI RESIDENTIAL COMMUNITY
FIGURE 1

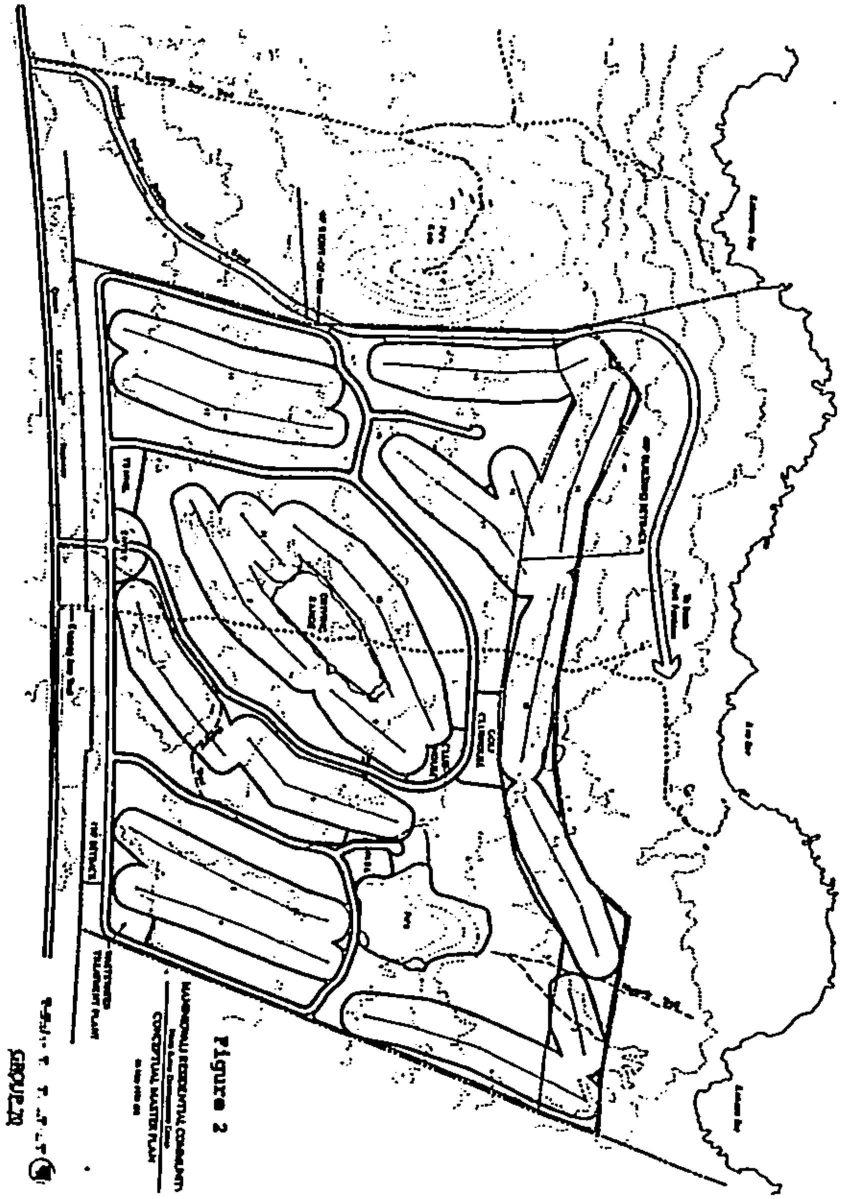


Figure 2

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration: National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	µg/m³	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	µg/m³	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	µg/m³	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	µg/m³	Annual	100	100	70
Carbon Monoxide	mg/m³	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	µg/m³	1 Hour	235[b]	235[b]	100[b]
Lead	µg/m³	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 MANINIOWALI PROJECT

Parameter / Location	1985	1986
Sulfur Dioxide / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	31	40
Range of 24-Hr Values (ug/m3)	<5-8	<5-12
Average Daily Value (ug/m3)	<5	<5
No. of State AAQS Exceedances	0	0
Particulate / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	34	40
Range of 24-Hr Values (ug/m3)	6-22	4-28
Average Daily Value (ug/m3)	12	16
No. of State AAQS Exceedances	0	0

Source: State of Hawaii Department of Health, "Hawaii Air Quality Data for the Period of January 1985 to December 1987"

Table 3

ESTIMATED WORST-CASE CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR MANINIOWALI RESIDENTIAL COMMUNITY
(milligrams per cubic meter)

Year/Scenario	Averaging Time 1-Hour	Averaging Time 8-Hours
1991/Present	0.6	0.3
2006/Without Project	1.2	0.6
2006/With Project	6.3	3.2
Air Quality Standard:		
National	40.0	10.0
State	10.0	5.0

Table 4

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM MANINIOWALI PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	3
Sulfur Dioxide	38
Carbon Monoxide	8
Volatile Organics	3
Nitrogen Oxides	36

[a]Based on U.S. EPA emission factors for utility gas turbines [5]. Assumes electrical demand of 15 million kw-hrs per year and low-sulfur oil used to generate power.

Table 5

AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)[a]

Air Pollutant	Emission Factor
Particulate	0.38
Lead	0.022
Sulfur Dioxide	1.1
Carbon Monoxide	2.2
Volatile Organic Compounds	0.11
Nitrogen Oxides	3.6

[a]Assumes mass burn unit with 99 percent control of particulate emissions. Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.

Source: U.S. Environmental Protection Agency [5]

APPENDIX N

Manini'owali Residential Community

Social Impact Assessment

Prepared for North Kona Development Group

by Earthplan

October 1991

1 Background and Introduction

The North Kona Development Group (NKDG) proposes to develop the Manini'owali Residential Community in North Kona, Hawai'i. An Environmental Impact Statement (EIS) is being prepared to provide pertinent information in these processes. This report assesses the potential social impacts of the project and was prepared by Earthplan. Assistance was provided by three independent contractors: John Clark (ocean recreational assessment and assistance in field interviews), Lani Nedbalek (assistance in field interviews), and Michael P. Mays (research in demographics and community issues).

2 Profile of the Existing Region and Communities

The study area for this study encompasses the North Kona and South Kohala Districts, as illustrated in *Figure A*. From a social impact standpoint, the most significant characteristic of the study area is the rapid population and economic growth over the last twenty years. North Kona and South Kohala was home to an estimated 31,424 residents in 1990, which is over four times the combined 1970 population of 7,142 persons (*Figure B*). The District's average annual growth rate of almost eight percent for those twenty years is extremely high by any standard (*Table 1*). This rapid growth can be attributed primarily to the development and growth in visitor facilities.

Housing trends were consistent with population changes. *Table 2* indicates that in 1970, the study area contained approximately 2,773 housing units; by 1980, the total study area count increased to 8,853 units which represents an increase of 219 percent. The bulk of the growth occurred in North Kona, where housing units increased by almost 5,000 units. The preliminary 1990 housing count is 14,225 housing units. Although North Kona contained the bulk of the housing supply (almost 10,000 units), it was South Kohala which experienced the major housing supply increase in the 1980s.

Demographic trends based on the 1970 and 1980 census indicate the following:

1. **Ethnic, age and education distinctions.**

   Whereas the two largest ethnic groups in Hawai'i County are Caucasians and Japanese, the two largest ethnic groups in North Kona and South Kohala are Caucasians and Hawaiians. North Kona's population is slightly younger than the island-wide norm with a median age of 28.9 years. Also, study area residents tended to receive more post-high school education than the county-wide averages (*Table 4*).

2. **Statistical evidence of high in-migration.**

   The study area had proportionally more people who were born in other states, when compared to Hawaii County. In North Kona, about 40 percent of the 1980 population were born in another state, while 30 percent of South Kohala fit this category. In-migration tended to be more recent in North Kona (*Table 4*).

3. **Low unemployment rate and predominance of visitor-related jobs**

   In 1990, the study area unemployment rates of 2.8 and 2.9 percent were significantly low compared to the county-wide rate of 3.8 percent. In 1980, North Kona and South Kohala were highly represented in service occupations. Consistent with the predominant visitor industry, the study area was highly represented in the personal, entertainment, and recreational industries, as well as the retail trades. Both North Kona and South Kohala were under-represented in public administration compared with the county.

   Ranching and agriculture are still important in South Kohala, as can be seen in the high representation in farm/fish/forest occupations and agriculture/mining industries (*Table 5*).

4. **Small households, increase in owner-occupied units and high housing costs.**

   At an average of 2.92 persons, North Kona households tended to be smaller than the overall county average household size of 3.09 persons. Comparing 1970 to 1980, more owners lived in their housing units in 1980.

   For North Kona, the median monthly rent was $331; South Kohala, $307. Both were much higher than Hawai'i County's $223 median monthly rent. The 1980 median value of owner occupied houses was also higher in North Kona ($114,000) and South Kohala ($97,500). Hawai'i County median value was $70,300 (*Table 6*).

5. **Distinctions among the individual communities** (*Tables 7 and 8*).

   In 1990, the individual communities generally shared the characteristics discussed earlier. The following are distinctions among these communities:

   - *Kalaoa* (the CDP nearest the project site):
     - home to an estimated 4,500 people in 1990;
     - the most family-oriented of the study area (three-fourths of the population were in family households; almost two-thirds include married couples);
     - slightly higher median age than the County and a higher proportion of people in the labor force ages of 18 through 64;
     - most housing units (95 percent) are single-family units, and three-fourths of units are owner-occupied; and

     - largest household sizes with 2.92 persons and 2.76 persons for owner- and renter-occupied units, respectively.
   - *Kailua*:
     - the largest community near the project site (9,100 persons in 1990);
     - the youngest of the nearby communities with a median age of 31.8 years;
     - less family-oriented and less married couples than Kalaoa;
     - almost equal number of single- and multi-family units;
     - highest proportion of crowding with 17 percent of the units having one or more persons per room; and
     - lowest rent and value of owner-occupied homes.
   - *Puako*:
     - the smallest community (1990 estimated population of 397 persons;
     - almost 80 percent are Caucasian;
     - oldest of all the nearby communities (median age in 1990 was 36.6 years);
     - least family-oriented of the nearby communities;
     - highest housing vacancy rate;
     - most expensive homes (1990 median value averaged over $500,000); and
     - smallest households.
   - *Waikoloa*:
     - newest community with a population of 2,200 people in 1990;
     - youngest population (median age of 32.8 years in 1990);
     - more multi-family units (55 percent) than single family units;
     - high level of renters; and
     - highest median monthly rent ($882).

3 No-Project Scenario

This study examined major public policies and proposed development projects -- along with the profile on the existing community -- to develop a profile of what the study area would be like without the Maniniʻowali Residential Community. This profile is the basis for identifying potential social impacts of the project and community expectations for the future. A possible future of the study area is as follows:

1. **Continued and rapid in-migration.**

   The Office of State Planning estimates that, if all of the proposed resort developments are built, the population in West Hawaiʻi (including North Kohala and South Kona) could reach 79,000 by 2005 and, at ultimate build-out, 99,000 persons. This population increase would be due to the increase in labor force needed to support the proposed number of visitor rooms.

   In 1990, North Kona and South Kohala accounted for 72 percent of the total West Hawaiʻi population count, which also includes North Kohala and South Kona. If this proportion is maintained, the study area could have a 2005 population of 57,000. 20 This implies an 83 percent increase over the 1990 population of 31,424, and an average annual increase of 4.09 percent. Though lower than historical trends for this area, this average annual growth rate is still higher than county-wide and statewide norms.

2. **Increased need for affordable housing and increased supply.**

   The study area has a very low unemployment rate and it is anticipated that non-area residents will be needed to fill most of the projected anticipated new jobs. This expectation is consistent with State assumptions in developing the planning scenario for the **West Hawaii Regional Plan.**

   The new residents will compete with existing residents who are seeking affordable housing. Affordable housing is already a pressing need in West Hawaiʻi, and further in-migration will exacerbate this need.

   An increase in the supply of affordable housing will be due mostly to two sources. First, publicly-sponsored housing in support communities such as Kawaihae, Waikoloa, Lalamilo and Kealakehe, will provide a large portion of the much-needed housing. Only Kealakehe is being developed at this time.

20 *This is a very conservative share of study area population in West Hawaiʻi, since all of the support communities are located in South Kohala and North Kona.*

   Second, resort developers have made housing commitments yielding over 3,330 units. Many of these commitments will be implemented in the designated support communities.

3. **Creation of new communities and continued social diversity.**

   The study area currently experiences a high level of in-migration, as indicated in the census information presented in Section 2. As a result, North Kona and South Kohala differ from the rest of Hawaiʻi County in terms of ethnicity, age, education and other social factors.

   New support and resort-residential communities will emerge along the Kohala coast, as well as at Kealakehe. These communities will bring more new residents and the study area is expected to continue to vary from the average social characteristics of the State and the County.

4. **Decrease in centralization of employment and residential services and commercial establishments.**

   Currently the support services, commercial establishments and other facilities serving the West Hawaiʻi resident are located in primarily in Kailua, and secondarily in Waimea. As the new communities take form, they will contain many of these services and facilities though perhaps at a scale less than currently in these urban centers. These services and facilities include schools, shops, restaurants, social service agencies, churches and police and fire protection facilities. The degree to which new communities may be distinct from the existing communities, will depend on the extent of the full-service nature of the new developments.

4. **Increased diversity in types of jobs.**

   The visitor industry will continue to be the major source of employment in West Hawaiʻi, as expected due to public policy and proposed resorts. It is expected, however, that non-visitor-related jobs will also increase. As the community grows, there will be an increased need to service the various needs of the population. Thus, more and more development proposals are including industrial and commercial components as major elements, such as the Keahuolu business district proposed by the Queen Liliuokalani Trust.

5. **Change in visual landscape.**

   The coastline in the study area is expected to undergo drastic changes if all approved resort and resort residential units are built. Within the study area's four Resort Destinations Nodes, most of the approved 7,000+ hotel units already lie in the Urban boundaries of the State Land Use Map. Over 12,475 resort-residential units are also proposed for the study area's designated resort areas.

> As these developments occur, the vast openness of the study area's coast will become punctuated with pockets of communities. The communities will include golf courses, hotels, mid-rise and low-rise apartments, and single family houses. Public policy-makers will undoubtedly scrutinize each project to ensure minimal visual impact. Nevertheless, the openness, the "sense of space" and the vastness will be different from what exists today.

4 Potential Social Impacts

4.1 Potential Population Increase

The Manini'owali Residential Community will cause an increase in resident population in the study area, as indicated in *Table 1*. First, the Manini'owali Residential Community will house approximately between 2,000 and 2,230 residents. Second, an increase in residential population may also result from in-migration of 330 residents to fill permanent on-site jobs. The total population increase generated by the proposed project is between 2,300 and 2,600 persons.

This increase represents about an eight percent increase over the 1990 estimate of 31,424 residents in the combined North Kona and South Kohala Districts, and an approximate eleven percent increase over the current North Kona population. The actual share of population will be less by the time the project is fully built in 2005. The Manini'owali Residential Community and its permanent employees and their families would account for approximately three percent of the projected 2005 population.

4.2 Impacts on the Regional Character and Desired Future

Consistency with Expected Settlement Patterns

The community, including public officials, residents and business people, generally expects changes in what is now vast open spaces along the Kohala - Kona coast. Between Kawaihae and Keahole will eventually be three Resort Destination Nodes and three inland support residential communities.

The Manini'owali Residential Community is proposed in the context of these expected settlement patterns in North Kona and South Kohala. It is believed that the Manini'owali Residential Community will be seen as a compatible extension of the Kaupulehu-Kuki'o Resort Destination Node both visually and in type of residential community. Though there may be design distinctions between the proposed project and adjacent residential development, the Manini'owali Residential Community will likely be perceived as similar in market and concept as the residential components of the Kuki'o and Kaupulehu developments.

An Upscale Community

The project and other similar developments may contribute to social problems if it exacerbates the increasing economic disparities between the "haves and have-nots." Whether this occurs, however, depends on how the study area evolves over time. The following are two extreme scenarios for consideration:

- *Scenario #1: Social and economic integration* -- For the existing and new study area residents, the upscale nature of Manini'owali and other similar communities may not be a problem if the region strives towards social and economic integration. For successful integration among the existing and new residents, there needs to be a wide range and locational mixing of housing types. Community organizations should be easily accessible for residents and there should be no apparent exclusionary groups, facilities or areas. People feel comfortable with socio-economic diversity if they believe they have physical, legal and some economic access to most facilities. They need to believe that they have -- or can attain -- the same ability as others to compete for jobs and public services.
- *Scenario #2: Social Disharmony* -- On a societal level, social disharmony occurs when a definable group repeatedly feels excluded from a facility, area, service or otherwise resource they wish to access. This becomes increasingly problematic if access to a desirable area is terminated or altered to accommodate an exclusive group of people. Further, an individual's anxiety during personal economic crisis is heightened when faced with evidence of "conspicuous consumption" (expensive cars, exclusive clubs, designer clothes, etc.) exhibited by the wealthy.

Diversity in overall study area housing and jobs is a major ingredient in working towards social integration. Manini'owali Residential Community will help achieve diversity by contributing to or developing off-site affordable housing. On the other hand, Manini'owali Residential Community is expected to be a gated community and this will be problematic if there is extensive social disharmony at the time of project operation. Public officials, community leaders, developers and social service agencies will need to work together to attain a healthy balance of social and economic characteristics.

Location of Affordable Housing Units

By itself, the proposed project would not have a negative social impact if the project's required affordable units are located off-site. If there is a regional trend towards this option, however, then there is a potential for locating all of these off-site affordable units in one area. This would lead to a socially-undesirable situation because it would physically segregate people of low or moderate incomes.

Lifestyle

Lifestyle is the prevailing way of life dictated by the attitudes and values of an individual or a community. The area's current lifestyle has four major components: (1) the agricultural/rural legacy, (2) the retirement communities, (3) resort workers, and (4) the growing executive/professional group. Given the types of development projects already approved for South Kohala and North Kona, the latter three components will be greatly enhanced by increased resort and business development, additional resort-residential units, and a substantial increase in affordable housing units.

The Manini'owali Residential Community could potentially affect the area's lifestyle because it will likely bring more retirees and executive/professional residents into the area. The project will therefore supplement and continue the type of lifestyles anticipated given the existing community and approved development projects. This lifestyle impact may be seen as a logical one to those who have accepted the existing and projected growth. For those who wish to retain a rural or agricultural lifestyle, however, the project will make no contribution to this way of life. To them, Manini'owali may be seen as another step in the undesirable urbanization of South Kohala and North Kona.

4.3 Compatibility with Nearby Uses

Kaupulehu - Kuki'o Resort Destination Node

The proposed project is expected to be compatible with the proposed uses in these adjacent developments. The housing product will be similar in nature to the types of residential uses proposed in these communities. Although the Manini'owali housing product will compete with these other developments, there will also be a complementary relationship. Manini'owali residents will undoubtedly patronize the nearby hotel restaurants, shopping areas and resident-oriented facilities. The residents and guests at Kaupulehu and Kuki'o may also benefit from the recreational aspects of Manini'owali. They have an additional choice of golf course, and would be able to use the improved Kua Bay.

Awake'e Wilderness Area

NKDG proposes to have the entrance of the Kua Bay access roadway run through a portion of the State Awake'e property. This off-site alignment will provide the beachgoer a natural wilderness environment on the way to the new beach park, and will eliminate any type of monitoring which would be necessary if access were through a gated community. Discussion with State Department of Land and Natural Resources officials have been underway for some time, and there is currently a tentative agreement on the access siting.

In providing access to Kua Bay, NKDG is also helping to improve pedestrian and hiking access to the Awake'e wilderness area. Although vehicular traffic at Awake'e is to be minimized, day hikers will be encouraged to explore the resources available in the wilderness setting of Awake'e. The Manini'owali Beach Park facilities will be available for their use.

Veterans' Cemetery

The Manini'owali Residential Community is directly makai of the proposed Veterans Cemetery, and would be part of the makai view from the Cemetery. The project would extend the visual experience of Kuki'o 1 with a golf course and residences. This experience may be positive for those who find the green space and houses an attractive foreground to the ocean. The view may also be a negative experience if one prefers a totally natural view of the ocean. In this

case, the project would add to the obstruction already created by adjacent urban uses. Visual obstruction may be minimized by maintaining low building heights; at the proposed project buildings are not expected to exceed 45 feet in height.

4.4 Housing Impacts

Housing impacts will be generated on three levels. The first level is the on-site housing impacts. The proposed project represents a six percent increase over existing housing count of North Kona and South Kohala. There will be a continued need for market housing, and the Manini'owali Residential Community will provide alternatives to those who can afford homes above median prices. The marketing study has found that there is significant market demand for residences in the price range projected for this project.

The second level of impact is affordable housing. NKDG will either directly increase the supply of affordable housing units or contribute funds as appropriate.

The third of housing impact is the indirect impact due to possible in-migration of permanent on-site employees at Manini'owali. In the worst-case scenario, the project's 120 employees will need housing. It is expected that this housing need will be met by the developer's affordable housing requirement.

4.5 Golf Course Impacts

The market study finds that there is an existing shortage of golf facilities and the proposed golf course is expected to have positive impacts on Hawai'i County's supply of golf course.

The golf course has two implications for the local community. First, the golf course will increase recreational opportunities for local golfers. The extent of positive impact depends on access in terms of rates and time. Second, community awareness of golf courses has increased and issues such as ecological effects inevitably arise. On a more complex level, the golf course has also become a symbol for the larger issues of tourism and foreign investment.

4.6 Impact on Ocean Recreation

Physical Environment

The shoreline fronting the Manini'owali Residential Community includes Puialoa Point, Kua Bay, Manini'owali Beach, Papiha Point and Kakapa Bay. Kua Bay and Manini'owali Beach are the primary features. Located at the head of Kua Bay, Manini'owali Beach is one of the few significant white sand beaches on the island of Hawai'i. The beach is subject to severe sand erosion during the high surf periods from October to April. Once the high surf subsides, the sand begins to accrete immediately and the beach will regain its normal sand deposits within one or two weeks.

User Groups

The shoreline is presently accessible via a secondary gravel road that was constructed in August 1985. It ends approximately 200 yards from Manini'owali Beach where a foot trail over the lava extends to the beach. Access to the bottom of the road is possible only for vehicles with four-wheel drive. Manini'owali Beach attracts or allows for the following activities: boating; bodysurfing and bodyboarding; camping; fishing; hiking; kayaking and canoeing; skimboarding; snorkeling and scuba diving; and swimming and sunbathing.

Management Recommendations

NKDG's development of a beach park at Manini'owali Beach will generally have positive impacts. Public access to one of Hawai'i Island's most significant white sand beaches is especially important because there are few sand beaches. Restroom facilities and a litter disposal systems will eliminate the present sanitation and litter problems. Paved pedestrian paths, roads and parking lots will hopefully minimize the current destruction of the natural terrain by 4-wheel drive vehicles driving off the access road. Further, sand anchoring opportunities are excellent off the shoreline, and restroom facilities and fresh water onshore may attract more boaters to the shoreline.

Opening up the beach to more people may also present problems and the following summarizes these and suggests mitigation. Ultimately, the improvements at and ongoing management of Kua Bay will be in the hands of the State Department of Land and Natural Resources, and these recommendations are hereby made to the State.

- *Water safety* -- The increase in swimmers, bodysurfers and bodyboarders, many of whom will be tourists unfamiliar with the ocean, may create a serious water safety problem during medium and high surf conditions. It is suggested that lifeguard service be arranged through the County of Hawai'i. Further, the roadway should be designed so there is easy access to the beach for emergency vehicles.

- *User conflicts* -- Increasing user densities under any circumstance will lead to conflicts between users. It is suggested that the State (1) prohibit commercial ocean recreation use of the shoreline from land; (2) prohibit surfing near the beach; (3) designate an area allowing skim boarding; and (4) balance consumptive and non-consumptive uses.

- *Coral reefs* -- Increased boating has the potential of damaging the coral reefs at Pulaloa and Papiha Points, and day-use mooring buoys have been installed in other areas as a preventive measure.

- *Other measures* -- The extensive sand reservoir offshore Manini'owali Beach should be explored for its potential as a sea shell habitat. Siting of the parking lot should attempt to minimize car thefts. Signage and enforcement may be needed to prohibit nudist sunbathing.

Carrying Capacity

Establishing carrying capacity requires defining the relationship between management objectives and social impacts and arriving at reasonable agreement among user groups about management objectives and evaluative standards. The primary management objective of the project shoreline should be to continue accommodating all of the current and potential users without degradation of the resources or the recreation experiences associated with the resources.

Based on the size of the beach and park guideline standards, Manini'owali Beach should easily be able to accommodate 400 or more sunbathers; this is the low-density carrying capacity guideline. This is consistent with usage patterns at White Sands Beach Park on Ali'i Drive in Kailua-Kona. Like Manini'owali, it is a white sand beach subject to high winter surf and severe erosion from high surf and is a popular site for swimming, bodysurfing, and bodyboarding. During field surveys, it was observed that the average number of weekday and weekend beachgoers at White Sands was 150 and 200, respectively. White Sands Beach Park is half the size of Manini'owali Beach, so the carrying capacity is consistently half of what Manini'owali could handle.

4.7 Public Services and Facilities

Police Protection

The project site is in Area 2, which includes Waimea, Kohala and Kona. This area is served by centralized services at the Kona Police Headquarters located in Kealakehe one-half mile from Kailua, and seven miles south of the project site.

In recognition of the growth planned for West Hawai'i, there are currently two possibilities for future expansion of police facilities. First, a 30-acre civic center is included in the master plan of the Kealakehe Planned Community south of the project site. Second, the new Civic Center proposed in the Keahole to Kailua Plan may house police facilities. Both are long range in nature.

The Manini'owali Residential Community will increase the population and therefore increase the demand for police protection services. The project can minimize the need for police protection through on-site security and project design. The project is envisioned as a gated community and visitors would be monitored by private security guards. Neighborhood watch programs are also effective in crime detection and deterrence. Finally, design measures, such as well-lit roads, sidewalks, and parking and common areas, would help eliminate crime opportunities.

Fire Protection

First alarm response for the project site is from the Kailua Fire Station located twenty miles south. The Kailua Fire Station has a 1,500 gallon-per-minute (gpm) pumper with 1,000 gallons of water; a 750 gpm tanker with 1,200 gallons of water; and a 65-foot aerial ladder truck carrying 500 gallons of water. Emergency and rescue facilities include a 26-foot rescue boat and an ambulance. This station has a staff of 33 personnel in three shifts.

Approximately 15 miles north of the Manini'owali Residential Community is the South Kohala Fire Station. This station responds to first alarms up to the entrance road to the Kona Village Resort, but excluding the resort itself. The facility is equipped with a 1,500 gpm pumper with 1,000 gallons of water, an ambulance, and a 2.5 ton 1,000-gallon tanker. The South Kohala Fire Station is staffed by 18 firefighters in three shifts.

Currently, there are plans for new facility in Keahuolu. As of this writing, funding is still insufficient, so the future of this station is unclear. Also, as with a new police station, a new fire station may be located at either the 30-acre civic center in the Kealakehe Planned Community, or the new Civic Center proposed in the **Keahole to Kailua Plan.**

The proposed project will increase the demand for fire protection services, and NKDG needs to work with fire department officials to work out specific responsibilities to mitigate project impacts.

Education

Students in the Manini'owali Residential Community would attend the Kealakehe Elementary, Kealakehe Intermediate and Konawaena High Schools. Enrollment at the first two school experienced major increases between the school years beginning in 1988 and 1989.

The entire West Hawai'i public school system needs to expand to accommodate growth. The most immediate planned addition is a new Konawaena Elementary School on a ten-acre site one-half mile south of the existing Konawaena intersection. The school was to open in 1993, but the timing of implementation is unclear because of current problems related to land acquisition. Also being planned is a new high school in Kealakehe; ideally, operations would begin in the 1995 - 1996 school year. A 45-acre site in the Kealakehe Planned Community is programmed for the new high school.

The project's impact on the school system will be mitigated by developer contribution to the development of new classrooms. It is estimated that Manini'owali will generate 220 students, as indicated in *Table 14*. The State Department of Education has requested that NKDG contribute funds to cover 50 percent of the cost of constructing classrooms to accommodate the new students. Further discussions with DOE officials will determine the extent of participation.

Hospital

Currently, there are five acute care facilities in Hawai'i County. All part of the County/State Hospital system, these facilities are the Hilo, Honoka'a, and Ka'u Hospitals in East Hawai'i and Kohala and Kona Hospitals in West Hawai'i. A total of 406 licensed acute care and other beds serve Hawai'i County. The West Hawai'i hospitals (in Kona and Kohala) contained 87 acute care, skilled nursing facility, intermediate care, related swing beds and psychiatric beds in 1989 - 1990.

If no changes are made to the hospital system prior to project implementation, the Manini'owali Residential Community would be most immediately served by the Kona Hospital. The hospital has a service area extending from Ocean View

Estates in Ka'u to Kohala. Currently Kona Hospital contains 61 licensed beds, 44 of which are acute care beds. As shown on *Table 15*, utilization has been increasing at the Kona Hospital. Currently, Kona Hospital is undergoing Phase 1 of renovations, which include a new wing with operating rooms and surgery, a new coronary intensive care unit, and physical and occupational therapy facilities. Phase 2 includes a new wing for administration and laboratory, renovation of the existing services, and an increase in floor space for support services.

In the long range scheme, the hospital system for the northern and western portions of Hawai'i Island is being planned for major changes. The North Hawai'i Community Hospital (NHCH) is a 50-bed facility to be located in Waimea adjacent to the Lucy Henriques Medical Center. It is scheduled to begin operations in 1994, and will replace the 27 licensed beds located in Honoka'a. The West Hawai'i Regional Health Center (WHRHC) would be near the project site in the Keahole area of North Kona. It would contain 120 beds, of which 90 would be acute care and 30 would be swing beds. The Hawaii Family Medical Center has filed a Certificate of Need application for a primary care medical clinic in Waikoloa Village.

The Manini'owali Residential Community would increase the population in the area and would therefore increase the demand for hospital services in the study area. This impact will not be significant, however, provided that proposed improvements are implemented as scheduled.

5 Preliminary Community Issues On The Project

Whereas social impacts are social changes which are likely to occur, social issues are reactions to community events, changes and problems. Issues change over time, as people's priorities and values change. This section presents an overview and analysis of issues related to the Manini'owali Residential Community as of September 1991.

5.1 Sources of Information on Community Issues

Earthplan conducted 50 interviews with people who live or work near the project site, are active in regional affairs, or whose services would be affected by the implementation of this project. Those interviewed also included people who could give us specific information about how the nearby shoreline is used.

The interviews were conducted for issue identification and analysis. This type of analysis assists both the developer and policy makers in ascertaining community reaction to a project, and in assessing the need and types of mitigation which may be acceptable to the community. The emphasis of issues analysis is capturing the *range* of community reactions; the product is a broad picture of the variety of concerns.

To identify a broad range of concerns on Manini'owali Residential Community, the selection of people was based on achieving a cross-section of interests. Those interviewed included (1) members of environmental and cultural organizations;

(2) ocean recreation people; (3) members of community organizations and non-organizational referrals; and (4) members of public or social service agencies.

5.2 Non-Project Issues Described in the Interviews

Community Aspects That People Liked

What people valued the most about the community are its non-urban qualities. There was an appreciation for the lack of structures, and the relatively rural lifestyle. Specifically, these qualities included the predominance of natural settings; the community's people who were described as sharing, kind, and protective of each other; the ocean environment; and the village or small-town atmosphere.

Community Problems

Problems cited by those interviewed were mostly related to the area's transition from a rural to urban environment. All of the informants felt that the area grew and developed too much too soon, and the following are specific problems which were cited:

- need to play "catch-up" regarding infrastructure development (traffic), public services (fire, schools, hospitals), and affordable housing;
- shortage of land-based and ocean recreational facilities;
- social adjustments due to the sheer influx of people, and the combination of in-migrant workers and affluent retirees;
- environmental problems, such as those due to golf course chemicals, the loss of anchialine ponds, and the increase in air pollution; and
- loss of cultural resources.

Desires for the Future

People were generally optimistic that the problems will be corrected in the future and government was often at the core of the solution. The following are specific desires for the future of the area:

- Informants wanted to see government and developers fund and implement public improvement projects more efficiently.
- Those interviewed wanted to see development controlled through planning and consistent regulations.
- People wanted to see current environmental laws enforced, and urged the creation of new laws which will further protect the ocean, the land and the air.

- Informants hoped that West Hawai'i would eventually gain more political clout as the population increases.
- Interviewees wanted to make sure that developer contributions are realized in a timely fashion.

5.3 Issues Related to the Manini'owali Residential Community

Interviewees were asked to discuss their views on (1) what might be good things or benefits of the Manini'owali Residential Community, (2) problems arising from the project, and (3) revisions and modification. Because this is not a statistical survey, frequency of statements are provided only for exceptional cases.

Good Things or Positive Aspects

Those interviewed felt that the good things about Manini'owali Residential Community centered mostly around the on-site and shoreline recreational components. Two people felt that the project had no positive value.

1. *Improvements at Kua Bay* -- This was a very positive aspect to almost all interviewed; they liked this because it would facilitate public access to the much touted Manini'owali Beach.
2. *Location Away From the Shoreline* -- It was felt that, in being 1,000 feet mauka from the shoreline, the project should have less impact on the ocean.
3. *Contiguity to Urban Development* -- The project appeared to be a logical extension of the adjacent Kaupulehu-Kuki'o Resort Destination Node.
4. *Advantages of Specific Project Components* -- The positive aspects about the golf course had mostly to do with its open space nature. The positive side of housing component was that the price range of the new houses suggests older residents and smaller households at Manini'owali. The impact on certain public services, such as schools and police protection, would therefore be less than if there were a wide range of housing prices. The lack of hotels was also a big plus for informants.

Problems and Concerns

Project-related problems and concerns ranged from site-specific to regional in nature. The two most frequent concerns were related to the project's contribution to cumulative regional impacts and effects of the golf course.

1. *Contribution to Cumulative Regional Impacts* -- The most common concern about the Manini'owali Residential Community was that it would stress the already-burdened infrastructure problems. Traffic was often raised, as well as sewerage system problems and the water system. Public services and facilities were also cited by those interviewed.

2. *Golf Course Impacts* -- There were concerns regarding golf course chemical impacts on the land and ocean. Further, it was felt that the island, and in particular West Hawai'i, has more than enough golf courses.

3. *Relationship of New People and Existing Community* -- Interviewees had two reactions to the additional population attributable to the proposed project. First, they were concerned that the addition of more affluent people to West Hawai'i will exacerbate economic disparity problems. Second, the project required in-migration of labor needed to fill on-site jobs and the new employees would compete with the existing population for housing and public services.

4. *Exclusivity* -- Informants were concerned that West Hawai'i would have another community which would physically exclude the general community. They felt that any kind of physical barrier, such as a sentry gate, would make the existing residents feel that they are once again excluded from what was formerly perceived as public domain. Those interviewed also believed, however, that the new access to be developed by NKDG, will greatly improve the situation by "legalizing" beach access.

   Another concern related to possible exclusivity is the on-site golf course and tennis facility, and informants urged that local residents feel welcomed at these places. Finally, those interviewed did not want to see Manini'owali Beach become a private beach for subdivision residents.

5. *Visual Impact and Preservation of On-Site Trails and Archaeological Resources* -- It was felt that the project should be designed to minimize visual obstruction of the mauka-makai view plane. Those interviewed wanted to see ancient Hawaiian trails and on-site burials preserved as much as possible.

6. *Appropriateness of Site for Development* -- While the site's contiguity to the Kaupulehu-Kuki'o Resort Destination Node was a plus, it was also pointed out that the project is inconsistent with public plans because it is outside that node.

7. *Effects of Opening Up Manini'owali Beach* -- Although public access to Kua Bay was a prime advantage for those interviewed, there was also apprehension about opening the area up to the general public. Opening up the area would mean loss of seclusion value and the general effects of frequent usage, such as litter.

Recommendations

It was generally felt that project impacts could be mitigated and almost all of those interviewed suggested changes or emphasized the need for certain kinds of solutions. Four people felt that the project should simply not proceed because of concerns or problems which they earlier raised.

1. *Relationship To The Land* -- It was suggested that the project be blended in with the environment as much as possible. A very important aspect was the effects on the mauka-makai view plane, and informants suggested that buildings be low-rise and clustered to avoid continuous rows of houses. Further, it was felt that planners should make sure that buildings are not visible from the beach.

2. *Relationship To The Ocean* -- There were a number of recommendations geared to minimizing impacts on the ocean, and the most frequent was for the developer to establish a coastal monitoring program. Other recommendations pertained to improvements at Kua Bay, including an interpretative center for the historic resources, parking for beach users and a mooring buoy to facilitate day boating trips to Kua Bay.

3. *Relationship To The Community* -- Informants wanted to see the project blend in with the existing community as much as possible. It was recommended that local people have access to on-site recreational facilities, including both the golf course and tennis facility. On a broader level, informants wanted to make sure that NKDG will meets its affordable housing requirements. The project's timing was important to some, and they suggested that the project not be built until most of the adjacent Resort Destination Node was built.

4. *Conservation* -- It was suggested that the developer encourage future Manini'owali residents to be environmentally responsible. Interviewees recommended on-site composting, as well as a recycling program for the residents. It was also suggested that the design of structures optimize natural lighting and ventilation.

Comments About NKDG

Slightly over half of those interviewed knew of or had some interaction with NKDG officers or representatives. Almost all of them commended the developer for efforts to address community concern, particularly regarding the improvements at Kua Bay, and the land exchange which sites the project at least 1,000 feet from the shoreline. They welcomed the new entity because they felt that there has been increasing openness and responsiveness to the community, and they expressed hope that the established working relationship can continue.

5.4 Analysis of Comments Raised During Interviews

The following presents observations and an analysis of comments provided during interviews conducted for this project:

1. *Informants were consistent in their feelings about the positive aspects and problems of South Kohala and North Kona.*

   There was a consensus among those interviewed about what were the area's positive elements and its problems. Regardless of one's background or length of residence, informants valued the rural and country qualities of North Kona and South Kohala. In terms of problems, the common ones were those having to do with increasing urbanization -- crowding, traffic, inadequate infrastructure and environmental impacts. Further, informants wanted to see the same types of things happen in North Kona and South Kohala.

   Hence, there were no strong polarities among those interviewed. There were no stereotypical divisions between those involved in business and environmentalists. In fact, there were often people who belonged to both business-oriented and environmental groups.

2. *The nature of project-related concerns is consistent with general community issues.*

   Most of the project-related concerns were similar in nature to other issues which prevail in North Kona and South Kohala. Concerns about traffic, schools and other public service are typical of community reactions to proposed development in the area. Further, the ocean- and shoreline-related issues were similar to those reported in the news concerning development projects along the coast. Hence, the interviews did not elicit comments unique to this site or project.

3. *Positive project aspects were mostly related to improvements at Kua Bay.*

   The project's biggest plus is its off-site contribution. Because NKDG will participate in major improvements at Kua Bay, the Manini'owali Residential Community represents an opportunity. This was seen as the project's most positive aspect, and was the most frequently-expressed "good thing" about the Manini'owali Residential Community.

4. *Reasons for project-related problems were mostly related to cumulative regional impacts, rather than site-specific impacts.*

   Just as the project's positive aspects are mostly off-site, so is the nature of problems associated with Manini'owali Residential Community. The project's biggest problem is that it would add to growth-related problems; it would bring in more people and would impact the roads, schools, hospitals, and so on. Further, even when people referred to site-specific resources or

   characteristics, such as on-site trails or the nearby Kua Bay, the reactions were in the context of regional systems and community-wide needs.

6. *Some project aspects received mixed reactions.*

   Reactions to some aspects of the project were clearly mixed, as follows:

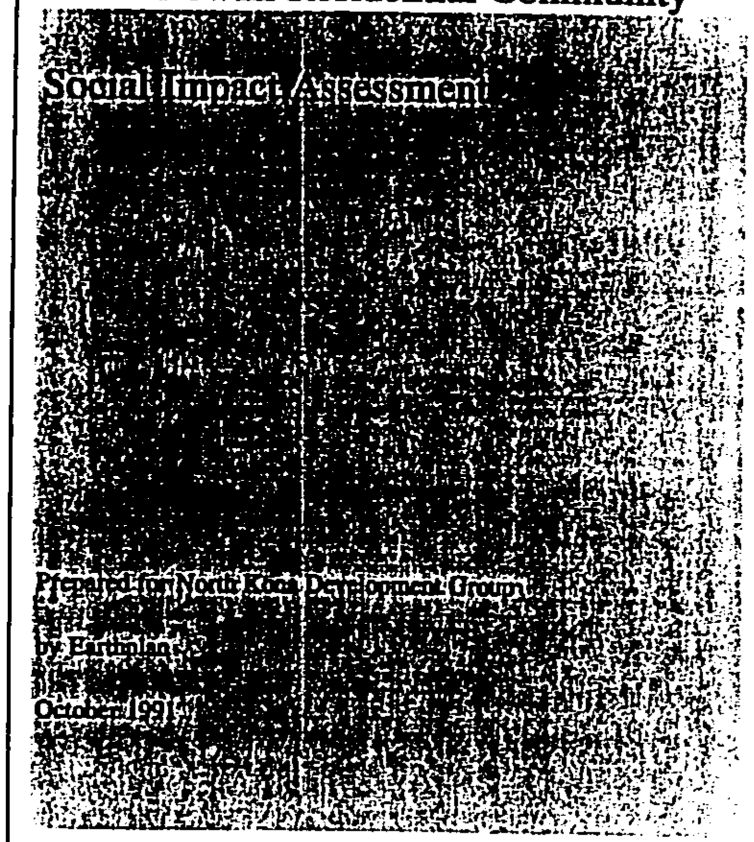
   - The housing component was seen as a plus because it would bring in fewer large families and older residents, thus reducing competition for public and social services. It was also a negative because the addition of more affluent residents would exacerbate problems related to economic disparity.

   - Affordable housing should be on-site to avoid a community exclusively for the rich; others felt that an off-site affordable housing contribution, preferably in Kealakehe, would make more sense from a density and economic feasibility standpoint.

   - Public access to Kua Bay was mostly positive, but the negative side was expressed strongly. Some did not want any of this shoreline opened to the general public because it would "trash the area."

   - Whereas the golf course means attractive, green open space, it also means chemical impacts to the environment. Both were characteristics were raised during the interviews.

Manini'owali Residential Community



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1 BACKGROUND AND INTRODUCTION

1.1 Purpose

The North Kona Development Group (NKDG) proposes to develop the Manini'owali Residential Community in North Kona, Hawai'i. Implementation of the proposed action requires major land use approvals, including reclassification of the project site to the Urban District of the State Land Use Map, an amendment to the Hawai'i County General Plan, a Special Management Area Permit and re-zoning. An Environmental Impact Statement (EIS) is being prepared to provide pertinent information in these processes. This report assesses the potential social impacts of the project; it is appended to and summarized in the EIS.

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, interviewer and writer. Assistance was provided by three independent contractors. John Clark prepared the recreational assessment, and assisted in field interviews with those familiar with ocean recreational resources. Lani Nedbalek assisted in field interviews with general community members. Michael P.Mays conducted research in demographics and community issues.

1.2 Project Description

1.2.1 Project Site Description

The project site is located in the North Kona district of West Hawai'i, as illustrated in *Figure A*. The site is approximately 1,000 feet mauka of the shoreline, and is bounded by the Queen Ka'ahumanu Highway to the east and Kuki'o 1 and Kaupulehu to the north. The latter two areas, plus the Kona Village Resort, comprise a resort node, and is planned for urban uses. To the south is the makai portion of the Awake'e ahupua'a. A 1,000-foot wide shoreline fronts the makai boundary of the project site. Most of this 132-acre area is owned by the State.

The 388-acre project site is covered with lava. A small pu'u is located on the northern end of the site and kiawe bushes and fountain grasses are the primary forms of vegetation. Just south of the project site is Pu'u Kuili, a prominent cinder cone landmark. Kua Bay is located on the shoreline makai of the project site.

The site is currently used as part of informal access system to the shoreline and Kua Bay. A dirt road passable by four-wheel drive vehicles runs mauka-makai from Queen Ka'ahumanu Highway to the Kua Bay area. There are no other uses currently existing on the site.

NKDG's ownership of this site is the result of a land exchange transaction with the State of Hawai'i. The project site was formerly owned by the State. NKDG previously owned 334 acres of the Awake'e ahupua'a adjacent to the southern boundary of the project site. The Awake'e parcel extended to the shoreline. The State plans to develop a regional shoreline wilderness park from Keahole to Kua Bay. The public acquisition of the Awake'e parcel and retention of the

shoreline at Kua Bay consolidates State ownership of coastal lands in this area. Nine acres of the shoreline along Kua Bay is privately owned, and the State is currently exploring acquisition of these lands.

1.2.2 Project Components

The master plan for Manini'owali Residential Community includes the following components:

- **Residences.**

  NKDG proposes to develop between 900 and 1,100 residential units on approximately 132 acres. The types of units will vary and will include single-family residences, townhouses and condominiums. NKDG plans to develop the units, and sell lot-and-house packages.

- **Golf Course.**

  A golf course will be an amenity and a prominent feature of this community. Ponds will be added as aesthetic water features, and will function as part of the storm water runoff control system and for irrigation storage.

- **Golf Course Support Facilities.**

  These include a clubhouse, driving range and an administrative office, and a maintenance area with offices and storage facilities. The clubhouse complex will house functions and services typical to such facilities, including a restaurant, snack bar, offices, locker rooms, and a pro-shop. In addition, there may be neighborhood commercial uses in conjunction with the clubhouse. A practice putting green, small swimming pool, and tennis courts will also be provided.

- **Tennis Facility.**

  This complex will comprise tennis courts, a tennis clubhouse, and, possibly, a swimming pool and weight training room.

A new entrance road off of Queen Ka'ahumanu Highway will provide access to the project site. In the future, an interchange will service the Kaupulehu, Kona Village and Kuki'o Resort Node.

1.2.3 Description of the Project Market

The project is envisioned as a residential community which would be unique among the typical Kona and Kohala Coast developments, as well as other Resort-Residential communities in the State. Based on the market assessment by John Zapotocky for this project, the major distinctions at the Manini'owali Residential Community are as follows:

- The Manini'owali Residential Community will offer pre-designed single- and multi-family dwellings within the context of the planned development. Currently, no planned resort community in Hawai'i County or the State is offering single-family homes or attached single-family homes in any price range. The West Hawai'i resorts typically offer single family lots on which custom houses are built; the resulting lot and house packages are valued in excess of $1 million.
- The bulk of the single family units will comprise larger-than-average units. Unlike many resort properties in Hawai'i, these units will be designed for year-round living rather than as vacation homes for short-term residents.
- On-site residents will be given better golf priority than is current provided by golf courses at nearby resorts.

The three market segments which this project would be targeting are:

- **Primary Homes.**

  The Manini'owali Residential Community is envisioned as a community in which people will live year round. Seventy-five percent of the households are expected to be occupied by full-time residents. The advantages of this community is that it is near existing employment centers of Kailua, Keauhou and the industrial areas and adjacent to a future major employment generator, the Kaupulehu-Kuki'o Resort Destination Node.

- **Second Homes.**

  A quarter of the proposed homes are expected to be second homes. Neighbor Island destination resorts have a large percentage of second home buyers. It is expected that Manini'owali will offer the same amenities which would attract second home buyers in other parts of the State, including a high degree of amenity availability and maintenance services.

- **Retirement Homes.**

  For those who are retired and soon to be retired, who are generally earning their peak income or receive retirement incomes, the proposed project may have special appeal. The market study asserts that many long time Honolulu residents find themselves living in residences which have appreciated to the point where many have major equity; hence, there is a large population of retirees with the resources to purchase in Manini'owali.

A typical profile of a household in the Manini'owali Residential Community is as follows:

- The household will comprise, executives, professionals and small business owners who work and operate businesses in conjunction with the West Hawai'i resorts.
- An average of 2.23 persons would make up a household.
- The residents are expected to be older than average, with an average age of 55 years.
- It is expected that income levels of Manini'owali residents would be twice that of statewide averages.

1.3 Report Organization

The remaining sections in this report describe the existing community and a possible future, identify potential social impacts, and discuss preliminary social issues. Section 2 provides a profile of North Kona and South Kohala, as well as specific communities within the region. Information includes demographics, housing and labor force information.

Section 3 describes the changes likely to occur in the study area without the Manini'owali Residential Community. Indicators include public policy and proposed developments.

Section 4 identifies potential social impacts. Population and housing impacts are discussed, as well as project effects on the regional character and desired future. Another possible impact discussed is compatibility with nearby uses. Social impacts of the golf course is explored, and impacts on ocean recreation are presented. Further, project impacts on public services and facilities are discussed.

Section 5 presents preliminary social issues. Earthplan conducted interviews with community members to identify the range of general community and project-related issues, and Section 5 presents the methodology, findings and analyses of these interviews.

2 PROFILE OF THE EXISTING REGION AND COMMUNITIES

2.1 Study Area Definition

The study area for this project encompasses the South Kohala and North Kona districts of the island of Hawai'i. The project site is geographically located in the North Kona region; it also shares many physical characteristics and qualities with the South Kohala district. *Figure A* delineates the study area for this study.

The entire study area is described in Section 2.2, which presents information on the economic base, population and housing, family characteristics and income levels and labor force characteristics. Most of the information is based on the 1970 and 1980 census by census tracts. Three census tracts made up the study area. South Kohala was Census Tract 217. North Kona contained Census Tracts 216 (Kailua-Kona) and 215 (the remainder).

In the 1990 census, Census Tract 215 was further delineated into four separate tracts. Hence, the study area contained six census tracts in the 1990 process. At the time of this writing, available 1990 information by census tract is limited to sheer housing and population numbers.

The only 1990 census information specific to the study area available at the time of this writing is by Census Designated Places (CDPs). Section 2.3 presents current information about specific communities in the study area, including the Kalaoa, Kailua, Puako and Waikoloa CDPs.

2.2 Description of North Kona and South Kohala

2.2.1 Population and Housing Trends

The study area grew rapidly between 1970 and 1990. *Figure B* shows that North Kona grew from 4,800 people in 1970 to almost 22,300 people in 1990. Hence, North Kona's population quadrupled over two decades. North Kona's average annual growth rate was almost eight percent for those twenty years, as shown on *Table 1*.

The entire study area grew by over 17,400 people between 1970 to 1990. In the 1970s, this growth occurred at an average annual rate of almost ten percent; during the 1980s, this rate was 5.5 percent a year.[1]

The study area's growth trend is significantly high when compared to Hawai'i County as a whole. The 1990 population estimate of 120,317 residents in Hawai'i County represents a 30 percent increase since 1980, or a 2.7 percent average annual growth rate over the ten-year period.

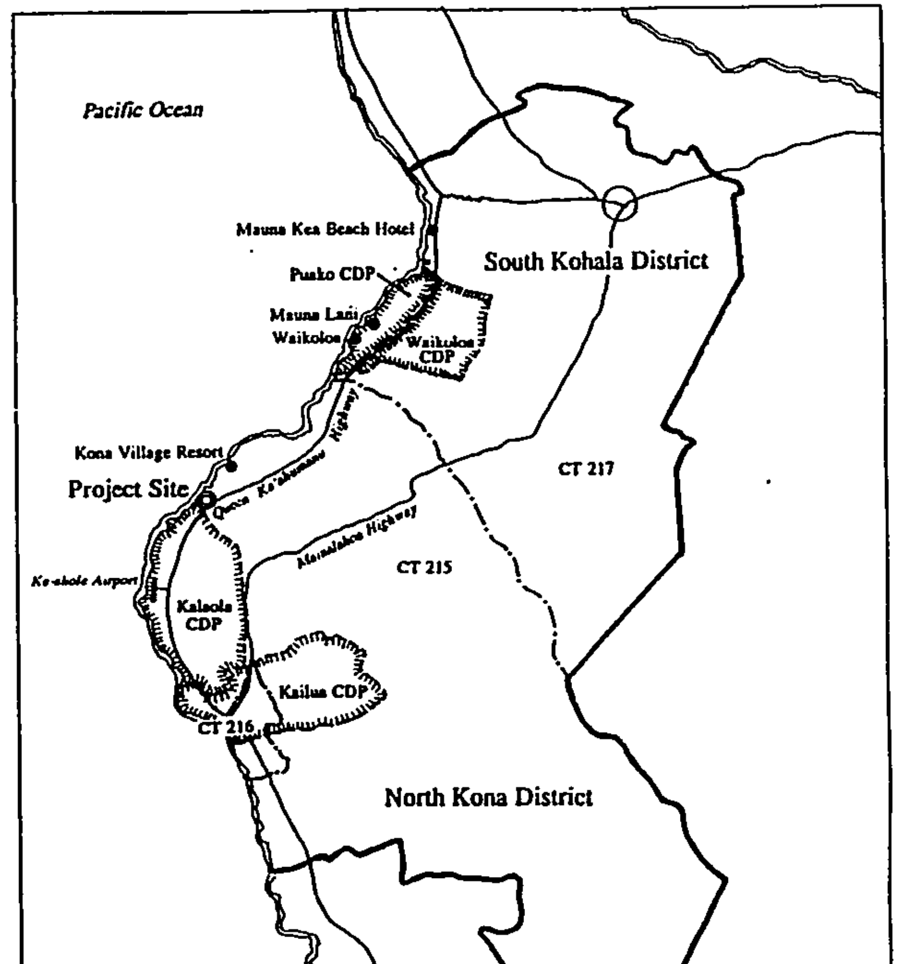

Figure A

Manini'owali Residential Community Study Area for SIA

Note the CDPs are 1990 designations
The Census Tracts (CT) are 1980 boundaries.

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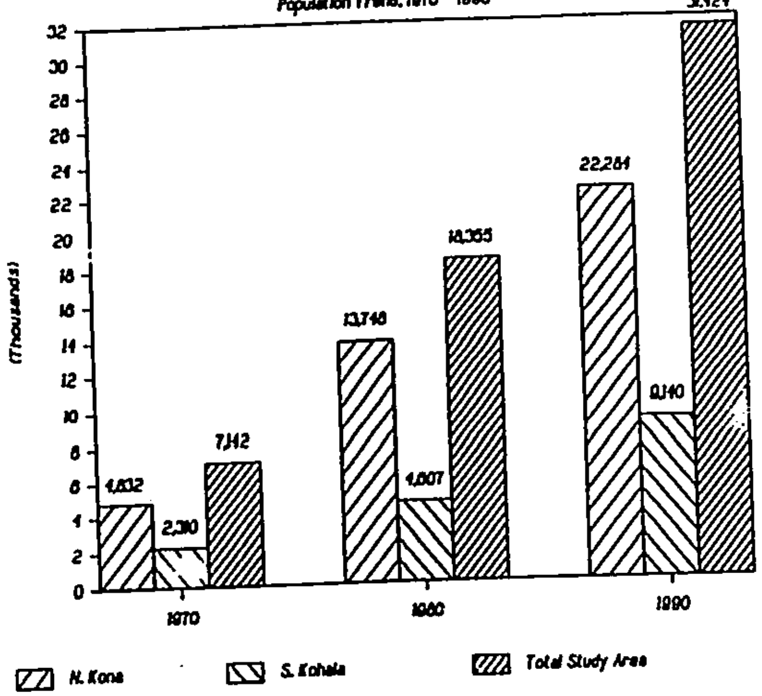
1 *U.S. Department of Commerce, Bureau of the Census, 1972, 1981a, 1981b, 1991a.*

Figure B

Population Trend, 1970 - 1990



Sources: U.S. Bureau of Census, 1972, 1981a, 1981b, 1991a.

Table 1

Average Annual Growth Rate, 1970 to 1990

	1970–1980	1980–1990	1970–1990
North Kona	11.0%	4.9%	7.9%
South Kohala	7.1%	7.1%	7.1%
Total Study Area	9.9%	5.5%	7.7%
Hawai'i County	3.8%	2.7%	3.2%

Housing trends were consistent with population changes. In Hawai'i County, housing units increased 79 percent from 1970 to 1980, from 18,939 to 33,954 units. The estimated 1990 housing count of 48,253 represents a 42 percent increase over the 1980 inventory.

As shown in *Table 2*, the increase in the study area housing units between 1970 and 1980 was much greater, as follows:

- In 1970, the study area contained approximately 2,773 housing units, with 1,975 units located in North Kona. By 1980, the total study area count increased to 8,853 units which represents an increase of 219 percent. The bulk of the growth occurred in North Kona, where housing units increased by almost 5,000 units.
- It is estimated that the study area contained 14,225 housing units in 1990. Although North Kona contained the bulk of the housing supply (almost 10,000 units), it was South Kohala which experienced the major housing supply increase. South Kohala units increased 116 percent, from 1,959 units in 1980, to 4,235 in 1990.

County population projections for the study area are presented in *Table 3*. Hawai'i County projects that, if the sugar industry ended and there was modest expansion of the visitor industry, North Kona and South Kohala would grow at a collective annual rate of 3.6 percent, for a 2005 population of 53,543 persons. This rate is much lower than the annualized 5.5 percent of the 1980s. On the other hand, if the hotel room supply increases by 17,800 units plus condominium units, the study area is projected to have a population of 93,138 persons, which means an average annual growth rate of 7.5 percent between 1990 and 2005. This latter growth rate is similar to the study area's rate between 1970 and 1990.[2]

2.2.2 Ethnicity, Age, Place of Birth and Education

The two largest ethnic groups in Hawai'i County are Caucasians and Japanese, as shown on *Table 4*. Between 1970 and 1980 the proportion of Caucasians increased from 29 to 35 percent of the county's population. There was a decrease of those of Japanese ancestry from 37.5 percent in 1970 to 26.6 percent in 1980. Together, the Caucasians and Japanese made up almost two-thirds of the population.

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2 *County of Hawai'i, 1989.*

Table 2

Housing Counts: 1970, 1980 and 1990

	1970	1980	1990	Change between 1970 and 1980	Change between 1980 and 1990
North Kona	1,975	6,894	9,990	249.1%	44.9%
South Kohala	798	1,959	4,235	145.5%	116.2%
Total Study Area	2,773	8,853	14,225	219.3%	60.7%
Hawai'i County	18,939	33,954	48,253	79.3%	42.1%

Source: U.S. Bureau of the Census, 1970, 1980 and 1991a.

Notes:
In 1980, North Kona comprised Census Tracts 215 and 216. In 1990, the area was made up of Census Tracts 215.01, 215.02, 215.97. 215.98 and 216 in 1990. South Kohala was in Census Tract 217 in both 1980 and 1990.

Table 3

Population Projections: 2005

	Estimated 1990	Projected 2005			Annual Rate of Growth Between 1990 Population and		
		Series A	Series B	Series C	Series A	Series B	Series C
North Kona	22,284	43,520	54,250	64,500	4.6%	6.1%	7.3%
South Kohala	9,140	10,023	24,087	28,638	0.6%	6.7%	7.9%
Total Study Area	31,424	53,543	78,337	93,138	3.6%	6.3%	7.5%
Hawai'i County	120,317	173,000	217,000	258,000	2.5%	4.0%	5.2%

Source: County of Hawai'i, 1989.

Notes:
Series A assumes demise of the sugar industry and modest expansion of the visitor industry.
Series B is a "medium series." Assumes sugar employment is maintained.
Series C assumes that 17,800 hotel rooms plus additional condominium units will be built in the County by 2005.

Table 4

Total Population and Demographics for the County of Hawaiʻi, North Kona and South Kohala, 1970 and 1980

	County of Hawaiʻi		North Kona		South Kohala	
	1970	1980	1970	1980	1970	1980
Total Population	63,468	92,053	4,832	13,748	2,310	4,607
Ethnicity (*)						
Caucasian	28.8%	35.0%	44.0%	53.8%	39.2%	46.5%
Japanese	37.5%	26.6%	23.1%	11.8%	24.4%	14.6%
Chinese	2.9%	1.7%	3.7%	1.6%	1.3%	1.4%
Filipino	16.5%	13.9%	8.4%	7.2%	6.6%	5.6%
Hawaiian	12.3%	18.8%	19.3%	22.1%	26.4%	28.5%
Other	2.0%	4.1%	1.5%	3.5%	2.0%	3.4%
Age						
Less than 5 years	8.6%	9.1%	9.1%	9.1%	9.3%	10.2%
5 -17 years	27.8%	21.5%	27.0%	20.3%	28.3%	23.6%
18 - 64 years	54.4%	59.2%	55.7%	63.9%	56.1%	58.6%
65 or more years	9.2%	10.2%	8.2%	6.7%	6.4%	7.7%
Median age (yrs.)	28.9	29.4	28.6	28.9	28.1	29.3
Place of Birth (*)						
Hawaii	NC	70.5%	NC	54.4%	NC	64.9%
Other U.S.	NC	20.0%	NC	39.9%	NC	30.4%
Foreign country	NC	9.4%	NC	5.7%	NC	4.7%
Residence 5 Years Previous						
Same house	62.5%	52.9%	51.1%	38.8%	45.6%	50.7%
Same island	NC	24.9%	NC	28.1%	NC	17.3%
Different island	NC	8.1%	NC	7.0%	NC	14.9%
Different state	NC	11.0%	NC	23.1%	NC	16.4%
Different country	NC	3.1%	NC	3.0%	NC	0.7%
Education (*) (people aged 25+)						
0-8 years only	37.2%	20.1%	28.9%	8.0%	24.1%	8.6%
High school only	31.6%	35.5%	66.0%	40.9%	34.2%	37.0%
College, 4+ years	7.5%	15.2%	8.8%	18.8%	13.1%	20.7%

Notes:
(*) Figures are estimates based on 15% sample.
NC 1970 categories or bases are not comparable to 1980.

Sources: U.S. Bureau of the Census, 1972, 1981a, and 1981b

In North Kona and South Kohala, the two largest ethnic groups are Caucasians and Hawaiians. Caucasians comprised over half of North Kona's population in 1980 at 54 percent; this was up from 44 percent in 1970. A similar increase was found in South Kohala. Hawaiians comprised over 28 percent of South Kohala's population in 1980, and over 21 percent of North Kona's population. Both districts experienced an increase of Hawaiian people (about two percent) between 1970 and 1980. Almost all other major ethnic groups showed a decrease over the decade.

The 1980 census indicates North Kona had a sightly younger population with a median age of 28.9 years, compared to Hawaiʻi County's median of 29.4 years.

Due to the high in-migration in North Kona and South Kohala, the study area had proportionally more people who were born in other states, when compared to Hawaii County. In North Kona, about 40 percent of the 1980 population were born in another state, while 30 percent of South Kohala fit this category.

In-migration tended to be more recent in North Kona, where only 39 percent of North Kona's population lived in the same house five years previous to the 1980 census. By comparison, half of South Kohala's population were in this category.

A major shift occurred in education of residents of West Hawaiʻi between the 1970 and 1980 census. Most notably, there was an increase in the numbers of people attending college. In 1980, North Kona and South Kohala had 19 percent and 21 percent, respectively, with four years college experience; this reflects an increase of ten and eight percent from the previous decade. In Hawaiʻi County, 15 percent attended college.[3]

2.2.3 Labor Force Characteristics

The study area has a major labor force. Compared to Hawaiʻi County's potential civilian labor force of 61 percent of the total labor force in 1980, North Kona's was over eleven percent higher at 72.1 percent. Further, in 1980 unemployment was lower than Hawaiʻi County's seven percent with 5.2 (North Kona) and 6.3 (South Kohala) percent.[4]

As with the rest of Hawaiʻi, the unemployment rate continues to decline. The State Department of Labor and Industrial Relations cites 2.9 and 2.8 percent for the two census tracts in North Kona in 1990. South Kohala had an unemployment rate of 3.4 percent. Both are lower than the county-wide rate of 3.8 percent.[5]

3 *U.S. Department of Commerce, Bureau of the Census, 1972, 1981a, and 1981b.*
4 *U.S. Department of Commerce, Bureau of the Census, 1972, 1981a and 1981b.*
5 *Personal communication with State Department of Labor and Industrial Relations personnel, August 19, 1991.*

Table 5 shows the occupational distributions for 1970 and 1980. Compared to Hawai'i County, North Kona and South Kohala were highly represented in service occupations. North Kona had slightly more people in management and professional occupations than the County, and technical, sales and administration were also favored in North Kona.

Consistent with the predominant visitor industry, North Kona and South Kohala were highly represented in the personal, entertainment, and recreational industries. Visitor related industries such a retail trades were also exceptionally represented in North Kona due to the concentration of hotels and shops in Kailua-Kona. South Kohala was under-represented in this area. Both North Kona and South Kohala were under-represented in public administration compared with the county.

Though agriculture in North Kona has given way to hotel/resort and recreational residential development, this trend has not moved as rapidly in South Kohala where luxury resort development commenced in the 1960s. Ranching and agriculture are still important in South Kohala, as can be seen in the high representation in farm/fish/forest occupations and agriculture/mining industries, both of which exceeded county levels for 1980.

The construction industry also flourished in North Kona and South Kohala, although there was a noticeable plunge of nearly 12 percent in North Kona between 1970 and 1980. This can probably can be attributed to the major boom in the early 1970s, followed an economic slow down later in the decade.

2.2.4 Housing Stock Characteristics

Housing characteristics shown in *Table 6* demonstrate significant increases in housing units between 1970 and 1980 in West Hawaii. The total year-round housing units for North Kona in 1980 (6,894 units) was 3.5 times the 1970 supply. In South Kohala, the 1980 housing supply of 1,959 units was 2.5 times the 1970 count. By comparison, Hawai'i County's housing supply increased 79 percent between 1970 and 1980.

At the time of the 1980 census, housing vacancy rates were high and had increased from 1970. The relative high vacancies of 33.3 percent (North Kona) and 24.3 percent (South Kohala) are indicative of the use of some units as second homes and vacation rentals.

Comparing 1970 to 1980, more owners lived in their housing units in 1980. In North Kona, the percentage of renter-occupied units decreased from 55 percent to 45 percent; in South Kohala, from 51 percent to 41 percent.

Reflecting national trends, household sizes decreased in Hawai'i County and the study area. At an average of 2.92 persons, North Kona households tended to be smaller than the overall county average household size of 3.09 persons.

The median rents in 1980 were higher in the study area than in Hawai'i County. For North Kona, the median monthly rent was $331; South Kohala, $307. Both were much higher than Hawai'i County's $223 median monthly rent.

Table 5

Labor Force Characteristics for the County of Hawai'i, North Kona and South Kohala, 1970 and 1980

	County of Hawai'i		North Kona		South Kohala	
	1970	1980	1970	1980	1970	1980
Potential Labor Force						
(aged 16+)	43,075	67,205	3,632	10,115	1,446	3,290
not in labor force	39.5%	38.7%	44.3%	27.8%	34.2%	35.9%
armed forces	0.4%	0.3%	0.0%	0.1%	0.0%	0.0%
civilian labor force	60.1%	61.0%	55.7%	72.1%	65.8%	64.1%
Civilian Labor Force	25,889	41,006	2,022	7,293	951	2,110
unemployed	2.7%	7.0%	4.8%	5.2%	4.1%	6.3%
Employed Civ. Labor Force	25,180	38,150	1,925	6,913	912	1,978
Occupation						
Service	16.3%	16.5%	19.3%	21.5%	15.9%	18.0%
Managerial,professional	NC	20.0%	NC	21.2%	NC	20.6%
Techical, sales, administration	NC	26.1%	NC	28.2%	NC	19.2%
Farm, fish, forestry	NC	10.3%	NC	7.1%	NC	14.0%
Precision, craft, repair	NC	12.7%	NC	12.1%	NC	16.5%
Operators, fabricators, laborer	NC	14.4%	NC	9.9%	NC	11.8%
Selected Industry						
Agriculture, mining	12.5%	11.2%	N/A	6.2%	N/A	16.8%
Construction	10.6%	9.1%	23.6%	11.2%	13.6%	12.3%
Manufacturing	15.0%	8.3%	1.0%	1.9%	2.3%	5.1%
Retail trade	14.8%	17.5%	13.1%	23.6%	15.9%	13.8%
Finance, real estate	2.8%	5.7%	4.0%	8.6%	3.5%	7.6%
Personal, entertainment, recreation	11.2%	10.9%	N/A	20.7%	N/A	16.0%
Health, education, professional	14.1%	16.7%	7.8%	11.4%	13.9%	14.8%
Public administration	6.5%	7.3%	4.2%	2.7%	3.1%	2.1%
Commute to work						
45 minutes or more	N/A	6.0%	N/A	4.8%	N/A	13.9%
mean travel in minutes	N/A	16.5	N/A	16.4	N/A	21.7

Notes:
(*) Figures are estimates based on 15% sample.
NC 1970 categories or bases are not comparable to 1980.

Sources: U.S. Bureau of the Census, 1972, 1981a, and 1981b

Table 6

Housing Stock Characteristics
the County of Hawai'i, North Kona
and South Kohala, 1970 and 1980

	County of Hawai'i		North Kona		South Kohala	
	1970	1980	1970	1980	1970	1980
Year-Round Housing Units	18,939	33,954	1,975	6,894	798	1,959
Total vacant	9.0%	13.9%	27.4%	33.3%	18.5%	24.3%
Vacant for sale	1.0%	1.3%	3.2%	3.2%	0.1%	2.9%
Vacant for rent	2.0%	5.5%	8.3%	18.9%	1.9%	4.1%
Held for occasional use	N/A	2.5%	N/A	4.9%	N/A	5.3%
Other vacant	N/A	2.0%	N/A	6.2%	N/A	12.0%
Year-Round Occupied Units	17,260	29,237	1,431	4,602	650	1,483
Tenure						
Owner-occupied	56.9%	60.6%	44.7%	55.1%	48.8%	59.3%
Renter-occupied	43.1%	39.4%	55.3%	44.9%	51.2%	40.7%
Selected Conditions						
Lacking some/all plumbing	17.1%	6.4%	26.3%	7.3%	15.4%	2.0%
1.51+ persons/room	6.5%	5.0%	14.1%	6.1%	8.2%	5.3%
Persons per household	3.61	3.09	3.36	2.92	3.51	3.07
1980 Median rent (renter-occupied)	N/A	$223	N/A	$331	N/A	$307
1980 Median value (*) (owner-occupied)	N/A	$70,300	N/A	$114,000	N/A	$95,700

Notes:
(*) Figures are estimates based on 15% sample.
NC 1970 categories or bases are not comparable to 1980.

Sources: U.S. Bureau of the Census, 1972, 1981a, and 1981b

The 1980 median value of owner occupied houses was also higher in North Kona ($114,000) and South Kohala ($97,500). Hawai'i County median value was $70,300.

2.2.5 Economic Forces

Tourism is the major economic activity in North Kona, primarily in Kailua. North Kona currently contains twelve hotels for a total of 2,543 hotel units. In addition, 1,535 condo units provide visitor accommodations in North Kona. [6]

Coffee production has also been a major economic force in North Kona, and the mauka population has centered around the coffee growing areas. Besides coffee, agricultural activities include cattle ranching and the growing of fruit, macadamia nuts and vegetables. Timber and fishing are small industries in Kona. The Kailua harbor is considered a center for big game fishing; annual international tournaments are popular events for residents and tourists alike.

In South Kohala the primarily economic activities are tourism, cattle ranching and diversified crops. Seven hotels are located in South Kohala; these contain 3,049 hotel units. There are also 256 condo units, ten bed and breakfast units and twelve apartment/hotel units providing visitor accommodations. [7]

Cattle ranching uses most of the land in South Kohala; the headquarters for Parker Ranch is located in Waimea. Waimea is also one of the most productive areas for vegetable crops on this island. Other activities which contribute to the economy include education and scientific research.

2.3 Description of Communities Nearest the Project Site

This section presents preliminary findings of the 1990 census for Census Designated Places (CDP) near the Manini'owali Residential Community. A CDP is simply an urban area, and is not indicative of a municipality or jurisdiction. As depicted in *Figure A*, four CDPs are near the project site. The project site is adjacent to the Kalaoa CDP, which extends south to Kailua-Kona from the project site and includes lands from the shoreline to the Hawai'i Belt Road. The other three CDPs include the Kailua-Kona CDP and, to the north, the Puako and Waikoloa CDPs. [7]

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6 *Hawaii Visitors Bureau, 1991.*
7 *All of the information provided in this section was from* 1990 Census of Population and Housing: Summary Population and Housing Characteristics: 1990 CPH-1 (Proof Copy) *by the U.S. Department of Commerce, Bureau of the Census.*

2.3.1 Kalaoa

Table 7 shows that, in 1990, an estimated 4,500 people lived near the Manini'owali project site. Almost two-thirds were Caucasians, which is high compared to Hawai'i County proportions, but in keeping with other North Kona and South Kohala communities.

Median age in Kalaoa was 35.4 years, which is slightly higher than the 34.3 years median in Hawai'i County. There was proportionally less elderly people, however, and a higher proportion of people in the labor force ages of 18 through 64.

Kalaoa is the most family-oriented of all the nearby communities. About three-fourths of the population were in family households; almost two-thirds include married couples.

Most of Kalaoa's housing units (95 percent) are single-family units, and there was an eight percent housing vacancy rate. Seventy-three percent of the units were owner-occupied, which is very high compared to other nearby communities. As *Table 8* indicates, Kalaoa also had the largest household sizes with 2.92 persons and 2.76 persons for owner- and renter-occupied units, respectively.

Kalaoa's rent was more than double Hawai'i County's average rent, and the median value of owner-occupied homes was $209,400.

2.3.2 Kailua

Kailua is the largest community near the project site with an estimated 9,100 persons in 1990. About 55 percent were Caucasian, which is the lowest proportion of Caucasians of the four nearby communities. Kailua's population is the youngest of the nearby communities with a median age of 31.8 years. The proportion of 8.6 percent under five years of age is higher than county-wide averages.

Kailua tends to be less family-oriented than Kalaoa, with only two-thirds of its population in family households. Slightly more than half contain married couples.

Unlike the predominance of single-family units in Kalaoa, Kailua's housing stock is almost equally divided between single- and multi-family units. Roughly ten percent of the housing units are vacant. Of all the nearby communities, Kailua has the highest proportion of crowding with 17 percent of the units having one or more persons per room.

Over half of the housing units are occupied by renters, and rent is the lowest of all the nearby communities at an average of $573 per month. Also, the median value of owner-occupied homes was the lowest at $179,900.

Table 7

Population and Age by CDPs and Hawai'i County, 1990

	Hawai'i	Census Designated Place			
	County	Kalaoa	Kailua	Puako	Waikoloa
Total Population	120,317	4,490	9,126	397	2,248
Sex					
Male	50.4%	50.6%	49.7%	55.7%	54.3%
Female	49.6%	49.4%	50.3%	44.3%	45.7%
Ethnicity					
Caucasian	39.7%	64.9%	54.5%	79.3%	72.7%
Asian/Pacific Islander	57.1%	32.6%	42.2%	18.5%	23.0%
Black	0.5%	0.6%	0.3%	0.3%	1.1%
American Indian/Eskimo	0.7%	0.6%	0.8%	0.5%	1.5%
Other	2.0%	1.3%	2.1%	1.3%	1.8%
Age					
Under 5 years	7.9%	7.7%	8.6%	5.0%	8.9%
5 to 17	20.8%	20.1%	19.6%	12.6%	12.0%
18 to 64	58.8%	64.4%	63.8%	71.5%	71.9%
65 plus	12.5%	7.7%	7.9%	10.8%	7.2%
Median age	34.3	35.4	31.8	36.6	32.8
Persons living in group quarters	1.4%	0.0%	5.3%	6.8%	0.0%
Family Households	30,235	1,173	2,125	89	551
As % of total households	72.9%	75.8%	67.6%	52.4%	63.6%
Married couples	56.5%	63.6%	51.4%	38.2%	52.8%
Other family householders	16.4%	12.2%	16.2%	14.1%	10.7%
Non-Family Households	11,226	375	1,019	81	316

Source: U.S. Department of Commerce, 1991b.

Table 8

Housing Stock Characteristics by CDPs and Hawai'i County, 1990

	Hawai'i County	Census Designated Place			
		Kalaoa	Kailua	Puako	Waikoloa
Total Housing Units	48,253	1,685	3,739	545	1,303
Single-family	78.8%	94.5%	48.0%	34.7%	45.4%
Multi-family	19.4%	4.6%	50.6%	65.3%	54.6%
Mobile/other	1.8%	0.9%	1.3%	0.0%	0.0%
Total Vacant Units	6792	137	595	375	436
Vacant for rent	10.1%	9.0%	10.4%	43.8%	31.7%
Total Occupied Units	41,461	1,548	3,144	170	867
Units with 1.0 or more persons/room	12.4%	8.6%	17.3%	9.4%	6.7%
Tenure					
Owner-occupied	61.1%	73.1%	44.7%	35.9%	37.9%
Renter-occupied	38.9%	26.9%	55.3%	64.1%	62.1%
Persons Per Unit					
Owner-occupied	2.93	2.92	2.86	2.30	2.59
Renter-occupied	2.76	2.84	2.66	2.11	2.60
1990 Median Rent	$428	$881	$573	$644	$882
1990 Median Value	$113,000	$209,400	$179,900	$500,000	$255,100

Source: U.S. Department of Commerce, 1991b.

2.3.3 Puako

North of Manini'owali Residential Community, Puako is the smallest community with a 1990 estimated population of 397 persons. Almost 80 percent are Caucasian, and the population is the oldest of all the nearby communities. Seventy-one percent are in the working age category of 18 to 64 years of age and eleven percent are elderly. The median age in 1990 was 36.6 years.

Puako is the least family-oriented of the nearby communities, with only 52 percent in family households. Further only 38 percent of the households have married couples.

Indicative of the large number of second homes in Puako, the housing vacancy rate is high in Puako; of the 545 housing units, 375 or 69 percent were vacant. Of the 170 occupied units, 64 percent were renter-occupied. Renters paid an average of $644 a month for housing. Significantly, Puako had the most expensive homes. The 1990 median value averaged over $500,000 in 1990.

Household sizes were small in Puako. An average of 2.1 persons lived in a rental unit, and the average household size of owner-occupied units is 2.3 persons.

2.3.4 Waikoloa

In 1990, Waikoloa, which is also north of the project site, was home to over 2,200 people. As with other communities, the largest ethnic group is Caucasian with 73 percent.

Waikoloa has the youngest population. Almost nine percent are under 5 years of age, and only 7.2 percent were elderly. The proportion of people aged 18 to 64 years was high at 72 percent. Waikoloa's median age is 32.8 years.

Sixty-four percent of Waikoloa's households are family households, and over half contained married couples.

Waikoloa shares some housing stock characteristics with Puako. As with Puako, Waikoloa has more multi-family housing units, with 55 percent of the housing stock in this category. Most of the occupied units (62 percent) are used by renters. Household sizes were small at 2.59 persons and 2.6 persons for owner-occupied and renter-occupied units, respectively.

In contrast with Puako are Waikoloa's rents and housing values. Waikoloa had the highest median monthly rent at $882. The median value of the housing units was half that of Puako at $500,000.

2.4 Summary of Existing Characteristics

From a social impact standpoint, the most significant characteristic of the study area is the rapid population and economic growth over the last twenty years. North Kona and South Kohala was home to an estimated 31,424 residents in 1990, which is over four times the combined 1970 population of 7,142 persons.

The District's average annual growth rate of almost eight percent for those twenty years is extremely high by any standard. This rapid growth can be attributed primarily to the development and growth in visitor facilities.

Housing trends were consistent with population changes. In 1970, the study area contained approximately 2,773 housing units; by 1980, the total study area count increased to 8,853 units which represents an increase of 219 percent. The bulk of the growth occurred in North Kona, where housing units increased by almost 5,000 units. The preliminary 1990 housing count is 14,225 housing units. Although North Kona contained the bulk of the housing supply (almost 10,000 units), it was South Kohala which experienced the major housing supply increase in the 1980s.

Demographic trends based on the 1970 and 1980 census indicate the following:

1. **Ethnic, age and education distinctions.**

   Whereas the two largest ethnic groups in Hawai'i County are Caucasians and Japanese, the two largest ethnic groups in North Kona and South Kohala are Caucasians and Hawaiians. North Kona's population is slightly younger than the island-wide norm with a median age of 28.9 years. Also, study area residents tended to receive more post-high school education than the county-wide averages.

2. **Statistical evidence of high in-migration.**

   The study area had proportionally more people who were born in other states, when compared to Hawaii County. In North Kona, about 40 percent of the 1980 population were born in another state, while 30 percent of South Kohala fit this category. In-migration tended to be more recent in North Kona.

3. **Low unemployment rate and predominance of visitor-related jobs**

   The study area unemployment rates of 2.8 and 2.9 percent are significantly low compared to the county-wide rate of 3.8 percent. North Kona and South Kohala were highly represented in service occupations. Consistent with the predominant visitor industry, the study area was highly represented in the personal, entertainment, and recreational industries, as well as the retail trades. Both North Kona and South Kohala were under-represented in public administration compared with the county.

   Ranching and agriculture are still important in South Kohala, as can be seen in the high representation in farm/fish/forest occupations and agriculture/mining industries.

4. **Small households, increase in owner-occupied units and high housing costs.**

   At an average of 2.92 persons, North Kona households tended to be smaller than the overall county average household size of 3.09 persons. Comparing 1970 to 1980, more owners lived in their housing units in 1980.

   For North Kona, the median monthly rent was $331; South Kohala, $307. Both were much higher than Hawai'i County's $223 median monthly rent. The 1980 median value of owner occupied houses was also higher in North Kona ($114,000) and South Kohala ($97,500). Hawai'i County median value was $70,300.

5. **Distinctions among the individual communities.**

   In 1990, the individual communities generally shared the characteristics discussed earlier. The following are distinctions among these communities:

   - *Kalaoa* (the CDP nearest the project site):
     - home to an estimated 4,500 people in 1990;
     - the most family-oriented of the study area (three-fourths of the population were in family households; almost two-thirds include married couples);
     - slightly higher median age than the County and a higher proportion of people in the labor force ages of 18 through 64;
     - most housing units (95 percent) are single-family units, and three-fourths of units are owner-occupied; and
     - largest household sizes with 2.92 persons and 2.76 persons for owner- and renter-occupied units, respectively.
   - *Kailua*:
     - the largest community near the project site (9,100 persons in 1990);
     - the youngest of the nearby communities with a median age of 31.8 years;
     - less family-oriented and less married couples than Kalaola;
     - almost equal number of single- and multi-family units;

- highest proportion of crowding with 17 percent of the units having one or more persons per room; and
- lowest rent and value of owner-occupied homes.

• *Puako*:
- the smallest community (1990 estimated population of 397 persons;
- almost 80 percent are Caucasian;
- oldest of all the nearby communities (median age in 1990 was 36.6 years);
- least family-oriented of the nearby communities;
- highest housing vacancy rate;
- most expensive homes (1990 median value averaged over $500,000); and
- smallest households.

• *Waikoloa*:
- newest community with a population of 2,200 people in 1990;
- youngest population (median age of 32.8 years in 1990);
- more multi-family units (55 percent) than single family units;
- high level of renters; and
- highest median monthly rent ($882).

3 NO-PROJECT SCENARIO

This section identifies forces for change in the study area independent of the proposed project. This information extends the baseline information on the existing communities, by exploring a possible future scenario without the Manini'owali Residential Community. Project impacts are then weighed against this "no-action" scenario. Section 3.1 discusses major public policies which guide the future of the project site, its environs and the study area. Major proposed developments in the study area are identified in Section 3.2. Based on these guidelines and proposals, a possible future scenario of the project site is presented in Section 3.3.

3.1 Major Public Policies

This study examined public policies to estimate what the study area may be like in the future without the Manini'owali Residential Community. Though there are numerous public approvals which the proposed project needs to be implemented, this discussion is limited to major plans and policies which underlie County and State regulations.

3.1.1 County General Plan

Underlying Hawai'i County policies, plans and rules is the General Plan. Hawai'i County's General Plan was originally adopted in 1971, and comprehensively revised in 1989 through County Ordinance 89-142.

The proposed land use pattern acreage for the study area is presented in *Table 9*. As expected, North Kona and South Kohala are programmed for higher levels of resort use compared to land allocation in the overall county. In North Kona, three percent of the total 33,801 acres under County jurisdiction is allocated for resort. The proportion of resort-allocated lands in South Kohala is higher, at five percent. Overall, two percent of County lands are for resort use.

The General Plan calls for orderly resort development in both North Kona and South Kohala. Economic diversity is encouraged, and the County is to support further development of agriculture. The General Plan calls for the development of a wide variety of housing to attain a diversity of socio-economic housing mix; in North Kona, the use of cluster and planned unit developments is encouraged to take advantage of the sloping topography. Further, numerous courses of action deal with the improvement of shoreline access and recreational facilities.

The Manini'owali Residential Community project site is part of the State Land Use Conservation District, and, as such, designated Conservation on the General Plan Land Use Pattern Allocation Guide Map.

Table 9

Hawai'i County General Plan
Proposed Land Use Pattern Acreage for
North Kona, South Kohala and the County

District	Residential		Commercial		Industrial		Resort		Total Acreage
	Acreage	% of Total	Acreage	% of Total	Acreage	% of Total	Acreage	% of Total	
North Kona	25,066	74%	2,507	7%	5,068	15%	1,160	3%	33,801
South Kohala	11,056	74%	1,106	7%	2,034	14%	746	5%	14,942
Total County	96,365	75%	9,638	8%	19,230	15%	2,695	2%	127,928

Source: County of Hawai'i, 1989

3.1.2 Other County Plans

The County produced the **Keahole to Kailua Development Plan** in 1990. Although the area for this plan does not include the Manini'owali Residential Community, this plan was examined because its recommendations and requirements are major determinants in the future of the study area.

The land use portion of the plan delineated three development zones in the subject area. The largest is the "Coastal Zone," which is a 6,200-acre area with a wide range of uses including a civic and business center, ocean research, the airport and industrial activities. The plan assumes that the Kailua area will continue to serve as the main urban service center for the region. Thus, the proposal for a new distinct regional center is seen as a crucial plan component. As the region grows, this new business center is expected to serve as the urban center for government, finance, service and retail commercial activities; it is considered a complement to the historic resources and visitor orientation of Kailua Village. Other development zones are the "lowland urban zone" and the "upland residential zone."

Also of import to the project site is the **Northwest Hawai'i Open Space and Development Plan**, which is currently being prepared by the County Department of Planning. The plan will cover the region extending from Keahole Point in North Kona to Upolu Point in North Kohala. A private consultant was recently retained and a draft of the plan should be completed in July 1992.

3.1.3 West Hawaii Regional Plan

The Office of State Planning produced the **West Hawaii Regional Plan** to (1) coordinate State activities in responding to emerging needs and problems; (2) address State concerns; (3) coordinate the Capital Improvements Program in a regional planning framework; and (4) provide guidance in the State's decision-making process.

The plan identifies critical needs in the region, and looks at ways to address current and anticipated needs. Because of the integrated nature of the West Hawaii Regional Plan, most of the plan's recommendations and directives involve the proposed project in some way, whether it is how to provide needed infrastructure, or which resources should be preserved. Specific strategy and actions outlined in the regional plan which have social implications on the Manini'owali Residential Community are as follows:

1. *Resort Destination Nodes and Support Communities*

   Resort additions and expansions are expected to be the main impetus for changes and growth in West Hawai'i because of the region's favorable market conditions. To avoid uncontrolled sprawl and to manage anticipated growth, the State developed the concept of "Resort Destination Nodes," which are planned clusters of resort and related development.

Table 10 summarizes information about the four resort nodes in West Hawai'i; these include Mauna Kea, Mauna Lani, Kaupulehu-Kuki'o, and Keahole-Keauhou. The proposed Manini'owali Residential Community will be adjacent to the Kaupulehu-Kuki'o Resort Destination Node.

The plan designates support communities to house employees working in the Resort Destination Nodes and other employment generators in West Hawai'i. Government-assisted support communities are designated in Kealakehe, Signal Puako, Lalamilo, Waikoloa and Kawaihae. Kealakehe is the only support community in the North Kona district, and is located approximately twelve miles south from the Manini'owali Residential Community.

2. *Outdoor Recreation*

The plan encourages an improved and expanded recreation delivery system to meet increased and diversified recreational needs; it further suggests that prime swimming beaches be given priority. Recommended in the plan are several sites for new public parks; one of the sites is the Manini'owali Beach, or Kua Bay.

3. *Heritage Resources*

Three types of heritage resources are identified in the West Hawaii Regional Plan: natural, scenic, and cultural. The plan encourages the identification and preservation of these resources, and designates four "Heritage Areas." One of the areas is the adjacent Awake'e for (1) Pu'u Kuili, (2) the anchialine pond complex, and (3) the site's relationship to adjacent proposed park areas at Manini'owali and Makalawena. Further, Pu'u Kuili is specifically identified as a significant natural landmark.

In addition, the plan calls for the preservation of views from the Queen Kaahumanu Highway and the shoreline, as well as the evaluation of potential impact of land use proposals on the visual quality of the landscape.

4. *Public Acc[illegible]*

The plan directs the State to conduct a comprehensive study to identify areas for public shoreline access. It is already acknowledged that the shoreline adjacent to the project site is a valuable recreational resource. In the Awake'e-Manini'owali land exchange, NKDG agreed to reimburse the State for the full cost in an amount not to exceed the maximum sum of $2.5 million, in the event that the State constructs the public roadway and park facilities.

Table 10

Summary of Information on Resort Destination Nodes

Resort Destination Node	Hotel Units Existing	Hotel Units Proposed	Resort/Residential Units Existing	Resort/Residential Units Proposed	Total Existing and Proposed
Mauna Kea Node	310	350	0	700	1,360
Mauna Kea Beach Resort	310	0	0	250	560
South Kohala Resort	0	350	0	450	800
Mauna Lani Node	2,688	2,297	256	4,764	10,005
Mauna Lani Bay Hotel	354	1,000	92	1,948	3,394
Ritz-Carlton	550	100	0	0	650
Waikoloa Beach [illegible]	543	1,197	164	2,816	[illegible]
Hyatt Regency Waikoloa	1,241	0	0	0	1,241
Kaupulehu-Kuki'o Node	125	2,275	0	2,558	4,958
Kaupulehu Resort	0	900	0	600	1,500
Kuki'o Resort	0	1,350	0	1,958	3,308
Kona Village Resort	125	25	0	0	150
Keahole-Keauhou Node	2,585	2,785	1,959	4,453	11,782
O'oma II	0	600	0	600	1,200
Kohanaiki	0	700	0	950	1,650
Kailua-Kona	1,294	200	1,511	200	3,205
Keauhou	1,291	1,285	448	2,703	5,727

Notes:
Existing counts were updated from the May 1988 estimates provided by the Office of State Planning.

Sources: Hawai'i State Office of State Planning, 1989; Hawaii Visitors Bureau, 1991

3.2 Major Development Projects

The study area has undergone major changes in the last two decades, and, though the pace of growth is expected to slow down, still more significant changes are expected. Approved developments are under construction, more are in the land use approval process and under environmental study, and still others are on the drawing boards. This section identifies major proposed developments in the study area which may occur independent of the Manini'owali Residential Community.

The nearest change which will occur without the Manini'owali Residential Community is the Kaupulehu-Kuki'o Resort Destination Node, located just north of the project site. Three complexes comprise this node:

- **The Kona Village Resort** encompasses about 60 acres and currently contains 125 units. This is a low-rise development comprised mostly of thatched individual hales. Current expansion plans call for 25 more units.[8]
- **The Kaupulehu Resort** surrounds the Kona Village Resort to the north, east and south. Approximately 623 acres are located on the portion of the property makai of the highway. The project includes 626 residential units in a mix of lots, single family units and attached units; a golf course; a commercial area; and hotel units. Currently the golf course and 358-unit Four Seasons Hotel are under construction.[9]
- Adjacent to Manini'owali Residential Community, the **Kuki'o I** project has zoning for 1,250 resort units and 1,620 residential units. The 675-acre project site is on both sides of Queen Kaahumanu Highway, though the near-future development is to occur on the makai portion. Currently in design is a golf course, and in January of this year, the 350-unit Regent International Hotel received a Special Management Area permit to proceed. The golf course is expected to begin operation in the summer of 1993, and the hotel is scheduled to open a year later.[10]
- **A Veterans Cemetary** is being considered for Pu'u'o'o, which is mauka of the project site. A two- to three-acre site is under consideration.[11]

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8 *Personal communication with Fred Duerr, General Manager, Kona Village Resort, July 18, 1991.*
9 *Personal communication with Roger Harris, Project Manager, Potomac Investment Associates, July 18, 1991.*
10 *Personal communication with Carl Carlson, Senior Project Manager, Huehue Ranch Associates LP., July 18, 1991.*
11 *Personal communication with Confessor Riveira, member of the County Veterans Advisory Committee.*

Major changes proposed in North Kona between the project site and Kailua-Kona are as follows:

- **Mauka of Keahole Airport** and south of the Kona Palisades subdivision is **Pu'uhonua**, a proposed community by HASEKO (Hawaii), Inc. On a 240-acre site, the project includes single-family residential lots, townhouses, a neighborhood commercial center, and a two-acre park. Sixty percent of the residential units will be affordable.[12]
- **At O'oma II**, which is south of Keahole Airport, Kahala Capital Corporation wants to develop 600 hotel rooms, a shopping area, a golf course, an office/industrial park and a "sea-space center." The project site encompasses approximately 240 acres. The project is currently seeking Urban designation from the State Land Use Commission.[13]
- **Kohanaiki Resort** is just south of O'oma II. The project site encompasses 470 acres and is located near the Kaloko-Honokohau National Park. Included in the project are 1,250 hotel units, a golf course, 300 multi-family units, 380 single-family units. Proposed by Nansay Hawaii, the project received a Special Management Area use permit, but is currently being contested by community groups.[14]
- **Kohanaiki Mauka** is a proposed development on 70 acres by Kamaaina Eight Partnership. The project includes developing light industrial and commercial lots mauka of Queen Kaahumanu Highway about five miles north of Kailua-Kona.[15]
- The State Housing Finance and Development Corporation has begun to develop the **Kealakehe Planned Community**. This is considered a support community which will feed into the Resort Destination Nodes described in the previous section. Fourteen villages in the community will contain a total of 4,158 residential units; 60 percent of the units will designated affordable. The project includes a public golf course, three parks, two natural preserves, an elementary school and a high school, sites for churches and day care centers, and commercial areas.[16]

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12 *HASEKO (Hawaii), Inc., undated.*
13 *Office of Environmental Quality Control, May 23, 1991.*
14 *Kaniho, 1991b.*
15 *Office of Environmental Quality Control, May 23, 1991.*
16 *Belt Collins and Associates, 1990.*

- The Queen Liliuokalani Trust proposes to develop a business district on 758 acres makai of the Queen Kaahumanu Highway and just north of Kailua-Kona. Plans for Keahuolu include a proposed hospital, hotel, government center, office buildings, light industrial space and a 135-acre regional shopping center. The project site recently received Urban designation from the State Land Use Commission.[17]

In South Kohala, the proposed changes are primarily resort and residential, as follows:

- Nansay Hawaii is the developer of two projects in the South Kohala portion of the study area. The Puako Residential Golf Community will feature six golf courses on 3,000 acres in Waikoloa. The community will contain over 2,000 market-priced single- and multi-family units, a golf academy and a commercial center.[18] Further, Nansay was selected by the Hawai'i County as the developer of 1,200 affordable housing units, commercial uses, park and schools on 165 acres in Waikoloa.[19]
- The 761-acre Waikoloa Highlands is located adjacent to and mauka of the existing Waikoloa Village. Rezoning for the project permits an 18-hole golf course and 400 one- and two-acre house lots.
- The four hotels in the Mauna Lani Resort Destination Node are slated for further expansion. About 2,300 hotel units have received Land Use Commission approval, but are not yet built. Over 4,700 resort/residential units are also approved but not yet built.
- The Mauna Kea Resort Destination Node also will bring change to the study area. The South Kohala Resort proposes to build 350 hotel units and 450 resort/residential units. The Mauna Kea Beach Resort will add 250 resort/residential units to the inventory.

3.3 Possible Future Without the Manini'owali Residential Community

The information on major public policies and proposed development projects -- along with the profile on the existing community -- are ingredients in developing a profile of what the study area would be like without the Manini'owali Residential Community. This profile is the basis for identifying potential social impacts of the project and community expectations for the future. A possible future of the study area is as follows:

17 *Yamaguchi, 1991.*
18 *Smith, 1991.*
19 *Pang, 1991.*

1. **Continued and rapid in-migration.**

   The Office of State Planning estimates that, if all of the proposed resort developments are built, the population in West Hawai'i (including North Kohala and South Kona) could reach 79,000 by 2005 and, at ultimate build-out, 99,000 persons. This population increase would be due to the increase in labor force needed to support the proposed number of visitor rooms.

   In 1990, North Kona and South Kohala accounted for 72 percent of the total West Hawai'i population count, which also includes North Kohala and South Kona. If this proportion is maintained, the study area could have a 2005 population of 57,000.[20] This implies an 83 percent increase over the 1990 population of 31,424, and an average annual increase of 4.09 percent. Though lower than historical trends for this area, this average annual growth rate is still higher than county-wide and statewide norms.

2. **Increased need for affordable housing and increased supply.**

   The study area has a very low unemployment rate and it is anticipated that non-area residents will be needed to fill most of the projected anticipated new jobs. This expectation is consistent with State assumptions in developing the planning scenario for the West Hawaii Regional Plan.

   The new residents will compete with existing residents who are seeking affordable housing. Affordable housing is already a pressing need in West Hawai'i, and further in-migration will exacerbate this need.

   An increase in the supply of affordable housing will be due mostly to two sources. First, publicly-sponsored housing in support communities such as Kawaihae, Waikoloa, Lalamilo and Kealakehe, will provide a large portion of the much-needed housing. Only Kealakehe is being developed at this time. Second, resort developers have made housing commitments yielding over 3,330 units. Many of these commitments will be implemented in the designated support communities.

20 *This is a very conservative share of study area population in West Hawai'i, since all of the support communities are located in South Kohala and North Kona.*

3. Creation of new communities and continued social diversity.

The study area currently experiences a high level of in-migration, as indicated in the census information presented in Section 2. As a result, North Kona and South Kohala differ from the rest of Hawai'i County in terms of ethnicity, age, education and other social factors.

New support and resort-residential communities will emerge along the Kohala coast, as well as at Kealakehe. These communities will bring more new residents and the study area is expected to continue to vary from the average social characteristics of the State and the County.

4. Decrease in centralization of employment and residential services and commercial establishments.

Currently the support services, commercial establishments and other facilities serving the West Hawai'i resident are located in primarily in Kailua, and secondarily in Waimea. As the new communities take form, they will contain many of these services and facilities though perhaps at a scale less than currently in these urban centers. These services and facilities include schools, shops, restaurants, social service agencies, churches and police and fire protection facilities. The degree to which new communities may be distinct from the existing communities, will depend on the extent of the full-service nature of the new developments.

4. Increased diversity in types of jobs.

The visitor industry will continue to be the major source of employment in West Hawai'i, as expected due to public policy and proposed resorts. It is expected, however, that non-visitor-related jobs will also increase. As the community grows, there will be an increased need to service the various needs of the population. Thus, more and more development proposals are including industrial and commercial components as major elements, such as the Keahuolu business district proposed by the Queen Liliuokalani Trust.

5. Change in visual landscape.

The coastline in the study area is expected to undergo drastic changes if all approved resort and resort residential units are built. Within the study area's four Resort Destinations Nodes, most of the approved 7,000+ hotel units already lie in the Urban boundaries of the State Land Use Map. Over 12,475 resort-residential units are also proposed for the study area's designated resort areas.

As these developments occur, the vast openness of the study area's coast will become punctuated with pockets of communities. The communities will include golf courses, hotels, mid-rise and low-rise apartments, and single family houses. Public policy-makers will undoubtedly scrutinize each project to ensure minimal visual impact. Nevertheless, the openness, the "sense of space" and the vastness will be different from what exists today.

4 POTENTIAL SOCIAL IMPACTS

4.1 Potential Population Increase

The Manini'owali Residential Community will cause an increase in resident population in the study area, as follows:

- **On-Site Residents.**

  The Manini'owali Residential Community will house approximately between 2,000 and 2,230 residents, based on the market study's projected household size of 2.23 persons. It is expected that about 1,670 residents, or 75 percent, would be full-time or permanent residents.

- **Permanent Employment.**

  An increase in residential population may also result from in-migration necessary to fill permanent project-generated jobs. It is estimated that the residential portion of the project will generate 25 jobs. The golf course and related retail components will generate approximately 95 jobs, 75 of which would be in conjunction with operation of the golf course. In total, 120 on-site long-term direct jobs may result from the project.[21]

  The unemployment rate in the study area continues to remain at very low levels and new jobs would be filled by out-of-area residents who would move into the area to work. The new on-site jobs may also be filled by established residents, in which case in-migrant workers would fill the jobs vacated by the established residents. If the low unemployment level continues, the worst-case scenario is that the project's 120 jobs will attract new residents who will either work at Manini'owali or fill jobs of existing residents who become employed on-site. Hence, the project may attract up to approximately 330 residents by creating permanent employment.

Table 11 contains the potential residential impacts of the project. The total population increase generated by the proposed project is between 2,300 and 2,600 persons. This increase represents about an eight percent increase over the 1990 estimate of 31,424 residents in the combined North Kona and South Kohala Districts, and an approximate eleven percent increase over the current North Kona population.

21 *Zapotocky, 1991.*

Table 11

Manini'owali Residential Community

Potential Residential Impact in 2005

Determining Unit	Factor	Number of Residents
900 - 1,000 housing units	2.23 persons per household (1)	2,007 to 2,230 residents
120 permanent jobs (1)	2.61 - 2.75 persons per household (2)	314 to 330 residents
	Total Population Impact	2,321 to 2560 residents

Notes:

(1) Zapotocky, 1991b

(2) Zapotocky, 1991 and KPMG Peat Marwick, 1990.

The actual share of population will be less by the time the project is fully built in 2005. Full build-out is scheduled for 2005, if the project begins delivering units in 1996. Based on the projected number of visitor units in 2005, and the number of jobs estimated to support the visitor units, it is anticipated that the 2005 population in West Hawai'i may reach 79,000 persons.[22] The Manini'owali Residential Community and its permanent employees and their families would account for approximately three percent of the projected 2005 population.

4.2 Impacts on the Regional Character and Desired Future

4.2.1 Consistency with Expected Settlement Patterns

The community, including public officials, residents and business people, generally expects changes in what is now vast open spaces along the Kohala - Kona coast. Between Kawaihae and Keahole will eventually be seven "pockets" of development. Three of these pockets are the Resort Destination Nodes of Mauna Kea, Mauna Lani/Waikoloa and Kaupulehu-Kuki'o. The other three are the inland support residential communities of Kealakehe, Waikoloa and Lalamilo. Another possible pocket of development comprise the O'oma and Kohanaiki projects.

While it may be difficult to envision the transformation of existing open spaces and lava beds into resort and residential communities, the community is already witness to change. The Mauna Kea, Mauna Lani/Waikoloa and Waikoloa residential community have all expanded over the past few years, and construction at Kaupulehu is very obvious.

Proposed in the context of these expected settlement patterns in North Kona and South Kohala, the Manini'owali Residential Community is consistent with the predicted development scenario. It is believed that the Manini'owali Residential Community will be seen as a compatible extension of the Kaupulehu-Kuki'o Resort Destination Node both visually and in type of residential community.

The proposed project will be part of the visual experience initiated by the adjacent Kuki'o in that there will be similar setbacks from the highway and complementary entrances to the communities. Further association with the adjacent community will be made if roadway ingresses/egresses may eventually be shared by these other developments.

Though there may be design distinctions between the proposed project and adjacent residential development, the Manini'owali Residential Community will likely be perceived as similar in market and concept as the residential components of the Kuki'o and Kaupulehu developments.

22 *Office of State Planning, 1989. This also includes North Kohala and South Kona.*

4.2.2 An Upscale Community

Manini'owali Residential Community is targeting executives, professionals, retirees and second home buyers. It is considered an upscale community, and will resemble the nearby resort/residential communities, although it will not have any on-site hotel or resort units.

The project is being proposed to meet the growing demand for the housing priced higher than average, but lower than the typical $1 million and above resort-residential housing product. The marketing consultant found that, in Hawai'i County, all of the condominium resales for units in this price range and 95 percent of the residential resales occurred in this region. In addition to the market trend to date, the pent-up demand and unique concept of the Manini'owali Residential Community should result in the proposed project being a viable competitor for housing in the higher price range.

In the overall development scenario for the study area, the proposed project would provide housing choices for executives working at Kailua, the proposed Keahuolu, and the various resort destinations. Hence, Manini'owali functions as an integral part of the settlement pattern expected in this region.

The upscale nature of this project and other similar developments may contribute to the potential for social conflicts due to economic disparities between existing and future study area communities. West Hawai'i's in-migrants have been mostly affluent retirees and workers. Executives and professionals are emerging as another in-migrant group as the business center develops and as the types of proposed housing becomes more diverse in terms of housing prices.

The project and other similar developments may contribute to social problems if it exacerbates the increasing economic disparities between the "haves and have-nots." Whether this occurs, however, depends on how the study area evolves over time. The following are two extreme scenarios for consideration:

- **Scenario #1: Social and economic integration.**

  For the existing and new study area residents, the upscale nature of Manini'owali and other similar communities may not be a problem if the region strives towards social and economic integration. On a community-wide level, successful integration among the existing and new residents requires several factors:

  - There needs to be a wide range and locational mixing of housing types.
  - Community organizations should be easily accessible for residents and there should be no apparent exclusionary groups, facilities or areas.
  - People feel comfortable with socio-economic diversity if they believe they have physical, legal and some economic access to most facilities.

- They need to believe that they have -- or can attain -- the same ability as others to compete for jobs and public services.

- **Scenario #2: Social Disharmony.**

  On a societal level, social disharmony occurs when a definable group repeatedly feels excluded from a facility, area, service or otherwise resource they wish to access. This becomes increasingly problematic if access to a desirable area is terminated or altered to accommodate an exclusive group of people.

  Further, an individual's anxiety during personal economic crisis is heightened when faced with evidence of "conspicuous consumption" (expensive cars, exclusive clubs, designer clothes, etc.) exhibited by the wealthy.

  Living conditions are the most obvious differences between economic groups. If a community was made up of only pockets of mansions and ghettos, equitable interaction between the two groups of people is limited, as is the upward mobility of the poorer group.

Diversity in overall study area housing and jobs is a major ingredient in working towards social integration. Another key factor is minimal exclusivity, whether it is a particular facility or a gated community.

As Section 3 discusses, there is major public effort to bring more diversity into the housing market. Affordable housing is a standard condition in development approvals, and many of the proposals include some type of housing mix in terms of price and type. In developing the new "second city" at Keahuolu, there is also an attempt to diversify employment and the economic base.

On the other hand, there will be an increase in gated communities and the Manini'owali Residential Community will be among these. Study area residents will be particularly aware of this whenever they use the future public access to Kua Bay; they will personally experience the physical barrier separating them from the Manini'owali residents.

The social future of the study area probably lies somewhere between these two scenarios. Public officials, community leaders, developers and social service agencies will need to work together to attain a healthy balance of social and economic characteristics.

4.2.3 Location of Affordable Units

It is expected that affordable housing requirements will be place on NKDG. Options include on- or off-site affordable units, an in-lieu contribution, or a combination of these.

By itself, the proposed project would not have a negative social impact if the affordable units are located off-site. If there is a regional trend towards this option, however, then there is a potential for locating all of these off-site affordable units in one area. This would lead to a socially-undesirable situation because it would physically segregate people of low or moderate incomes.

4.2.4 Lifestyle

Lifestyle is the prevailing way of life dictated by the attitudes and values of an individual or a community. Prior to the 1970s, the lifestyle in North Kona and South Kohala was mostly influenced by the agricultural activities occurring in the upland country. Ranching was the major form of activity in South Kohala, and North Kona's coffee industry was a leader among the ranching and other agricultural activities in the area. The lifestyle at that time was definitely rural, with country values and small-town social interactions. In interviews held for this study, this lifestyle was considered the ideal "Kona way of life."

With the 1970s came resort development. New people moved into the area and hotels, condominiums and subdivisions added diversity to the physical landscape. The newer residents generally were of two types. There were the affluent retirees and the workers in the visitor facilities. Census figures show that in-migrants originated from other parts of Hawai'i and the United States and both groups brought different kinds of lifestyles characteristic of their origins. Though many of the more recent residents have assimilated into the then-Kona way of life, they nevertheless influenced the social structures and interactions in subtle ways. Interviewees pointed out, for example, that the more recent residents tend to be more vocal in meetings.

Executives and professionals are emerging as another in-migrant group as the business center develops and as the types of proposed housing becomes more diverse in terms of housing prices.

Thus, the area's current lifestyle has four major components: (1) the agricultural/rural legacy, (2) the retirement communities, (3) resort workers, and (4) the growing executive/professional group. Given the types of development projects already approved for South Kohala and North Kona, the latter three components will be greatly enhanced by increased resort and business development, additional resort-residential units, and a substantial increase in affordable housing units.

The Manini'owali Residential Community could potentially affect the area's because it will likely bring more retirees and executive/professional residents into the area. The project will therefore supplement and continue the type of lifestyles anticipated given the existing community and approved development projects. This lifestyle impact may be seen as a logical one to those who have accepted the existing and projected growth. For those who wish to retain a rural or agricultural lifestyle, however, the project will make no contribution to this way of life. To them, Manini'owali may be seen as another step in the undesirable urbanization of South Kohala and North Kona.

4.3 Compatibility with Nearby Uses

4.3.1 Kaupulehu-Kuki'o Resort Destination Node

At full build-out, the Kaupulehu-Kuki'o Resort Destination Node could contain 2,400 hotel units and 2,558 resort-residential units. It will serve as the urban center nearest the Manini'owali Residential Community.

The proposed project is expected to be compatible with the proposed uses in these adjacent developments. The housing product will be similar in nature to the types of residential uses proposed in these communities. Although the Manini'owali housing product will compete with these other developments, there will also be a complementary relationship. Manini'owali residents will undoubtedly patronize the nearby hotel restaurants, shopping areas and resident-oriented facilities.

The residents and guests at Kaupulehu and Kuki'o may also benefit from the recreational aspects of Manini'owali. They have an additional choice of golf course, and would be able to use the improved Kua Bay.

4.3.2 Awake'e Wilderness Area

Awake'e, the property adjacent to the project site, has been designated a Heritage Area in the West Hawaii Regional Plan. The proposed project is generally compatible with Awake'e and State plans guiding the area's future. The project uses will be buffered from Awake'e by a roadway and landscaping.

The main effects of the proposed project and Awake'e are indirect in that they relate to the development of a beach park at Manini'owali Beach and not to the golf course/residential proposal. The follows are potential effects:

- NKDG proposes to have the entrance of the Kua Bay access roadway run through a portion of the State property. This off-site alignment is preferable to an access road running through the Manini'owali Residential Community. It will provide the beachgoer a natural wilderness environment on the way to the new beach park, and will eliminate any type of monitoring which would be necessary if access were through a gated community. The proposed alignment is sited to minimize grading and affecting Awake'e's physical, cultural and biological resources. Discussion with State Department of Land and Natural Resources officials have been underway for some time, and there is currently a tentative agreement on the access siting.

- In providing access to Kua Bay, NKDG is also helping to improve pedestrian and hiking access to the Awake'e wilderness area. Although vehicular traffic at Awake'e is to be minimized, day

hikers will be encouraged to explore the resources available in the wilderness setting of Awake'e. The Manini'owali Beach Park facilities will be available for their use.

The current plans for access and beach improvements are the result of extensive discussions with the user communities and State officials. To ensure that the improvements at Manini'owali are compatible with the Awake'e area, as well as with the development of a shoreline park from Kua Bay to Mahai'ula south of the project site, NKDG will continue these discussions.

4.3.3 Veterans Cemetery

The Manini'owali Residential Community is directly makai of the proposed Veterans Cemetery, and would be part of the makai view from the Cemetery. The project would extend the visual experience of Kuki'o 1 with a golf course and residences. This experience may be positive for those who find the green space and houses an attractive foreground to the ocean. The view may also be a negative experience if one prefers a totally natural view of the ocean. In this case, the project would add to the obstruction already created by adjacent urban uses. Visual obstruction may be minimized by maintaining low building heights; at the proposed project buildings are not expected to exceed 45 feet in height.

4.4 Housing Impacts

Housing impacts will be generated on three levels. The first level is the on-site housing impacts. The second level of impact is affordable housing and the third is the indirect housing impact due to possible in-migration of permanent on-site employees at Manini'owali.

- **Impacts of On-Site Housing.**

  Preliminary census figures indicate that the entire study area contained 14,225 housing units in 1990; 9,990 of these were located in North Kona. The proposed project represents a six percent increase over existing housing count of North Kona and South Kohala. It is a nine percent increase over North Kona's 1990 housing count.

  Manini'owali's actual share of unit increase, however, will be much smaller because it is expected that many of the approved projects will have begun construction by 2005. In recent years, the State Land Use Commission approved between 8,800 to 10,300 housing units in North Kona. If these approved units are built, North Kona would contain between 23,000 and 24,500 housing units. Manini'owali Residential Community will be an increase of about four percent over combined existing and approved housing units.

  Diversity in housing types and prices is needed for a healthy, heterogeneous community. The Kealakehe Planned Community, for example, includes a mix of housing with the emphasis on affordable housing. There will be a continued need for market housing, and the Manini'owali Residential Community will provide alternatives to those who can afford homes above median prices. The marketing study has found that there is significant market demand for residences in the price range projected for this project.

- **Affordable Housing.**

  The project will also benefit the affordable housing market. NKDG will either directly increase the supply of affordable housing units or contribute funds as appropriate. It is likely that NKDG will either develop off-site housing, or make appropriate contributions.

- **Housing for Employees.**

  As discussed in the previous section, in-migration may be necessary to fill permanent project-generated jobs. In the worst-case scenario, the project's 120 employees will need housing. It is expected that this housing need will be met by the developer's affordable housing requirement.

4.5 Golf Course Impacts

The proposed golf course is expected to have positive impacts on Hawai'i County's supply of golf course. The market study finds that there is an existing shortfall of golf facilities. Existing golf courses are operating at maximum capacity and golf fees are escalating. Further there is a projected increase in the retirement population. There are currently twelve golf courses in Hawai'i County. It was found that there is a demand for between 14 and 50 additional golf courses in Hawai'i County. Nine are under construction and 26 are in various stages of planning. It is believed that only half of those in planning could be developed by 2010.

Most of the projected golf rounds are expected to be played by Manini'owali residents. Second home residents would generate 50 percent of the total rounds; full-time residents would account for 38 percent. The remaining 13 percent would be generated by local residents and the visitor population.

The golf course has two implications for the local community. First, the golf course will increase recreational opportunities for local golfers. The extent of positive impact depends on access in terms of rates and time. NKDG has not yet determined how the golf course will accommodate local residents, and it recommended that provisions be made to optimize local access.

The second implication for the local community relates to problems typical to any golf course proposed in this region, the county and the state. Community awareness of golf courses has increased and issues such as ecological effects inevitably arise. On a more complex level, the golf course has also become a symbol for the larger issues of tourism and foreign investment. Section 5 deals with these issues in more detail.

4.6 Impact on Ocean Recreation

The Manini'owali Residential Community may affect ocean recreation in two ways. First, the site's boundary is 1,000 feet from the shoreline. Second, in the land exchange with the State, NKDG agreed to provide access and improve the area for shoreline users.

Ocean recreation consultant John Clark conducted a beach and ocean recreation survey in conjunction with this social impact assessment. His study is included in *Appendix A* and is summarized in this section.

4.6.1 Physical Environment

Spanning a distance of 1.5 miles, the shoreline fronting the Manini'owali Residential Community includes Puialoa Point, Kua Bay, Manini'owali Beach, Papiha Point and Kakapa Bay.

Kua Bay and Manini'owali Beach are the primary features. Located at the head of Kua Bay, Manini'owali Beach is one of the few significant white sand beaches on the island of Hawai'i. The inland edge of the beach is bordered by a low wall of lava and several broken fingers of rock from the lava wall extend seaward. The beach is subject to severe sand erosion during the high surf periods from October to April. When the beach is eroding, the high surf will penetrate the entire width of the beach and strike the lava wall. Occasionally, up to an eight-foot thickness of sand will be scoured from the beach and transported into nearshore sand reservoirs. A sand beach always remains, however, no matter how severe the surf, and even though much of it may be awash. Once the high surf subsides, the sand begins to accrete immediately and the beach will regain its normal sand deposits within one or two weeks.

The shoreline in this vicinity is subject to high surf from all of the swell sources except the east-northeast tradewinds. The winter surf strikes the island's northern and western shores; its surf wraps around Papiha Point into Kua Bay. The surf severely erodes the sand at Manini'owali Beach, and strikes Papiha Point with such force that it has created several large underwater canyons in the center of the point and has produced a steep foreshore on the point's coral rubble beach.

4.6.2 User Groups

The shoreline is presently accessible via a secondary gravel road that was constructed in August 1985. It ends approximately 200 yards from Manini'owali Beach where a foot trail over the lava extends to the beach. Access to the bottom of the road is possible only for vehicles with four-wheel drive.

Manini'owali Beach attracts many different user groups and the following summarizes their activities:

- **Boating.**

  Boaters travel long distances to reach Kua Bay and the only regular visitor is the Makani Kai, a commercial charter boat from the Kona Village Resort. Scuba diving charters to Papiha Point originate from Ocean Sports Waikoloa in Anaeho'omalu Bay.

- **Bodysurfing and Bodyboarding.**

  The beach is a popular site for both sports and is comparable to the shore breaks at White Sands Beach Park and at Hapuna Beach State Recreation Area.

- **Camping.**

  Camping is common at the beach, and to a lesser extent at Puialoa and Papiha Points. Campers are usually resident fishers and their families or others seeking a secluded coastal wilderness camping site. Homeless people are occasionally found camping on the beach or in their cars on the access road.

- **Fishing.**

  The three most common types of fishing here are pole fishing, thrownet fishing, and spear fishing. Pole fishers go to Puialoa and Papiha Points for papio, ulua and other nearshore fish; some pole fishing for o'io from boats also occur.

  Thrownet fishing most commonly occurs at Puialoa Point for nenue, kala, and manini and at Kakapa Bay for moi, uouoa and mullet; some overnight lay net fishing occurs offshore for moi, uouoa, mullet and o'io.

  Skin divers from shore and scuba divers from boats spear fish at Puialoa and Papiha Points. Opihi gathering occurs, as well as crabbing for a'ama crabs, but both resources have become scarce.

- **Hiking.**

  Manini'owali Beach is often used as a starting and stopping point for short, roundtrip day hikes, and also as a stopover site for long distance overnight hikes along the Kona-Kohala shoreline.

- **Kayaking and canoeing.**

  Kayakers and outrigger canoe paddlers sometimes use the beach as a rest stop while transiting the North Kona-South Kohala shoreline.

- **Skimboarding.**

  The conditions at Manini'owali are good for skimboarding because of the slope, type of sand, the long expanse of beach and waves surging up the beach most of the year.

- **Snorkeling and scuba diving.**

  Visibility in offshore waters is conducive to snorkeling and scuba diving at both Puialoa and Papiha Points. The underwater topography a Papiha Point is spectacular with its small rock islets, several deep underwater canyons and a wide variety of fish and invertebrates. Several commercial dive boats use the point as a diving destination.

- **Swimming and sunbathing.**

  These are the most popular activities, and the majority of these users concentrates at Manini'owali Beach. The ocean bottom is sandy and rock-free with a gentle slope to overhead depths; the water is usually very clear. Though the beach is safe under normal surf conditions, medium and high surf conditions can be dangerous for swimmers of novice or intermediate ability. Nude sunbathing and swimmers occasionally use the north end of the beach.

4.6.3 Management Recommendations

NKDG's development of a beach park at Manini'owali Beach will generally have positive impacts, as follows:

- **Permanent public access.**

  Public access to one of Hawai'i Island's most significant white sand beaches is especially important because there are few sand beaches. This access would expand opportunities for many residents and will be a new scenic area for more passive activities such as picnicking.

- **Cleanup.**

  Restroom facilities and a litter disposal systems will eliminate the present sanitation and litter problems.

- **Minimize destruction of natural terrain.**

  Currently 4-wheel drive vehicles driving off the access road destroy the terrain. Paved pedestrian paths, roads and parking lots will hopefully minimize this problem.

- **Possible new anchorage.**

Sand anchoring opportunities are excellent off the shoreline, and restroom facilities and fresh water onshore may attract more boaters to the shoreline.

Opening up the beach to more people may also present problems and the following summarizes these and suggests mitigation. Ultimately, the improvements at and ongoing management of Kua Bay will be in the hands of the State Department of Land and Natural Resources, and these recommendations are hereby made to the State.

- **Water safety.**

  The increase in swimmers, bodysurfers and bodyboarders, many of whom will be tourists unfamiliar with the ocean, may create a serious water safety problem during medium and high surf conditions. Two mitigation measures are suggested for consideration. First, lifeguard service should be arranged. The Division of State Parks of the State Department of Land and Natural Resources is the managing agency for the proposed beach park. This agency does not have a lifeguard service, however, and should arrange to provide lifeguards through the County of Hawai'i. The second mitigation is to design the roadway so there is easy access to the beach for emergency vehicles such as ambulances, helicopters and fire department rescue trucks.

- **User conflicts.**

  Increasing user densities under any circumstance will lead to conflicts between users. It is suggested that the following management options be considered to minimize this conflict:

  - Prohibit commercial ocean recreation use of the shoreline from land. If the beach becomes a tour destination, it may be overcrowded to the exclusion of residents.
  - Prohibit surfing at the beach. It is expected that although the plunging waves would be used mostly for bodysurfing and bodyboarding, they may be used by some expert surfers. Surfing would be hazardous to all other users, including swimmers, bodyboarders and bodysurfers.
  - Designate area allowing skim boarding. Skimboarders who lose control while skimming may collide with other users or may lose control.
  - Balance consumptive and non-consumptive uses. Food gathering or consumptive activities already occur at the beach and development of the beach park will lead to a substantial increase of non-consumptive users such as snorkelers and scuba divers. Generally, resolution of this conflict in other areas of the state has been in favor of the non-consumptive user and has often taken the form of a

  marine life conservation district. It is suggested that a compromise solution is to allow certain consumptive activities in certain areas.

- **Coral reefs.**

  Increased boating has the potential of damaging the coral reefs at Puialoa and Papiha Points, and day-use mooring buoys have been installed in other areas as a preventive measure. If visiting boats anchor in the extensive deep sand reservoir offshore, day-use mooring will be unnecessary.

- **Other measures.**

  The extensive sand reservoir offshore Manini'owali Beach should be explored for its potential as a sea shell habitat. Siting of the parking lot should attempt to minimize car thefts. Signage and enforcement may be needed to prohibit nudist sunbathing.

4.6.4 Carrying Capacity

Establishing carrying capacity requires defining the relationship between management objectives and social impacts and arriving at reasonable agreement among user groups about management objectives and evaluative standards. The primary management objective of the project shoreline should be to continue accommodating all of the current and potential users without degradation of the resources or the recreation experiences associated with the resources.

Carrying capacity is often expressed as a number, usually a number of individuals or groups in relation to time and area dimensions. In a recreational setting, carrying capacity is a combination of physical, facility, ecological and social capacity. The latter is concerned with impacts which impair or alter human experience and has been a difficult capacity to determine.

Park planning guidelines suggest that a person needs 45 square feet in a high density situation, 60 square feet in medium density, and 90 square feet in low density.[23] Manini'owali Beach measures 39,600 square feet which means that it can accommodate 880 people in a high density situation, 660 in medium density and 440 in low density.

Because of its undeveloped state, Manini'owali Beach is used well below its carrying capacity. During field surveys for this study, the average weekday number of beachgoers was 50; during the weekend, 100.

When developed, Manini'owali Beach should easily be able to accommodate 400 or more sunbathers, which is the low density carrying capacity guideline. This is consistent with usage patterns at White Sands Beach Park on Ali'i Drive in Kailua-Kona. Like Manini'owali, it is a white sand beach subject to high winter

23 *Fogg, undated.*

surf and severe erosion from high surf and is a popular site for swimming, bodysurfing, and bodyboarding. During field surveys, it was observed that the average number of weekday and weekend beachgoers at White Sands was 150 and 200, respectively. White Sands Beach Park is half the size of Manini'owali Beach, so the carrying capacity is consistently half of what Manini'owali could handle.

4.7 Public Services and Facilities

4.7.1 Police Protection

Hawai'i County's crime rate for the de facto population was second lowest of the counties in 1989. There were 5219.3 offenses per 100,000 de facto population in 1989. Statewide, the rate was 5,989.1.[24] In 1988, there was one police officer for every 430 persons in Hawai'i County; five years prior, the ratio was on 1:402.

The project site is in Area 2, which includes Waimea, Kohala and Kona. This area is served by centralized services at the Kona Police Headquarters located in Kealakehe one-half mile from Kailua.

The study area experienced a decrease in most offenses between 1989 and 1990. *Table 12* shows that Kona experienced between 415 and 421 offenses a month in 1989 and 1990, respectively. The increase in offenses are due to an 8.5 increase in Part 1 offenses, which are the more serious offenses of murder, rape and robbery. Part 2 offenses, including arson, fraud, vandalism, and so on, decreased by four percent in Kona.

In South Kohala, there was an overall 1.6 percent decrease in offenses. Part 2 offenses decreased by almost 27 percent.[25]

In recognition of the growth planned for West Hawai'i, there are currently two possibilities for future expansion of police facilities. First, a 30-acre civic center is included in the master plan of the Kealakehe Planned Community south of the project site.[26] Second, the new Civic Center proposed in the Keahole to Kailua Plan may house police facilities. Both are long range in nature.

The project site is located seven miles north of the Kona Police Headquarters. The Manini'owali Residential Community will increase the population and therefore increase the demand for police protection services.

24 *State of Hawaii Department of the Attorney General, 1990.*
25 *Computer printout from the Hawai'i County Police Department.*
26 *Belt Collins and Associates, 1990.*

Table 12

Offenses Known to Police for
North Kona and South Kohala, 1989 and 1990

Classification of Offenses	1989				1990 (Jan. through Sept.)				Percent change in monthly ave. between 1989 and 1990	
	Kona		South Kohala		Kona		South Kohala			
	Number	Ave/mo.	Number	Ave/mo.	Number	Ave/mo.	Number	Ave/mo.	Kona	South Kohala
Part 1	2,237	186.42	603	50.25	1,820	202.22	562	62.44	8.5%	−6.8%
Part 2	2,739	228.25	560	46.67	1,973	219.22	410	45.56	−4.0%	−26.8%
Total	4,976	414.67	1,163	96.92	3,793	421.44	972	108.00	1.6%	−16.4%

Source: Computer printout provided by statistician at Hawai'i County Police Department.

Part 1 offenses include murder, manslaughter, rape, robbery, assault, and other serious crimes.
Part 2 offenses include crimes such as arson, fraud, vandalism, drunkenness, and vagrancy.

The project can minimize the need for police protection through on-site security and project design. The project is envisioned as a gated community and visitors would be monitored by private security guards. Neighborhood watch programs are also effective in crime detection and deterrence. Finally, design measures, such as well-lit roads, sidewalks, and parking and common areas, would help eliminate crime opportunities.

4.7.2 Fire Protection

First alarm response for the project site is from the Kailua Fire Station located twenty miles south. The Kailua Fire Station has a 1,500 gallon-per-minute (gpm) pumper with 1,000 gallons of water; a 750 gpm tanker with 1,200 gallons of water; and a 65-foot aerial ladder truck carrying 500 gallons of water. Emergency and rescue facilities include a 26-foot rescue boat and an ambulance. This station has a staff of 33 personnel in three shifts.

Approximately 15 miles north of the Manini'owali Residential Community is the South Kohala Fire Station. This station responds to first alarms up to the entrance road to the Kona Village Resort, but excluding the resort itself. The facility is equipped with a 1,500 gpm pumper with 1,000 gallons of water, an ambulance, and a 2.5 ton 1,000-gallon tanker. The South Kohala Fire Station is staffed by 18 firefighters in three shifts.

Currently, there are plans for new facility in Keauhou. This new facility would be funded in an arrangement similar to the South Kohala Fire Station, whereby resort owners would contribute funds to develop the facility. The primary entity is Kamehameha Investment Company, who provided 0.7 acres; other owners have also been approached for funding contributions. The County Council passed a resolution approving the fire station on January 16, 1991; funding commitments were to have been made within 120 days of the resolution. As of this writing, funding is still insufficient, so the future of this station is unclear.[27]

Also, as with a new police station, a new fire station may be located at either the 30-acre civic center in the Kealakehe Planned Community, or the new Civic Center proposed in the Keahole to Kailua Plan.

The proposed project will increase the demand for fire protection services, and NKDG needs to work with fire department officials to work out specific responsibilities to mitigate project impacts.

[27] *Information compiled from (1) letter dated 3 July 1991 from Fire Chief Daniel Ayala to Group 70 Limited; (2) personal communication with Hardig Fragas, Jr., Deputy Fire Chief, on September 12, 1991; and (3) Pang, 1991.*

4.7.3 Education

Students in the Manini'owali Residential Community would attend the Kealakehe Elementary, Kealakehe Intermediate and Konawaena High Schools. Enrollment at the first two school experienced major increases between the school years beginning in 1988 and 1989. As *Table 13* shows, the enrollment at Kealakehe Elementary and Kealakehe Intermediate increased by 17.6 and 12.8 percent, respectively. This was much higher than the 6.1 percent increase of the overall West Hawai'i complex.

The entire West Hawai'i public school system needs to expand to accommodate growth. The most immediate planned addition is a new Konawaena Elementary School on a ten-acre site one-half mile south of the existing Konawaena intersection. The school was to open in 1993, but the timing of implementation is unclear because of current problems related to land acquisition.[28]

Also being planned is a new high school in Kealakehe; ideally, operations would begin in the 1995 - 1996 school year. A 45-acre site in the Kealakehe Planned Community is programmed for the new high school.[29]

The project's impact on the school system will be mitigated by developer contribution to the development of new classrooms. DOE estimates that Manini'owali will generate 220 students, as indicated in *Table 14*. The agency requested that NKDG contribute funds to cover 50 percent of the cost of constructing classrooms to accommodate the new students. NKDG will hold further discussions with DOE officials to (1) estimate the number of students given the project's retirement home emphasis and (2) discuss a corresponding fair share contribution.

4.7.4 Hospitals

Currently, there are five acute care facilities in Hawai'i County. All part of the County/State Hospital system, these facilities are the Hilo, Honoka'a, and Ka'u Hospitals in East Hawai'i and Kohala and Kona Hospitals in West Hawai'i. A total of 406 licensed acute care and other beds serve Hawai'i County. The West Hawai'i hospitals (in Kona and Kohala) contained 87 acute care, skilled nursing facility, intermediate care, related swing beds and psychiatric beds in 1989 - 1990.[30]

If no changes are made to the hospital system prior to project implementation, the Manini'owali Residential Community would be most immediately served by the Kona Hospital. The hospital has a service area extending from Ocean View Estates in Ka'u to Kohala.

[28] *Kaniho, 1991c.*
[29] *Belt Collins and Associates, 1990 and Kaniho, 1990.*

Table 13

Enrollment in Schools Which Would Serve the Manini'owali Residential Community, FY 1988 and 1989

School	Enrollment 1988 – 1989	Enrollment 1989 – 1990	Percent Change
Kealakehe Elementary (K-5)	779	916	17.6%
Kealakehe Intermediate (6-8)	711	802	12.8%
Konawaena High and Elementary	2,216	2,215	-0.0%
Total West Hawai'i (*)	5,284	5,605	6.1%

(*) also includes Hookena, Holualoa Elementary, Honaunau, Kahakai Elementary

Source: Office of State Planning, 1989, and personal communication with Tom Saka, Demographics Specialist, State Department of Education.

Table 14

Projected School Enrollment of the Manini'owali Residential Community

Grade	Factor per 100 Units	Students Per 100 Units
Kindergarten through Grade 5	0.11	11
Grade 6 through Grade 8	0.05	5
Grade 9 through Grade 12	0.06	6
Total Students Per 100 Units		22
Total Students For 1,000 Units		220

Source: Tom Saka, Demographics Specialist, State Department of Education

Currently Kona Hospital contains 61 licensed beds, 44 of which are acute care beds. In 1990, the hospital's 3,932 acute care admissions accounted for 34 percent of the island's total. As shown on *Table 15*, utilization has been increasing at the Kona Hospital. Comparing FY 1989 and FY 1990, admissions were up 23 percent, and there were 18.5 percent more deliveries made.[31]

Currently, Kona Hospital is undergoing Phase 1 of renovations, which include a new wing with operating rooms and surgery, a new coronary intensive care unit, and physical and occupational therapy facilities. Phase 2 includes a new wing for administration and laboratory, renovation of the existing services, and an increase in floor space for support services.[32]

In the long range scheme, the hospital system for the northern and western portions of Hawai'i Island is being planned for major changes, as follows:

- **The North Hawai'i Community Hospital (NHCH)** is a 50-bed facility to be located in Waimea adjacent to the Lucy Henriques Medical Center. It is scheduled to begin operations in 1994, and will replace the 27 licensed beds located in Honoka'a. The NHCH will be a not-for-profit, private hospital, although State funding for facility capital costs and operating subsidy is expected.
- **The West Hawai'i Regional Health Center (WHRHC)** would be near the project site in the Keahole area of North Kona. It would contain 120 beds, of which 90 would be acute care and 30 would be swing beds.
- **The Hawaii Family Medical Center** has filed a Certificate of Need application for a primary care medical clinic in Waikoloa Village.

The WHRHC would eventually replace the acute care services at Kona Hospital; the latter would continue to provide emergency services and its acute care beds would be converted to long-term care and specialty care beds.[33]

The Manini'owali Residential Community would increase the population in the area and would therefore increase the demand for hospital services in the study area. This impact will not be significant, however, provided that proposed improvements are implemented as scheduled.

31 *Kona Hospital Strategic Plan and computer printout entitled "Selected Statistical Data: July 1, 1989 - June 30, 1990."*
32 *Personal communication with Jennie Wung, Administrator, Kona Hospital, July 18, 1991.*
33 *Herman Smith Associates, 1991.*

Table 15

Selected Utilization Information
for Kona Hospital, 1988 to 1990

	Kona Hospital		Percent Change
	1988 – 1989	1989 – 1990	
Admissions	3,249	4,014	23.5%
Acute Care	3,181	3,932	23.6%
Long Term Care	68	82	20.6%
Total Patient Days	18,307	19,125	4.5%
Obstetrics	540	640	18.5%
Emergency Room Visits	7,952	7,809	-1.8%

Source: State of Hawaii, Department of Health Community Hospitals Division, undated; and computer printout entitled "Selected Statistical Data: July 1, 1989 - June 30, 1990."

5 PRELIMINARY COMMUNITY ISSUES ON THE PROJECT

Whereas social impacts are social changes which are likely to occur, social issues are reactions to community events, changes and problems. Issues change over time, as people's priorities and values change. This section presents an overview and analysis of issues related to the Manini'owali Residential Community as of September 1991.

Section 5.1 identifies the sources of information used in this analysis. Section 5.2 summarizes non-project issues described in interviews conducted for this project. Section 5.3 presents project-related issues as discussed by community people recently interviewed. Section 5.4 presents an analysis of these comments.

5.1 Sources of Information on Community Issues

Earthplan conducted 50 interviews with people who live or work near the project site, are active in regional affairs, or whose services would be affected by the implementation of this project. Those interviewed also included people who could give us specific information about how the nearby shoreline is used.

The interviews were conducted for issue identification and analysis. This type of analysis assists both the developer and policy makers in ascertaining community reaction to a project, and in assessing the need and types of mitigation which may be acceptable to the community. The emphasis of issues analysis is capturing the *range* of community reactions; the product is a broad picture of the variety of concerns.

Issues analysis is different from a statistical survey in that polls focus on frequency of reactions, rather than the nature of the issues themselves. In our analysis, the only time we make reference to the quantity of opinion is where there was a significant difference in numbers, such as "only one respondent," or "all of those interviewed."

To identify a broad range of concerns on Manini'owali Residential Community, the selection of people was based on achieving a cross-section of interests. Every attempt was made to talk to people with different interests and walks of life. To network, interviewers asked informants to provide referrals, with the understanding that we were looking for a cross-section, rather than people with similar viewpoints.

The following is a breakdown of people interviewed in conjunction with this social impact assessment: [33]

- **Members of environmental and cultural organizations.**

  These included people who are actively involved with organizations addressing environmental issues, or working towards cultural enhancement. Examples of such organizations are Greenpeace Hawaii, the West Hawaii Sierra Club, and the Kona Hawaiian Civic Club. Thirteen people were contacted primarily because of their work in these areas, accounting for over a fourth of the total number of informants. Many of these people were frequent users of Manini'owali Beach and Kua Bay.

- **Ocean recreation.**

  Ten of those interviewed were interviewed because they were specifically familiar with the food gathering and ocean recreation activities of the area. These people knew the area because they fished in the area, or conducted ocean recreation activities related to nearby resorts and charters.

- **Community organizations and non-organizational referrals.**

  Another 13 people were contacted because they were involved with Kona-based community organizations, such as the Greater Kona Community Council, and the Kona-Kohala Chamber of Commerce. This group also includes referrals who are not affiliated with an organization but who provided a unique or different perspective.

- **Members of public or social service agencies.**

  Ten of those interviewed were involved in public agencies, such as the public hospital and police department, or in providing social services, such as family services.

- **Resort Destination Node.**

  Four of those interviewed were "neighbors," who were affiliated with the different entities of the Kaupulehu-Kuki'o Resort Destination Node.

33 *For the purposes of sorting, we identified people by their primary affiliation, such as whether one was interviewed because of his or her involvement with an environmental group. Many of those interviewed, however, are members of more than one group.*

The interviews were conducted mostly in person. The interviews were informal and most lasted about an hour. There were three general areas of questions, as follows:

1. **Feelings about their community.**[34]

   Interviewees were first asked to identify aspects about the community that they liked and to identify community problems. Next, they were asked to describe their expectations and desires for the community's future. The "community" which they described was mostly the North Kona and South Kohala regions.

2. **Manini'owali Residential Community.**

   Those interviewed were asked what they already knew about the proposed project, and the interviewer provided information based on the environmental assessment. Informants were then asked what kinds of good things they saw about this project, followed by a discussion of project-related problems. Informants were also asked if they had any recommendations or revisions.

3. **NKDG and Referrals.**

   The last category of questions was related to (1) the informants' knowledge of and opinion about NKDG and (2) recommendations for future contacts.

Each person was informed that input would be summarized in the Social Impact Assessment and that individual opinions would remain confidential.

Informational sources for community issues also included West Hawai'i and Honolulu newspaper articles between November 1990 and August 1991.

5.2 Non-Project Issues Described in the Interviews

5.2.1 Community Aspects That People Liked

What people valued the most about the community are its non-urban qualities. There was an appreciation for the lack of structures, and the relatively rural lifestyle. Specifically, these qualities include:

- **The Predominance Of Natural Settings.**

  "Open space" was a common, and often the first, response among those interviewed. They valued the open ranges mauka and makai of the highway. They liked being able to see no buildings for miles while driving, or while picnicking at a secluded beach.

34 *The "community" which was self-described tended to be the South Kohala and North Kona region.*

They liked the diversity in landscape, ranging from the shoreline, to the pu'us, to the mountains. The weather was also a major plus for those interviewed.

- **The People.**

  Those interviewed valued the community's people. They felt that the aloha spirit was alive and well in Kohala and Kona; people were sharing, kind, and protective of each other.

- **Clean Environment.**

  People felt that one of the main draws to the area is the clean environment. Water clarity in nearshore waters is important, and fishing and other food-gathering activities is a way of life for many. Those interviewed also noted that the air is still clean, though vog was an often-mentioned irritant.

- **Village or Small-Town Atmosphere.**

  Part of the area's value is the small-town environment, or the "Kona way of life." Those interviewed felt that there are still discernible communities. People are able to interact with each other in village settings. They know and are comfortable with most people around them because the scale of interaction is still manageable.

5.2.2 Community Problems

Problems cited by those interviewed were mostly related to the area's transition from a rural to urban environment. All of the informants felt that the area grew and developed too much too soon, and the following are specific problems which were cited:

- **Need To Play "Catch-Up."**

  All felt that infrastructure development is grossly inadequate to meet the needs of a growing population. They felt that roads are not widened or repaired fast enough, and the sewerage system needs to be expanded.

  A major problem for those interviewed was the slow response in terms of fire and school needs. While informants tended to be more tolerant of the slow fire station development, they were highly critical of the delay in school improvements. Further, there was frustration that the hospital and medical service delivery system is not keeping up with the increasing needs of the community.

Another item which has not kept pace with population needs is affordable housing. Informants were very concerned about crowding in individual units, the increasing tendency of young families living with parents, and the growing homeless population.

- **Shortage of Recreational Facilities.**

  Recreation is considered an important part of the Kona way of life, whether it is picnicking at the beach, hiking along the coast, fishing, or participating in ball games, or playing in the playground. To those interviewed, more people means increased competition for limited community and beach parks. They felt that, even though the population has been increasing rapidly, the development of recreational facilities has been too slow. Old-timers were especially frustrated that their grandchildren are limited to the same playgrounds that they themselves used as children.

- **Social Adjustments.**

  The sheer influx of people meant too many social changes over a short period of time. Those who lived in the area for a long time felt that the newcomers did not blend in, but tried to run or change things.

  People also felt that the combination of in-migrant workers and affluent retirees was socially problematic. The basic issue for many was economic disparity, as the distance between the "haves" and "have-nots" was growing. It was further pointed out that the "snowbirds" use the community's resources but do not contribute to the community on a long-term basis.

- **Environmental Problems.**

  The changing physical environment was a big problem. It was feared that the new golf courses were adding chemicals to the ocean, and that the damage to the ocean habitats will be irreversible. The loss of anchialine ponds was often symbolic of the effects of increasing urbanization.

  More cars meant air pollution to informants, and it was felt that the combination of vog and vehicular air emissions will eventually make the area intolerable for people with respiratory problems.

- **Loss of Cultural Resources.**

  Informants were afraid that many of the existing cultural resources, including archaeological sites, burials and ancient foot trails, are being sacrificed in favor of urbanization.

In addition to these growth-related problems was a frustration about a perceived inequity between East and West Hawai'i. It was felt that funds are more readily released to meet the needs of Hilo residents; recreational facilities and roadway improvements were often examples of uneven distribution. Those interviewed were frustrated mostly because they felt that the growing tax base would be entitling West Hawai'i to more public facilities and services.

5.2.3 Desires for the Future

People were generally optimistic that the problems will be corrected in the future and government was often at the core of the solution. The following are specific desires for the future of the area:

- **Meet Infrastructure and Public Service Needs.**

  Informants wanted to see government fund and implement public improvement projects more efficiently. It was pointed out that private developers are being asked to contribute to public improvements, but government is slow to use the funds. The types of projects which people wanted to see implemented were related to affordable housing, roadway systems, parks and recreation, and public beach access on public lands.

- **Control Growth; Regulate Development Better.**

  Those interviewed wanted to see development controlled through planning and consistent regulations. They pointed to examples of irregular requirements regarding water and roadway development. They also wanted to see population ceilings or targets enforced, and preferred that government be more assertive in scrutinizing proposed development projects.

- **Protect the Environment.**

  Government regulation was also seen as the key to protecting the environment. People wanted to see current environmental laws enforced, and urged the creation of new laws which will further protect the ocean, the land and the air.

- **Increase Political Power.**

  Informants hoped that West Hawai'i would eventually gain more political clout as the population increases. They felt that this would increase the potential for more and better public services and facilities and for improved government responsiveness to West Hawai'i's needs.

- **Developer Accountability.**

It was felt that, when developers propose developments, they often make promises regarding contributions to the community. Interviewees wanted to make sure that these contributions are realized in a timely fashion.

5.3 Issues Related to the Manini'owali Residential Community

Interviewees were asked to discuss their views on (1) what might be good things or benefits of the Manini'owali Residential Community, (2) problems arising from the project, and (3) revisions and modification. Because this is not a statistical survey, frequency of statements are provided only for exceptional cases.

5.3.1 Good Things or Positive Aspects

Those interviewed felt that the good things about Manini'owali Residential Community centered mostly around the on-site and shoreline recreational components. Two people felt that the project had no positive value.

1. **Improvements at Kua Bay.**

   Those interviewed had some knowledge about the contributions that NKDG will make to improve Kua Bay. This was a very positive aspect to almost all interviewed; they liked this because it would facilitate public access to the much touted Manini'owali Beach.

2. **Location Away From the Shoreline.**

   It was felt that the location of the project site away from the shoreline also has high positive value. People pointed out that recent proposals for development near the shoreline have been met with community opposition. They felt that, in being 1,000 feet mauka from the shoreline, the project should have less impact on the ocean.

3. **Contiguity to Urban Development.**

   For some, the project appeared to be a logical extension of the adjacent Kaupulehu-Kuki'o Resort Destination Node. They felt that eventually the resort-residential projects would blend into each other, and Manini'owali would be an extension of the neighboring or adjacent residential component.

4. **Advantages of Specific Project Components.**

   The positive aspects about the golf course had mostly to do with its open space nature. Both golfers and non-golfers preferred the golf course to continuous structural development (i.e. rows of houses) because it meant more greenery.

The positive side of housing component was that the price range of the new houses suggests older residents and smaller households at Manini'owali. The impact on certain public services, such as schools and police protection, would therefore be less than if there were a wide range of housing prices.

The lack of hotels was a big plus for informants. They felt that there were already too many hotels in operation and being proposed, and preferred housing units to hotel units.

5.3.2 Problems and Concerns

Project-related problems and concerns ranged from site-specific to regional in nature. The two most frequent concerns were related to the project's contribution to cumulative regional impacts and effects of the golf course.

1. **Contribution to Cumulative Regional Impacts.**

   The most common concern about the Manini'owali Residential Community was that it would stress the already-burdened infrastructure problems. Traffic was often raised, as well as sewerage system problems and the water system. The latter was especially problematic for those who were aware that the developer needs to find a source of water. They did not want to see public funds expended to accommodate the proposed project.

   Public services and facilities were also cited by those interviewed. People noted that schools, the police department and the fire department already had more than they can handle. They felt that any addition of people would further tax these services.

2. **Golf Course Impacts.**

   There were two types of comments regarding the proposed golf course. First and most frequent were the comments regarding chemicals needed to maintain the greens. People were very concerned about fertilizers needed to feed the vegetation, as well as the typical pesticides and insecticides used to maintain the greens. Associated problems they cited included chemicals leaching into the aquifer, and runoff into the ocean. Informants were aware of ciguatera, or fish poisoning, and the possible linkage to construction and development. Further, they did not want to see the groundwater contaminated, nor did they want any nearby anchialine ponds negatively affected.

   The second golf course-related problem raised by those interviewed is the need for another golf course. They felt that the island, and in particular West Hawai'i, has more than enough golf courses approved, and did not believe there is a market for more golf courses.

3. **Relationship of New People and Existing Community.**

   Interviewees had two reactions to the additional population attributable to the proposed project. First, they were concerned about the new on-site residents. They felt that the addition of more affluent people to West Hawai'i will exacerbate economic disparity problems. Those involved in social or public work were especially concerned about the problems associated with the "have/have-not" syndrome, because they felt that West Hawai'i is only beginning to expand its social service delivery system. They felt that the area is attracting two groups of people -- the rich and the laborers -- and felt that this situation creates an unhealthy community.

   The second population-related concern had to do with the possible in-migration of labor needed to fill on-site jobs. These employees, they felt, would compete with the existing population for housing and public services.

4. **Exclusivity.**

   Informants were concerned that West Hawai'i would have another community which would physically exclude the general community. They felt that any kind of physical barrier, such as a sentry gate, would make the existing residents feel that they are once again excluded from what was formerly perceived as public domain. Although this is private property, the community had access to the beach area simply because no one stopped people from using it. It was therefore believed that any barrier to cease trespassing would stimulate concern among the general community.

   Those interviewed also believed, however, that the new access to be developed by NKDG, will greatly improve the situation by "legalizing" beach access. They also preferred off-site beach access to having to drive through a residential community.

   Another concern related to possible exclusivity is the on-site golf course and tennis facility, and urged that local residents feel welcomed at these places.

   Finally, those interviewed did not want to see Manini'owali Beach become a private beach for subdivision residents. They especially did not want Manini'owali residents monopolizing the parking spaces, or have special facilities at the beach, similar to the Manele Bay Hotel situation in Lana'i.

5. **Visual Impact and Preservation of On-Site Trails and Archaeological Resources.**

   It was felt that the project should be designed to minimize visual obstruction of the mauka-makai view plane. Informants wanted to retain the panoramic view plane from the mountain to the ocean. The view from the beach looking mauka was extremely important; people wanted to make sure that the wilderness experience is retained as much as possible.

Those interviewed wanted to see ancient Hawaiian trails preserved as much as possible, and pointed to South Kohala resorts as examples of what can be done. Very important are any on-site burials; interviewees did not want these to be harmed or disturbed.

6. **Appropriateness of Site for Development.**

While the site's contiguity to the Kaupulehu-Kuki'o Resort Destination Node was a plus, it was also pointed out that the project is inconsistent with public plans because it is outside that node.

7. **Effects of Opening Up Manini'owali Beach.**

Although public access to Kua Bay was a prime advantage for those interviewed, there was also apprehension about opening the area up to the general public. It was felt that the area is accessible mainly to those who value the seclusion and pristine nature of the area and that the current users made a special effort to preserve the area. To interviewees with these concerns, opening up the area would mean loss of seclusion value and the general effects of frequent usage, such as litter.

5.3.3 Recommendations

It was generally felt that project impacts could be mitigated and almost all of those interviewed suggested changes or emphasized the need for certain kinds of solutions. Four people felt that the project should simply not proceed because of concerns or problems which they earlier raised.

1. **Relationship To The Land.**

It was suggested that the project be blended in with the environment as much as possible. Using dry land plants, or xeriscape, was recommended as a way to reduce the need for chemical maintenance and water, and to minimize introduction of exotic plants. The planting of fruit trees was also seen as a way to beautify the area while optimizing function.

A very important aspect was the effects on the mauka-makai view plane, and informants suggested that buildings be low-rise and clustered to avoid continuous rows of houses. Further, it was felt that planners should make sure that buildings are not visible from the beach. Informants felt that seeing a golf clubhouse from Kua Bay is inconsistent with a wilderness experience.

Some felt that the only way to minimize environmental impacts was to change the project. Suggestions included (1) density reduction and (2) changing the golf course to a park.

2. **Relationship To The Ocean.**

There were a number of recommendations geared to minimizing impacts on the ocean, and the most frequent was for the developer to establish a coastal monitoring program. Those familiar with environmental effects of golf course pointed to the difficulty with tracing non-point pollution sources, and suggested that the developer implement an ongoing coastal water monitoring system. This program would periodically test the ocean waters, and offshore plants and animals to see if there are any changes due to golf course chemicals.

Other recommendations in this area pertained to improvements at Kua Bay. An interpretative center for the historic resources in the area was seen as a way to contribute to the area's qualities. Informants suggested different locations for parking for beach users, including near the beach and near the pu'u. Boaters suggested a mooring buoy to facilitate day boating trips to Kua Bay.

3. **Relationship To The Community.**

Informants wanted to see the project blend in with the existing community as much as possible, and they suggested ways to reduce the exclusivity factor. It was recommended that local people have access to on-site recreational facilities, including both the golf course and tennis facility. Youth tennis and golf programs were seen as positive ways to encourage community interaction, and kama'aina rates would facilitate local access to these places.

On a broader level, affordable housing stimulated different kinds of recommendations. While it was suggested that affordable housing be on-site to create an economically diverse community, off-site affordable housing, at Kealakehe for example, was seen a more realistic way to contribute to the supply of affordable housing. Either way, informants wanted to make sure that NKDG will meets its affordable housing requirements.

The project's timing was important to some, and they suggested that the project not be built until most of the adjacent Resort Destination Node was built. They felt that it would be easier for the Manini'owali Residential Community to blend in to the then-existing communities.

4. **Conservation**

It was suggested that the developer encourage future Manini'owali residents to be environmentally responsible. Interviewees recommended on-site composting, as well as a recycling program for the residents. It was also suggested that the design of structures optimize natural lighting and ventilation.

5.3.4 Comments About NKDG

Slightly over half of those interviewed knew of or had some interaction with NKDG officers or representatives. Almost all of them commended the developer for efforts to address community concern, particularly regarding the improvements at Kua Bay, and the land exchange which sites the project at least 1,000 feet from the shoreline. They welcomed the new entity because they felt that there has been increasing openness and responsiveness to the community, and they expressed hope that the established working relationship can continue.

5.4 Analysis of Comments Raised During Interviews

The following presents observations and an analysis of comments provided during interviews conducted for this project:

1. **Informants were consistent in their feelings about the positive aspects and problems of South Kohala and North Kona.**

   There was a consensus among those interviewed about what were the area's positive elements and its problems. Regardless of one's background or length of residence, informants valued the rural and country qualities of North Kona and South Kohala. Generally, those who lived in the area the longest, 15 or more years, tended to cite the people and country lifestyle as the most important aspects they liked. More recent residents had a tendency to name the area's physical and environmental characteristics.

   In terms of problems, the common ones were those having to do with increasing urbanization -- crowding, traffic, inadequate infrastructure and environmental impacts.

   Further, informants wanted to see the same types of things happen in North Kona and South Kohala. They wanted more control over development and better response to infrastructure needs. The "no more development" feeling was expressed by only four people.

   Hence, there were no strong polarities among those interviewed. There were no stereotypical divisions between those involved in business and environmentalists. In fact, there were often people who belonged to both business-oriented and environmental groups.

2. **The nature of project-related concerns is consistent with general community issues.**

   Most of the project-related concerns were similar in nature to other issues which prevail in North Kona and South Kohala. Concerns about traffic, schools and other public service are typical of community reactions to proposed development in the area. Further, the ocean- and shoreline-related issues were similar to those reported in the news concerning development projects along the coast. Hence, the interviews did not elicit comments unique to this site or project.

3. **Positive project aspects were mostly related to improvements at Kua Bay.**

   The project's biggest plus is its off-site contribution. Because NKDG will participate in major improvements at Kua Bay, the Manini'owali Residential Community represents an opportunity. This was seen as the project's most positive aspect, and was the most frequently-expressed "good thing" about the Manini'owali Residential Community.

4. **Reasons for project-related problems were mostly related to cumulative regional impacts, rather than site-specific impacts.**

   Just as the project's positive aspects are mostly off-site, so is the nature of problems associated with Manini'owali Residential Community. The project's biggest problem is that it would add to growth-related problems; it would bring in more people and would impact the roads, schools, hospitals, and so on. Further, even when people referred to site-specific resources or characteristics, such as on-site trails or the nearby Kua Bay, the reactions were in the context of regional systems and community-wide needs. The value of these trails, for example, is that they are part of a system. The Kua Bay-related issues are part of the regional need for more beach parks.

   The most illustrative example of this observation is the reaction of the four informants who were totally opposed to the project. These people felt that this was "another typical development" which would spoil resources, take away community rights to the land, and bring in rich newcomers. They felt that growth and development are the sole sources of problems, and that solving these problems meant eliminating the source.

6. **Some project aspects received mixed reactions.**

   Reactions to some aspects of the project were clearly mixed, as follows:

   - The housing component was seen as a plus because it would bring in fewer large families and older residents, thus reducing competition for public and social services. It was also a negative because the addition of more affluent residents would exacerbate problems related to economic disparity.

- Affordable housing should be on-site to avoid a community exclusively for the rich; others felt that an off-site affordable housing contribution, preferably in Kealakehe, would make more sense from a density and economic feasibility standpoint.
- Public access to Kua Bay was mostly positive, but the negative side was expressed strongly. Some did not want any of this shoreline opened to the general public because it would "trash the area."
- Whereas the golf course means attractive, green open space, it also means chemical impacts to the environment. Both were characteristics were raised during the interviews.

REFERENCES

Belt Collins and Associates. **Kaupulehu Resort, North Kona: Final EIS.** Prepared for Kaupulehu Developments. June 1986.

Belt Collins and Associates. **Liliuokalani Trust, Keahuolu Lands of Kailua-Kona: Draft EIS.** Prepared for Liliuokalani Trust. August 1990.

County of Hawai'i. **The General Plan: County of Hawaii.** November 1989.

Fogg, George. **Park Planning Guidelines Revised.** National Society for Park Resources.

Hawai'i County Police Department. *Computer printouts on Part 1 and Part 2 Offenses Known to Police for North Kona and South Kohala, 1989 and 1990.* Undated.

Hawaii Visitors Bureau. **1990 Visitor Plant Inventory.** 1991.

Herman Smith Associates, a Coopers & Lybrand Division. **Joint Development Planning for North Hawaii Community Hospital and West Hawaii Regional Health Center on the Island of Hawaii.** January 16, 1991.

–. *Highlands project given final approval.* **West Hawaii Today.** December 20, 1991.

Kaniho, Mary. *State says it will build two new schools.* **West Hawaii Today.** December 12, 1990.

Kaniho, Mary. *Regent Kona Coast Hotel gets OK.* **West Hawaii Today.** February 15, 1991a.

Kaniho, Mary. *Battle for Kohanaiki rages on.* **West Hawaii Today.** February 15, 1991b.

Kaniho, Mary. *State says it will build two new schools.* **West Hawaii Today.** December 21, 1990.

KPMG Peat Marwick. **Market Assessment for Kealakehe Planned Community.** Prepared for Belt Collins and Associates. January 1990.

Helber, Hastert, Van Horn and Kimura. **O'oma II: Final EIS.** Prepared for Kahala Capital Corporation. September 1986.

Helber, Hastert, Van Horn and Kimura. **Kohana-iki Resort Community: Final EIS.** Prepared for Kona Beach Development Venture, L.P. August 1990.

Office of Environmental Quality Control. **OEQC Bulletin.** Various dates as referenced in text.

Pang, Gordon Y.K. *Council OKs fire station.* **West Hawaii Today.** January 16, 1991a.

Pang, Gordon Y.K. *Nansay named as developer of Waikoloa housing project.* **West Hawaii Today.** February 25, 1991b.

R.M. Towill Corporation. **Keahole to Kailua Development Plan.** Prepared to the County of Hawai'i Planning Department. November 1990.

Smith, Rod. *Nansay launches Puako project.* **Pacific Business News.** July 1, 1991.

State of Hawai'i Department of the Attorney General. **Crime in Hawaii: 1989.** August 1990.

State of Hawai'i Department of Health, Community Hospitals Division. **Kona Hospital Strategic Plan, 1990 - 1995.** Undated.

State of Hawai'i Department of Health, Community Hospitals Division. *Selected Statistical Data, July 1, 1989 to June 30, 1990.* Undated *(Computer printout provided by hospital administrator).*

State of Hawai'i Office of State Planning. **West Hawaii Regional Plan.** November 1989.

U.S. Department of Commerce, Bureau of the Census. **1970 Census of Population and Housing: Census Tracts - Honolulu, Hawaii Standard Metropolitan Statistical Area.** Washington, D.C., 1972.

U.S. Department of Commerce, Bureau of the Census. *Census of Population and Housing, 1980: Summary Tape File 1-A.* Available on microfiche, State Department of Business and Economic Development library. Washington, D.C., 1981a.

U.S. Department of Commerce, Bureau of the Census. *Census of Population and Housing, 1980: Summary Tape File 3-A.* Available on microfiche, State Department of Business and Economic Development library. Washington, D.C., 1981b.

U.S. Department of Commerce, Bureau of the Census. *Memorandum to FSCPE Agencies: 1990 Census PL Files Release.* February 5, 1991a.

U.S. Department of Commerce, Bureau of the Census. **1990 Census of Population and Housing: Summary Population and Housing Characteristics: 1990 CPH-1 (Proof Copy).** April 1991b.

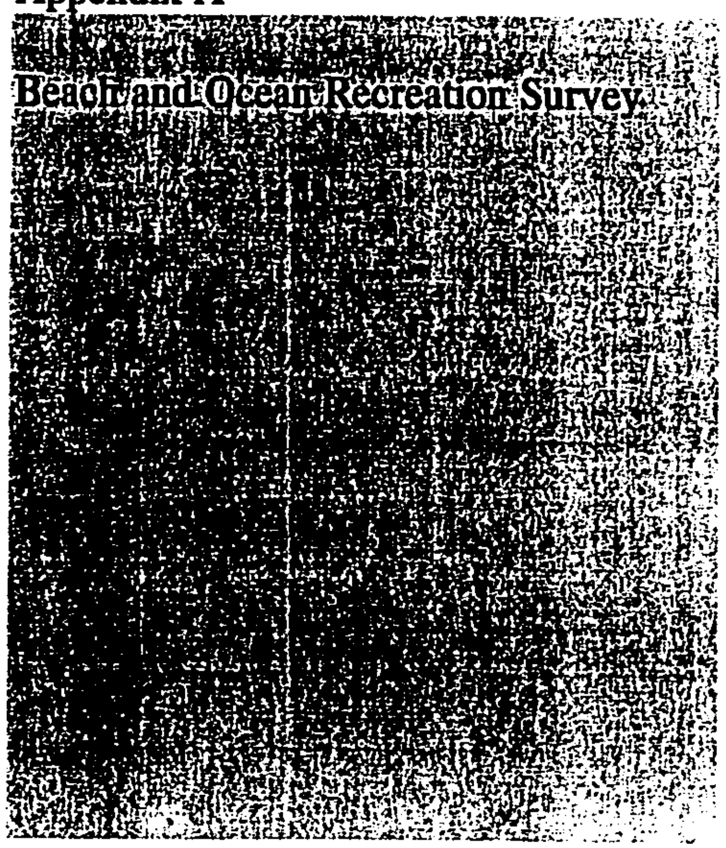
Yamaguchi, Andy. *First Kapolei, now Kona, trying for a 'second city.'* **Honolulu Advertiser.** August 23, 1991.

Zapotocky, John. **Draft Manini'owali Market Assessment.** Prepared for North Kona Development Group. August, 1991a.

Zapotocky, John. **Draft Fiscal Impact Assessment.** Prepared for North Kona Development Group. August, 1991b.

Appendix A

Beach and Ocean Recreation Survey



Manini'owali Residential Community
North Kona District, Island of Hawaii

Beach and Ocean Recreation Survey

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July 1991

CONTENTS

1.0 INTRODUCTION

1.1 Background.

The following information is provided in the Manini'owali Residential Community Environmental Assessment, prepared by Group 70 Limited, May 1991:

In May 1991 the North Kona Development Group (NKDG) acquired a 388-acre parcel at Manini'owali in a land exchange with the State of Hawaii. The Manini'owali parcel, formerly owned by the State of Hawaii, was exchanged for an adjacent parcel to the south at Awake'e totaling 334 acres, formerly owned by NKDG. The State's acquisition of Awake'e, while retaining the shoreline at Manini'owali, consolidates their ownership of coastal lands in this area, and furthers their goal of developing a regional shoreline wilderness park along the North Kona coast from Keahole to Kua Bay.

The parcel is roughly rectangular in shape and located approximately 1,000 feet from the shoreline. The entire site is covered with lava and slopes gently from approximately 60 feet above mean sea level (msl) to 250 feet above msl at the border of Queen Ka'ahumanu Highway, about 3,600 feet inland.

One of the conditions of the land exchange is that in a 400 feet wide zone mauka of and along the seaward boundary line of the parcel containing approximately 53 acres, the construction and placement of any buildings or structure is prohibited.

Another condition of the land exchange is that the landowner shall construct a public roadway from Queen Ka'ahumanu Highway to the Kua Bay area and public park facilities. In the event that the State constructs the public roadway and the park facilities, the landowner shall reimburse the State for the full cost in an amount not to exceed the maximum sum of $2,5000,000.

1.2 Purpose.

This beach and ocean recreation survey was undertaken to provide background information for the Manini'owali Residential Community Draft Environmental Impact Statement (Draft EIS) and to offer management recommendations for the planning of a public beach park at Manini'owali Beach.

1.3 Scope.

The scope of work consisted of:

a. Contacting and interviewing knowledgeable people for information on the survey area.

b. Field checking and describing the environs, including the nearshore recreation resources, in the survey area.

c. Field checking and describing the ocean conditions, including the hazardous conditions, in the survey area.

d. Field checking and describing the existing uses, problems, and issues in the nearshore waters.

e. Estimating the carrying capacity for the beach in the survey area.

2.0 PHYSICAL ENVIRONMENT

2.1 Shoreline Environment

The shoreline fronting the Manini'owali Residential Community project site extends south to north from Kahoiawa Bay to Kakapa Bay, a distance of approximately 1.5 miles, and includes Puialoa Point, Kua Bay, Manini'owali Beach, and Papiha Point. The shoreline is primarily rocky with the exception of Manini'owali Beach at the head of Kua Bay midway along this reach.

Puialoa Point. Puialoa Point is a low, rounded point consisting primarily of pahoehoe lava. It begins at Kahoiawa Bay at the base of Puu Kuili, a 342' high cinder cone, and ends at the south end of Manini'owali Beach. The point varies in height from sea level at the water's edge to approximately 50 feet above msl at the vegetation line. The slope from the water's edge inland is gradual, allowing easy pedestrian passage. The seaward edge of the point is indented with many small inlets and coves.

Manini'owali Beach. Manini'owali Beach, one of the few significant white sand beaches on the Big Island, is located at the head of Kua Bay. It is an arcuate beach approximately 660 feet long and 60 feet wide. The inland edge of the beach is bordered by a low wall of lava which varies in height from 1-6 feet. Several broken fingers of rock from the lava wall extend seaward, bisecting the beach at its north and south ends and partially dividing the backshore into a series of smaller pockets. One finger at the north end of the beach enters the water, but does not obstruct pedestrian passage along the foreshore.

At the north end of the beach the lava wall bordering the backshore drops to the level of the sand. This breach in the lava, combined with the prevailing winds blowing into this corner of the beach, has created a pocket of sand dunes. The dunes are vegetated primarily by pohuehue or beach morning glory. A small, shallow, silt-filled, brackish water pond is located immediately inland of the dunes at their inland extremity. Some portions of the pond appear to have been modified by human construction. The pond is inhabited by opae or shrimp, and Hawaiian stilts are occasionally observed feeding there.

Manini'owali Beach is subject to severe sand erosion during periods of high surf. These high surf periods occur primarily during the winter months from October to April. Swells from a west or northwest direction have the greatest impact on the beach. Infrequently high surf may occur during the summer months during a southwest swell. If the the waves from these swells are six feet or higher, they will often erode the entire beach within 24 hours. When the beach is eroding, the high surf will penetrate the entire width of the beach and strike the lava wall in the backshore. Sometimes as much as an eight foot thickness of sand will be scoured from the beach and transported into the nearshore sand reservoirs. A cave in the lava wall in the center of the beach is used to gauge the severity of the sand erosion. During normal conditions the cave is almost completely filled with sand. During periods of high surf an adult can stand erect inside the cave with over two feet of head clearance.

No matter how severe or high the surf is, a sand beach always remains, even though much of it, especially in the center of the beach, may be awash. Pockets of sand undisturbed by the surf are found only at the north and/or south ends of the beach. The north end is the most stable and protected section of the beach. During high surf no rocks or boulders are exposed in the shorebreak. The eroding sand forms a sandbar that extends seaward 50-75 feet into the surf zone. Waves form and break on the sandbar.

Once the high surf subsides, the sand begins to accrete immediately and the beach will regain its normal sand deposits within one to two weeks. During the winter months the sand levels tend to remain lower than during the summer months because of the impact of consecutive periods of high surf. The sand erosion and accretion process that occurs at Manini'owali Beach is almost identical to that at White Sands Beach on Alii Drive in Kailua-Kona. White Sands Beach is approximately half the length (300 feet) of Manini'owali Beach.

Papiha Point. Papiha Point is a wide, rounded point that forms a right angle with the north end of Manini'owali Beach. The point is the seaward edge of an unvegetated a'a flow, a newer flow than the vegetated pahoehoe flow behind the beach. The intersection of the two flows has helped to create a physically suitable site for a stable sand beach. The seaward edge of the point is bordered with a steep a'a and coral rubble beach. The steep slope of this rock beach is indicative of the force of the winter surf that strikes this point.

A number of small rock islets which front the point are wave-eroded remnants of former shorelines. Similar islets are commonly found at the seaward edge of other a'a flows along this coastline. Papiha Point ends at Kakapa Bay.

An ancient Hawaiian steppingstone trail crosses the a'a flow from the pond at the north end of Manini'owali Beach to the south end of Kakapa Bay. It is still paved with pa'ala or smooth, flat, water-worn stones, the traditional steppingstones used by Hawaiians for these types of trails. The trail is the fastest route from Manini'owali Beach to Kakapa Bay. The point can also be crossed by walking along its seaward margin over the coral rubble beach.

Kapaka Bay. Kapaka Bay is a small bay located between Papiha and Kikaua Points. Its shoreline is low and rocky with small pockets of coral rubble scattered along its seaward margin. A small pocket of sand is located in the south corner of the bay at Papiha Point.

2.2 Ocean Conditions.

Swells and Surf. The Hawaiian Islands are located in the center of the Pacific where swells from all directions reach Hawaii's shores. Created by winds pushing on the surface of the ocean, these swells travel hundreds or even thousands of miles before they reach the islands. When a swell finally reaches land and breaks on a reef or beach, it is called surf.

The three basic swell sources for Hawaii are the east-northeast trade winds, the North Pacific lows and the South Pacific (Southern Hemisphere) lows. Surf is also less frequently generated by hurricanes during their passages close to the Islands and by local Kona or southwest winds.

The shoreline of the Manini'owali Residential Community project is subject to high surf from all of the swell sources except the east-northeast trade winds. Trade wind generated surf strikes the Big Island primarily on its east and northeast shores and does not impact the northwest Manini'owali shoreline. Winds there are usually light and variable, generating small surging waves at Manini'owali Beach. Surf from South Pacific lows occurs during the summer months (April to August) and causes surf on the southern shores. On the Big Island the south shore surf does not usually extend north beyond Keahole Point, and therefore usually does not reach the project shoreline. During one of two field surveys conducted for this report, a south swell that was producing six foot surf along the entire Kailua-Kona shoreline produced no surf at Manini'owali Beach.

Surf from North Pacific lows occurs during the winter months (September to April) with the highest surf usually occurring in November, December and January. The winter surf strikes the northern and western shores of the Big Island, including the project shoreline. This surf wraps around Papiha Point into Kua Bay and severely erodes the sand at Manini'owali Beach. It also strikes Papiha Point with such force that it has created several large underwater canyons in the center of the point, it has eroded the point to form the small rock islets, and it has produced a steep foreshore on the point's coral rubble beach. High surf striking the point has been observed to spray 50 feet high or higher.

3.0 Existing Situation- User Group Activities.

The shoreline of the Manini'owali Residential Community project is presently undeveloped. It is accessed over a secondary gravel road that intersects Queen Kaahumanu Highway immediately north of mile marker 88. This road, constructed in August 1985, ends approximately 200 yards from Manini'owali Beach where a foot trail over the lava connects the end of the road to the beach. Access to the bottom of the road is possible only for vehicles with 4-wheel drive, so most shoreline users park along the road's upper reaches and walk the remaining distance to the trail.

Near the bottom of the public access road another secondary road intersects the public road and leads north to the privately-owned nine acre parcel immediately behind Manini'owali Beach. Although this private road has a heavy metal gate and is posted with a private property, no trespassing sign, many beach goers use it to access the beach rather than the trail. This road terminates at the north end of Manini'owali Beach.

As an increasingly popular West Hawaii shoreline destination, Manini'owali Beach attracts many different user groups including sunbathers, nudists, swimmers, bodysurfers, bodyboarders, skimboarders, snorkelers, scuba divers, pole fishermen, thrownet fishermen, boaters, kayakers, outrigger canoe paddlers, hikers, campers, and commercial boat tours. Users include both residents and tourists.

Boating. The nearest boat ramps to the project shoreline are located in Honokohau Boat Harbor to the south and in Puako Bay to the north. The long travel distances to reach Kua Bay from either ramp discourage most boaters from coming to the area. The only regular visitor is the Makani Kai, a commercial charter boat from the Kona Village resort to the north. For $55 visitors are offered a three-hour (9:00 am to 12:00 pm) swimming and snorkeling tour at Manini'owali Beach. Scuba diving charters to Papiha Point also originate from Ocean Sports Waikoloa in Anaehoomalu Bay.

Bodysurfing and Bodyboarding. Manini'owali Beach is one of the Big Island's few shorebreak bodysurfing and bodyboarding sites. It is a popular site for both sports and is comparable to the shorebreaks at White Sands Beach Park and at Hapuna Beach State Recreation Area. During the summer months the surf at Manini'owali

Beach is small, averaging 1-2 feet. These waves are usually gentle surging or spilling waves that break at the water's edge. Infrequently, medium surf (2-5 feet) or high surf (6 feet or higher) will break at the beach during a strong southwest swell or during a rare tropical storm or hurricane, but small surf normally prevails during the summer.

During the winter strong swells from the west or northwest produce powerful, plunging shorebreak waves. These waves offer excellent surf riding opportunities for experienced bodysurfers and bodyboarders, but are generally too hazardous for inexperienced bodysurfers and bodyboarders. These waves are also generally considered too hazardous for surfers.

Medium and high surf generate strong rip currents which are hazardous to swimmers of all abilities. During periods of very high surf, waves often break completely across the entire beach from one end to the other. This type of high surf condition "closes out" the bodysurfing and bodyboarding surfing site, making it unridable and too dangerous even for the experts.

Camping. Camping is a common activity at Manini'owali Beach and to a lesser extent at Puialoa and Papiha Points. The campers are usually either resident fishermen and their families or others who are looking for a secluded coastal wilderness camping site. Probably one of the largest concentrations of campers at Manini'owali Beach occurred on the night of July 10, 1991, the eve of a total solar eclipse. By dawn on July 11 there were 50 tents scattered over the length of the beach with approximately 200 campers.

Affordable housing is a problem on the Kona-Kohala coast, so homeless people are occasionally found camping on the beach or in their cars on the beach access road.

Fishing. The three most common types of fishing practiced in the project's shoreline are pole fishing, thrownet fishing, and spear fishing. The pole fishing methods include casting (using a rod and reel to throw a baited hook out into the ocean), hand poling (using a small bamboo pole with a baited hook and line), and whipping (using a rod and reel to drag an artificial lure or baited hook along the surface of the water). The pole fishermen are found at Puialoa and Papiha Points where they fish for papio and ulua and other popular fish that frequent the nearshore waters. Some pole fishing for oio

also occurs from boats offshore Manini'owali Beach. Oio are bottom feeders and frequent the large sand reservoir offshore the beach.

Thrownet fishermen are usually found on rocky points or in areas where there are rocks and surf activity close to shore. In the project shoreline they are most commonly seen at Puialoa Point where schooling fish such as nenue, kala, and manini frequent the shallow nearshore ledges to feed. [One translation of the place name Manini'owali is a "string of manini fish".] Thrownet fishermen are also found in Kakapa Bay where other schooling fish such as moi, uouoa and mullet feed in nearshore pockets of sand. Some overnight lay net fishing occurs offshore Manini'owali Beach for moi, uouoa, mullet, and oio.

Spear fishermen prefer rocky areas with ledges, cracks, overhangs, and caves. These areas offer hiding places for fish and lobsters and are usually where most of the marine life tends to congregate. Skin divers from shore and scuba divers from boats spear fish at both Puialoa and Papiha Points. Kua Bay is known for its abundance of uhu. There is also some spearing of octopus, but they are more plentiful further south at Makalawena. Little spear fishing occurs immediately offshore Manini'owali Beach because of the extensive, nearly rock-free sand reservoir there.

Some shellfish gathering of opihi occurs in the project shoreline as well as some crabbing for a'ama crabs, but both of these resources are now considered to be scare in this area.

Hiking. Hiking, including both short and long distance hiking, is a popular activity in the project shoreline. Manini'owali Beach is used as a starting and stopping point for short, roundtrip day hikes and also as a stopover site for long distance overnight hikes along the North Kona-South Kohala shoreline.

Hiking along the project shoreline is presently being addressed by Na Ala Hele, a trail and access program that is under the jurisdiction of the Department of Forestry and Wildlife, Department of Land and Natural Resources, State of Hawaii. Na Ala Hele has proposed the establishment of a public shoreline trail extending from Puukohola Heiau National Historic Site in Kawaihae to the Old Kona Airport State Recreation Area in Kailua-Kona. This route covers 35 miles of shoreline and includes the historic steppingstone trail across Papiha Point from Kakapa Bay to Manini'owali Beach. In the remaining areas of the project the trail simply follows the shoreline and whatever trail remnants are visible.

The Big Island chapter of Na Ala Hele has named the Kawaihae to Kailua trail the Ala Kahakai. They feel that it is of such importance to the Big Island and to the state that they have designated it as a "Demonstration Trail", a priority trail for acquisition and development.

Kayaking and canoeing. Kayakers and outrigger canoe paddlers occasionally use Manini'owali Beach as a rest stop while transiting the North Kona-South Kohala shoreline. During the field surveys a group of campers at the beach was observed with a 4-man outrigger canoe rigged with a sail. There is little kayaking and canoeing activity originating from shore because of the inconvenience of carrying a kayak or canoe over the trail.

Skimboarding. Skimboard riding is performed on either a bodyboard or on a wood or fiberglass skimboard. All are used at Manini'owali Beach where the beach and surf conditions are good for skimboarding. The foreshore usually has a moderate slope, the sand is highly compacted ("hard"), there is a long expanse of beach, and there are usually waves surging up the beach at any time of the year. Manini'owali Beach also offers good opportunities for expert skimboard riders who prefer to ride into a shorebreak with medium to high surf. The expert riders skim over the sand and into the shorebreak waves where they surf the waves back to shore or use the waves as launching ramps to perform acrobatic maneuvers.

Snorkeling and scuba diving. Visibility in the waters offshore the project shoreline is excellent except during periods of high surf. Snorkeling and scuba diving opportunities are good at both Puialoa and Papiha Points, but are probably better at Papiha Point. The underwater topography at Papiha Point is spectacular with its small rocks islets, several deep (50 feet) underwater canyons, and a wide variety of fish and invertebrates. Several commercial dive boats use the point as a diving destination.

There is little scuba diving activity originating from shore because of the inconvenience of carrying scuba gear over the trail, but the potential for it is good. An excellent snorkeling and scuba diving trail could be established from Manini'owali Beach to the north end of Papiha Point and back or from Manini'owali Beach,

around Papiha Point, ending in the south corner of Kakapa Bay. From Kakapa Bay snorkelers and scuba divers could walk back to Manini'owali Beach over the steppingstone trail if they have protective footwear.

Swimming and sunbathing. Swimming and sunbathing are the most popular activities in the project shoreline. The majority of the swimmers and sunbathers are concentrated at Manini'owali Beach. The ocean bottom is sandy and rock-free with a gentle slope to overhead depths, and the water is usually very clear. Under normal surf conditions there are usually no waves or currents that pose threats to swimmers of any age. These features are ideal for swimmers. Many Big Island resident believe that Manini'owali Beach is one of the best swimming beaches on the island.

During periods of medium and high surf dangerous ocean conditions are generated including a pounding shorebreak and powerful rip currents. These conditions pose a hazard for all swimmers of novice or intermediate ability. Periods of extremely stormy or high surf will probably preclude all in-water activities, especially swimming.

During normal surf conditions the beach is flat and wide, providing good conditions for sunbathers. Nude sunbathers and swimmers occasionally use the north end of beach. This end is slightly more secluded than the south end where the public trail meets the beach and pedestrian traffic is heavier.

During the winter months high surf may inundate most of the beach at Manini'owali, considerably reducing the area available for sunbathing. For the duration of these high surf periods sunbathing is concentrated primarily at the north and south ends of the beach.

4.0 MANAGEMENT RECOMMENDATIONS

4.1 Positive Impacts with Park Development. The development of a beach park at Manini'owali Beach will have positive impacts for the beach and the rest of the project shoreline. The positive impacts will include the following:

- Permanent public access will be opened to one of the Big Island's most significant white sand beaches and important ocean recreation sites. This is especially important on the Big Island where there are few sand beaches and very few shorebreak bodysurfing/bodyboarding sites. Public access will also provide additional opportunities for swimmers, snorkelers, fishermen and other ocean recreation users and may also encourage new activities such as organized outrigger canoe paddling and scuba diving from shore. It will also a new scenic area for more passive activities such as picnicking.

- Development of a public beach park will include restroom facilities and a litter disposal system which will eliminate the present sanitation and litter problems.

- Development of the beach park will include paved pedestrian paths, roads and parking lots which will eliminate the destruction of the natural terrain by 4-wheel drive vehicles. The paved roads and paths will also open access to the beach for the handicapped and for emergency vehicles.

- Development of the beach park may create a new anchorage for boaters. With restroom facilities and fresh water onshore more boaters may be attracted to the project shoreline, especially offshore the beach where sand anchoring opportunities are excellent. Kua Bay has the potential to become a summer anchorage similar to Waimea Bay on Oahu and Hanalei Bay on Kauai.

4.2 Problems With Park Development and Mitigations. Some of the problems that the beach park development may generate and possible mitigations are as follow:

- Development of the beach park will bring many more people to the project shoreline, especially to Manini'owali Beach. This increase in swimmers, bodysurfers and bodyboarders, many of whom will be tourists unfamiliar with the ocean, will create a serious water safety problem during periods of medium and high surf. Daily lifeguard service should be provided at the beach, although this in itself will also be a problem. The Division of State Parks, the managing agency for the proposed Manini'owali beach park, does not have a lifeguard service and for this reason there are no lifeguards in any state beach park. Without a lifeguard at Manini'owali Beach, however, the possibility of regular drownings, such as those that occur almost every winter at Hapuna Beach State Recreation Area, is great. The state should arrange to provide lifeguards at Manini'owali Beach through the County of Hawaii who does maintain a lifeguard service. Development of the park should also include easy access to the beach for emergency vehicles such as ambulances, helicopters and fire department rescue trucks.

- Development of the beach park may lead to the use of the area by ocean recreation businesses such as snorkeling and scuba diving tours. If Manini'owali Beach becomes a tour destination and is used excessively by businesses, it may become overcrowded to the exclusion of residents. Consideration should be given to prohibiting commercial ocean recreation use of the shoreline from land.

- Although shorebreak sites with steep, plunging waves are primarily used for bodysurfing and bodyboarding, they are also used occasionally by advanced and expert surfers. Surfing, however, at Manini'owali Beach would be hazardous to all other users, especially when the water is crowded with swimmers, bodysurfers, and bodyboarders. Prohibiting surfing at the beach should be considered as a management option.

- Manini'owali Beach is one of the few places on the Big Island where skimboarding is possible. As an important site for other users besides skimboarders, the potential for conflicts between skimboarders and other users is high. Skimboarding is a high speed sport that is practiced in the same areas that are used by swimmers, bodysurfers and bodyboarders. Skimboarders who lose control while skimming may collide with other users or may loose their boards. Their loose boards also may collide with other users. This situation at Sandy Beach on Oahu was mitigated by limiting skimboarding to a specific area of the beach and by holding discussions between skimboard riders and lifeguards.

- An increase of boating traffic to the project shoreline has the potential of damaging the coral reefs at Puialoa and Papiha Points. In other areas of the Kona-Kohala coast, day-use mooring buoys have been installed to prevent coral damage. Day-use mooring buoys are probably not necessary offshore the project shoreline as long as boats visiting the area anchor in the extensive deep sand reservoir offshore Manini'owali Beach.

- At present there are a number of consumptive activities practiced in the project shoreline: pole fishing, net fishing, spear fishing, crabbing, opihi picking, and so on. The development of the park will lead to a substantial increase in the number of non-consumptive users such snorkelers and scuba divers. There is a potential for conflict between the consumptive and non-consumptive users. The resolution of this conflict in other areas of the state has usually been in favor of the non-consumptive users and has often taken the form of a marine life conservation district or other similarly restrictive area. Consumptive users, most of whom are residents, often perceive this type of resolution as being favorable to the visitor industry and unfavorable to residents. If this problem arises in the project shoreline, a compromise resolution should be negotiated that would permit certain consumptive activities in certain areas rather than a ban on all consumptive activities.

- The extensive sand reservoir offshore Manini'owali Beach needs to be explored for its potential as a sea shell habitat. If it harbors augers and other shells that favor deep sand environments, some restrictions may be necessary to control shell collecting.

- The beach park's parking lot will probably be developed away from the beach. Consideration should be given to selecting a site that will minimize thefts from cars.

- Nudists are presently one of the user groups at Manini'owali Beach, but their presence in state parks is prohibited by park regulation. Signage and enforcement may be necessary if conformity to the regulation is desired.

4.3 Carrying Capacity

Carrying capacity is often expressed as a number, usually a number of individuals or groups in relation to time and area dimensions. In a recreation setting, the minimum might be the number of users necessary to keep a recreation area open. The maximum might be the number not only when the recreation area is full but when there are accompanying problems: an overcrowded resource, overcrowded facilities, inappropriate activities, and a deterioration of safety. The median between the minimum and maximum capacities is the optimal capacity, the desirable capacity. Carrying capacity in general, then, is the level of use beyond which certain impacts are not acceptable.

Carrying capacity in a recreation setting is a combination of four components:

1. Physical capacity which is concerned with the amount of actual space per person.

2. Facility capacity which is concerned with improvements intended to handle visitor needs.

3. Ecological capacity which is concerned with impacts on the ecosystem.

4. Social capacity which is concerned with impacts which impair or alter human experience. Impact parameters focus on the number, type, and location of encounters with others and the way these encounters affect the recreation experience. It has traditionally been a difficult capacity to determine.

Probably one of the most misunderstood aspects of carrying capacity is the effect of density, an area sociologists and social psychologists have explored in many contexts. Density is a descriptive term which refers to the number of people per unit area. It is measured by counting the number of people and measuring the space they occupy, and it can be determined objectively. Crowding is a negative evaluation of density; it involves a value judgement that the specified number is too many. Although it seems counterintuitive that satisfaction does not drop as use levels and contacts increase, most studies show little or no relationship between density and quality of experience. Possible explanations are:

a. People may do things they don't enjoy in other areas of their lives, but recreation usually involves free choice. Generally, people choose recreation activities they enjoy and avoid those they do not. Assuming that visitors' expectations are realistic, there are high levels of satisfaction, regardless of density, simply because people select experiences they will enjoy. As a result, they may remain satisfied as contacts increase.

b. As use increases and capacities in a recreational setting are exceeded, the kind of experience available changes. Dissatisfied users may leave the area in search of lower-density experiences more desirable to them, being replaced by those less sensitive to high density. A cross-sectional study in area might show a high level of satisfaction in spite of crowding problems because density-sensitive users would not be represented in the user population. This displacement hypothesis assumes that acceptable alternate recreation settings are available.

Finally, carrying capacity cannot be established in the absence of management objectives, the objectives that define the recreational opportunity the area is intended to provide. Establishing carrying capacity requires defining the relationship between management objectives and social impacts and arriving at a reasonable agreement among user groups about management objectives and evaluative standards. The primary management objective of the project shoreline should be to continue accommodating all of the current and potential users without degradation of the resources or the recreation experiences associated with the resources.

The following carrying capacity guidelines are provided in George Fogg's Park Planning Guidelines Revised for the square footage needed per person at a beach: high density- 45, median density- 60, and low density- 90. Manini'owali Beach measures approximately 660 x 60 feet, an area of 39,600 square feet. Using

these guidelines the beach can accommodate the following numbers of people:

High density:	880
Medium density:	660
Low density:	440

During two field surveys conducted in June and July 1991 the average weekday number of beachgoers at Manini'owali Beach between the hours of 10:00 am and 4:00 pm was 50. The average weekend number was 100. These numbers are low because the area is presently undeveloped and unmarked with public right-of-way signs, but will increase substantially with the development of the public beach park.

White Sands Beach Park on Alii Drive in Kailua-Kona is almost identical to Manin[illegible]: it is a white sand beach, it is subject to high winter surf, it is subject to severe erosion from high surf (the reason it is also known as Vanishing Sands, Disappearing Sands and Magic Sands), it is a shorebreak with waves breaking on a shallow sandbar, and it is a popular swimming/bodysurfing/bodyboarding site. The main difference between the two beaches is that White Sands at 300 feet long is approximately half the size of Manini'owali. During the field surveys for Manini'owali Beach, beach counts were also taken at White Sands Beach. The average number of weekday beachgoers between 10:00 am and 4:00 pm was 150 (100 on the beach and 50 in the water). The average number of weekend beachgoers was 200 (150 on the beach and 50 in the water). In comparison Manini'owali Beach at more than twice the size of White Sands Beach should easily be able to accommodate 400 or more sunbathers, the low density carrying capacity figure noted above.

5.0 SUMMARY

Although the area of the Big Island (4,038 square miles) is larger than all of the other seven major Hawaiian Islands combined, it has the fewest sand beaches per mile of shoreline. As the newest island in the chain, it has not existed long enough to form the extensive beaches found on the older islands to the northwest. For this reason, all beaches on the Big Island, especially the few white sand beaches, are very important, highly used resources. Hapuna Beach State Recreation Area in South Kohala is an excellent example with people driving from as far away as Puna and Hilo to go to the beach there.

Manini'owali Beach, although only 660 feet long, is one of the Big Island's most important white sand beaches and ocean recreation sites. For many years it was regarded as a secret beach and was visited only by those who were willing to walk over rough terrain or by those who had a boat. There was no direct land access to the beach, and it could be reached by land only by hiking in from the Queen Kaahumanu Highway or by hiking along the shoreline from the 4-wheel drive road to Makalawena to the south.

In August 1985 the present gravel road leading directly to the shoreline from Queen Kaahumanu Highway was constructed. Most of this road is passable in an ordinary passenger car, so the beach is now easily accessible and well used. When the proposed public beach park is developed , bringing with it a paved access road, paved parking, showers, restrooms, and a landscaped park, use of the site will escalate substantially. Its popularity will probably be statewide, attracting visitors and residents alike. Conscientious development of the resources and sound management of the wide variety of activities that occur there will eventually provide the Big Island with one of its most important beach parks.

6.0 REFERENCES

Apple, Russell. Trails. Bishop Museum Special Publication 53. Honolulu, 1965.

Clark, John. Beach and Ocean Recreation Study, Ha'ena, Kaua'i. Honolulu: Division of State Parks, Department of Land and Natural Resources, State of Hawaii, 1991.

Clark, John. Beaches of the Big Island. Honolulu: University of Hawaii Press, 1985.

Fogg, George. Park Planning Guidelines Revised. National Society for Park Resources.

Group 70 Limited. Manini'owali Residential Community: Environmental Assessment. Honolulu: Group 70 Limited, 1991.

Haraguchi, Paul. Weather in Hawaiian Waters. Honolulu: Hawaii Reprographics, 1979.

Hawaii State, Department of Land and Natural Resources, Division of Forestry and Wildlife. Na Ala Hele Hawai'i Trail & Access System: Program Plan. Honolulu: DLNR, 1991.

Hawaii State, Department of Land and Natural Resources and Department of Planning and Economic Development. Na Ala Hele. Honolulu: DLNR and DPED, 1973.

Hosaka, Edward. Sport Fishing in Hawaii. Honolulu: Watkins Press, 1944.

Maguire, Eliza D. Kona Legends. Hilo, Hawaii: Petroglyph Press, 1966.

Moffatt & Nichol, Engineers. Ewa Marina: Evaluation of Project Impacts on Surf Sites. Long Beach, California: Moffatt & Nichol, Engineers, 1990.

Shelby, Bo and Heberlein, Thomas. Carrying Capacities in Recreation Settings. Corvallis, Oregon: Oregon State University Press, 1986.

Appendix B

List of People Interviewed For This Study

Appendix B

List of People Interviewed for This Study

Those interviewed were asked to share their knowledge and opinion about the study area and Manini'owali. They were not asked to take a position or to "represent" their organization. If their organization had taken a position, they were asked to discuss the formal position.

Name	Organization/Affiliation
Ron Aronson	Planning Committee Chair of Greater Kona Community Council Realtor
Fanny Auboy	Curator of Hulihee Palace Member of Kona Hawaiian Civic Club
Ian Birnie	Hawai'i District Manager of the Harbors Division of the State Department of Transporation
Doug Blake	Conservation Council of Hawai'i Kona Conservation Group
Linda Bradley	Resident of Kona Palisades
Bobby Camara	Naturalist Member of Na Ala Hele
Carl Carlson	Senior Project Manager of Huehue Ranch Associates Rancher
Lisa Choquette	Part ofwner of Dive Makai Charters Member of TORCH

Name:	Organization/Affiliation
Dennis Correa	Major of Area 2 of the Hawai'i County Police Department
Lakin Crane	Office Manger of Potomac Investment Associates
John Dinmore	Planning Review Committee of Greater Kona Community Council Architect
Fred Duerr	General Manager of the Kona Village Resort Director of United Way Member of TORCH Member of Kealakehe School Advisory Committee
Jo Ann Farnsworth	Executive Director of Family Support Services of West Hawai'i
Amy Freitas	President of the Kona Hawaiian Civic Club Resource teacher in Hawaiian Studies
Rose Fujimori	Cultural demonstrator of the Puuhonua Cultural Park Member of DLNR Burial Council Member of the University of Hawai'i West Hawai'i Advisory Board
Rick Gaffney	Ocean recreation specialist Member of Hawai'i Big Game Fishing Club
Mary Green	Member of Kai Opua Canoe Club
Jack Greenwell	Rancher
Jean Greenwell	Historian with the Kona Historic Society
Jay Hanson	Program Chair of the West Hawai'i Sierra Club Member of TORCH

Name:	Organization/Affiliation
Roger Harris	Project Manger of Kaupulehu Resort
Marni Herkes	Executive Director of the Kona-Kohala Chamber of Commerce
Carol Hogan	Works with Carol Hogan Ocean Promotion, Hogan's Boatworks and Discovery Charters
Karen Klein	Member of TORCH Water quality chemist
Lilly Kong	Kona Area Supervisor of the Hawai'i County Economic Opportunity Council
Denver Leaman	Executive Director of Greenpeace Hawaii
Pete Lindsey	Field Representative of AFL-CIO, Local 368
Peter L'Orange	President of Hawai'i Leeward Planning Conference Operating Officer of West Hawai'i Housing Force
Jeff Lorrance	Member of Big Island Casting Club
Jan Marrack	Director of The West Hawai'i Family Center
Jeff McConnel	Owner of Ocean Sports Waikoloa
Ruby McDonald	Liaison with the Office of Hawaiian Affairs West Hawai'i Office

Name	Organization/Affiliation
Hugh Montgomery	Owner of EcoTours of Hawai'i Na Ala Hele Member of Hawai'i Island Environmental Council Member of North Hawai'i Trails and Greenway Coalition
Marge Mulhall	Vice Chair of Kona Adult Cay Care Center Member of League of Women Voters Member of Kona Business and Professional Women
Kent Nakashima	Realtor
Mike O'Kieffe	6th District Representative in the State House of Representatives Waimea/Kawaihae Community Association
Confessor Rivera	Farmer Member of Farmers Lokahi Alliance
Estella Rivera	Farmer
Robbie Robertson	Administrative Assistant to the Governor West Hawai'i
Jerry Rothstein	Member of Public Access Shoreline Hawai'i Member of West Hawai'i Sierra Club Member of Hawai'i Island Environmental Council
Norman Sakata	Vice President of the Kona Coffee Festival District Governor (District 50) of the Lions Club International Director of the Kona Japanese Civic Club
Richard Schulze	President of the Puako Community Association

Name	Organization/Affiliation
Hannah Kihalani Springer	Ethnogeographer and ethnohistorian Member of Na Ala Hele Member of Kona Historical Society
Mike Stevenson	Manager of ocean activities at Mauna Lani
Leon Sterling	Minister President of the West Hawai'i Housing Foundation Member of the Kona Hawaiian Civic Club
Dave Tarnas	West Hawai'i Extension Agent for the University of Hawai'i Sea Grant Extension Service
Michael Tomich	Fire fighter and emergency medical technician with the Hawai'i Fire Department Member of Kona Historical Society Member of Na Ala Hele
Mark Van Pernis	Nearby landowner Member of and Legal Advisor to the Greater Kona Community Council Member of Friends of Makallawena
Jennie Wung	Administrator of the Kona Hospital
Chris Yuen	Founder of Friends of Makalawena Member of Na Ala Hele

APPENDIX O

Fiscal Impact Assessment

Manini'owali Residential Community

Prepared for
North Kona Development Group

Prepared by
John Zapotocky

October 1991

EXECUTIVE SUMMARY

Introduction

The North Kona Development Group (NKDG), a Hawaii Corporation, acquired the Manini'owali property in May 1991 through a land exchange with the State of Hawaii. The NKDG proposes to develop a medium density residential community with recreational amenities on a 388 acre parcel located approximately 4 miles north of the Keahole Airport.

Manini'owali preliminary design plans include:

An 18-hole championship golf course and amenities. These amenities will include a tennis center, club house and supporting infrastructure. Although this course is intended to serve the residents of the Manini'owali Community public play will be allowed.

A total of 1,000 residential units, including single family, cluster housing and condominiums.

A small retail building of approximately 10,000 square feet. The main focus of this building will be to serve the sundry needs of the community.

Impact on State and County Finances

Net income for both the State and the County is expected to be significant from the development of the Manini'owali Residential Community. At project completion, County net revenues are projected to be 5.5 million annually (in 1991 dollars).

Total revenues accruing to the state during the construction phase are expected to be 36 million. Upon completion, State net revenues derived from the Manini'owali Residential Community are expected to be 3.4 million annually.

Thus the implementation of the Manini'owali development program is expected to result in net state and county revenues of approximately 8.9 million annually.

Impact on Employment

A number of employment opportunities are also expect to result from development of the Manini'owali Residential community.

Manini'owali Residental Community

Table 1
Average Annual Jobs

		Construction Phase (12 years)	Ongoing Operations
Direct Employment			
Golf Course & Infrastructure		295	75
Retail (1)			20
Residential Management & Maintenance			25
Total Direct Employment		295	120
Indirect Employment:			
Construction	1.4	413	
Operations	0.5		60
Total Direct & Indirect Jobs		708	180

(1) One employee for very 500 square feet of retail space.

(2) One owners association employee for every 40 units.

INTRODUCTION

Location

The project site for Manini'owali residential community is located in the North Kona district on the leeward side of the island of Hawaii. (see Exhibit 1) The parcel is identified by TMK: 7-2-04: por. 17.

The site is approximately four miles north of the Keahole Airport. It is bounded on the north by the Kukio-Kaupulehu Resort Destination Node; The Queen Ka'ahumanu Highway lies to the east; the proposed state Wilderness Park is to the south and 1,000 feet to the west before the shoreline.

Surrounding Developments

Primary development and land use located to the north of the proposed Manini'owali Residential Community include the existing Kona Village Resort and approved Kaupulehu Resort and the Kukio I (Regent Beach) Resort.

Kona Village consists of 100 cottage bungalows in a very low density project on 88 acres of land. The resort was developed in the early 1960's.

Kukio I, formerly known as the Huehue Ranch, has approvals to construct 1,350 hotel units, including a 480 room Regent Hotel (under construction), an 18-hole Championship Golf Course, Club House, equestrian center along with other recreational amenities. Currently plans are under review and a lower overall density is expected to result.

Kaupulehu Resort's plans are to construct 358 room Four Seasons Resort, Hawaii's first PGA Tournament Players Course which has been designed by Jack Nicklaus both of which are now under construction, with grand openings scheduled for late 1992. Future plans include a 600 room hotel, another 18-hole golf course and up to 480 low rise cottages.

Development Timetable

Assuming timely governmental approvals, construction of Manini'owali Residential Community is expected to begin at the beginning of 1994, commencing with construction of a golf course and infrastructure and the first phase of the residential units. Based on a two year construction timetable, the golf course, infrastructure and phase I of the residential units is expected to be completed by the end of 1996.

The residential construction is expected to continue to progress in a evenly spread phasing through the end of 2005. It is expected that the commercial center will be completed over an eighteen month period starting in the first part of 1996.

METHODOLOGY

Per capita State and local revenue estimates shown in this analysis contain all sources of revenues including; taxes; user fees; and other. Per capita State and local expenditures estimates contain all expenditure including : operations; Maintenance; debt service and capital expenditures (in the case of the County, most, in the case of the State a portion).

Inclusion of per capita operating and maintenance expenditures as well as debt service and capital expenditures in the analysis provides a conservative bent to the results of the analysis. This conservatism is due to the fact that the Manini'owali Residential Community will be developing the bulk of it's own infrastructure, including: roads; water; irrigation water; and onsite sewer collection and treatment facilities. In addition, the Manini'owali Residential Community will provide it's residents with golf, tennis and other recreational facilities in the community thereby reducing the need for additional public recreational facilities.

Providing per capita operational and maintenance expenditures estimates does not take into account economies of scale in providing public services or recognize that the cost of servicing additional communities may be accomplished at a marginal

incremental rate which may be substantially lower than the average cost of providing the total service. Property owners within the Manini'owali Residential Community will be maintained infrastructure and landscaping at no expense to the governmental agencies.

GROWTH ASSUMPTIONS

Growth assumptions for development of the Manini'owali Residential Community are summarized in Table 2 through Table 5 and explained below.

Growth Due to Construction Activity

Construction of the golf course is slated for completion before the bulk of the residential community is initiated. All construction is expected to be complete in the year 2005. Highlights of growth due to construction include:

Approximately 295 construction jobs will be created annually in the twelve-year development period, for golf course, offsite and onsite improvements, residential construction and commercial. Resulting in a total 3,539 man years of construction related employment over the term of the project.

An Additional 413 indirect jobs will be created during the construction phase based on the 1.4 multiplier used in the State's Input-Output model for construction jobs.

An additional 60 indirect full-time permanent jobs will be created from the ongoing operations of the new community based upon the .5 multiplier used in the states Input-Output model.

Total estimated Direct Construction Costs for the Manini'owali Residential Community are estimated to include over $466 million in 1991 dollars:

The cost for golf course, clubhouse, and on-site and offsite infrastructure improvements is estimated to be $123.5 million in 1991 dollars.

Direct Construction of residential units is estimated at $340.5 million in 1991 dollars.

Construction of the commercial building (including tenant improvements) is estimated to be $2 million in 1991 dollars.

Assuming an average annual income of $42,530 among construction workers, average annual payroll during the twelve-year development period, in 1991, is projected to be $12.5 million (excluding any multiplier impact).

Growth in Employment

Direct employment at Manini'owali is estimated to result in the creation of 120 new jobs, versus none currently since the parcel is vacant.

The 18-hole championship golf course is expected to generate a total of 75 full time jobs when the course and the clubhouse are fully operational.

The commercial facilities are projected to result in a creation of 1 job for every 500 square feet of space, therefore it is expected that the retail operation will generate 20 jobs.

Resident development is expected to generate approximately one job for every 40 units. Jobs include management, landscaping, maintenance, security and other jobs. Approximately 25 new direct jobs will be generated by the development of the residential units.

Growth in Property Tax Base

The total property tax base upon completion of proposed development is expected to be over $6.3 million in 1991 dollars, verse a current estimated real property tax of $33,500.

The assessed value of the new dwellings, is estimated to be $750 million.

Less anticipated home exemptions of 45 million.

The golf course, tennis and commercial facilities are estimated at approximately $31.6 million.

Growth in Golf and Retail Sales

Golf and Retail Sales are expected to be approximately $6.6 million at full development of the Manini'owali Residential Community.

The golf course is expected to generate approximately $3.3 million per year upon full development.

New retail sales are projected to generate an additional $3.0 million per year in sales.

Rental of the retail space is expected to generate an additional $270,000 per year in revenues.

Growth in Payroll for Ongoing Direct Employment

Approximately 120 new jobs would directly result from completed development of the Manini'owali Residential Community.

The golf facility is expected to require 75 employees at full development.

The retail space is expected to require additional 20 full time equivalent employees.

Residential management and maintenance is expected to require 25 new full time equivalent jobs.

Using Hawaii's average annual wage payroll would be approximately $2.9 million for jobs created as a result of the Manini'owali Residential Community.

Impact on State And County Finances: Revenues

State Revenues-Construction Phase

The construction phase of the Manini'owali Residential Community is expected to result in an average of $3.0 million in annual tax revenues for the State, for a total of $36.1 million over the 12 year development period. This includes excise taxes on finished development, excise taxes on building materials, conveyance tax and State income taxes.

Net State Revenues - Full Development

At full development, added State Revenues resulting from Manini'owali are expected to total 7.3 million per year.

$1.9 million per year from general excise taxes on sales.

$4.7 million per year from income taxes, are based on the average tax rate of 5.8 percent.

$0.7 million per year from other income per resident @ $451.

At full development total expenditures are $3.9 million annually based on $1,736 per resident. Thus State net revenues are expected to be 3.4 million annually.

Net County Revenues - Full Development

At full development Manini'owali Residential Community will result in added County revenues of $7.1 million annually.

$0.8 million annually other income based on revenues of $372 per resident.

$6.3 million annually in revenues from real property taxes.

Expenditures at full development are $1.6 annually million based on a per resident expenditures of $730 annually. Thus, Net County Income is $5.5 million per year.

Net Combined State and County Revenues

Annual State and County revenues at full project completion are estimated at $14.4 million (see Table #6). Expenditures are $ 5.5 million annually, generating a net revenue of $8.9 million per year.

Conclusion

The development of Manini'owali Residential community will be fiscally beneficial for both the State and the County of Hawaii providing estimated State and County revenues totalling $ 14.4 million annually. Approximately 120 new direct jobs will be created. Using the most conservative method of increasing cost by current per capita resident expenditures results in a net income to the State and County of $ 8.9 million per year.

In addition, the State is expected to receive additional revenues based on construction put in place of $36.1 million over the development term of the project.

Manini'owali Residental Community

Table 2
Real Property Tax Values
Value Assumptions
(1991$)

	Number of Units	Estimate of Assessed Value (1)	Total Assessed Value of Development	Less Resident Exemptions (2)	Tax Rates for 1991 per 1,000	Total Tax Revenues Generated
Residential Units	1,000	750,000	750,000,000	45,000,000	8.50	5,992,500
Commercial						
Structures	1	2,000,000			8.50	17,000
Land (1 acre)	1	1,089,000			10.00	10,890
Total Commercial						27,890
Golf Course (3)	1	28,500,000			10.00	285,000
Total						6,305,390

(1) For fiscal impact statement purposes the consultant has assumed a per unit price of $750,000. This assumption is based on developer representations that units will be sold at market prices but that units will be sold at market prices but that given current market conditions, most will be priced between $500,000 and $1,000,000. As these are market units the developer make ever effort to price the units higher, while at the same time maintaining the rates of absorption.
(2) Assumes that 75% of the residences will be primary residences and that the average resident will qualify for $60,000 in home exemption to be applied against appraised value.
(3) Value includes Golf Course, Clubhouse & Tennis Center.

Manini'owali Residental Community

Table 3
Direct Construction Value
And State Revenue Generation
(1991$)

	Number of Units	Unit Square Footage	Estimate of Constr Costs per Sq Ft	Estimate of Direct Construction Costs per Unit	Total Estimated Value of Direct Constr
Residential Units					
Single Family	150	3,200	150	480,000	72,000,000
Cluster Housing	550	2,300	150	345,000	189,750,000
Condominiums	300	1,750	150	262,500	78,750,000
	1,000				340,500,000
Commercial		10,000		$200 (1)	2,000,000
Amenities					
Golf Course					20,000,000
Clubhouse, Cart Barn, Maintenance Facility and Comfort Stations					7,500,000
Tennis Center					1,000,000
					28,500,000
Infrastructure					
Offsite					40,000,000
Onsite					55,000,000
Total Cost of Amenities					95,000,000
Total Cost of Direct Construction					466,000,000
Estimate of Income from Construction to State (2)					
General Excise Tax				4.17%	19,432,200
Excise Tax on Building Materials				0.13%	611,625
Conveyance Tax				0.05%	233,000
Income Tax				3.40%	15,844,000
Total				7.75%	36,120,825

note: Construction Costs are based April 25, 1991 letter from Michael Hands.
(1) Assumes $200 will cover the cost of construction for the shell and interior of the building.
(2) Percentages listed are based on the publication
"Impact of Construction on Employment and Tax Revenues", April 1978
(3) Construction costs exclude, land cost, a *City and County of Honolulu* and engineering costs, financing costs and impact fees.

Manini'owali Residental Community

Table 4
Construction Schedule and
Job Generation
(1991$)

Year	Amenities	Infra-structure	Residential Single Family	Residential Cluster Housing	Condo	Com-mercial	Total Construction Costs	Number of created At a rate of 1 Job for every 131,660 Spent on Constr
1994	14,250	31,000					45,250	344
1995	14,250	31,000					45,250	344
1996		3,300	7,200	18,975	7,875	1,333	38,683	294
1997		3,300	7,200	18,975	7,875	667	38,017	289
1998		3,300	7,200	18,975	7,875		37,350	284
1999		3,300	7,200	18,975	7,875		37,350	284
2000		3,300	7,200	18,975	7,875		37,350	284
2001		3,300	7,200	18,975	7,875		37,350	284
2002		3,300	7,200	18,975	7,875		37,350	284
2003		3,300	7,200	18,975	7,875		37,350	284
2004		3,300	7,200	18,975	7,875		37,350	284
2005		3,300	7,200	18,975	7,875		37,350	284
	28,500	95,000	72,000	189,750	78,750	2,000	466,000	3,539

Average Annual Jobs Created	295
Average Construction Related Payroll Costs (1)	42,530
Estimated average Annual Payroll	12,544,367

(1) Based on updated 1990 Data Book information found in table number 367 increased 5% to adjust $1990 to $1991.

Manini'owali Residental Community

Table 5
Estimated Retail
Expenditure Assumptions
(1991$)

Golf Course

Rounds	Greens Fees	Days	Total
(1)	(2)		
150	60	365	3,285,000

Retail

	Square Footage	Dollars per Sq Ft	
Sales	10,000	300	3,000,000
Space Rental	10,000	27	270,000
			6,555,000
State Revenue on Retail Sales (General Excise Tax)		4.17%	273,344

(1) Based on the consultants estimate of average rounds per course experienced at West Hawaii golf courses in 1990.
(2) Based on the consultant's estimate of average revenue per round Experienced at West Hawaii Golf Courses in 1990. Reduced by consultant to provide a conservative basis for fiscal impact statement.

Manini'owali Residental Community

Table 6 – Footnotes
Summary of Economic Impacts
Annual Revenues

(1) Assumes twelve year development period.

(2) Assumes $451 per resident based on State Revenues excluding General Excise, Income Tax and Visitor Accomodation Tax per Resident, extrapolated to $1991
Source: Department Accounting & General Services State of Hawaii Comprehensive Annual Financial Report, June 30, 1989

(3) Estimate of population of the Manini'owali Residential Community is assumes that there will be an average population of 2.23 residents per household.

(4) Assumes $372 per resident based on State Revenues excluding General Excise, Income Tax and Visitor Accomodation Tax per Resident, extrapolated to $1991
Source: The County of Hawaii 1989-90 Annual Report.

(5) Based on the Department of Business Economic Development & Tourism's 1st Quarter 1991, Estimated annual income for 1991 multipled by 2. Although we have doubled the projected personal income, considering the projected sales prices we consider this estimate to be conservative. Estimate of 1.9% General Excise Tax is based on the Tax Foundation of Hawaii The Tax Burden of the Arnie Aloha Family (November 1989).
($24,054*2)*1.9%=$914

(6) Based on the Department of Business Economic Development & Tourism's 1st Quarter 1991, Estimated annual income for 1991 Big Island residents was $24,054. Considering the projected sales price of the average unit in this development we have double the income to $48,108, which we still beleive to be a conservative estimate.
Source: The Tax Burden of the Arnie Aloha Family (November 1989).
($24,054*2)*5.8%=$2,790.26

(7) Based on the Hawaii Visitors Bureau, Visitor Expended Survey 1988, Table A-3, pg 37. Extrapolated to 1991.

(8) Assumes that the Second Home owners are either residents of other States or are residents of Hawaii and therefore already included in the state income or paid to other states.

Manini'owali Residental Community

Table 6
Summary of Economic Impacts
Annual Revenues
(1991$)

STATE CONSTRUCTION PHASE (see Table #3)	
Construction Activity	36,120,825
Average Annual State (1)	3,010,069
STATE – FULL DEVELOPMENT	
Primary Residents (75% of Residents)	
General Excise Tax (5) (3)	1,529,351
Income Tax (6) (3)	4,668,803
Other (2) (3)	754,636
Second Home Residents (25% of Residents)	
General Excise Tax (7)	347,503
Income Tax (8)	0
Other	0
Annual State Revenue upon Full Development	7,300,293
COUNTY FULL DEVELOPMENT	
Property Taxes (see table #2)	
Residential	5,992,500
Golf Course	285,000
Retail	27,890
Total Property Tax Revenue	6,305,390
Other Revenue (3) (4)	829,932
Annual County Revenue upon Full Development	7,135,322

Manini'owali Residential Community

Table 7
Summary of Economic Impacts
Annual Revenues
(1991$)

State	
Revenues	7,300,292
Expenditures (1) ($1,736 per resident)	3,873,016
Net Revenues	3,427,276
County	
Revenues	7,135,322
Expenditures (2) ($730 per resident)	1,628,630
Net Revenues	5,506,692
Total State and County	
Revenues	14,435,614
Expenditures	5,501,646
Net Revenues	8,933,968

(1) Total expenditures per person in FY 1990 increased by 5% to 1991 dollars
Source Comprehensive annual financial Report for the Fiscal Year Ended June 30, 1990 State of Hawaii

(2) Total expenditures per person in FY 1990 increased by 5% to 1991 dollars
Source: The County of Hawaii 1989-90 Annual Report.

Manini'owali Residental Community

Table 8
Total Annual Wages
For New Direct Employment

Number of Employees	120
Average Wage in 1991	24,054
Average Total Wage	2,886,480

(1) Average wage is based on the Department of Business Economic Economic Development & Tourism's "Quarterly Statistical & Economic Report, 1st Quartler 1991", Table 1-4 page 7 Projected Personal Income. This report uses the the projection for the year 1991.