LINDA LINGLE
Mayor

DAVID W. BLANE
Director

LISA M. NUYEN
Deputy Director

COUNTY OF MAUI
DEPARTMENT OF PLANNING

CLAYTON I. YOSHIDA
Planning Division

AARON H. SHINMOTO
Zoning Administration and
Enforcement Division

September 10, 1998 SEP 11 A11:33

OF QUALITY

Mr. Gary Gill, Director
Office of Environmental Quality Control
State Office Tower, Room 702
235 South Beretania Street
Honolulu, Hawaii 96813-2437

Dear Mr. Gill:

RE: Final Environmental Assessment (EA) for Makena Resort's Roadway and Utility Infrastructure Improvements at TMK: 2-1-05:108; 2-1-08:108; 2-1-7:Por. 94; 2-1-8:Por. 80, Por. 90, Por. 98, Por. 99, Por. 100, Por. 106, Por. 108, Makena, Island of Maui, Hawaii (EA 980007)

The Maui Planning Department (Department), as the accepting authority, is transmitting for publication in the upcoming Office of Environmental Quality Control (OEQC) Bulletin, the Final Environmental Assessment in which a Finding of No Significant Impact (FONSI) has been determined for Makena Resort's Roadway and Utility Infrastructure Improvements.

A description of the proposed action is attached to the OEQC Bulletin Publication Form and will also be sent by electronic mail (E-Mail) by the Applicant to OEQC in a WordPerfect format. In addition, the Department has enclosed four (4) copies of the Final Environmental Assessment Report (prepared by the Applicant).

Thank you for your cooperation. If additional clarification is required, please contact Ms. Ann T. Cua, Staff Planner, of this office at 243-7735.

Sincerely,

for: LISA M. NUYEN
Director of Planning

250 SOUTH HIGH STREET, WAILUKU, MAUI, HAWAII 96793
PLANNING DIVISION (808) 243-7735; ZONING DIVISION (808) 243-7253; FACSIMILE (808) 243-7634

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LMN:ATC:cmh
Enclosures
c: Clayton Yoshida, AICP, Planning Program Administrator
Ann T. Cua, Staff Planner
Roy Figueiroa, Makena Resort
Milton Arakawa, Munekiyo, Arakawa & Hiraga, Inc.
Project File
General File
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1998-09-23-MA-FEA-

Final Environmental Assessment

MAKENA RESORT ROADWAY AND UTILITY INFRASTRUCTURE IMPROVEMENTS

Prepared for:

Makena Resort Corp.

September 1998

MUNEKIYO, ARAKAWA & HIRAGA, INC.

Final Environmental Assessment

MAKENA RESORT ROADWAY AND UTILITY INFRASTRUCTURE IMPROVEMENTS

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Makena Resort Corp.

September 1998

MUNEKIYO, ARAKAWA & HIRAGA, INC.

CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

Preface

The applicant, Makena Resort Corp., proposes to construct roadway and utility infrastructure improvements in Makena, Maui, Hawaii (TMK 2-1-5:por. 108; 2-1-7:por. 94; 2-1-8:por. 80, por. 90, por. 98, por. 99, por. 100, por. 106, and por. 108). Pursuant to Chapter 343, Hawaii Revised Statutes, and Chapter 200 of Title 11, Administrative Rules, Environmental Impact Statement Rules, this Environmental Assessment documents the project's technical characteristics and environmental impacts, and advances findings and conclusions relative to the significance of the project.

Chapter I

Project Overview

I. PROJECT OVERVIEW

A. BACKGROUND

The applicant, Makena Resort Corp., proposes to construct roadway and utility infrastructure improvements in Makena, Maui, Hawaii. See Figure 1.

The proposed improvements are part of the implementation of the long range master plan for the development of the resort and are intended to service future development at the Makena Resort. Existing developed portions of the Makena Resort include the Maui Prince Hotel, the Makena North and South Golf Courses, and the Makena Tennis Club. See Figure 2.

It is anticipated that the proposed infrastructure improvements will service future development of Sites M-5, M-6, and S-7. Sites M-5 (22.4 acres) and M-6 (13.4 acres) are intended for future multi-family residential use, while Site S-7 (3.1 acres) is intended for single family residential use. It is noted that development of Sites M-5, M-6, and S-7 are not within the scope of this application. Once development plans are finalized for M-5, M-6 and S-7, future Special Management Area Use Permit applications will be prepared for these proposed developments. Affected tax map parcels for the proposed infrastructure improvements include TMK 2-1-05:por. 108, 2-1-07:por. 94; and 2-1-08:por. 80, por. 90, por. 98, por. 99, por. 100, por. 106, and por. 108.

The ownership of lands on which the proposed improvements are situated is described in Table 1.

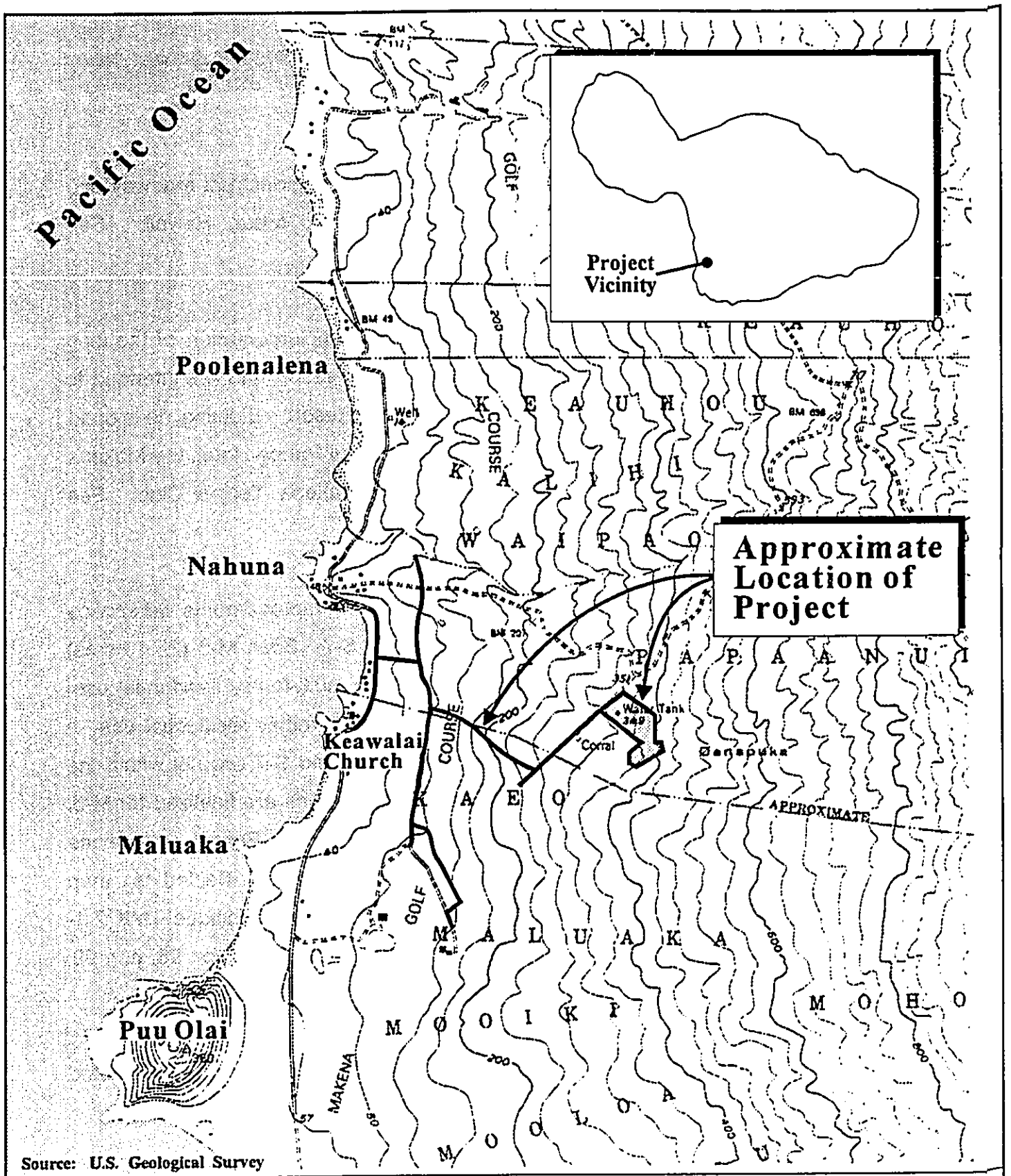


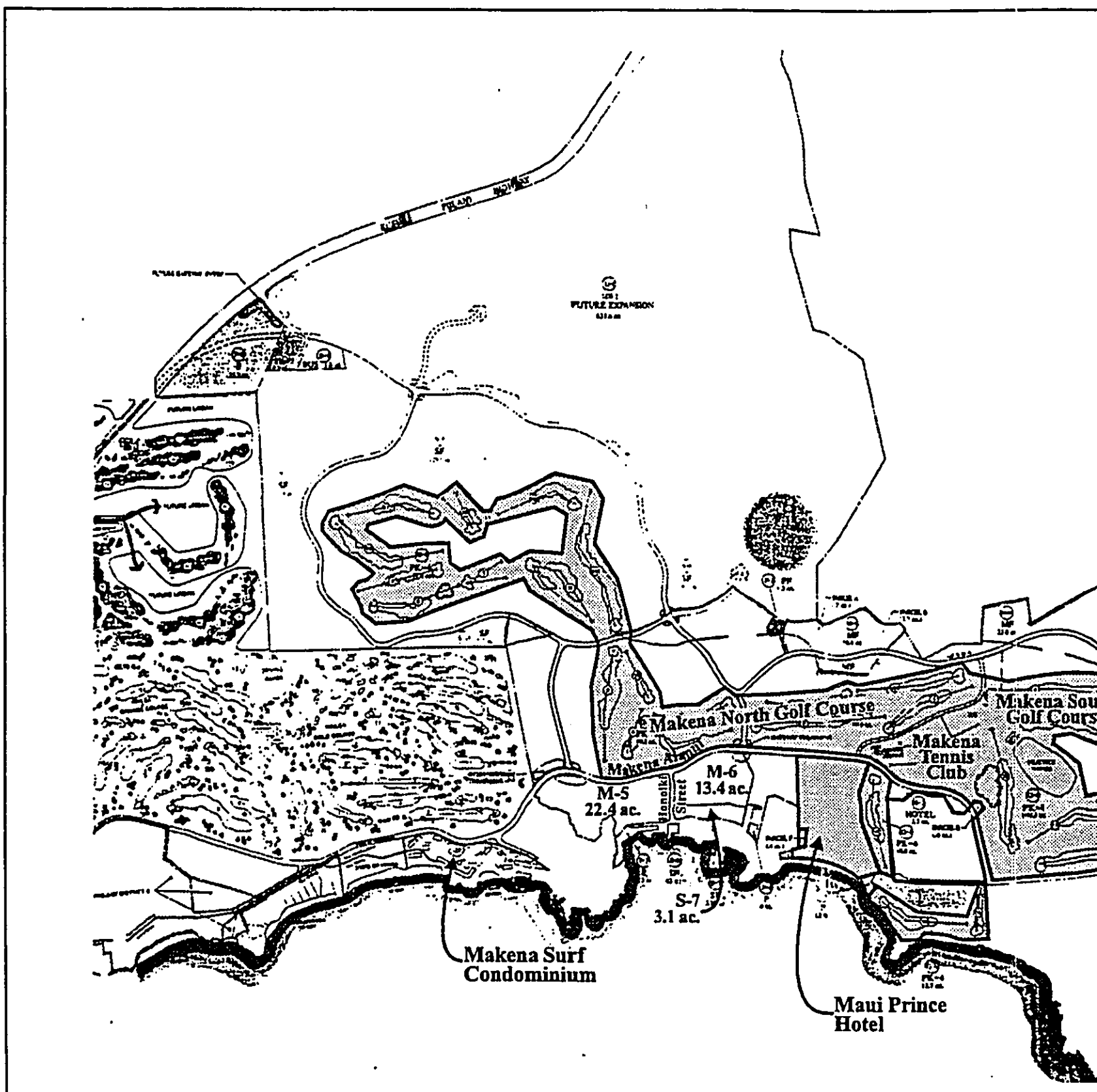
Figure 1 Makena Resort Roadway and Utility Infrastructure Improvements

Regional Location Map

MUNEKIYO, ARAKAWA & HIRAGA, INC.

1000 0 2000 4000 Feet

Prepared for: Makena Resort Corp.



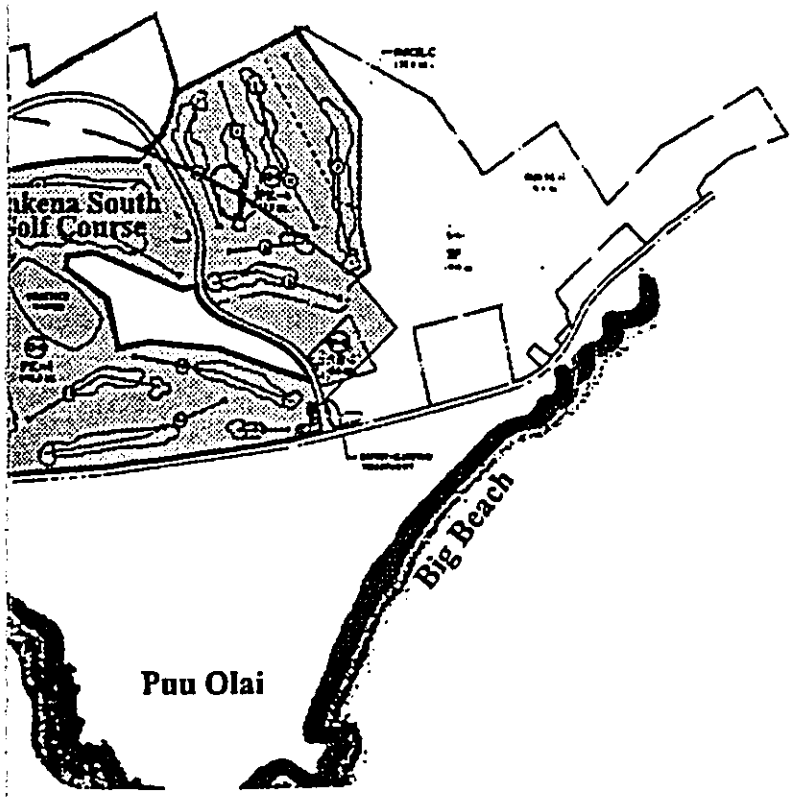
Source: PBR Hawaii

Figure 2

Makena Resort Roadway and U
Infrastructure Improvements
Existing Uses Within Makena Resort Mas

Prepared for: Makena Resort Corp.

Note: Shaded Areas indicate existing developed portions of Makena Resort



nd Utility
nents
rt Master Plan

MUNEKIYO, ARAKAWA & HIRAGA, INC.

NOT TO SCALE

Table 1

Name of Owner	*TMK or Street Ownership*
County of Maui	Makena Alanui, Honoiki Street, Makena Keoneoio Road
Maui Prince Hotel Corp.	2-1-5:108 and 2-1-8:90
Makena Aina Corp.	2-1-7:94 and 2-1-8:80, 98, 99,100, 106
Ainamua Corp.	2-1-8:108

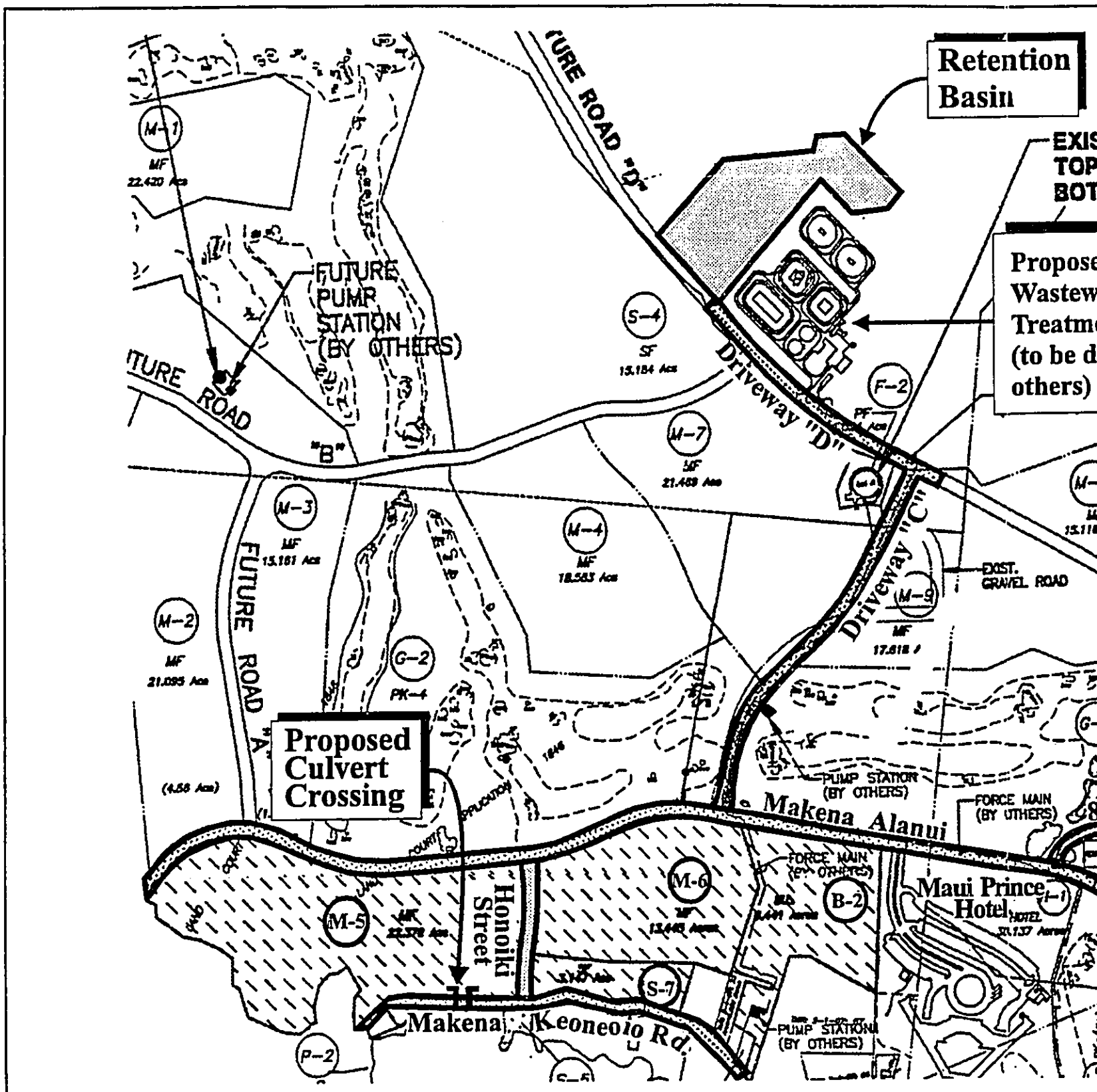
B. PROPOSED PROJECT

Lands within the scope of the project are shown in Figure 3. The proposed project is described more specifically as follows:

1. Improvements to Makena Alanui, Honoiki Street and Makena Keoneoio Road

Makena Alanui, Honoiki Street, and Makena Keoneoio Road are proposed to be widened in accordance with subdivision standards.

Both Makena Alanui and Honoiki Street have one (1) 12-foot wide travel lane in each direction. There are no curbs, gutters, or sidewalks on either road except for a portion of Makena Alanui fronting the Maui Prince Hotel. Improvements to these roads include widening travel lanes from 12 to 22 feet, which includes the addition of concrete curbs, gutters and sidewalks. Sidewalks will be 6 feet wide and constructed on the project side of the roadway. For the portion of Makena Alanui fronting the Maui Prince Hotel site, the existing 6-foot wide concrete sidewalk will be relocated to match the new roadway improvements. Since the right-of-way width for both roads is 60 feet, no additional land will be needed. See Figure 4.



Source: Sato & Associates, Inc.

Figure 3

Makena Resort Roadway and U
Infrastructure Improvements
Lands Within Application Scope

Prepared for: Makena Resort Corp.

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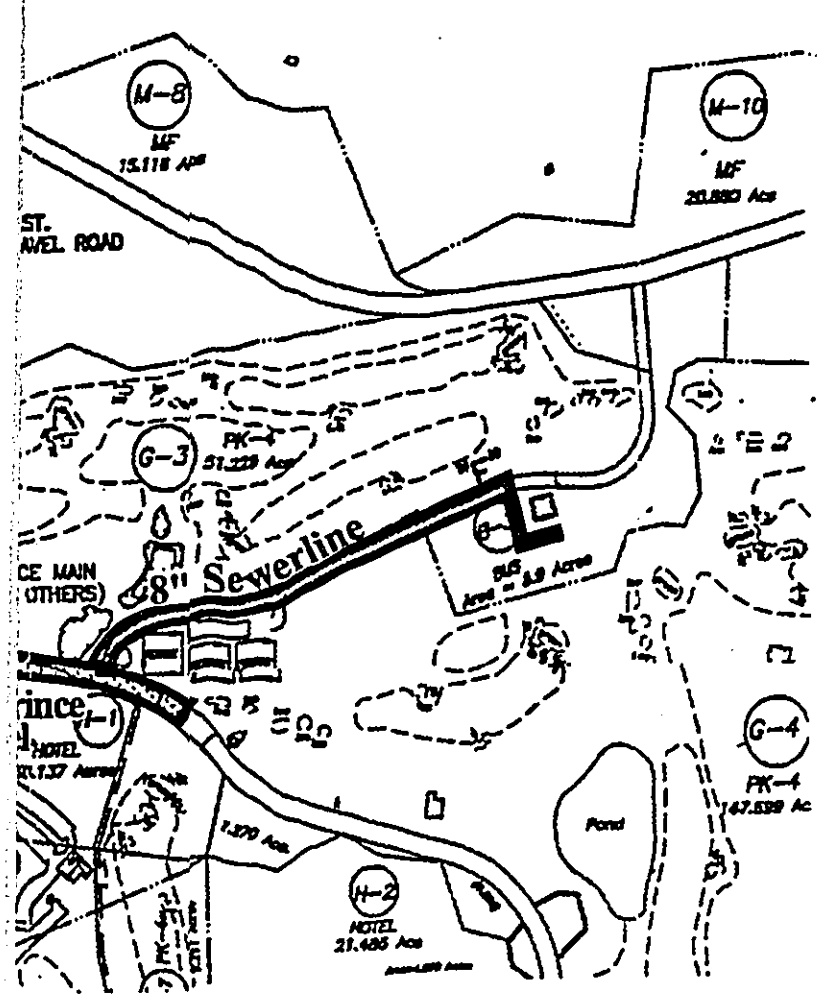
EXIST. 1.5 M.G. CONC
TOP ELEV.=285'
BOTTOM ELEV.=285'

Shaded Areas Indicate Lands within Scope of this SMA Application

Proposed Wastewater Treatment Facility (to be done by others)



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Scope

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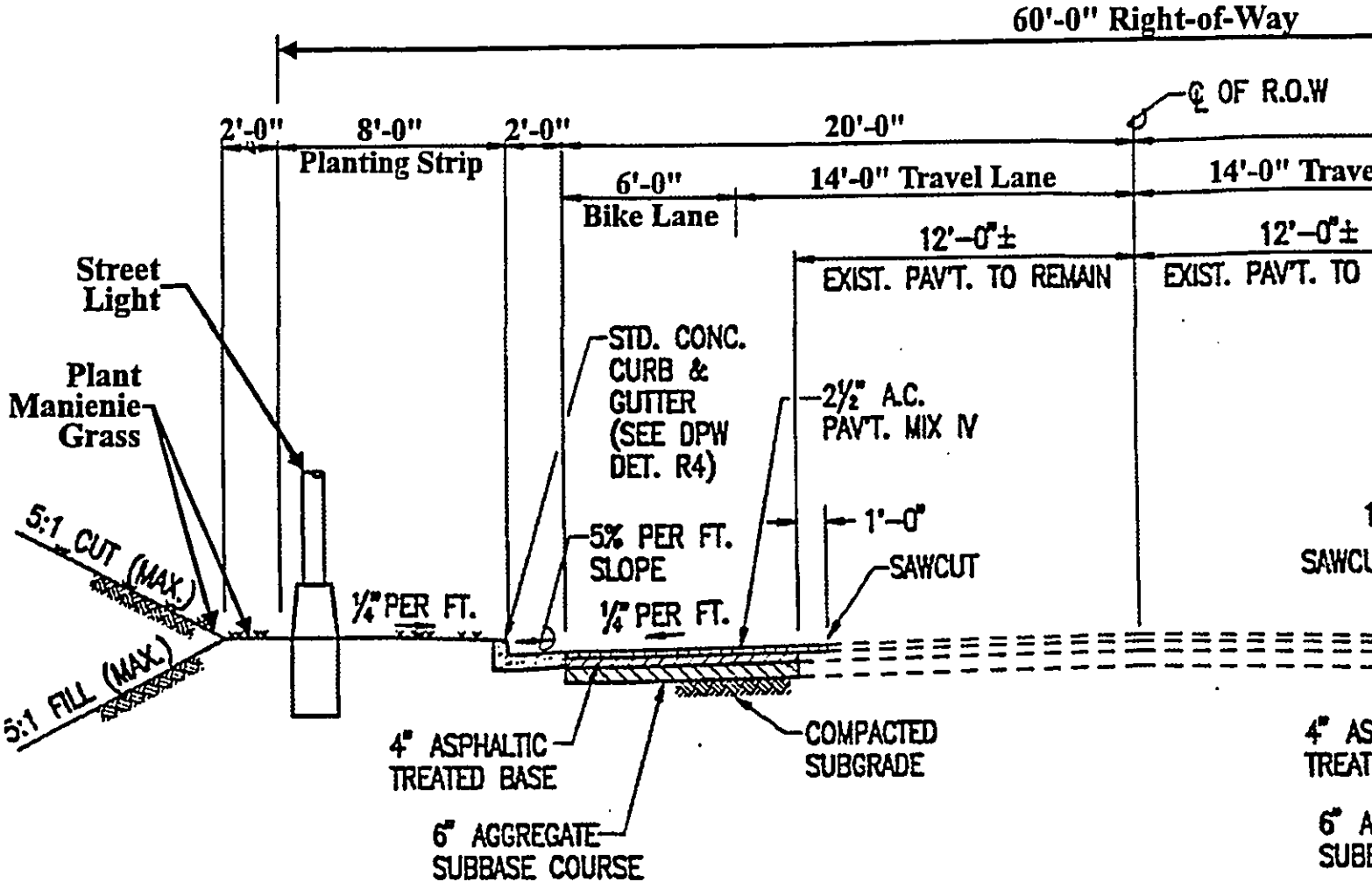
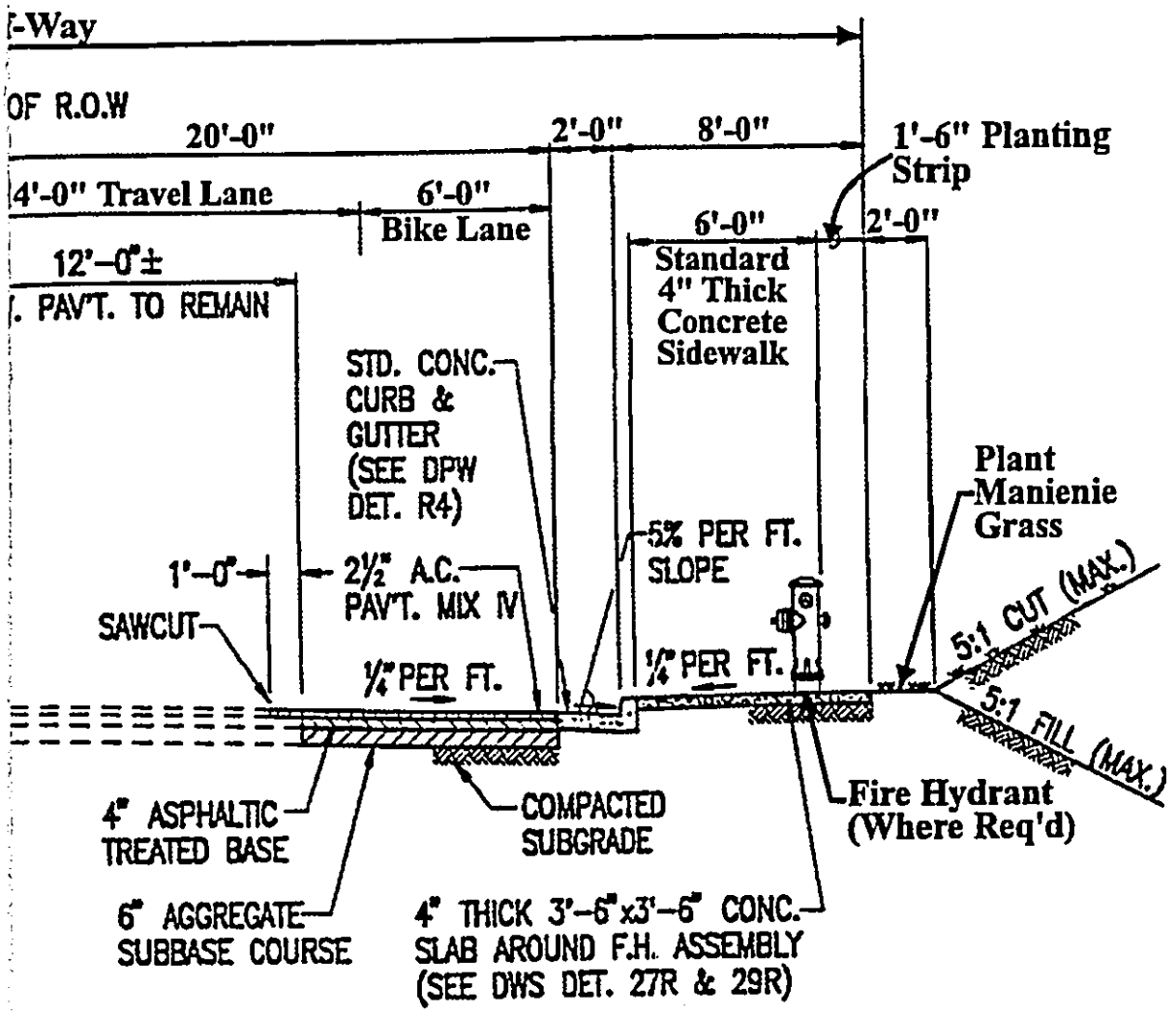


Source: Sato & Associates, Inc.

Figure 4 Makena Resort Roadway and Utility Infras

Typical Section for 60 Feet Wide R

Prepared for: Makena Resort Corp.



y Infrastructure Improvements
Wide Right-of-Way

MUNEKIYO, ARAKAWA & HIRAGA, INC.

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Portions of Makena Alanui will also be regraded to improve driving conditions. The curve on Makena Alanui at the northern end of the project will be super-elevated and its vertical curve will be lengthened.

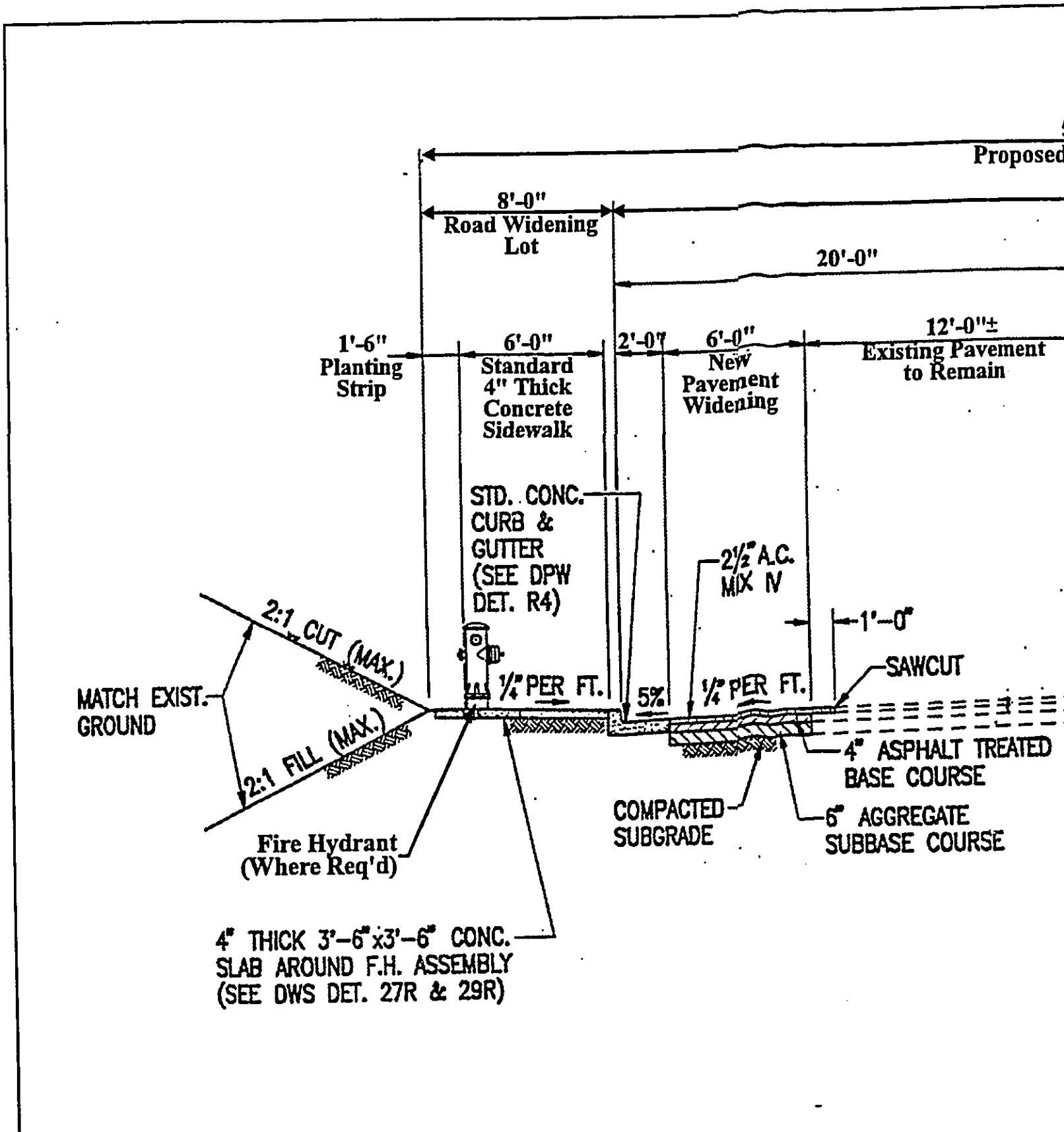
Makena Keoneoio Road will also be widened to accommodate an ultimate right-of-way of 56 feet. Currently, the right-of-way width varies from 40 feet or less. The widening for this particular project would occur along the project's frontage on the mauka side of the roadway. Improvements to the south of Honoiki Street include pavement widening, concrete curb and gutter, and 6-foot wide concrete sidewalk. See Figure 5. Makena Keoneoio Road improvements to the north of Honoiki Street also include resurfacing of the existing pavement. See Figure 6.

2. ***Water Improvements***

Development on Sites M-5, M-6, B-2 and S-7 can obtain water from existing lines in Makena Alanui, Honoiki Street and Makena Keoneoio Road. Although there are fire hydrants connected to these lines, spacing does not meet applicable County standards. Thus, new hydrants are proposed.

3. ***Sewer System***

There is no sewage collection system serving Sites M-5, M-6 and S-7. New sewerlines are proposed to be installed in Makena Alanui, Honoiki Street and Makena Keoneoio Road. These gravity lines are proposed to be constructed in conjunction with roadway construction activities. Also, a new sewerline is proposed connecting the Golf Club and Tennis Complex with the new system in Makena Alanui.

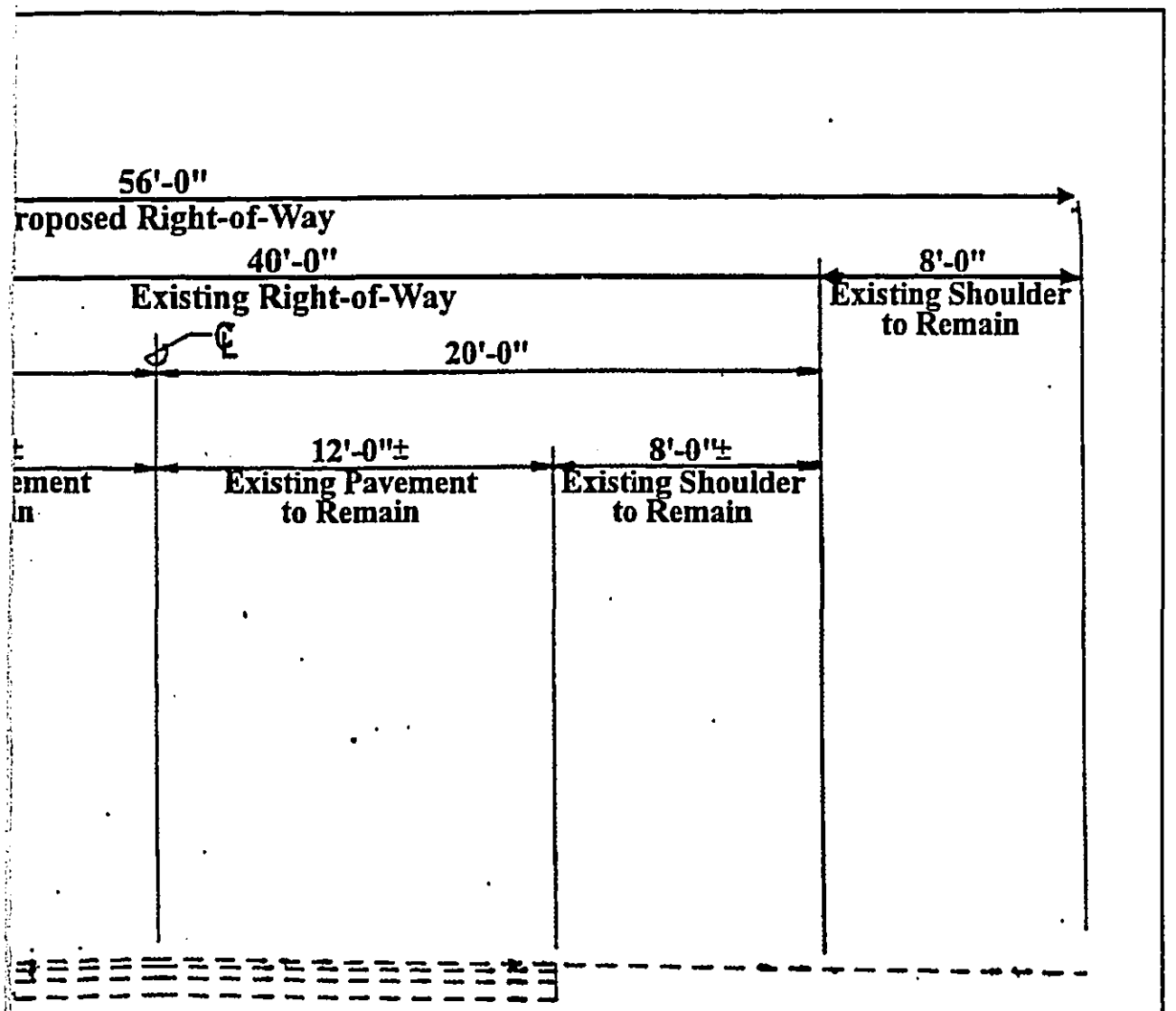


Source: Sato & Associates, Inc.

Figure 5 Makena Resort Roadway and Utility Infrastr

Typical Section for Makena Keoneoio Road, Sou

Prepared for: Makena Resort Corp.



rastructure Improvements
South of Honoiki Street

MUNEKIYO, ARAKAWA & HIRAGA, INC.

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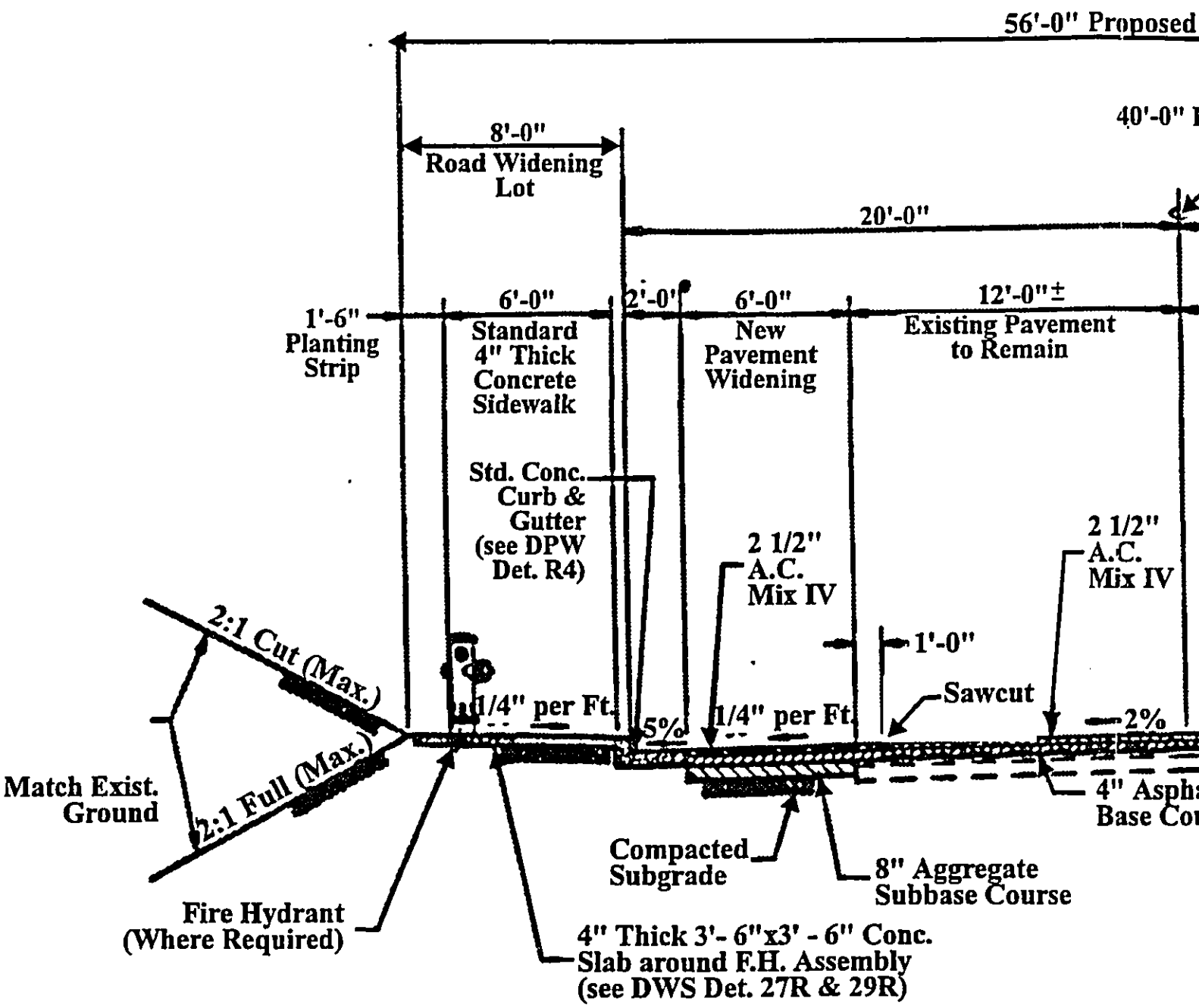
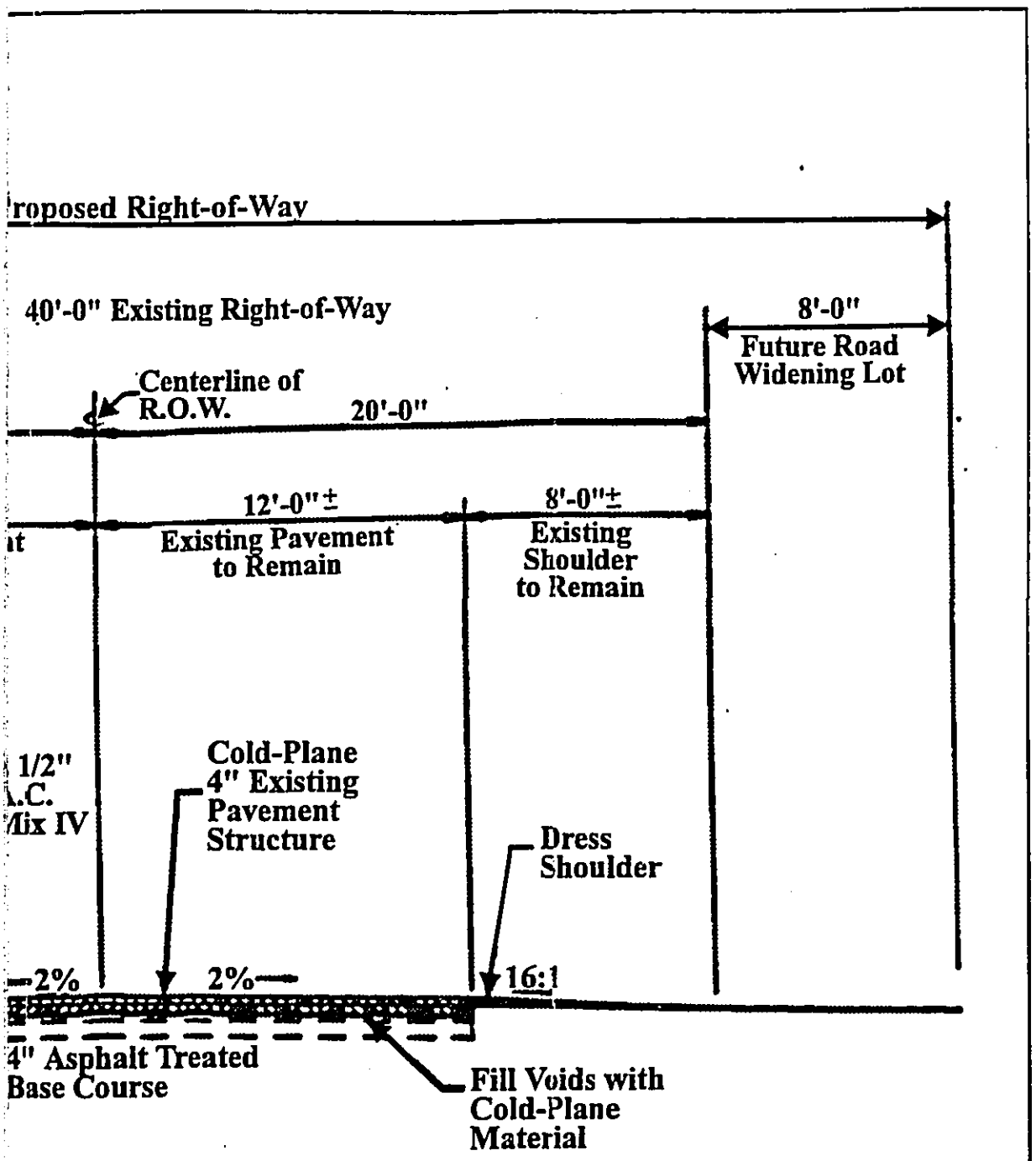


Source: Sato & Associates, Inc.

Figure 6 Makena Resort Roadway and Utility Infrast

Typical Section for Makena Keoneoio Road, No

Prepared for: Makena Resort Corp.



Infrastructure Improvements
ad, North of Honoiki Street

MUNEKIYO, ARAKAWA & HIRAGA, INC.

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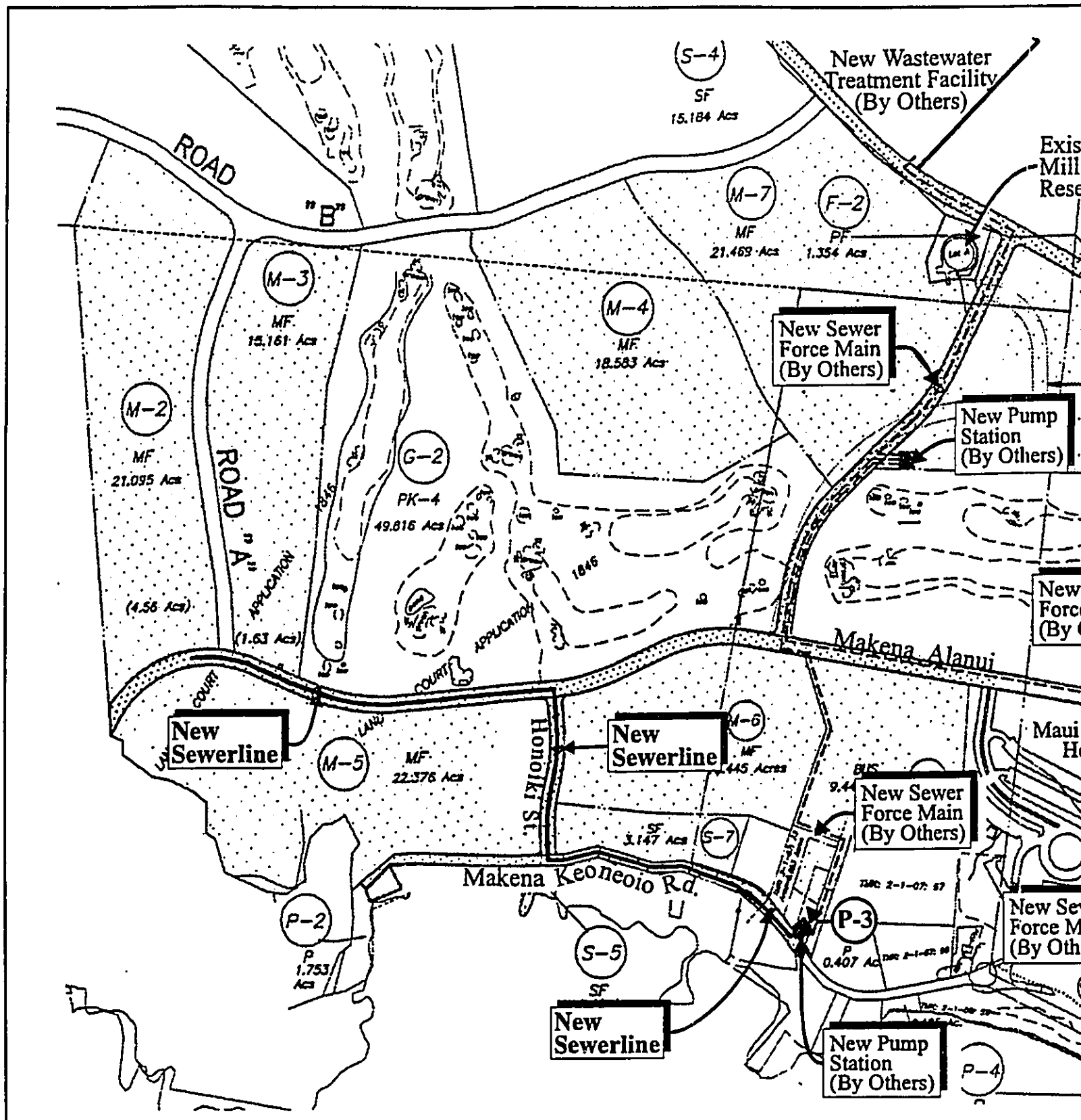
The gravity lines within Makena Alanui, Honoiki Street, and Makena Keoneoio Road are proposed to connect with a new pump station near Site P-3. Flows would then be pumped mauka to another pump station located near the 8th tee. Flows are then pumped to the proposed wastewater treatment facility to be constructed near the existing 1.5 million gallon reservoir. See Figure 7. It is noted that the pump stations, force mains and treatment facility are not within the scope of this application.

4. ***Service Driveways***

To provide access to the wastewater treatment plant, approximately 3,500 linear feet of paved service driveway will be constructed. Driveway "C" will connect with Makena Alanui extending mauka between the second and third holes of the Makena North Golf Course up to the existing water tank. At the tank, the driveway forms a T-intersection with Driveway "D" which extends north along the treatment facility's frontage.

In the future, it is anticipated that this driveway alignment will service future development. Thus, the driveway corridor is proposed to be graded to accommodate a 60 foot right-of-way width. Actual pavement widths for the driveway are proposed to be 12 feet with the remainder being grassed shoulder. When the areas adjacent to the driveway are developed, then the driveway is proposed to be upgraded pursuant to County standards to a major collector road.

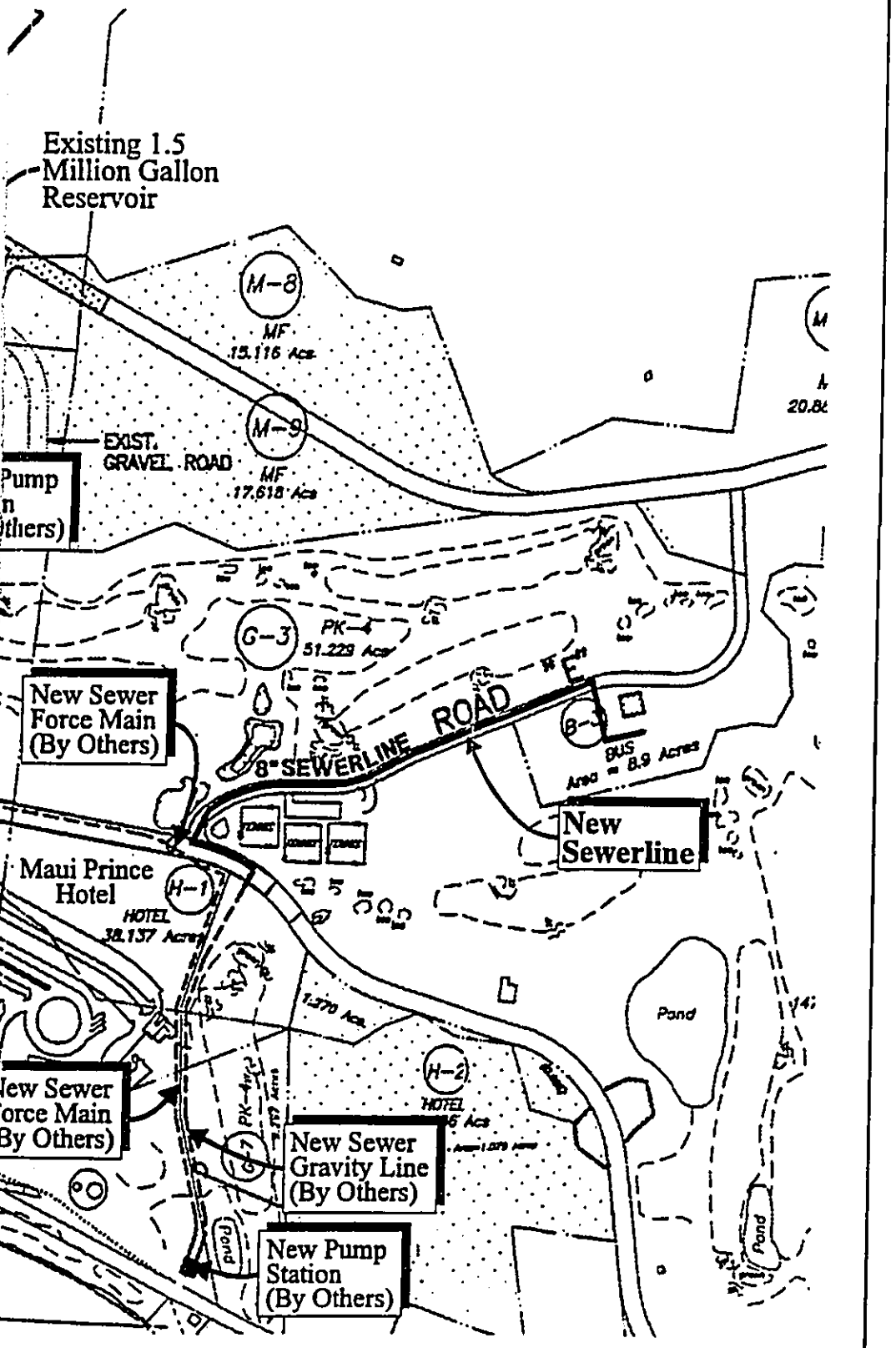


Source: Sato & Associates, Inc.

Figure 7 Makena Resort Roadway and Utility Infrastru

Proposed Sewer Improvements

Prepared for: Makena Resort Corp.



astructure Improvements
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MUNEKIYO, ARAKAWA & HIRAGA, INC.

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5. ***Drainage***

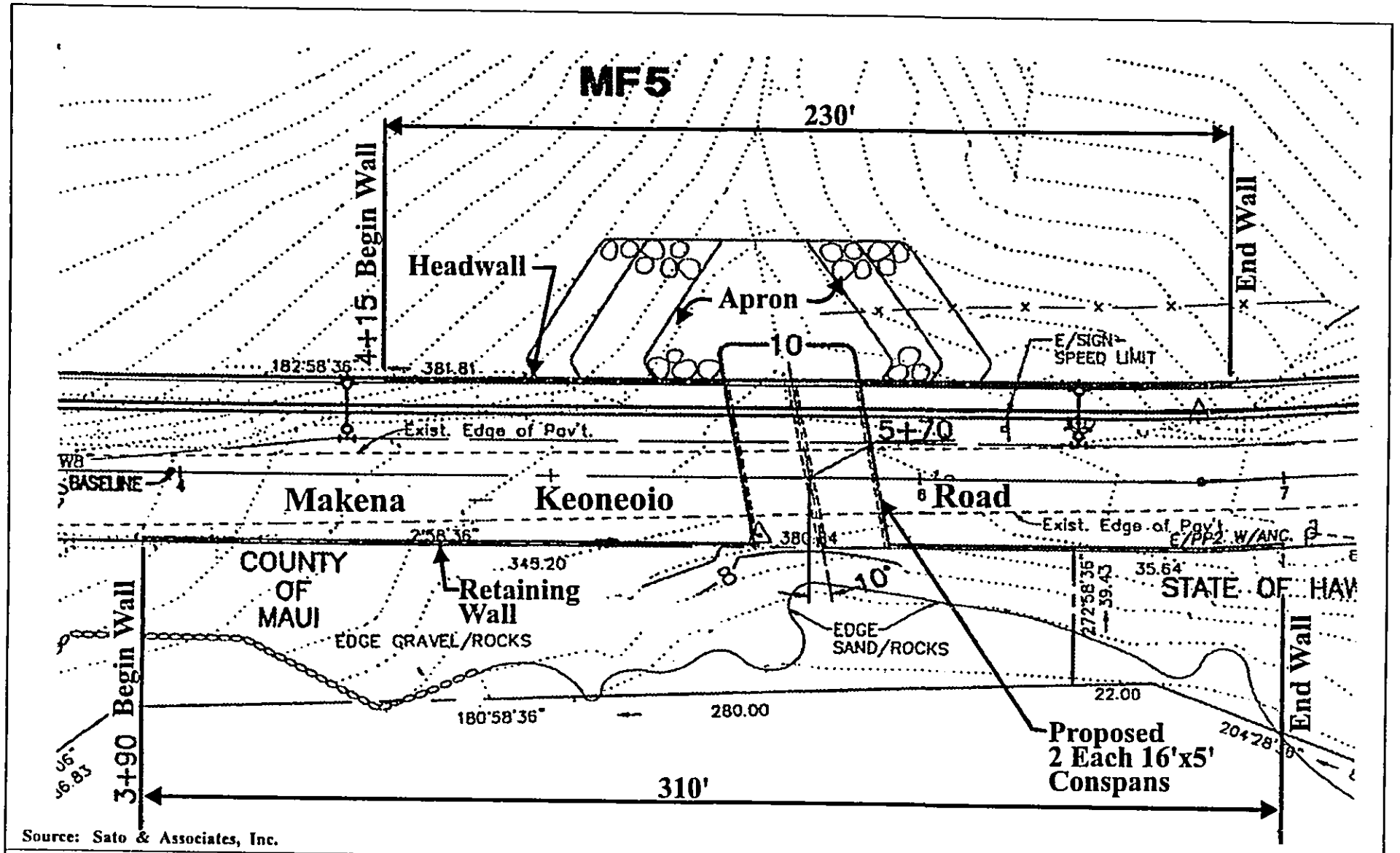
Proposed drainage improvements will be guided by recommendations made in Makena Resort's Drainage Master Plan (Muroda & Associates, Inc., 1983). The plan defines the drainage basins affecting the entire property and establishes drainage routes to the ocean. The proposed improvements will result in no more than negligible increases in runoff due to development.

A new retention basin of approximately 13 acres is proposed adjacent to the new wastewater treatment facility. New catch basins will be installed in Driveways "C" and "D" in anticipation of future road widening and development. The drainage system for the service driveways will be sized for existing runoff conditions and driveway runoff only.

Along Makena Alanui, there are existing drainage crossings which were designed in accordance with the master plan. Thus, no additional crossings are warranted.

Along Makena Keoneoio Road, two (2) 16 feet by 5 feet conspan culverts are proposed. Work for the culverts involve raising the road profile and construction of a retaining wall at the makai edge of the right of way. See Figure 8 and Figure 9.

During development of the various sites, the designer shall take developed flows to the major crossings defined in the Master Plan. The crossings should then be re-evaluated to check if additional flows can be accommodated. If the crossings cannot accommodate developed flows, provisions should be incorporated into the project to release flows at pre-developed rates. This can



Source: Sato & Associates, Inc.

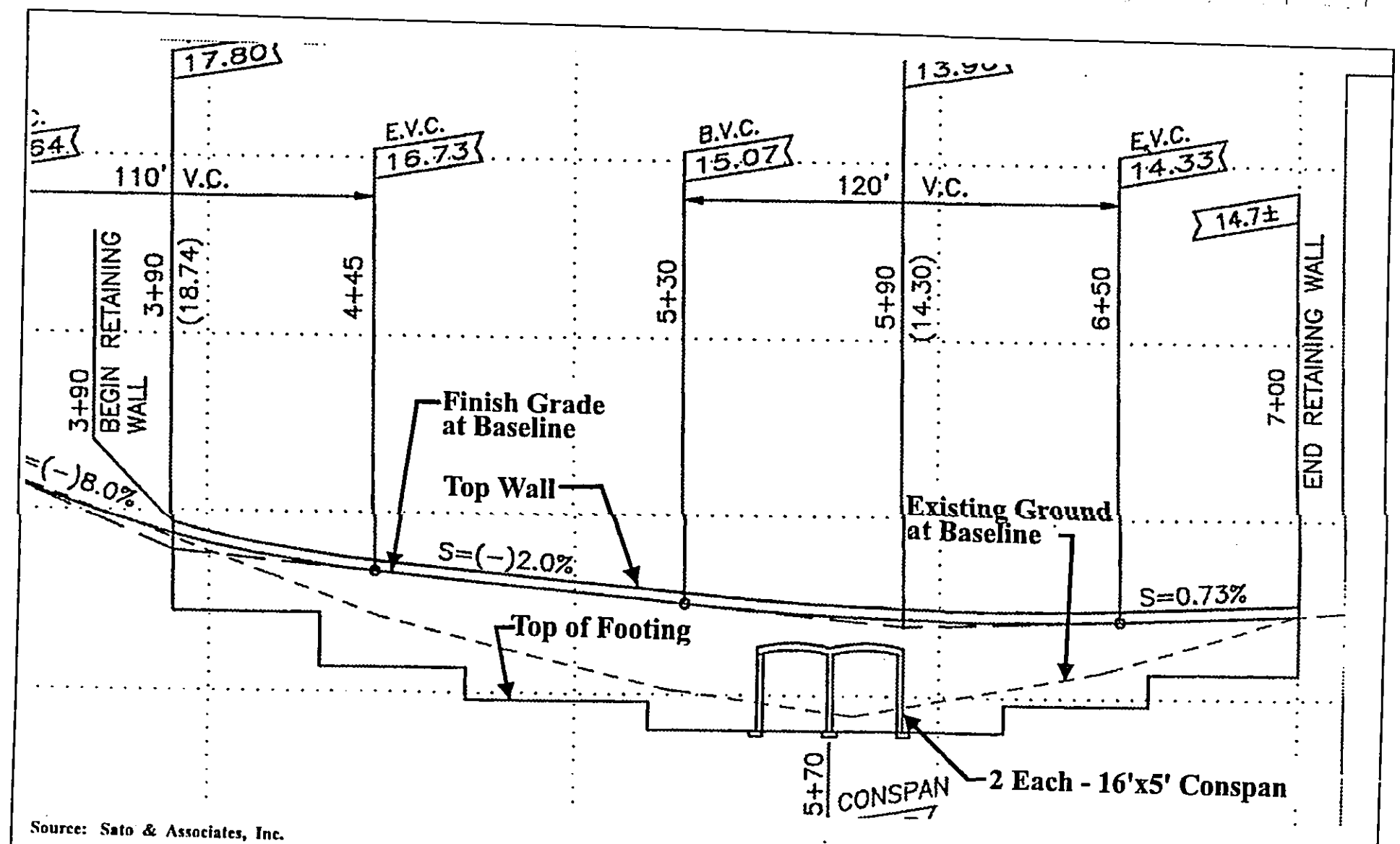
Figure 8

Makena Resort Roadway and Utility Infrastructure Improvements

Proposed Culvert Crossing at Makena Keoneoio Road

Prepared for: Makena Resort Corp.

MUNEKIYO, ARAKAWA & HIRAGA, INC.



Source: Sato & Associates, Inc.

Figure 9

Makena Resort Roadway and Utility Infrastructure Improvements

Profile of Proposed Culvert at Makena Keoneoio Road

Prepared for: Makena Resort Corp.

MUNEKIYO, ARAKAWA & HIRAGA, INC.

Horizontal Scale 1 Inch = 40 Feet
Vertical Scale 1 Inch = 8 Feet

be accomplished by using trench drains or detention/retention basins.

6. ***Electrical, Telephone and CATV***

In areas where road widening improvements are proposed, overhead lines will be installed underground. Where no overhead lines exist, provisions will be made for future underground conduits as required by Maui Electric Company, Hawaiian Telephone and TCI.

Since Makena Alanui, Honoiki Street, and Makena Keoneoio Road are County roadways, this triggers environmental review through Chapter 343, Hawaii Revised Statutes. Accordingly, an environmental assessment is being prepared.

The proposed project is located within the County Special Management Area. A Special Management Area Use Permit is also being prepared.

It is noted that the proposed project does not involve work on shoreline lots and is not subject to shoreline setback provisions. However, there should be clarification of the applicability of shoreline setback provisions to lands near the northern project limits of Makena Keoneoio Road. Land designated as TMK 2-1-7:94 is owned by Makena Aina Corp. and encompasses:

1. A portion of property located mauka of Makena Keoneoio Road;
2. The northern project limits of Makena Keoneoio Road; and
3. The Makena Landing which has been developed for public recreational use by Makena Resort Corp.

Makena Keoneoio Road is the roadway which traditionally provided

access to the Makena area before the construction of Makena Alanui and has been in public use for a number of years. According to the County of Maui, Department of Public Works and Waste Management, Engineering Division, land designated as TMK 2-1-7:94 is comprised of three (3) parcels:

1. Parcel 69 (0.346 acre);
2. Roadway parcel (0.27 acre): and
3. Parcel 70 (1.298 acres).

Makena Resort Corp. is proposing roadway improvements on the mauka side of Makena Keoneoio Road (Parcel 69) and resurfacing the existing asphalt roadway (Roadway parcel). The proposed project does not involve work within the Makena Landing property (Parcel 70) which is the shoreline lot.

It should also be noted that the proposed conspan culverts would be constructed within the Makena Keoneoio Road right-of-way. Other shoreline lots are located seaward of this portion of the right-of-way.

Since the roadway and proposed improvements do not take place on any shoreline lot, the proposed action is not subject to shoreline setback rules and regulations.

The total cost of all improvements for the project is estimated to be $4.95 million. Assuming all applicable permits are obtained, construction is projected to start in Fall 1998 and be completed by Fall 1999.

Chapter II

Description of the Existing Environment

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. PHYSICAL ENVIRONMENT

1. Surrounding Land Use

The proposed improvements are located within lands of the Makena Resort. General land uses within the resort include hotel, recreational, and golf course functions. The Maui Prince Hotel is currently the only hotel in Makena. Recreational land uses include activities provided by Makena Resort's two (2) 18-hole championship golf courses and six (6) tennis courts.

To the north of the proposed service driveways (Driveway "C" and Driveway "D") are portions of the Makena North Golf Course and vacant lands. Further north is the Wailea Resort area. General land uses within Wailea include hotel, multi-family residential, recreational, single family residential, and golf course functions.

On the eastern or mauka side of the project site, some lands are vacant while others are utilized for cattle grazing up to the Kula and Ulupalakua areas.

To the south of the proposed improvements are the Maui Prince Hotel, portions of the Makena North and South Golf Courses, and the Makena Golf and Tennis Club. There are several vacant properties surrounded by golf course frontage.

Puu Olai lies to the southwest of the property. Oneloa Beach is located to the south of the proposed improvements. Lands are predominantly vacant to the south of Makena Resort with scattered residential uses along the shoreline.

On the west or makai side of the Maui Prince Hotel, there is an approximately 1,100 lineal foot pedestrian walkway which extends parallel to the shoreline. The walkway is within a 20-foot wide corridor for public use which replaced this segment of the Makena Keoneoio Road. Shoreline landscaping is located makai of the walkway which extends to a sandy beach. To the west of proposed project improvements to Makena Keoneoio Road, there are single family residential uses clustered near the shoreline. The historic Keawalai Church is also located on the makai side of Makena Keoneoio Road. There are also public beach access accommodations and parking at Makena Landing, across Keawalai Church, and near the southern portion of the Makena-Keoneoio pedestrian walkway.

2. ***Climate***

Climatic conditions on Maui are characterized by mild and consistent year-round temperatures, moderate humidity and consistent northeasterly tradewinds. However, local terrain can greatly influence the climate in different areas. Because of its location on the leeward coast of the Island, the property experiences a higher range of temperatures and lower rainfall than those areas located on the Island's windward side. The region experiences a relatively even climate with little seasonal and day-night temperature variation. Cool tradewinds from the northeast help keep the warm summer months pleasant. During the months from October to April, Kona storms occasionally develop, bringing strong winds and rain out of the south.

The Ma'alaea-Kihei-Makena region is subject to unique wind conditions due to specific terrain. The Ma'alaea area, which lies at

the base of the central isthmus flanked by two mountain masses, is subject to a wind tunnel effect. As the wind squeezes between the mountain masses, its force becomes compressed, at times increasing velocity to more than 50 percent above the normal velocity in the Wailuku area. The wind fans out over Ma'alaea Bay, retaining the added velocity, with the inshore segment blowing parallel to the Kihei Coast. Along the shore, it meets the eddy current of the trades deflected along the southeast slopes of Haleakala. This results in unpredictable local winds from Kalama Park to Cape Kina'u.

Annual rainfall distribution in the region ranges between five (5) to fifteen (15) inches per year with most falling during the months of November to March. The months of April to October are generally drier with measurements reflecting less than one-half inch per month. In 1993, Makena recorded an annual rainfall of approximately 10 inches (Maui Data Book and Newcomers Guide, 1995).

Temperatures recorded at Keawakapu Beach indicate a hotter climate for the Kihei-Makena area, compared with Maui's average range. During the summer months, average mean high temperatures are near 90 degrees Fahrenheit and minimum temperatures are in the mid- to upper 60's. The winter months are cooler with average highs in the low 80's and average lows in the low 60's.

3. ***Soil Characteristics***

Underlying the project site are soils of the Makena-Keawakapu association. These soils are typically found on the low uplands and

consist of lands gently sloping to moderately steep, well-drained, and having medium textured soil. This soil ranges in depth from shallow to deep and is comprised of fragmental Aa lava.

Soil series in the vicinity of the subject properties consist of Makena loam (MXC), which is typically found on the lower leeward slopes of Haleakala between Makena and Kamaole, and Oanapuka extremely stony silt loam (OED), which occurs on lower uplands.

The Makena loam (MCX) soil is typified by 3 to 15 percent slopes, slow to medium runoff, and slight to moderate erosion hazards. The Oanapuka extremely stony silt loam is typified by seven (7) to twenty-five (25) percent slopes, with stones covering 3 to 15 percent of the surface area. Also, permeability is moderately rapid, runoff is slow, and the erosion hazard is slight to moderate.

4. ***Flood and Tsunami Hazard***

The subject properties are situated within Zone C, which is defined as areas of minimal flooding.

5. ***Flora and Fauna***

Vegetation associated with the Makena region varies between developed and undeveloped properties. The developed areas of Makena include the two (2) golf courses and the Maui Prince Hotel. Monkeypod, palm, wili wili, hibiscus and lauhala are examples of trees and shrubs which enhance Makena's landscape. In areas of undeveloped parcels, however, thickets of kiawe trees, haole-koa, cactus, buffel grass and swollen fingergrass represent the predominant vegetation. Four (4) species of endemic plants which are not endangered are found in the general vicinity: ilima hialoa

(*Waltheria americana*), prickly poppy (*Argemone glauca*), and wili wili (*Erythrina sandwicensis*) (R.M. Towill Corp., October 1997).

Cats, mongoose, rats, axis deer and wild boar are among the feral animals that are commonly found in the area. Avifauna in the vicinity of the Project are generally typical of the Kihei-Makena region. Species of birds common to the area are the Mynahs, Golden Plovers, Japanese White-eye, Northern Cardinals, Sparrows, Spotted Doves, and Zebra Doves.

The Hawaiian black necked stilt (Ae'o) has been sighted occasionally at water features within the golf courses. The Ae'o is considered endemic and endangered. Collectively, open bodies of water such as water hazards at golf courses and irrigation ponds (punawai) on the Island are used as a limited loafing and feeding habitat for the Ae'o. Kanaha and Kealia Ponds provide important nesting and feeding habitat for the Ae'o.

The American golden plover (kolea) and the black crowned night heron ('auku'u) have also been sighted at the golf courses. The kolea and 'auku'u are considered indigenous but not endangered. Kolea are generally found on mudflats, lawns and fields. The 'auku'u frequents water features such as ponds, streams, marshes and lagoons.

6. ***Air Quality***

There are no point sources of airborne emissions in the immediate vicinity of the subject properties. The air quality of the Makena area is considered good with existing airborne pollutants attributed to automobile exhaust from the region's roadways. The closest

Department of Health air monitoring site is located at the Kihei Wastewater Reclamation Facility which is approximately 5.5 miles to the north. Particulate matter and sulfur dioxide are monitored. Available data indicate that pollutant levels are significantly below the applicable State standards.

7. ***Noise***

The subject properties are situated within and adjacent to a resort community. With the exception of temporary construction activities, the predominant noise sources are attributed to local vehicular traffic, ocean surf and recreational activities, such as golf, tennis and swimming.

8. ***Scenic and Open Space Resources***

The subject properties are situated within the master-planned community of Makena. Vacant, undeveloped lands are located to the east. The Makena coastline and the islands of Molokini, Kahoolawe and Lanai are visible to the west. The subject properties are not a part of valuable or scenic open space or view corridors.

9. ***Archaeological Resources***

The project area involves lands which are incorporated in a number of previous archaeological studies. These include Clark (1974) who conducted an archaeological surface survey of approximately 1,300 acres for Seibu Hawaii, Inc. Cordy (1978) conducted an archaeological survey and excavations for the third increment of the Seibu golf course. Rogers-Jourdane (1979) conducted an archaeological reconnaissance survey of the Maui Prince Hotel and surrounding areas. Sinoto (1981) conducted a phase I

archaeological survey of Fairways 2 to 6 of the second increment of the proposed golf course. Sinoto (1997) implemented archaeological procedures for six (6) petition areas proposed for State district boundary amendment in Makena. Sinoto (1997) also conducted a surface survey for the proposed wastewater treatment facility, force main and pump stations.

Most of the project area also involves lands which have been disturbed by previous construction activities. Work on Honoiki Street and Makena Alanui take place within the existing rights-of-way which have been previously disturbed. Widening of Makena Keoneoio Road would extend approximately 8 feet from the mauka edge of the existing right-of-way. These lands were included in the Rogers-Jourdane study. The proposed 8-inch sewerline extending from the golf clubhouse traverses developed property within the vicinity of the driving range, golf course and the clubhouse roadway. Work on Driveways "C" and "D" generally extend through portions of the golf course and existing maintenance roads. Mauka portions of Driveway "C" and Driveway "D", however, do not follow the existing maintenance road. The Driveway "C" and Driveway "D" right-of-way follows a sewer force main to be constructed as part of the Makena Wastewater Reclamation Facility (MWRF) project. It is noted that the sewer force main alignment has been found to have "no effect" on known historic sites. See Appendix A. It has also been confirmed that the area of the proposed retention basin was included in the 1997 Sinoto survey for the proposed wastewater treatment facility, force main and pump station.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Community Character

From a regional standpoint, the subject properties are part of the Kihei-Makena Community Plan region which extends from Maalaea to LaPerouse Bay. The region includes a diverse range of physical and socio-economic environments. With its dry and mild climate and proximity to recreation-oriented shoreline resources, the visitor-based economy has grown steadily over the past few years. The subject properties are situated along the southwestern coast of Maui, which includes the community of Kihei and the master-planned communities of Wailea and Makena. The town of Kihei serves as the commercial and residential core of the region, with Wailea and Makena serving as the focal point for visitor activities.

2. Population

The population of the County of Maui has exhibited relatively strong growth over the past decade, with recent estimates placing the County's population at 108,000 (Maui County Data Book, 1997). Growth in the County is expected to continue, with resident population projections to the years 2000 and 2010 estimated to be 112,349 and 133,459, respectively (Community Resources, Inc., January 1994).

Just as the County's population has grown, the resident population of the Kihei-Makena region has increased dramatically in the last two decades. Population gains were especially pronounced in the 1970's as the rapidly developing visitor industry attracted many new residents. The 1990 population of the Kihei-Makena region was estimated at 15,365. Regional projections for the years 2000 and 2010 are 20,092 and 24,846, respectively (Community

Resources, Inc., January 1994).

3. *Economy*

The economy of Maui is heavily dependent upon the visitor industry. The dependency on the visitor industry is especially evident in Kihei-Makena, which is one of the State's major resort destination areas. The opening of the Four Seasons Resort, the Grand Wailea Resort Hotel and Spa, and the Kea Lani Hotel have continued to reinforce the region's status as a premier resort destination.

In 1996, Maui was frequented by 2.3 million visitors (Maui County Data Book 1996-97). Projections for the years 2000 and 2010 reflect the estimated arrival of 3.3 million and 4.3 million visitors, respectively (Community Resources, Inc., January, 1994).

The Kihei-Makena region accounted for 42 percent, or 988,375 of the island's 1990 visitor arrivals. Regional forecasts for the years 2000 and 2010 reflect an estimated 1.4 million and 1.8 million visitors, respectively (Community Resources, Inc., January, 1994).

Maui's economy and employment is largely sustained by tourism, with the Makena and Wailea areas serving as a major component of the island's visitor industry. In 1990, employment in the hotel industry accounted for 16 percent, or 8,500 of Maui's 51,756 total jobs. The island's hotel industry employment is projected to increase to 9,299 and 10,468 in the years 2000 and 2010, respectively (Community Resources, Inc., January, 1994). Within the Kihei-Makena region, employment in the hotel industry accounted for 39 percent, or 2,979 of the region's 7,574 total jobs.

Projected hotel industry employment for this region is estimated to increase to 3,981 and 4,456 in the years 2000 and 2010, respectively. These estimates reflect gains of 44 and 43 percent for the years 2000 and 2010, respectively (Community Resources, Inc., January, 1994).

4. ***Police and Fire Protection***

The County of Maui's Police Department is headquartered at its Wailuku Station. The Department's Kihei Patrol covers the Kihei-Makena region.

Fire prevention, suppression and protection services are offered by the County's Department of Fire Control. The Kihei Station, which services the Kihei-Makena region, is located at the corner of South Kihei Road and Waimahaihai Street.

5. ***Medical Facilities***

Maui Memorial Hospital, the only major medical facility on the Island, services the Kihei-Makena region. Acute, general and emergency care services are provided by the 185-bed facility which is located in Wailuku. Medical/dental offices are located in the Kihei area to serve the region's residents.

6. ***Recreational Facilities***

The subject property is located in a master-planned resort area. Recreational opportunities in the Kihei-Makena community are abundant and diverse. In the Makena area, there are two championship golf courses, a tennis center, and open space for jogging and walking. Shoreline resources in the vicinity include Makena State Park's Oneloa Beach, the Ahihi-Kinau Natural Area

Reserve and LaPerouse Bay. To the north of the project area, there are numerous beaches, municipal parks, golf courses, and other recreation opportunities available.

In addition, Makena Resort Corp. has developed for public use, comfort stations and public parking at Makena Landing, across Keawalai Church and near the southern portion of the Makena-Keoneoio pedestrian walkway.

7. *Schools*

The State Department of Education operates three (3) schools in the Kihei area. Kihei Elementary School and Kamalii Elementary School cover Grades K to 5, while Lokelani Intermediate School includes Grades 6 through 8. Public school students in Grades 9 through 12 attend Maui High School in Kahului.

8. *Solid Waste*

Single-family residential solid waste collection service is provided by the County of Maui on a once-a-week basis. Residential solid waste collected by County crews are disposed at the County's 55-acre Central Maui Landfill located four miles southeast of the Kahului Airport. In addition to County-collected refuse, the Central Maui Landfill accepts commercial waste from private collection companies.

C. *INFRASTRUCTURE*

1. *Roadways*

Access to the Kihei-Makena region is provided by South Kihei Road and Piilani Highway. Wailea Ike Drive extends from Piilani Highway and serves as the main entrance into the Wailea Resort

area. This four-lane roadway intersects Wailea Alanui near the Wailea Shopping Village. Wailea Alanui is a four-lane divided road which carries traffic north-south through Wailea. This parkway intersects with Kaukahi Street approximately one mile south of its intersection with Wailea Ike Drive. Wailea Alanui joins with Makena Alanui and the Makena-Keoneoio Road.

Makena Alanui is an undivided road linking Wailea Alanui extending past the Makena Resort to an area south of Paako Point. The right-of-way width is 60 feet containing two (2) 12-foot wide travel lanes. The makai fork from Wailea Alanui becomes the Makena-Keoneoio Road which extends southward until vehicular access terminates near the Maui Prince Hotel. The right-of-way width along this segment of the Makena-Keoneoio Road varies. The old road becomes a pedestrian path for approximately 1,100 feet. At the southern terminus of the pedestrian path, Makena-Keoneoio Road resumes in the southerly direction.

Honoiki Street links Makena Alanui and the Makena-Keoneoio Road to the north of the Maui Prince Hotel. Honoiki Street contains two (2) 12-foot travel lanes within a 60-foot right-of-way.

2. ***Water***

The Kihei-Makena region is served by the County of Maui, Department of Water Supply's domestic water system. This system consists of a network of transmission and distribution lines and reservoirs. Waterline sizes range between eight (8) inches and twenty (20) inches. A 1.5 million gallon watertank is located at approximately 265 feet above sea level. Built by Makena Resort Corp. and turned over to the Department of Water Supply, the

water tank serves the Makena area.

3. ***Wastewater***

The developed portions of the Makena Resort are presently serviced by a private treatment plant located at the southwest corner of the Maui Prince Hotel site. The design capacity of the plant is 127,000 gallons per day. Daily flows to the plant range from 30,000 to 107,000 gallons per day.

A new private wastewater reclamation facility is being proposed at the mauka terminus of Driveway "D". The initial plant increment is proposed to accommodate an average daily flow of 700,000 gallons per day. Wastewater is proposed to be processed and reused for golf course irrigation purposes. Upon completion of the new facility, use of the existing treatment plant will be phased out.

Properties in the Wailea area and the Makena Surf Condominium are hooked up to the County wastewater collection and treatment system. The remainder of developed properties in the Makena area are served by cesspools and septic tanks.

4. ***Drainage***

The proposed project will affect five (5) wastewater areas. Watershed 1 is the northernmost watershed comprising 487 acres. Existing runoff is estimated to be 1,265 cfs. Watershed 2 is located just south of Watershed 1. It is approximately 220 acres in size with existing runoff estimated at 744 cfs.

Proceeding further south, Watershed 3 is approximately 946 acres in size with existing runoff of approximately 2,600 cfs.

Watershed 4 is located just south of Watershed 3. Watershed 4 is approximately 110 acres in size with estimated existing runoff of 1,210 cfs. Watershed 5 is the southernmost watershed with a size of approximately 110 acres and estimated runoff of 627 cfs. See Appendix B.

Storm flows from these watersheds generally run east to west via natural gullies and gulches. Existing culverts in Makena Alanui allow the flows to cross the road where they eventually sheet flow into the ocean.

5. ***Electrical and Telephone Systems***

Electrical and telephone service to the Makena region is provided by Maui Electric Company and GTE Hawaiian Telephone, respectively.

Chapter III

Potential Impacts and Mitigation Measures

III. POTENTIAL IMPACTS AND MITIGATION MEASURES

A. IMPACTS TO THE PHYSICAL ENVIRONMENT

1. Surrounding Uses

The proposed project will traverse lands which are within existing rights-of-way, already in use as a dirt maintenance road, or currently vacant. In this regard, impacts of roadway and utilities construction are not anticipated to adversely affect adjacent land uses. In the long term, the improvements will function as integral components of the transportation and utilities network which serve Makena Resort.

2. Flora and Fauna

There are no known habitats of rare, endangered or threatened species of flora and fauna located within the project limits. With regard to avifauna, the endemic and endangered Ae'o occasionally utilizes water features at the golf courses as a limited loafing and feeding habitat. However, the proposed project will not affect any open bodies of water and thus should not have an effect upon the Ae'o.

3. Air Quality

Air quality impacts attributed to the project will include dust generated by short-term construction-related activities. Site work, such as clearing, grubbing, grading, and utilities and roadway construction for example, will generate air-borne particulates. Dust control measures, such as regular watering and sprinkling, will be implemented to minimize wind blown emissions.

Once the project is completed, project-related vehicular traffic will generate automotive emissions. However, project-related

emissions are not expected to adversely impact local and regional ambient air quality conditions.

4. ***Noise***

Ambient noise conditions will be temporarily impacted by construction activities. Heavy construction equipment would be the dominant source of noise during construction. Construction activities will be limited to daylight working hours. The contractor will be required to comply with applicable State noise provisions.

Once completed, the project is not anticipated to adversely impact surrounding properties.

5. ***Scenic and Open Space Resources***

The proposed improvements are intended to service future development in accord with Makena Resort's master plan. In the context of existing and proposed uses, the roadway and utilities improvements do not conflict with visual or scenic resources. As part of the overall project scope, roadway shoulders will be grassed to ensure that the roadways do not detract from the surrounding visual character.

6. ***Archaeological Resources***

The applicant will work with the State Historic Preservation Division regarding appropriate monitoring requirements for work proposed along Makena Keoneoio Road. For the remainder of the project area, should cultural materials be found during construction, work shall cease in the area of the find and the State Historic Preservation Division shall be consulted to determine appropriate mitigation measures.

B. IMPACTS TO THE SOCIO-ECONOMIC ENVIRONMENT

1. Land Use and Community Character

The proposed improvements would be located within the Makena planned resort community. Existing uses include two (2) 18 hole golf courses, a tennis club and hotel use. Additional multi-family residential, single family residential, business, and hotel uses are proposed within the context of the master plan. The proposed improvements provide necessary infrastructure to proceed with development of the next phase of master plan implementation. In this regard, the proposed action will support and enhance land uses along and surrounding the project corridor.

2. Population and Local Economy

On a short-term basis, the proposed action will support construction and construction-related employment.

On a long-term basis, the project will provide roadway and utility related facilities provided in advance of implementation of abutting multi-family and single family residential development. Population impacts of the roadway and utility improvements should be negligible. It is noted that any impacts relating to the multi-family and single-family residential developments should be assessed in future applications for the respective residential projects.

3. Police, Fire and Medical Services

The proposed action will not increase demands placed upon police, fire, and medical services. In improving traffic circulation, the implementation of the project is anticipated to improve accessibility to the area by police, fire and emergency medical services.

4. Recreation

The proposed action will not result in any loss of existing recreation space nor increase demand upon existing recreation facilities. However, improvements in traffic circulation attributed to the project could indirectly increase accessibility to various recreational facilities in Makena.

5. Schools

The proposed action will not affect public schools in the Kihei area. Any educational impacts from the development of future multi-family and single-family residential development should be assessed at the time specific details are presented in future project-specific applications.

6. Solid Waste

A solid waste management plan will be developed in coordination with the Solid Waste Division of the County Department of Public Works and Waste Management for the disposal of clearing and grubbing material from the site during construction.

The completed project is not considered a direct solid waste generator.

C. IMPACTS TO INFRASTRUCTURE

1. Roadways

During roadway construction, at least one (1) lane of each operating roadway will remain open at all times with the temporary exception of the northern-most segment of construction on Makena Alanui. Because of work involving the placement of fill to elevate the mauka portion of the curve in the roadway, Makena Alanui is

required to be closed temporarily during the initial earthwork phase. After rough grades have been established, Makena Alanui may be open to vehicular traffic during periods of non-construction (i.e., nighttime, holidays, weekends). Detours during road closure will be through Makena Keoneoio Road and Honoiki Street.

In the long term, since roadway improvements to Makena Alanui, Honoiki Street, and Makena Keoneoio Road are being proposed in accordance with County standards in advance of development of abutting parcels, there is no adverse impact to traffic parameters. Service driveways (Driveway "C" and Driveway "D") are being constructed in order to access the proposed wastewater reclamation facility. As abutting properties are developed, these driveways should be upgraded to County roadway standards.

2. ***Water***

The installation of additional fire hydrants in accordance with County spacing requirements upgrades the existing water system in the area. No additional water system improvements are required to support development of Sites M-5, M-6 and S-7.

3. ***Wastewater***

Sewage collection system improvements proposed as part of this project are a portion of a new sewer system being installed as part of the Makena Resort master plan. The entire system will be upgraded as a result. Collection system improvements specifically service Sites M-5, M-6, S-7, and B-2 which currently have no service.

4. ***Drainage***

Proposed infrastructure improvements extend across five (5) watershed areas. Driveways "C" and "D" are located in Watersheds 3 and 4. Roadway improvements to Makena Alanui, Honoiki Street, and Makena Keoneoio Road stretch across all five (5) watersheds.

As a result of the proposed improvements there will be negligible increases in runoff in Watersheds 1 through 5. New catch basins are proposed to be installed in Driveways "C" and "D", in anticipation of future road widening and development. The drainage system for Driveways "C" and "D" will accommodate existing runoff flowing onto the roadway and flows from the roadway itself.

Along Makena Alanui, existing drainage crossings have been designed in accordance with the Makena Resort drainage master plan. Thus, no new drainage crossings are needed.

To accommodate existing flows from Watershed 3, an approximately 13 acre retention basin is proposed to the north of the proposed wastewater treatment facility. Further downstream at Makena Keoneoio Road, two (2) 16 feet wide by 5 feet high conspan culvert crossings are proposed. The culverts are proposed to accommodate the peak outflow rate from the retention basin plus the existing peak runoff rate from the watershed below the retention basin.

As properties are developed in the future, the Makena Resort's Drainage Master Plan (Muroda & Associates, Inc.) shall be used as

a guide. Additional drainage studies shall be done, as warranted, to avoid potential negative impacts.

Chapter IV

Relationship to Governmental Plans, Policies and Controls

IV. RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES AND CONTROLS

A. STATE LAND USE DISTRICTS

Chapter 205, Hawaii Revised Statutes, relating to the Land Use Commission (LUC), establishes four (4) major land use districts in which all lands in the State are placed. These districts are designated "Urban", "Rural", "Agricultural", and "Conservation". See Figure 10.

There are mauka portions of the Driveway "C", all of Driveway "D", the retention basin and a short segment of the Makena Keoneoio Road near Keawalai Church within the Agricultural District. Remaining portions of the project are within the Urban District. Roadways and utility improvements are permitted uses within the Urban and Agricultural Districts.

It is noted that the LUC recently approved an application from Makena Resort Corp. (LUC Docket No. A97-721) for a reclassification to the Urban District for six (6) Petition Areas. The public hearing was held on November 13, 1997 and the Land Use Commission decision was made on February 12, 1998.

B. MAUI COUNTY GENERAL PLAN

The Maui County General Plan (1990 Update) sets forth broad objectives and policies to help guide the long-range development of the County. As stated in the Maui County Charter, "(t)he purpose of the General Plan is to recognize and state the major problems and opportunities concerning the needs and the development of the County and the social, economic and environmental effects of such development and set forth the desired sequence, patterns and characteristics of future development".

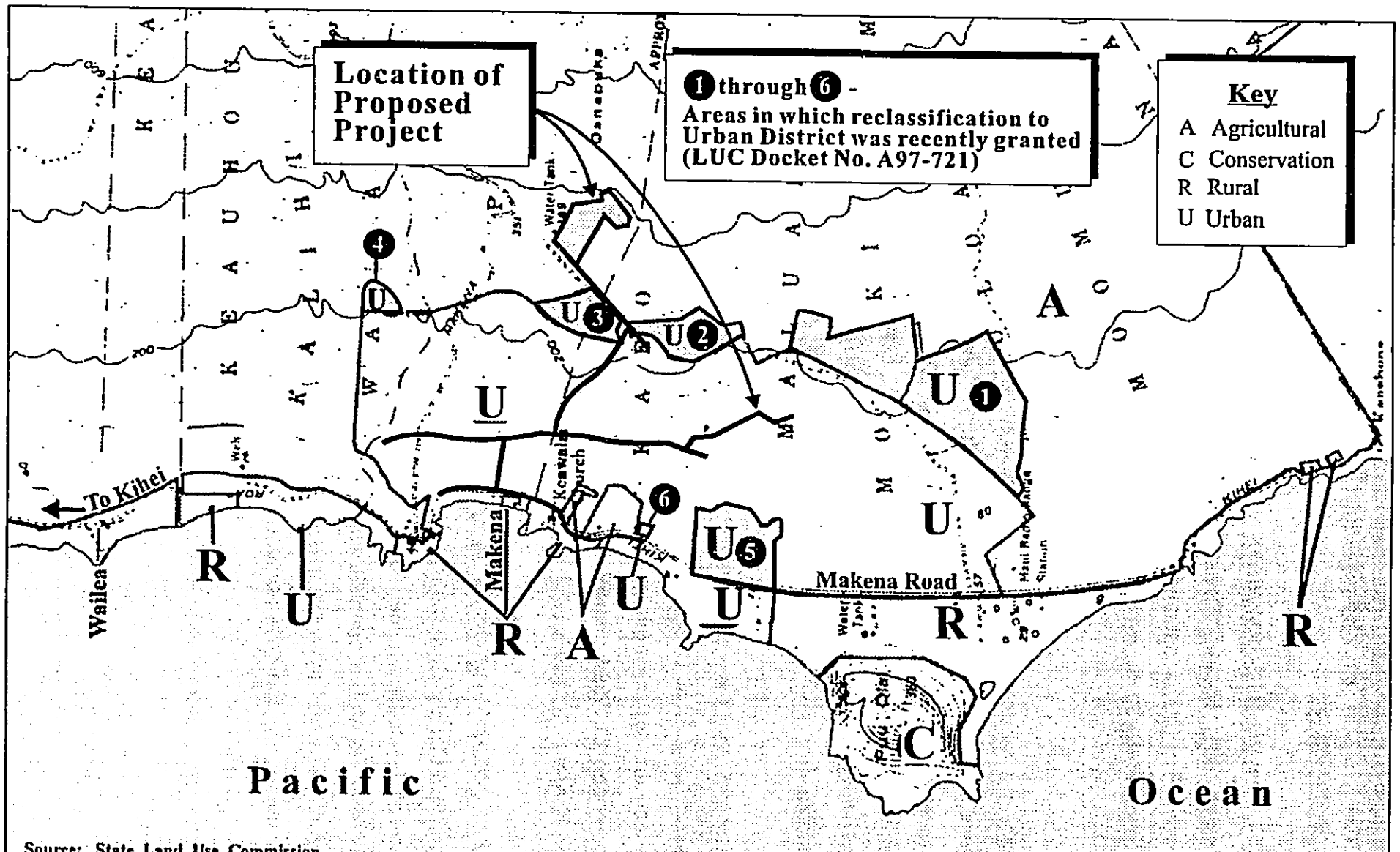


Figure 10

Makena Resort Roadway and Utility Infrastructure Improvements
State Land Use Classifications

1000 0 2000 4000 Feet

MUNEKIYO, ARAKAWA & HIRAGA, INC.

Prepared for: Makena Resort Corp.

The proposed action is in keeping with the following General Plan objectives and policies:

Objective: To develop a program for anticipating and enlarging the local street and highway systems in a timely response to planned growth.

Policy: Ensure that transportation facilities are anticipated and programmed for construction in order to support planned growth.

Objective: To provide an adequate supply of potable and irrigation water to meet the needs of Maui County's residents.

Policy: Develop improved systems to provide better fire protection.

Objective: To provide efficient, safe, and environmentally sound systems for the disposal and reuse of liquid and solid wastes.

Policy: Establish programs for the development of waste disposal systems which anticipate planned growth.

C. *KIHEI-MAKENA COMMUNITY PLAN*

The proposed improvements are located in the Kihei-Makena Community Plan region which is one (1) of nine (9) Community Plan regions established in the County of Maui. Planning for each region is guided by the respective Community Plans, which are designed to implement the Maui County General Plan. Each Community Plan contains recommendations and standards which guide the sequencing, patterns and characteristics of future development in the region.

The County of Maui is currently in the process of comprehensively updating each community plan. For the Kihei-Makena Community Plan, the process involves review by the Kihei-Makena Citizens Advisory

Committee (CAC), the Department of Planning, the Maui Planning Commission and the Maui County Council.

The Maui County Council recently enacted amendments to update the Kihei-Makena Community Plan. The Council has previously acted on the Hana, Kahoolawe, Paia-Haiku, West Maui and Makawao-Pukalani-Kula Community Plans.

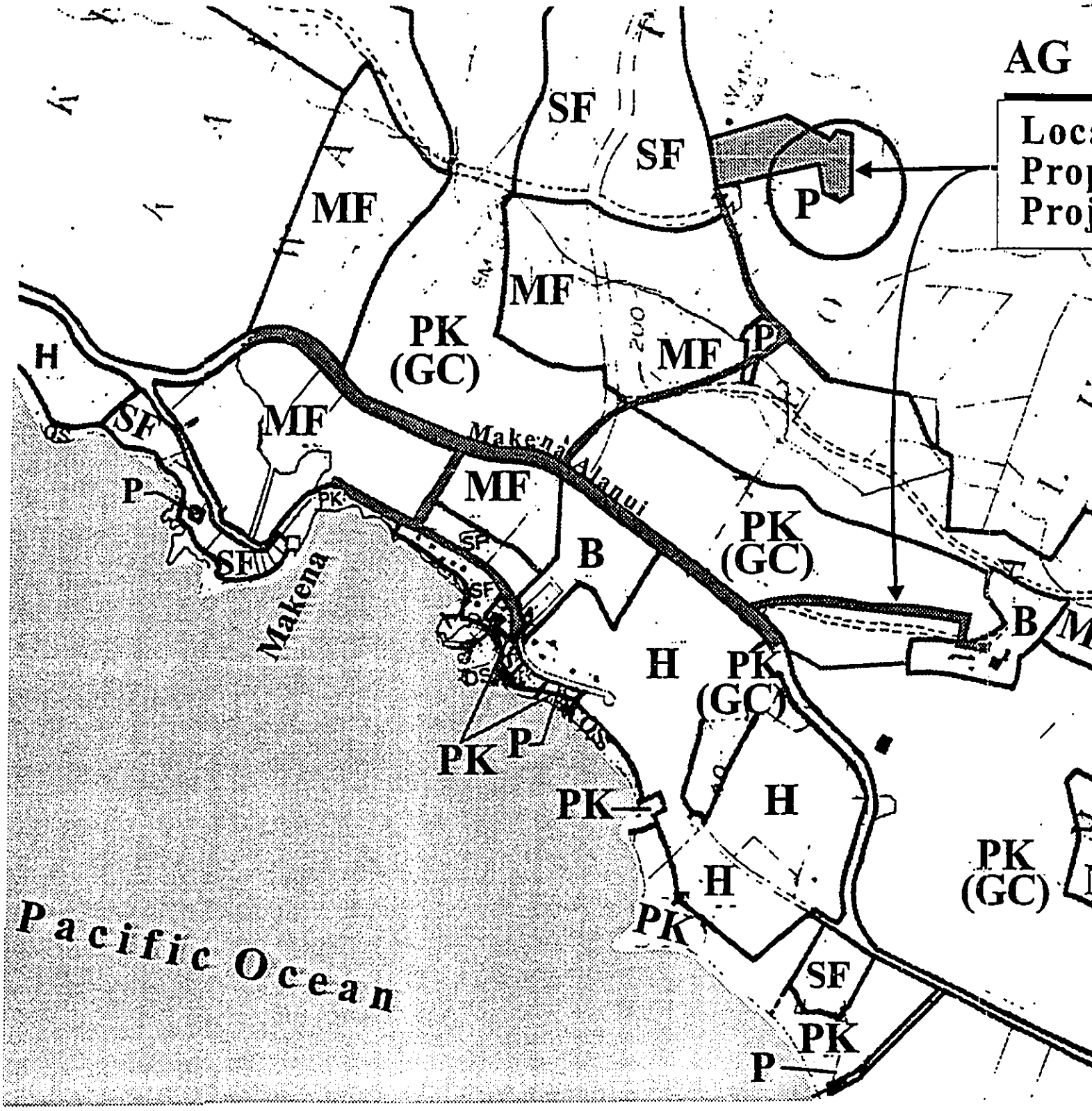
The proposed roadway and infrastructure improvements support the land use designations included in the Kihei-Makena Community Plan. See Figure 11.

D. ZONING

Ordinance No. 832 establishes zoning for the Makena area. Most of the project area falls within a variety of zoning districts including the R-1 Residential District, A-2 Apartment District, Golf Course and Open Space, and Resort Commercial District. Mauka portions of Driveway "C", all of Driveway "D" and the retention basin are within the County Agricultural District. The proposed roadway and utility infrastructure improvements are not inconsistent with the zoning. However, where necessary, appropriate zoning is intended to be sought to implement desired land uses in the Makena Resort master plan.

E. SPECIAL MANAGEMENT AREAS

The County Special Management Area (SMA) boundary encompasses most of the project area. See Figure 12. Pursuant to Chapter 205A, Hawaii Revised Statutes, and the Rules and Regulations of the Maui Planning Commission, projects located within the SMA are evaluated with respect to SMA objectives, policies and guidelines. This section addresses the project's relationship to applicable coastal zone

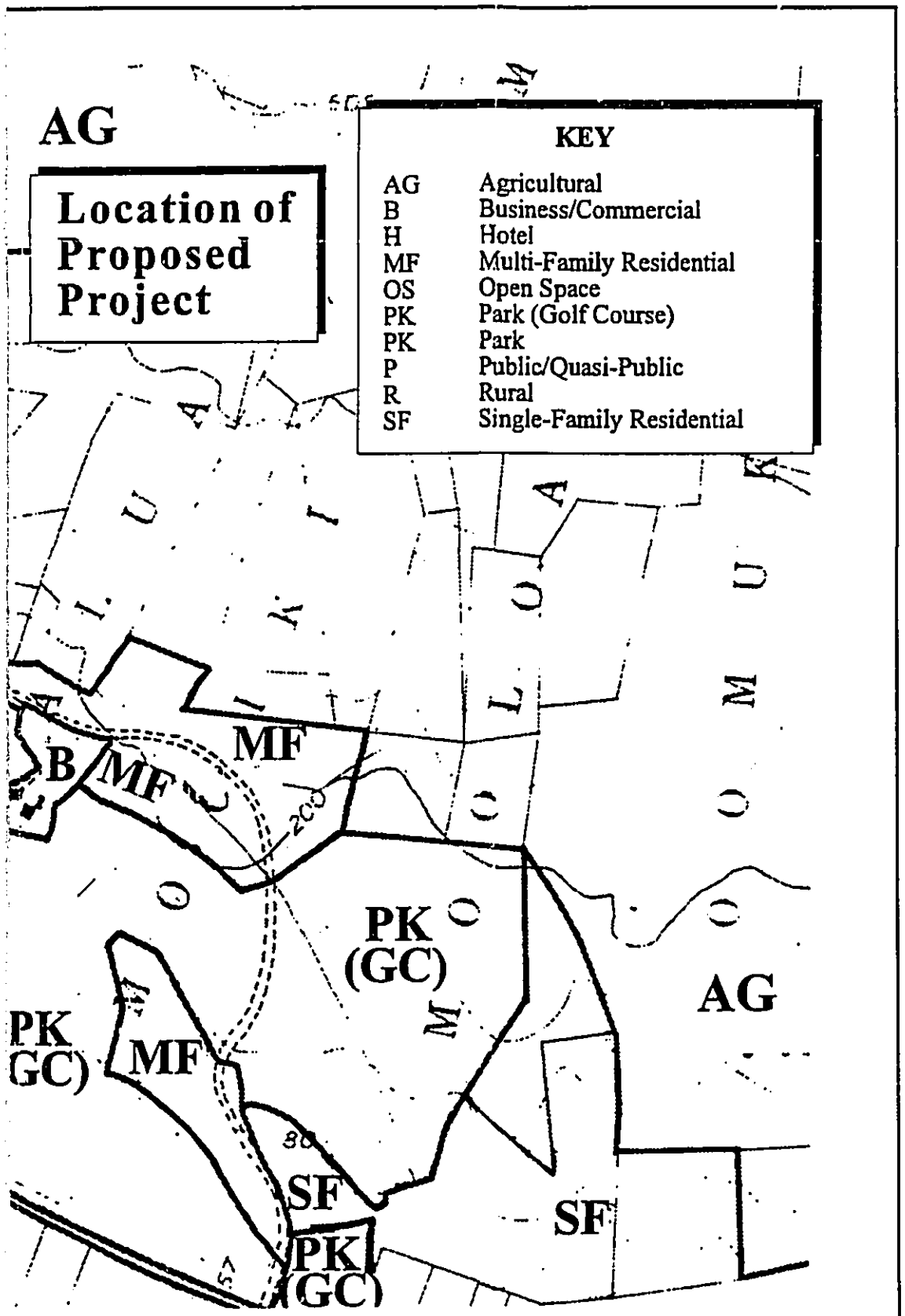


Source: County of Maui, Planning Department

Figure 11

Makena Resort Roadway
Utility Infrastructure Impro
Kihei-Makena Community Plan La

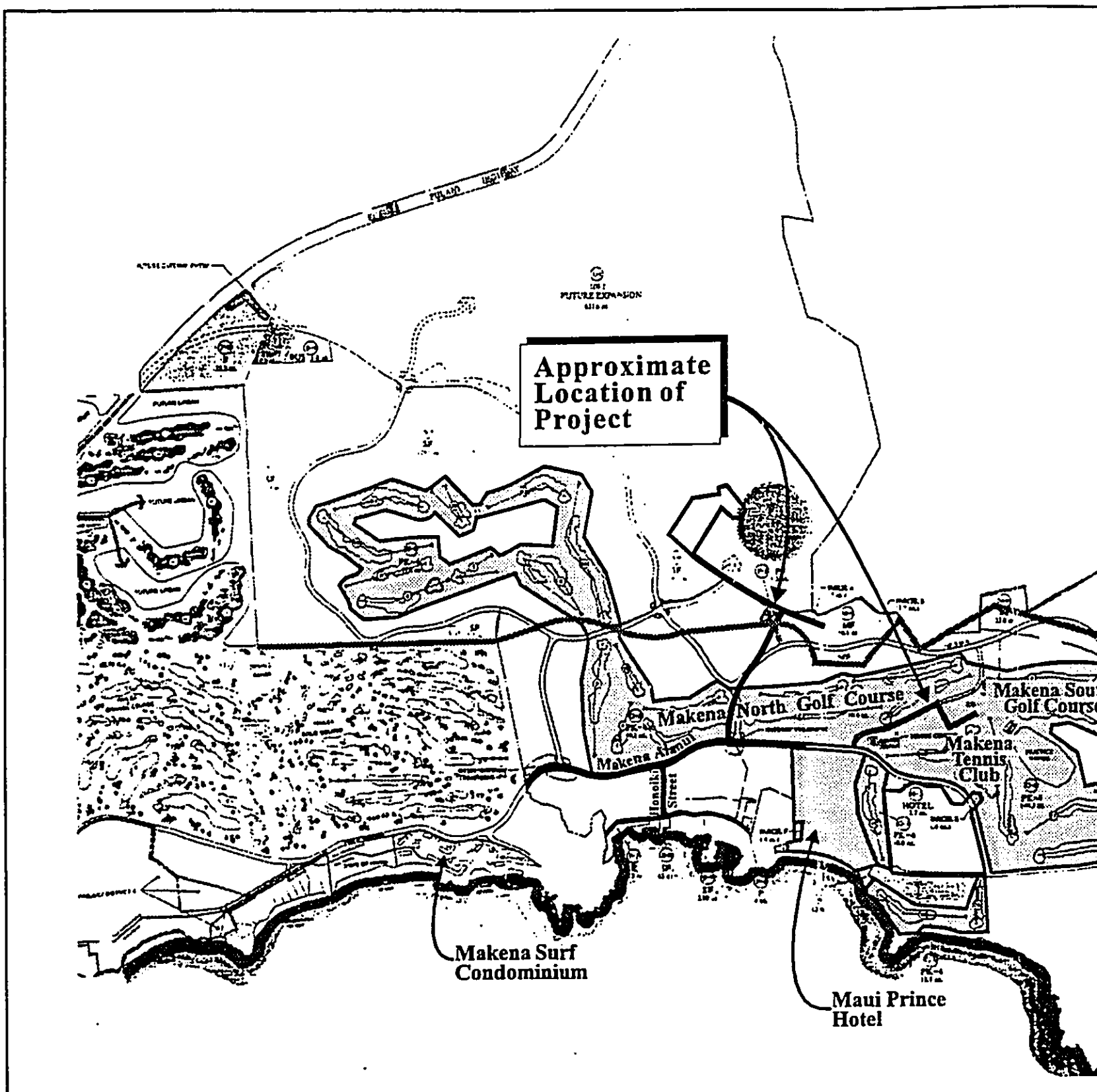
Prepared for: Makena Resort Corp.



oadway and
Improvements
Plan Land Use Map

MUNEKIYO, ARAKAWA & HIRAGA, INC.

0 500 1000 2000 Feet

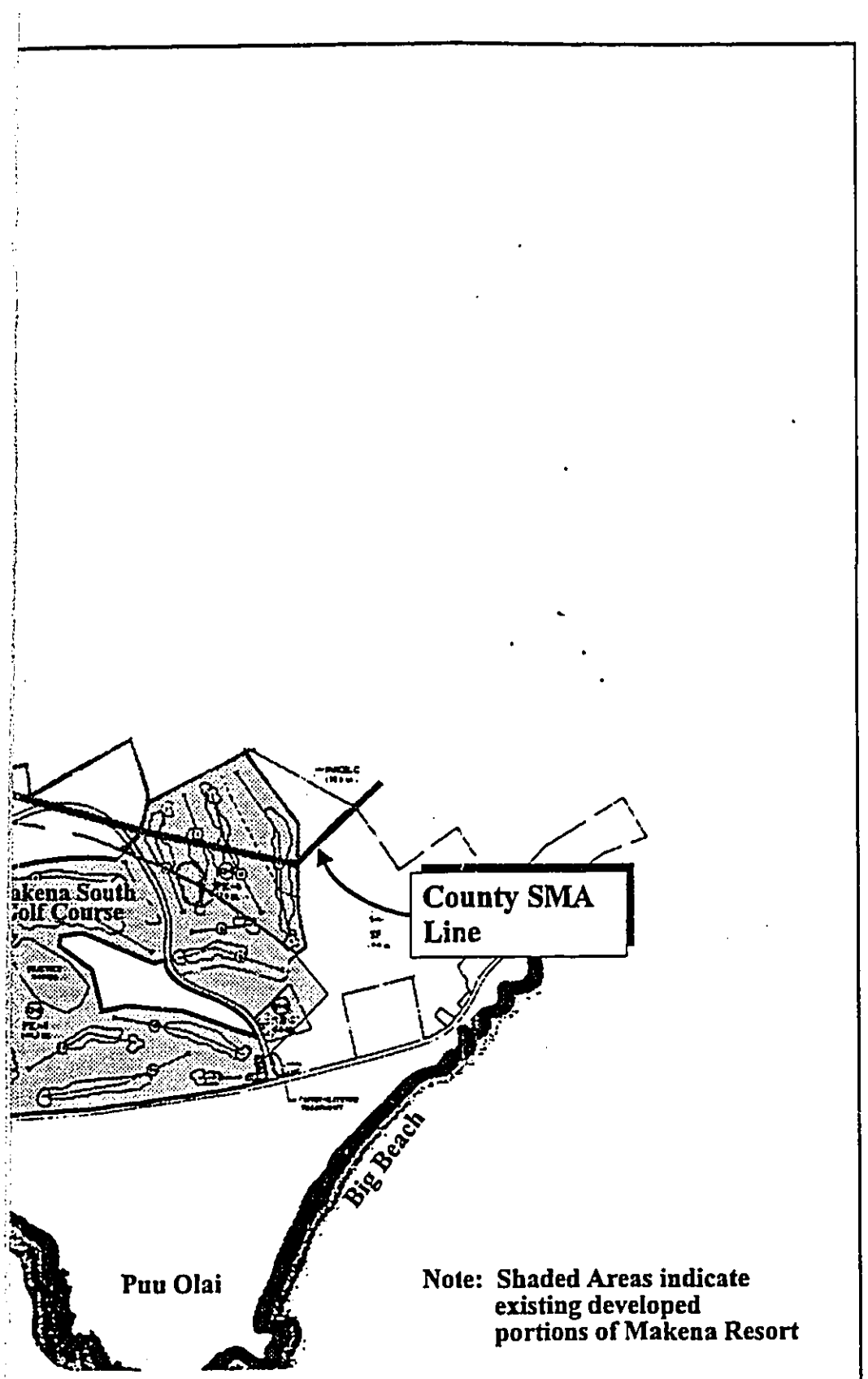


Source: PBR Hawaii

Figure 12

Makena Resort Roadway an
Infrastructure Improvem
County SMA Line

Prepared for: Makena Resort Corp.



Note: Shaded Areas indicate existing developed portions of Makena Resort

ay and Utility
rovements
Line

MUNEKIYO, ARAKAWA & HIRAGA, INC.

NOT TO SCALE

management considerations, as set forth in Chapter 205A and the Rules and Regulations of the Maui Planning Commission.

(1) ***Recreational Resources***

Objective:

Provide coastal recreational opportunities accessible to the public.

Policies:

(A) Improve coordination and funding of coastal recreational planning and management; and

(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

(ii) Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the state for recreation when replacement is not feasible or desirable;

(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

(v) Ensuring public recreational use of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

(vi) Adopting water quality standards and regulating point and non-point sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial

beaches, and artificial reefs for surfing and fishing; and

(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, county planning commissions; and crediting such dedication against the requirements of Section 46-6, HRS.

Response: The proposed project is not anticipated to affect existing coastal or inland recreational resources. However, accessibility to these resources may be indirectly improved as a result of the project.

(2) ***Historic Resources***

Objective:

Protect, preserve and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

(A) Identify and analyze significant archeological resources;
(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and
(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

Response: The project area has been included in previous archaeological studies and major portions have been previously disturbed. Should any cultural materials be found during construction, work will stop in the vicinity and the State Historic Preservation Division will be consulted to determine appropriate mitigation measures.

(3) ***Scenic and Open Space Resources***

Objective:

Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

(A) Identify valued scenic resources in the coastal zone management area;

(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

(C) *Preserve, maintain,* and, where desirable, improve and restore shoreline open space and scenic resources; and

(D) Encourage those developments which are not coastal dependent to locate in inland areas.

Response: The proposed roadway and infrastructure improvements will not impact coastal scenic and open space resources. Furthermore, the project will not affect public views to and along the shoreline.

(4) ***Coastal Ecosystems***

Objective:

Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

(A) Improve the technical basis for natural resource management;

(B) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;

(C) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

(D) Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards.

Response: Improvements to the subject property are not expected to adversely impact coastal ecosystems. Erosion control measures will be implemented during construction to ensure that coastal ecosystems are not impacted.

(5) Economic Uses

Objective:

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

(A) Concentrate coastal dependent development in appropriate areas;

(B) Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

(C) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

(i) Use of presently designated locations is not feasible;
(ii) Adverse environmental effects are minimized; and
(iii) The development is important to the State's economy.

Response: The project would have a beneficial short-term impact on the local economy during construction. In the long term, the proposed project serves to improve local transportation and utility

infrastructure in the Makena area. This would aid in maintaining and enhancing the region's long term economic stability.

(6) ***Coastal Hazards***

Objective:

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence and pollution.

Policies:

(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;

(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint pollution hazards;

(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program;

(D) Prevent coastal flooding from inland projects; and

(E) Develop a coastal point and nonpoint source pollution control program.

Response: Erosion control measures will be incorporated during the construction period to minimize soil loss and erosion hazards. All drainage improvements will conform to County standards. No adverse drainage impacts to downstream properties should result from the project.

(7) ***Managing Development***

Objective:

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

(A) Use, implement, and enforce existing law effectively to

the maximum extent possible in managing present and future coastal zone development;

(B) Facilitate timely processing of applications for development permits and resolve overlapping of conflicting permit requirements; and

(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life-cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

Response: In compliance with the Special Management Area Rules and Regulations of the County of Maui, required documentation will be filed with the County of Maui Planning Department and will undergo public hearing and decision by the Maui Planning Commission.

(8) Public Participation

Objective:

Stimulate public awareness, education, and participation in coastal management.

Policies:

(A) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management program;

(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal-related issues, developments, and government activities; and

(C) Organize workshops, policy dialogues, and site-specific medications to respond to coastal issues and conflicts.

Response: A public hearing is required as part of the County's SMA process. The proposed project is not contrary to the objective of public awareness, education and participation.

(9) ***Beach Protection***

Objective:

Protect beaches for public use and recreation.

Policies:

(A) Locate new structures inland from the shoreline setback to conserve open space and to minimize loss of improvements due to erosion;

(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and

(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

Response: The proposed improvements extend from Makena Keoneoio Road which extends parallel to the shoreline up to the new retention basin which is approximately 4,700 feet from the shoreline at its mauka terminus. Proposed improvements will not adversely impact any beaches in the vicinity.

(10) ***Marine Resources***

Objective:

Implement the State's ocean resources management plan.

Policies:

(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

(B) Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;

(C) Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency;

(D) Assert and articulate the interests of the State as a partner with federal agencies in the sound management

of ocean resources within the United States exclusive economic zone;

(E) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and

(F) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Response: The proposed action is not anticipated to adversely impact marine resources in the Makena area.

Chapter V

Summary of Adverse Environmental Effects Which Cannot Be Avoided

V. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The proposed project will result in unavoidable construction-related impacts as described in Chapter III, Potential Impacts and Mitigation Measures.

Potential effects include noise-generated impacts occurring from site preparation and construction activities. In addition, there may be temporary air quality impacts associated with dust generated from construction activities, and exhaust emissions discharged by construction equipment. Traffic inconveniences due to construction-related activities are also a potential effect.

The proposed project is not anticipated to create any long term adverse environmental effects.

Chapter VI

Alternatives Analysis

VI. ALTERNATIVES ANALYSIS

A. ALTERNATIVE A

Alternative A represents the "no build" alternative. As Makena Resort moves to implement its master plan, roadway and infrastructure improvements will be needed to service future development. The project proposes to implement improvements to Makena Alanui, Honoiki Street, and Makena Keoneoio Road in advance of development of abutting parcels. Should roadway improvements not be built as part of this project, it would normally be required when development of abutting parcels are proposed. Retention basin and culvert improvements are also being done in advance of proposed development.

Driveways "C" and "D" service the proposed wastewater reclamation facility. Since the wastewater reclamation facility pump stations and force mains are part of a separate application, the "no build" alternative would require the use of an existing dirt road for access to the wastewater reclamation facility. Similarly, the sewerline adjacent to the golf course is part of a system which feeds into the new wastewater reclamation facility. The "no build" alternative would then require continued usage of the existing settlement pond on the south side of the Maui Prince Hotel.

In total, the "no build" alternative does not upgrade existing facilities and does not adequately plan for a coordinated implementation of the Makena Resort master plan.

B. ALTERNATIVE B

Alternative B represents the proposed action. Proposed improvements to Makena Alanui, Honoiki Street, and Makena Keoneoio Road will upgrade the existing roadways and infrastructure to County standards along frontage which abuts property owned by affiliates of Makena Resort Corp.

Upon completion, these improvements would be within the roadway rights-of-way and would be a benefit to the general public as well as patrons of Makena Resort. The new retention basin and culvert crossings also upgrade the drainage system. New service roads and sewerlines are part of an upgrade to the wastewater treatment and disposal system.

The proposed action upgrades infrastructure in the area in a coordinated fashion generally in advance of future development which can be considered beneficial from a planning standpoint.

Chapter VII

Irreversible and Irretrievable Commitments of Resources

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed project will result in the loss of approximately 4.8 acres of land for the development of Driveways "C" and "D". Widening along Makena Keoneoio Road would require approximately 0.27 acre of land. The retention basin located adjacent to the wastewater treatment facility would occupy approximately 13 acres. While the loss of these lands are considered irretrievable, it is noted that portions of the proposed Driveway "C" and Driveway "D" corridor are already in use as a dirt road. Moreover, roadways would be needed to provide transportation related amenities for uses proposed in the Makena Resort master plan. Retention basin and culvert improvements provide public health and safety benefits.

No other irreversible and irretrievable commitments of resources have been identified in connection with the proposed action.

Chapter VIII

Findings and Conclusions

VIII. FINDINGS AND CONCLUSIONS

Every phase of the proposed land use amendments has been evaluated in accordance with the Significance Criteria of Section 11-200-12 of the Administrative Rules. Based on the analysis, the proposed land use amendments will not result in any significant impacts. Discussion of project conformance to the criteria is noted as follows:

1. ***No irrevocable commitment to the loss or destruction of any natural or cultural resource would occur as a result of the proposed project***

   The proposed action will not displace unique or endangered habitats of flora, fauna or avifauna. The project site has been previously studied in archaeological reports and most of the ground surface has been already disturbed. Should cultural materials be uncovered during construction, the applicant will comply with applicable provisions of Chapter 6E, HRS.

2. ***The proposed project would not curtail the range of beneficial uses of the environment***

   The project would not have an effect on the beneficial uses of the environment. Most of the project site is already within rights-of-way or in use as a dirt road.

3. ***The proposed action does not conflict with the State's long-term environmental policies or goals or guidelines as expressed in Chapter 344, Hawaii Revised Statutes***

   The State Environmental Policy and Guidelines are set forth in Chapter 344, Hawaii Revised Statutes. The proposed project is in consonance with the following policies and guidelines:

   Environmental Policy

   Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian.

Guidelines:

Transportation:

(a) Encourage transportation systems in harmony with the lifestyle of the people and environment of the State.

4. ***The economic or social welfare of the community or state would not be substantially affected***

The project would directly benefit the local economy during construction. In the long term, the project should have an indirect beneficial effect since the enhanced circulation system should benefit hotel and other future land uses noted in the Kihei-Makena Community Plan.

5. ***The proposed action does not affect public health***

Impacts to the public's health and welfare are not anticipated as a result of the proposed project.

6. ***No substantial secondary impacts, such as population changes or effects on public facilities, are anticipated***

The proposed action is not anticipated to significantly affect population and public service parameters. In terms of infrastructure, the project involves the upgrade of these systems servicing the Makena Resort.

7. ***No substantial degradation of environmental quality is anticipated***

No substantial degradation of environmental quality is anticipated as a result of the project. The project upgrades infrastructure in the Makena area providing enhanced services to existing and future residents and patrons.

8. ***The proposed action does not involve a commitment to larger actions, nor would cumulative impacts result in considerable effects on the environment***

The proposed project represents an incremental implementation of the Makena Resort Master Plan. The Seibu Makena Master Plan Environmental Impact Statement was accepted by the Maui Planning Commission in 1975. Although details of the master plan have evolved over time, the proposed action is still within the context of the original master plan document.

9. ***No rare, threatened or endangered species or their habitats would be adversely affected by the proposed action***

There are no rare, threatened or endangered species of flora or fauna or their habitats which would be adversely affected by the proposed action.

10. ***Air quality, water quality or ambient noise levels would not be detrimentally affected by the proposed project***

The implementation of the action is expected to result in short-term inconveniences due to construction-related activities. These include air quality and noise impacts. Dust control measures, such as watering and sprinkling, will be undertaken to minimize dust. Construction activities are anticipated to be limited to daylight hours.

In the long term, the proposed land use amendments are not anticipated to have a significant impact on air quality, water quality or noise parameters.

11. ***The proposed project would not affect environmentally sensitive areas, such as flood plains, tsunami zone, beach, erosion-prone areas, geologically hazardous lands, estuaries, fresh waters or coastal waters***

The subject properties would not adversely affect environmentally

sensitive areas. The properties are not subject to flooding or tsunami inundation and the underlying soils are not erosion-prone. Appropriate erosion control measures to be implemented in accordance to County standards are proposed as part of the project. No adverse drainage impacts to downstream properties or coastal waters are anticipated.

12. ***The proposed project does not substantially affect scenic vistas and viewplanes identified in County or State plans or studies***

The proposed project involves roadway and utility infrastructure improvements which occur generally at or below grade.

13. ***The proposed project requires substantial energy consumption***

The proposed action consists of roadway and infrastructure improvements which do not require substantial energy consumption.

Based on the foregoing findings, it is concluded that the proposed action will not result in any significant impacts.

Chapter IX

Agencies/Organizations Contacted Prior to the Preparation of the Draft Environmental Assessment and Responses Received

IX. AGENCIES/ORGANIZATIONS CONTACTED PRIOR TO THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT AND RESPONSES RECEIVED

1. Neal Fujiwara, Soil Conservationist
Natural Resources Conservation Service
U.S. Department of Agriculture
210 Imi Kala Street, Suite 209
Wailuku, Hawaii 96793-2100

2. Lolly Silva
Department of the Army
U.S. Army Engineer District, Hnl.
Attn: Operations Division
Bldg. T-1, Room 105
Fort Shafter, Hawaii 96858-5440

3. Brooks Harper
U. S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

4. Rick Egged, Director
State of Hawaii
Office of Planning
Department of Business, Economic, Development and Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

5. Herbert Matsubayashi
District Environmental Health Program Chief
State of Hawaii
Department of Health
54 High Street
Wailuku, Hawaii 96793

6. Michael Wilson, Director
State of Hawaii
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

7. Don Hibbard
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

8. Robert Siarot, Maui District Engineer
State of Hawaii
Department of Transportation
Highways Division
650 Palapala Drive
Kahului, Hawaii 96732

9. Ronald Davis, Chief
County of Maui
Department of Fire Control
200 Dairy Road
Kahului, Hawaii 96732

10. David W. Blane, Director
County of Maui
Department of Planning
250 South High Street
Wailuku, Hawaii 96793

11. Howard Tagomori, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

12. Charles Jencks, Director
County of Maui
Department of Public Works and Waste Management
200 South High Street
Wailuku, Hawaii 96793

13. David Craddick, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawaii 96793

14. Maui Electric Company, Ltd.
P. O. Box 398
Kahului, Hawaii 96732

15. Mr. Rudy Luuwai
Makena Homeowners Association
5100 Makena Road
Kihei, Hawaii 96753

16. Keauhou O Honuaula, Inc.
2087 Wells Street
0Wailuku, Hawaii 96793

APR 1 3 1998

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
P.O. BOX 1109
WAILUKU, MAUI, HAWAII 96793-7109
Telephone (808) 243-7816 • Fax (808) 243-7833

April 9, 1998

Mr. Milton Arakawa, Project Manager
Munekiyo, Arakawa & Hiraga, Inc.
305 South High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Re: Makena Resort Roadway and Utility Infrastructure Improvements

Dear Mr. Arakawa,

Thank you for the opportunity to provide comments in preparation of the environmental assessment (EA).

Water Source

The applicants should be made aware that water for planned future development projects will be deducted from the Central Maui Joint Venture allocation, if any remains.

The applicants should understand the potential long-term water supply limitations of the project area. This project area is served by the Central Maui System. The major source of water for this system is the Iao Aquifer. Rolling annual average groundwater withdrawals from the Iao Aquifer as of April 1, 1998 were 19.25 MGD. The regulatory sustainable yield of this aquifer is 20 MGD. On August 13, 1997, the State Commission on Water Resource Management (CWRM) elected not to designate Iao Aquifer as a State Groundwater Management Area. However, if rolling annual average withdrawals exceed 20 mgd, CWRM will designate Iao Aquifer. The Department is implementing a plan to mitigate withdrawals. No moratorium is currently in effect. Nevertheless, the applicants should be made aware that the timing of future developments may be affected with possible delays until new sources can be brought on line. No guarantee of water for this project or future development is granted or implied as a result of these comments. Water availability will be reviewed at the time of application for meter or meter reservation.

Water System

We have included a portion of our water system map pertaining to the project area. Areas of infrastructure improvement are delineated. The applicants should note that there are several important lines in and around the roadway improvement area. The applicants should coordinate with our engineering division to insure that improvements will minimize water service disruption and that planned water system improvements will be adequate for planned future development. Actual fire demand for future projects will be determined by BWS-approved fire flow calculations performed by a certified engineer.

Water Quality

The Department of Water Supply strives to protect the integrity of both surface water and groundwater resources by encouraging applicants to adopt best management practices (BMPs) relevant to potentially polluting project activities. We encourage the applicants to build BMPs into the design and implementation of the roadway and infrastructure improvements. There are many BMP references available. We have attached sample BMP for road construction and a reference list of BMP resources. Additional information can be obtained from the State Department of Health Environmental Planning Office (EPO) at (808) 586-4337:

Conservation

If the roadway and infrastructure improvements will require replanting and landscaping along roadsides and/or median strips, the applicant should refer to the attached documents and consider these measures:

Use Climate-adapted Plants: The project site is located in "Maui County Planting Plan" - Plant Zones 3 and 5. We encourage the applicants to consider using climate-adapted and salt-tolerant native plants. Please refer to the "Maui County Planting Plan" and to the attached documents. Native plants adapted to the area, conserve water and further protect the watershed from degradation due to invasive alien species.

Prevent Over-Watering By Automated Systems: Provide rain-sensors on all automated irrigation controllers. Check and reset controllers at least once a month to reflect the monthly changes in evapotranspiration rates at the site. As an alternative, provide the more automated, soil-moisture sensors on controllers.

If you have any other questions or need additional information, please don't hesitate to call our Water Resources and Planning Division at (808) 243-7199.

Sincerely,

David Craddick
Director

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attachments:

"Some of Maui's Native and Polynesian Plants"
"Hawaiian Alien Plant Studies - Pest Plants of Native Hawaiian Ecosystems"
"XERISCAPE - Water Conservation through Creative Landscaping"
Selected BMPs from "Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters.", U.S. EPA.
References for Further Reading from "The Megamanual - Nonpoint Source Management Manual." Commonwealth of Massachusetts

APR 0 1 1998

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

REPLY TO
ATTENTION OF

March 25, 1998

Operations Branch

Mr. Milton Arakawa
Munekiyo, Arakawa & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

This is in regard to your letter of January 28, 1998 requesting comments on the proposed construction of roadway and utility infrastructure improvements in Makena, Maui, Hawaii. Based on the information you provided, I have determined that the project will not impact waters of the U.S., including wetlands, and will not require a Department of the Army permit.

If you have any questions concerning this determination, please contact Mr. Peter Galloway of my staff at 438-9258, extension 15. Please refer to File No. 980000100.

Sincerely,

George P. Young, P.E.
Chief, Operations Branch

MAR 0 9 1998

LINDA LINGLE
Mayor

CHARLES JENCKS
Director

DAVID C. GOODE
Deputy Director

Telephone: (808) 243-7845
Fax: (808) 243-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration

EASSIE MILLER, P.E.
Wastewater Reclamation Division

LLOYD P.C.W. LEE, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

Solid Waste Division

March 4, 1998

Mr. Milton Arakawa
Munekiyo , Arakawa & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

SUBJECT: EARLY CONSULTATION
RESORT ROADWAY AND UTILITY INFRASTRUCTURE IMPROVEMENTS

We reviewed the subject submittal and have the following comments.

1. Road widening improvements shall be provided for the adjoining halves of Makena Alanui to provide for future 68 foot wide right-of-way and improved to County standards to include, but not be limited to, pavement widening, construction of curb, gutter and sidewalk, street lights, and relocation of utilities underground. Said improvements shall be dedicated to the County upon completion of the construction. An additional 8 foot road widening strip is required to provide bike lanes per Maui Bikeway Plan.

2. All structures, such as walls, trees, etc., shall be removed or relocated from the road widening strip. The rear boundaries of the road widening strip shall be clearly marked to determine if said structures have been properly removed and relocated.

3. A 30 foot radii shall be provided at all the intersections of the proposed subdivision road/driveway and the adjoining Makena Alanui.

4. A detailed and final drainage report and a Best Management Practices Plan (BMP) will be required to be submitted and approved with the grading plans prior to approval of development. The drainage report should include hydrologic and hydraulic calculations and the schemes

for disposal of runoff waters. It must comply with the provisions of the "Rules for Design of Storm Drainage Facilities in the County of Maui" and should provide verification that the grading and runoff water generated by the project will not have an adverse effect on adjacent and downstream properties. The BMP plan shall show the location and details of structural and non-structural measures to control erosion and sedimentation tc the maximum extent practicable.

5. All existing features, such as, structures, driveways, drainageways, edge of pavement, etc. shall be shown on the project site plans.

6. A site plan and a "sight distance" report to determine required sight distance and available sight distance at existing and proposed street intersections shall be provided for our review and approval.

7. The 100-year flood inundation limits, if applicable, shall be shown on the project site plans.

8. The construction plans for all proposed roadway improvements and that for new roadway construction shall be submitted for review and approval.

If you have any questions, please contact David Goode at 243-7845.

Sincerely,

for CHARLES JENCKS
Director of Public Works
and Waste Management

DG:co/mt
S:\LUCA\CZM\MAKENA.

MUNEKIYO, ARAKAWA & HIRAGA, INC.

June 1, 1998

Charles Jencks, Director
Department of Public Works and
Waste Management
County of Maui
200 South High Street
Wailuku, Hawaii 96793

SUBJECT: Makena Resort Roadway and Utility Infrastructure Improvements

Dear Mr. Jencks:

Thank you for your letter of March 4, 1998 pertaining to the subject project. In coordination with the applicant, Makena Resort Corp. and the project civil engineer, Sato & Associates, Inc., the Department's comments have been considered and analyzed. Our response to your concerns are as follows:

1. Regarding the issue of Makena Alanui widening improvements, representatives of Sato & Associates, Inc. have met with the Engineering Division. Based on that meeting of March 30, 1998, it was felt that widening of the existing 60-feet wide right-of-way would not be needed at this time. The existing 60-feet wide right-of-way could accommodate needed travel, turning and bike lanes. A typical section is attached.

   It should be noted that sidewalks will be 6-feet wide and constructed on the project side of the roadway. This would apply to Makena Alanui as well as improvements to Honoiki Street and Makena Keoneoio Road.

2. Road widening is proposed along Makena Keoneoio Road. All structures will be removed from the road widening strip. The rear boundary will be marked to assist in determining if structures have been properly removed from the road widening strip. It is noted that no road widening is proposed on Makena Alanui and Honoiki Street.

3. A 30-feet radius will be provided for all intersections and driveways within the scope of the project.

4. A final detailed drainage report and best management plan (BMP) will be submitted with the grading plans. The drainage report will include hydrologic and hydraulic calculations for improvements to the roadway system. The drainage report will comply with the provisions of the "Rules for Design of Storm Drainage Facilities in the County of Maui". The report will include provisions showing that the improvements will not have an adverse impact on adjacent and downstream properties. The BMP will show locations and details of structural and/or non-structural measures to control sedimentation and erosion.

5. The construction plans will show existing features such as driveways, structures, drainageways and edge of pavement.

6. A site plan and "sight distance" report for proposed intersections and driveways will be submitted for review and approval.

7. The 100 year flood inundation limits will be reflected on the project site plans pursuant to the effective flood insurance rate map.

8. Construction plans for the proposed improvements will be submitted to the required agencies for their review and approval.

If you have any questions or comments, please feel free to call me. Thank you for your consideration.

Very truly yours,

Milton Arakawa, Project Manager

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Attachment
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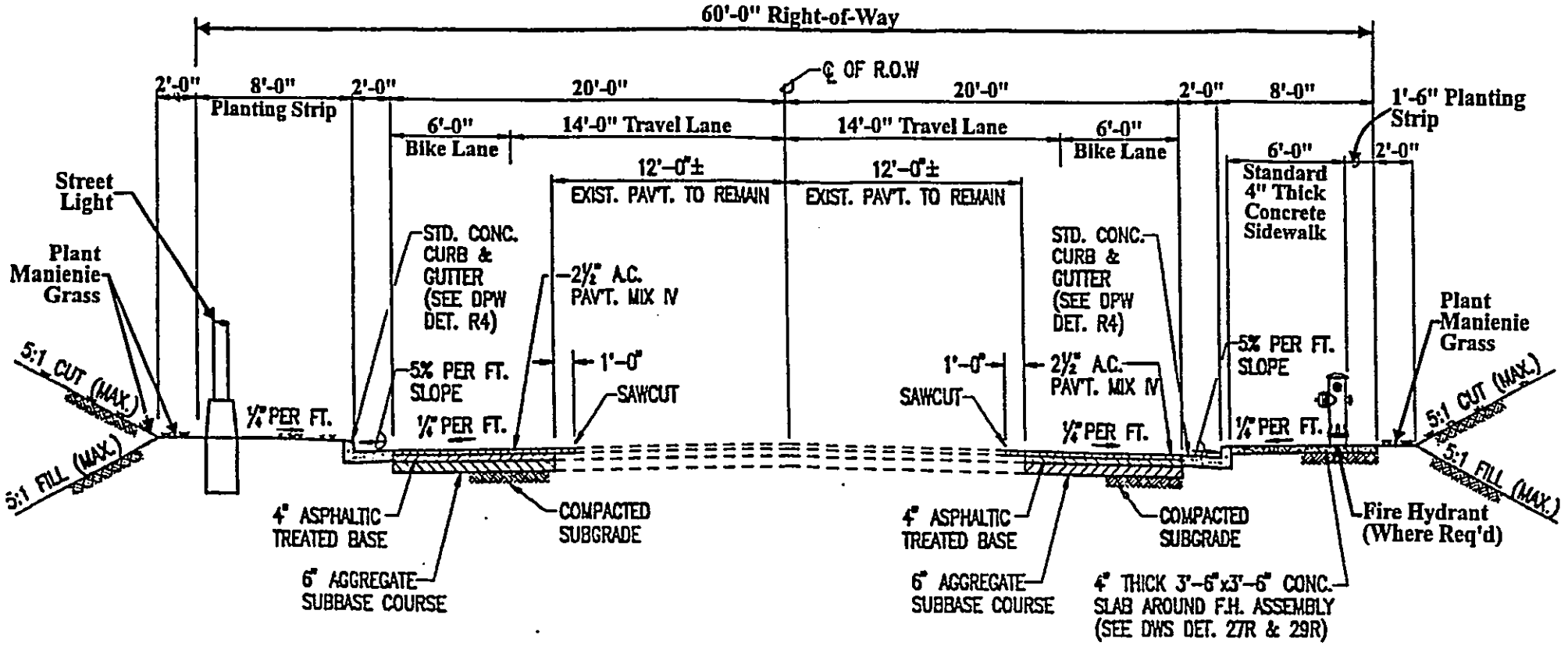

Source: Sato & Associates, Inc.

Figure 4 Makena Resort Roadway and Utility Infrastructure Improvements
Typical Section for 60 Feet Wide Right-of-Way

Prepared for: Makena Resort Corp.

NOT TO SCALE

LINDA LINGLE
MAYOR

OUR REFERENCE

YOUR REFERENCE RN:ac

POLICE DEPARTMENT
COUNTY OF MAUI

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

HOWARD H. TAGOMORI
CHIEF OF POLICE

THOMAS PHILLIPS
DEPUTY CHIEF OF POLICE

February 18, 1998

Mr. Milton Arakawa, Project Manager
Munekiyo, Arakawa & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

Subject: Makena Resort Roadway and Utility Infrastructure Improvements

We have received your letter of January 28, 1998 and reviewed your summary for the above project. The following are our concerns:

1. Ingress/egress to areas south of the proposed improvements not be prohibited to residents and the public without prior notification and/or plans to mitigate the situation.

2. Traffic control during periods of construction be planned and adequate to ensure the safety of the public utilizing the roadway.

3. Dust and noise control measures be implemented to preserve the ambiance of the area and to areas where construction equipment may travel.

4. During any interim period that roadways are not dedicated to the County of Maui and/or roadways that will remain private but accessible to the public, assurances be made to provide police "right of access" and "enforcement" of State and County traffic laws.

5. At the intersection of Makena Alanui Drive and Road "C":

   a. a left-turn lane be established for vehicles traveling south, then mauka into Road "C",

   b. an "Intersection Ahead" sign be posted for north and southbound traffic prior to the intersection, and

   c. a right-turn lane be established for vehicles traveling north, then mauka into Road "C".

6. At the intersection of Makena Alanui Drive and Honoiki Street:

   a. the same measures delineated above for the Makena Alanui-Road "C" intersection be instituted for this intersection.

7. The slope of Makena Alanui Drive between Road "C" and Road "A" be changed to mitigate the effect of vehicles "sliding" off the roadway.

8. If planned residential development will be "gated" communities, that access codes be provided to police.

Thank you for giving us the opportunity to comment on your project summary.

Very truly yours,

Assistant Chief Richie Nakashima
for: HOWARD H. TAGOMORI
Chief of Police

MUNEKIYO, ARAKAWA & HIRAGA, INC.

June 1, 1998

Howard H. Tagomori
Chief of Police
Police Department
County of Maui
55 Mahalani Street
Wailuku, Hawaii 96793

SUBJECT: Makena Resort Roadway and Utility Infrastructure Improvements

Dear Mr. Tagomori:

Thank you for your letter of February 18, 1998 transmitting early consultation comments on the subject project. We would like to provide a response to your letter.

1. During construction work within the public right-of-way, at least one (1) lane of traffic on Makena Alanui, Honoiki Street and Makena Keoneoio Road will remain open at all times with the exception of a curved section of Makena Alanui near the northern limits of the project site. During the temporary closure of this segment of Makena Alanui, a detour is proposed on Makena Keoneoio Road and Honoiki Street to provide continuous access. The intent is to require the contractor to notify residents of the construction schedule through notices in a newspaper of general circulation and radio ads.

2. The contractor for the project will be required to coordinate with the Police Department regarding adequate traffic control measures during periods of construction.

3. Compliance with applicable State and County dust and noise control provisions will be the responsibility of the contractor.

4. Makena Alanui, Honoiki Street and Makena Keoneoio Road are currently public rights-of-way. In the present application, Road "C" and Road "D" are intended solely as a paved access to Makena Resort's proposed wastewater reclamation facility. For the interim, it will remain privately owned and inaccessible to the general public. As lands abutting Road "C" and Road "D" are proposed for future development, the intent is to construct these roadways to County standards and dedicate it to the County.

5. Regarding turn lanes on Makena Alanui at the Road "C" and Honoiki Street intersections, we do not believe that these measures are warranted at this time since residential or commercial development are not being proposed as part of this application. However, as abutting lands are proposed for development, it is anticipated that traffic studies will be assessing probable impact and proposing appropriate mitigation measures. Public agency comments will be requested by the County of Maui prior to approval. Appropriate signage will be installed as part of this project, as warranted.

6. It is noted that Makena Alanui is a County roadway which was designed and constructed as a County project. Makena Resort Corp. is proposing revision of the slope of Makena Alanui, between Road "A" and Road "C", near the northern limits of the project site. The mauka edge of the curve is proposed to be elevated to correct the tendency to "slide" off the roadway. We appreciate your acknowledgment in raising this issue.

7. It is not known at this point in time whether future residential development will be gated. The issue of gated communities and providing access codes to the Police Department will be considered as details of future residential development are formulated.

Thank you for the opportunity to provide a response to your comments. If you have any questions, please feel free to call me.

Very truly yours,

Milton Arakawa, Project Manager

MA:tav
makenart\smi\tagomori.ltr

LINDA LINGLE
Mayor

DAVID W. BLANE
Director

LISA M. NUYEN
Deputy Director

FEB 2 0 1998

CLAYTON I. YOSHIDA
Planning Division

AARON H. SHINMOTO
Zoning Administration and
Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING

February 17, 1998

Mr. Milton Arakawa
Munekiyo, Arakawa & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

RE: Early Consultation Comments for Makena Resort's Roadway and Utility Infrastructure Improvements at Makena, Hawaii
TMK: 2-1-005, 008

Please be advised that the Community Plan designations for the proposed roadways are Single-family Residential, Multi-family Residential, Park, Business, and Agriculture. The County zoning for the proposed roadways are R-1, A-2, Golf Course and Open Space, B-R and Agriculture. However, once the streets are established, County zoning will not apply to said streets. At such time as the streets are vacated, the following provisions shall apply:

1. Maui County Code (MCC), Chapter 19.06.030, Districts and Boundaries:

   H. Vacation of Public Ways.

   "Wherever any street, alley or other public way is vacated in the manner authorized by law, the zoning district adjoining each side of such street, alley, or public way shall be automatically extended to the center of such vacation, and all areas included in the vacation shall then and henceforth be subject to all regulations of the extended districts."

B. Where Boundaries Parallel Street Lines, Alley Lines or Highway Right-of-way Lines. Where district boundaries are so indicated that they are approximately parallel to the centerlines or street lines of streets, the centerlines or alley lines of alleys, or the centerlines or right-of-way lines of highways, such district boundaries shall be construed as being parallel thereto and at such distance therefrom as indicated on the zoning map. If no distance is given, such dimension shall be determined by the use of the scale shown on the zoning maps."

G. District Regulations Apply to Schools, Parks, etc. Any area shown on the zoning maps such as park, playground, school, cemetery, water, street or right-of-way shall be subject to the zoning regulations of the district in which they are located. In case of doubt, the zoning regulations of the most restricted adjoining district shall govern."

If you need additional clarification, please contact Ms. Ann Cua, Staff Planner, of this office at 243-7735.

Very truly yours,

Lisa M. Nuyen

for DAVID W. BLANE
Director of Planning

DWB:ATC:cmh
c: Clayton Yoshida, AICP, Planning Program Administrator
Aaron Shinmoto, Planning Program Administrator
Ann Cua, Planner
Project File
General File
s:\all\ann\makenard.ea

FEB 17 1998

BENJAMIN J. CAYETANO
GOVERNOR
SEIJI F. NAYA
DIRECTOR
BRADLEY J. MOSSMAN
DEPUTY DIRECTOR
RICK EGGED
DIRECTOR, OFFICE OF PLANNING

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Flr., Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Tel.: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-7191

February 9, 1998

Mr. Milton Arakawa
Project Manager
Munekiyo, Arakawa & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

Subject: Makena Resort Roadway and Utility Infrastructure Improvements

We recommend that the draft environmental assessment for the proposed roadway and infrastructure improvements at Makena, Maui, address the following points.

A discussion of the project's impact on the Coastal Zone Management (CZM) objectives and policies of Chapter 205A, Hawaii Revised Statutes, should be included. We note that a portion of Honoiki Street and Makena Keoneoio Road appears to be in the Special Management Area. Additionally, the location of Makena Keoneoio Road in relation to the shoreline setback area should be described.

The relationship of the proposed improvement by Makena Resort Corp. to the State Land Use Commission (LUC) for reclassification of 146.209 acres from Agricultural District to Urban District (LUC Petition A97-721) should also be discussed.

Should you have any questions, please contact Howard Fujimoto of our Coastal Zone Management Program at 587-2898.

Sincerely,

Rick Egged
Director
Office of Planning

"NO EFFECT"
[ ] Agriculture, [ ] Ranching
[ ] Conservation, [ ] Roadway

"NO EFFECT"
[ ] Agriculture, [ ] Ranching
[ ] Conservation, [ ] Roadway

Byrd Dixon
SHPD - Maui

MUNEKIYO, ARAKAWA & HIRAGA, INC.

January 28, 1998

Don Hibbard
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

SUBJECT: Makena Resort Roadway and Utility Infrastructure Improvements

Dear Mr. Hibbard:

On behalf of Makena Resort Corp., we would like to request comments on a proposal to construct roadway and utility infrastructure improvements in Makena, Maui, Hawaii.

A draft Environmental Assessment will be prepared in support of the proposed improvements. Accordingly, we are seeking early input from agencies, individuals, and organizations who may have an interest in the proposed project.

The enclosed project summary provides a general overview of the proposed action and is submitted pursuant to the early consultation requirements established by Title 11, Chapter 200, Section 9, of the Administrative Rules of the State Department of Health (DOH).

We would appreciate receiving any comments you may have by February 20, 1998. If you have any questions, please call me at 244-2015.

Very truly yours,

Milton Arakawa

Milton Arakawa, Project Manager

MA:tv
Enclosure
[illegible]

Planning • Environmental Studies • Project Management
305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Phone: (808) 244-2015 • Fax: (808) 244-8729

TELECOPIER TRANSMISSION NOTE

DATE: 1/30/98

NUMBER OF PAGES 1 (INCLUDING THIS COVER SHEET)

TO: Mr. Milton Arakawa
Munekiyo, Arakawa, Hiraga, Inc.

FROM: Ferdinand Caltigal
DOT - State Highways, Maui

SUBJECT: Makena Resort Roadway Improvements and Utility Infrastructure Improvements, ME-98-03

We have no comments to offer at this time. The project summary does not provide enough information for us to comment on. Please provide us a copy of the EA when it is available, for our review.

/fmc

CORRECTION

TELECOPIER TRANSMISSION NOTE

DATE: 1/30/98

NUMBER OF PAGES 1 (INCLUDING THIS COVER SHEET)

TO: Mr. Milton Arakawa
Munekiyo, Arakawa, Hiraga, Inc.

FROM: Ferdinand Caiigal
DOT - State Highways, Maui

SUBJECT: Makena Resort Roadway Improvements and Utility Infrastructure Improvements, ME-98-03

We have no comments to offer at this time. The project summary does not provide enough information for us to comment on. Please provide us a copy of the EA when it is available, for our review.

/fmc

USDA

FEB 0 5 1998

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

210 Imi Kala St.
Suite 209
Wailuku, HI
96793-2100

Our People...Our Islands...In Harmony

February 2, 1998

Mr. Milton Arakawa, Project Manager
Munekiyo, Arakawa and Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa,

SUBJECT: Makena Resort Roadway and Utility Infrastructure
Improvements

I do not have any comment relating to the subject's project summary at this time.

Thank you for the opportunity to review prior to the draft environmental assessment of the project.

Sincerely,

Neal S. Fujiwara

Neal S. Fujiwara
District Conservationist

FEB 0 4 1998

BENJAMIN J. CAYETANO
GOVERNOR

LAWRENCE MIIKE
DIRECTOR OF HEALTH

LAWRENCE HART, M.D., M.P.H.
DISTRICT HEALTH OFFICER

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE
54 HIGH STREET
WAILUKU, MAUI, HAWAII 96793

February 2, 1998

Milton Arakawa
Project Manager
Munekiyo, Arakawa, &
Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Mr. Arakawa:

Subject: Makena Resort Roadway and Utility Infrastructure Improvements

Thank you for the opportunity to comment on the proposed roadway and infrastructure improvements at the Makena Resort.

It is expected that there will be comments from this office dealing with the permitting requirements for construction noise and with construction discharges into state waters.

Should you have any questions, please call me at 984-8230.

Sincerely,

HERBERT S. MATSUBAYASHI
District Environmental Health Program Chief

4657

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND DIVISION
STATE PARKS
WATER AND LAND DEVELOPMENT

'98 JUN 19 P1:36

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

June 17, 1998

Mr. Bert Ratte
Department of Public Works
Land Use and Codes Administration
250 South High Street
Wailuku, Hawaii 96793

LOG NO: 21706
DOC NO: 9806BD17

Dear Mr. Ratte:

SUBJECT: Chapter 6E-42 Historic Preservation Review of Makena Resort Roadway and Utility Infrastructure Improvements
Papa`anui Ahupua`a, Makawao District, Island of Maui TMK 2-1-05, 7 and 8

This letter is a Historic Preservation review of Makena Resort roadway and utility infrastructure improvements located in Papa`anui Ahupua`a. Our review is based on reports, maps, and aerial photographs maintained at the State Historic Preservation Division; no field check was conducted of the subject property.

Based on the results of previous archaeological research in the Makena Resort properties, it is likely that the area along Makena Road was once the location of pre-Contact habitations and perhaps burials. It is possible that archaeological remains could be present.

We therefore recommend archaeological monitoring of any ground-altering construction associated with infrastructure improvements along this highway. Before construction can begin within the project area, a monitoring plan should be submitted to SHPD for approval. This plan should outline what sort of subsurface remains are to be expected in different portions of the property (with a map), documentation procedures, and should present measures which will ensure that adequate time is allotted to the recording of these remains. A monitoring report will be submitted to SHPD upon completion of the project for our approval. In addition, we request that these monitoring recommendations be added to the State Historic Preservation Requirements listed on the construction plans submitted to any contractors.

We find the remainder of proposed construction along Makena Alanui, Honoiki Street, Driveway C, and Driveway D to have "no effect" on historic sites. However, in the event that historic sites (i.e. subsurface firepits, artifacts, or human skeletal remains) are inadvertently uncovered during monitored construction, all work should cease in the vicinity and the contractor should immediately contact the State Historic Preservation Division.

If you have any questions please contact Boyd Dixon at 243-5169.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

BD:jen

cc. Ralph Nagamine, Maui County Department of Public Works (fax: 243-7972)
David Blane, Maui County Planning Department (fax: 243-7634)

Chapter X

Letters Received During the Draft Environmental Assessment Public Comment Period and Responses to Substantive Comments

DEPARTMENT OF
PARKS AND RECREATION
COUNTY OF MAUI

1580-C KAAHUMANU AVENUE WAILUKU, HAWAII 96793

LINDA LINGLE
Mayor

HENRY OLIVA
Director

ALLEN SHISHIDO
Deputy Director

(808) 243-7230
FAX (808) 243-7934

July 30, 1998

Ms. Lisa M. Nuyen
Planning Director
County of Maui
250 South High Street
Wailuku, HI 96793

Dear Ms. Nuyen:

SUBJECT: SPECIAL MANAGEMENT AREA PERMIT APPLICATION FOR MAKENA RESORT'S ROADWAY AND UTILITY IMPROVEMENTS

We have reviewed the permit application for the above referenced project and have no objections to the proposed actions.

Thank you for the opportunity to comment on this matter. Please feel free to contact me or Mr. Patrick Matsui, Chief of Parks Planning and Development, at extension 7387 should you have any other questions.

Sincerely,

HENRY OLIVA
Director

c: Patrick Matsui, Chief of Planning and Development

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BENJAMIN J. CAYETANO
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
P.O. Box 2359
Honolulu, HI 96804-2359
Telephone: 808-587-3822
Fax: 808-587-3827

'98 AUG -3 P12:54

RECEIVED

July 31, 1998

Ms. Lisa Nuyen
Director of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Ms. Nuyen:

Subject: Special Management Area Use Permit Application (SM1 980013), for the Makena Resort Roadway and Utility Infrastructure Improvements, Makena, Maui, TMKs 2-1-05: por. 108; 2-1-07: por. 94; 2-1-08: por. 80, por. 90, por. 98, por. 99, por. 100, por. 106, and por. 108

We have reviewed the application for the subject project forwarded by your transmittal dated July 22, 1998, and have the following comments:

1) We confirm that the project site, as represented on Figure 10 of the Draft Environmental Assessment (DEA), is located within the State Land Use Urban and Agricultural Districts.

2) As noted in the DEA (p. 38), the project location is in the vicinity of the six petition areas reclassified from the Agricultural District to the Urban District under LUC Docket No. A97-721/Makena Resort Corp. On Figure 10, we note that Petition Area 5 is still identified as "Agricultural." Petition Area 5, as well as the other petition areas, should be identified with a "U" to indicate its Urban District designation as a result of the reclassification.

We have no further comments to offer at this time. We appreciate the opportunity to comment on the subject application.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

BENJAMIN J. CAYETANO
GOVERNOR
STATE OF HAWAII

KALI WATSON
CHAIRMAN
HAWAIIAN HOMES COMMISSION

JOBIE M. K. M. YAMAGUCHI
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

'98 AUG -3 P1:26

DEPT. PLANNING
COUNTY OF MAUI
RECEIVED

July 31, 1998

Mr. David W. Blane, Planning Director
County of Maui, Planning Department
250 S. High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Blane:

Subject: Makena Resort's Roadway and Utility Improvements, SM1 980013, TMK 2-1-5:108 por., 2-1-7:94 por., 2-1-8:80 por., 90 por., 98 por., 99 por., 100 por., 106 por., 108 por., Makena, Maui, Dated June, 1998

Thank you for the opportunity to review the subject application. The Department of Hawaiian Home Lands has no comment to offer.

If you have any questions, please call Daniel Ornellas at 586-3836.

Aloha,

Danelle Yagodich

KALI WATSON, Chairman
Hawaiian Homes Commission

fx

AUG 0 7 1998

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

OF COUNSEL:
G. RICHARD GESCH

August 5, 1998

Via Facsimile and U.S. Mail
244-8729

Mr. Milton Arakawa
Munekiyo and Arakawa
305 High Street, Suite 104
Wailuku HI 96793

Re: Draft Environmental Assessment for Makena Resort, Roadway and Utility Infrastructure Improvements, Makena, Maui, Hawaii

Dear Milton Arakawa:

This letter is written on behalf of Hui Alanui o Makena and Keauhou o Honua'ula, Inc. We have the following comments on the Draft Environmental Assessment ("DEA") for Makena Resort, Roadway and Utility Infrastructure Improvements:

1. Settlement Agreement

We thank Mr. Roy Figueiroa for meeting with us about the roadway and utility infrastructure improvements discussed in the DEA.

2. Proceeding by Way of Multiple Environmental Assessments

We do not believe that it is appropriate to proceed with new proposed developments via a succession of Environmental Assessments as opposed to an Environmental Impact Statement or a Supplemental Environmental Impact Statement. This is especially true for infrastructural improvements such as those proposed here. Our state's environmental regulations explicitly recognize that infrastructural improvements tend to induce secondary impacts which should be addressed. This is the case here as well.

The Makena Resort obtained a Boundary Amendment for various projects which it only described vaguely. The Resort then obtained a FONSI on a wastewater reclamation system only vaguely describing why it was necessary. Now the Makena Resort seeks a FONSI on roadway and other infrastructural improvements for vaguely described projects.

The Hawaii Supreme Court in The Kanaha Sunset Owners Assoc. v. The Maui Planning Commission, 86 Haw. 66, 947 P.2d 378 (1997) held that the impacts of infrastructure cannot be addressed alone. These infrastructural improvements have no independent utility. They would not be constructed except as part of a larger development. As such, isolating this particular component constitute "improper segmentation" of the project.

It must also be noted that as a result of this segmentation, the development which necessitates this infrastructure may not be publicly reviewed and may not be the subject of an Environmental Assessment. HEPA will not allow this.

Finally, should the projects which necessitate this infrastructure not receive appropriate, public review, the actual traffic impacts necessitating the infrastructure may not be addressed either. This is the appropriate time to address the projects necessitating the infrastructure and the traffic which will be generated by these projects. Without this information, it is impossible to know whether this infrastructure is proper or appropriate.

Based upon the foregoing, there is no basis for concluding that this project will not have any significant adverse impacts. Instead, if our environmental regulations are appropriately applied, a Supplemental EIS should be prepared.

Please contact me if you have any questions about any of the above. I look forward to hearing from you.

Sincerely yours,

Isaac Hall

IH/jp
cc: Keauhou o Honua'ula, Inc.
Hui Alanui o Makena
Roy Figueiroa
OEQC

MUNEKIYO, ARAKAWA & HIRAGA, INC.

September 2, 1998

Isaac Hall
Attorney At Law
2087 Wells Street
Wailuku, Hawaii 96793

SUBJECT: Draft Environmental Assessment (EA) for Makena Resort's Roadway and Utility Infrastructure Improvements

Dear Mr. Hall:

The following is in response to your letter to me dated August 5, 1998.

Please be advised that this draft EA was prepared specifically to address the impacts and mitigative measures for the proposed roadway and utility infrastructure improvements in the first phase of the development of multi-family and single-family parcels in the Makena Resort. The entire 1,030 acre Makena Resort was the subject of the Seibu Makena Master Plan Environmental Impact Statement (the "EIS"), accepted by the County of Maui Planning Commission on May 28, 1975, and published in the Office of Environmental Quality Control (OEQC) Bulletin, dated June 23, 1975. Said EIS described and evaluated the impacts of the entire Makena Resort's development.

Since the acceptance of that EIS, the overall proposed development has been substantially reduced from a total of 5,969 shelter units to 3,036 shelter units. Accordingly, the scope of action has been substantially reduced rather than increased and the intensity of environmental impacts will be reduced rather than increased. Further, the mitigative measures originally planned are to be implemented and there are no new circumstances or evidence which have brought to light different or likely increased environmental impacts which have not been previously dealt with. Accordingly, the subject EA addresses the requirements of Chapter 343, HRS and a supplemental environmental impact statement is not deemed necessary.

If you have any questions or require any further information, please contact this office.

Very truly yours,

Milton Arakawa, Project Manager

MA:tav
cc: Roy Figueiroa, Makena Resort Corp.
makenart\ama\hall.ltr

Planning • Environmental Studies • Project Management
305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Phone: (808) 244-2015 • Fax: (808) 244-8729

AUG 0 6 1998

August 5, 1998

Makena Resort Corporation
5415 Makena Alanui
Makena, Hawaii 96753

Attention: Roy Figueiroa:

Re: Draft Environmental Assessment for
Makena Resort Roadway and Utility
Infrastructure Improvements

Dear Mr. Figueiroa:

With respect to the proposed improvements and road widening to the Makena Keoneoio Road, please provide answers to the following:

1. How far south of Honoiki Street will the improvements and/or road widening to the Makena Keoneoio Road actually extend?

2. Will any improvements and/or road widening be done with respect to the 1100 lineal foot pedestrian walkway in front of the Maui Prince Hotel which is currently 20 feet wide?

3. Will any improvements and/or road widening be done to the Makena Keoneoio Road south of the 1100 lineal foot pedestrian walkway in front of the Maui Prince Hotel?

4. If there is going to be improvements and/or road widening done to the Makena Keoneoio Road south of the 1100 lineal foot pedestrian walkway, how far south will the improvements and/or road improvements actually extend?

Very truly yours,

George Ferreira
4580 Makena Road
Kihei, HI 96753

cc: Clayton Yoshida (County of Maui, Department of Planning)
Milton Arakawa (Munekiyo, Arakawa & Hiraga, Inc.)
OEQC

MAKENA RESORT CORP.

August 25, 1998

Mr. George Ferreira
4580 Makena Road
Kihei, Hawaii 96753

Re: Makena Resort Roadway and Utility Infrastructure Improvements

Dear Mr. Ferreira:

In response to your August 5, 1998 letter to us, the road widening improvements to Makena-Keoneoio Road will extend South from Honoiki Street up to and match the improvements in front of your parsonage parcel. The gravity sewer line will extend to our lot mauka of the comfort station across Keawalai Church.

In answer to your question numbers 2, 3, and 4 this project does not include improvements to the pedestrian walkway in front of the Maui Prince Hotel nor to Makena-Keoneoio Road south of that pedestrian walkway.

Sincerely,

Roy Figueiroa
Assistant General Manager

RF:ca

c Clayton Yoshida (County of Maui, Department of Planning)
Milton Arakawa (Munekiyo, Arakawa & Hiraga, Inc.)

BENJAMIN J. CAYETANO
GOVERNOR

AUG 1 0 1998

GARY GILL
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

August 7, 1998

Ms. Lisa M. Nuyen, Director
Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Ms. Nuyen:

Subject: Draft Environmental Assessment for Makena Resort's Roadway and Utility Infrastructure Improvements, Maui

Thank you for the opportunity to review the subject document. We have the following comments and questions.

1. The applicant, Makena Resort Corporation, proposes to construct roadway and utility infrastructure improvements in Makena. The proposed improvements are intended to service future development at the Makena Resort. This environmental assessment only describes the roadway and utility infrastructure improvements.

   The Hawaii Supreme Court in The Kanaha Sunset Owners Association v. The Maui Planning Commission ruled that that impacts of infrastructure cannot be addressed alone. The entire development must be analyzed as a whole.

   Furthermore, section 11-200-7, Hawaii Administrative Rules, states that "a group of actions proposed by an agency or applicant shall be treated as a single action when: (1) the component actions are phases or increments of a larger total undertaking; (2) an individual project is a necessary precedent for a larger project; (3) an individual project represents a commitment to a larger project; or (4) the actions in question are essentially identical and a single statement will adequately address the impacts of each individual action and those of the group of actions as a whole."

Accordingly, an environmental assessment must consider every phase of a proposed action as a single action. Therefore, we strongly recommend that a new environmental assessment or impact statement be prepared for all phases of the Makena Resort project.

Thank you for your consideration of this matter. Should you have any questions, please call Leslie Segundo at 586-4185.

Sincerely,

Gary Gill
Director

c: Munekiyo and Arakawa
Makena Resort

MUNEKIYO, ARAKAWA & HIRAGA, INC.

September 2, 1998

Gary Gill, Director
Office of Environmental Quality Control
State of Hawaii
236 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

SUBJECT: Draft Environmental Assessment (EA) for Makena Resort's Roadway and Utility Infrastructure Improvements

Dear Mr. Gill:

The following is in response to your letter to Ms. Lisa M. Nuyen of August 7, 1998.

Please be advised that this draft EA was prepared specifically to address the impacts and mitigative measures for the proposed roadway and utility infrastructure improvements in the first phase of the development of multi-family and single-family parcels in the Makena Resort. The entire 1,030 acre Makena Resort was the subject of the Seibu Makena Masterplan Environmental Impact Statement (the "EIS"), accepted by the County of Maui Planning Commission on May 28, 1975, and published in the Office of Environmental Quality Control (OEQC) Bulletin, dated June 23, 1975, a copy of which EIS remains in your library. Said EIS described and evaluated the impacts of the entire Makena Resort's development.

Since the acceptance of that EIS, the overall proposed development has been substantially reduced from a total of 5,969 shelter units to 3,036 shelter units. Accordingly, the scope of action has been substantially reduced rather than increased and the intensity of environmental impacts will be reduced rather than increased. Further, the mitigative measures originally planned are to be implemented and there are no new circumstances or evidence which have brought to light different or likely increased environmental impacts which have not been previously dealt with. Accordingly, the subject EA addresses the requirements of Chapter 343, HRS and a supplemental environmental impact statement is not deemed necessary.

Planning • Environmental Studies • Project Management
305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Phone: (808) 244-2015 • Fax: (808) 244-8729

If you have any questions or require any further information, please contact this office.

Very truly yours,

Milton Arakawa, Project Manager

MA:tav
cc: Roy Figueiroa, Makena Resort Corp.
makenart\ama\oeqc.ltr

References

References

Community Resources, Inc., Maui County Community Plan Update Program Socio-Economic Forecast Report, January, 1994.

County of Maui, Office of Economic Development, Maui County Data Book 1996-97, July 1997.

Environment Impact Study Corporation, Project Description and Environmental Assessment for Makena Golf Course, August 1983.

Environmental Communications, Inc., Final Environmental Impact Statement for the Makena-Keoneoio Road Cul-de-Sacs Plan - Supplemental Environmental Impact Statement, June 1988.

Maui County, Data Book and Newcomers Guide, 1995.

Michael T. Munekiyo Consulting, Inc., Application for Special Management Area Permit-New Golf Maintenance Facility, February, 1993.

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Munekiyo & Arakawa, Inc., Project Assessment Report - Kaonoulu Industrial Park, July 1994.

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R.M. Towill Corporation, Special Management Area Permit - Makena Resort Wastewater Reclamation System, October 1997.

State of Hawaii, Department of Business, Economic Development, and Tourism, Data Book, June 1994.

University of Hawaii, Department of Geography, Atlas of Hawaii, Second Edition, 1983.

U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, 1972.

Appendices

Appendix A

Letter from State Historic Preservation Division to R.M. Towill Corporation Dated March 12, 1998

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

GILBERT COLOMA AGARAN

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AQUATIC RESOURCES
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND DIVISION
STATE PARKS
WATER AND LAND DEVELOPMENT

'98 MAR 19 A11:18

STATE OF HAWAII

DEPT OF [illegible]
COUNTY OF [illegible]
RECEIVED

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

March 12, 1998

Ms. Colette Sakoda
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4914

LOG NO: 21166 ✔
DOC NO: 9803BD07

Dear Ms. Sakoda:

SUBJECT: **Chapter 6E-42 Historic Preservation Review of a Draft EA for the Makena Resort Reclamation Facility**
Papa`anui Ahupua`a, Makawao District, Island of Maui
TMK 2-1-08: Portion of 108

This letter is a Historic Preservation review of a draft Environmental Assessment for the Makena Resort Reclamation Facility located in Papa`anui Ahupua`a. Our review is based on reports, maps, and aerial photographs maintained at the State Historic Preservation Division; no field check was conducted of the subject property.

Based on the results of an inventory survey presented in a post-field summary letter to Makena Resort Corporation (Sinoto 1997), it appears that the majority of the area has been previously cleared by bulldozers, leaving a historic cattle wall on the southwestern boundary of the project area, and modern wooden cattle pens and corrals on the northwestern boundary. We therefore find the proposed construction project to have "no effect" on known historic sites.

However, archaeological monitoring of grubbing has been recommended by this office within the 15 acre Water Reclamation Facility area (SHPD DOC NO: 9712BD50), due to the possibility of unrecorded sites being located within dense stands of *wiliwili* which precluded intensive survey of intact portions of the rough lava landscape. This recommendation is based on observations from similar settings elsewhere in Makena which have been found to contain the remains of pre-Contact farming and scattered housing. Thus, before construction can begin within the project area, a monitoring plan (scope) should be submitted to our Division for approval. This plan should outline what sort of historic sites are to be expected in different portions of the property, note how these sites will be documented, and present measures which will ensure that adequate time is allotted to the recording of these remains. In addition, we request that these monitoring recommendations be added to the State Historic Preservation Requirements listed on the construction plans submitted to any contractors.

If you have any questions please contact Boyd Dixon at 243-5169.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

cc. Ralph Nagamine, Maui County Department of Public Works (fax: 243-7972)
David Blane, Maui County Department of Planning (fax: 243-7634)

'98 MAR 19 A11:18

DEPT OF PLANNING
COUNTY OF MAUI
RECEIVED

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

March 12, 1998

Ms. Colette Sakoda
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4914

LOG NO: 21166 ✔
DOC NO: 9803BD07

Dear Ms. Sakoda:

SUBJECT: **Chapter 6E-42 Historic Preservation Review of a Draft EA for the Makena Resort Reclamation Facility**
Papa`anui Ahupua`a, Makawao District, Island of Maui
TMK 2-1-08: Portion of 108

This letter is a Historic Preservation review of a draft Environmental Assessment for the Makena Resort Reclamation Facility located in Papa`anui Ahupua`a. Our review is based on reports, maps, and aerial photographs maintained at the State Historic Preservation Division; no field check was conducted of the subject property.

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DON HIBBARD, Administrator
State Historic Preservation Division

cc. Ralph Nagamine, Maui County Department of Public Works (fax: 243-7972)
David Blane, Maui County Department of Planning (fax: 243-7634)

Appendix B

Drainage Report

DRAINAGE REPORT
FOR
MAKENA RESORT ROADWAY AND UTILITY INFRASTRUCTURE IMPROVEMENTS
MAKENA, MAUI, HAWAII
T.M.K.: 2-1-5, 7, & 8: VARIOUS

PREPARED FOR:

MAKENA RESORT CORP.
5415 MAKENA ALANUI
KIHEI, MAUI, HAWAII 96753

PREPARED BY:

SATO & ASSOCIATES, INC.
CONSULTING ENGINEERS
2115 WELLS STREET
WAILUKU, MAUI, HAWAII 96793

MAY 1998

TABLE OF CONTENTS

I. INTRODUCTION

Makena Resort Corp. proposes to construct various infrastructure improvements in anticipation of future site development. This report examines the existing and developed drainage patterns that affect these infrastructure improvements. The report also contains hydrologic and hydraulic analysis for proposed and existing drainage systems, including information on size and approximate location of catch basins and inlet structures, and soil erosion control measures.

II. PROJECT LOCATION

The project site is located in Makena, Maui and will include improvements to Makena Alanui, Honoiki Street and Makena Keoneoio Road. Two service driveways will also be constructed to provide access from Makena Alanui to an existing 1.5 million gallon water tank and a future Sewage Treatment Plant. Both facilities are located mauka of Makena Alanui. Refer to Exhibit 1 and 2.

III. PROJECT DESCRIPTION

Makena Resort encompasses a total of approximately 1,843 acres divided into various proposed land uses. Of the total area, approximately 39.5 acres have been set aside for hotel use, 23.3 for business, 222.2 for multi-family, 365.1 for single family, 431.4 for golf course, 32.9 for park, and 25.8 for public/quasi public use. The remaining 702 acres have no proposed land use designation at this time or have been set aside for future road corridors.

Although there is no time frame as to when development will begin, it is expected that the first projects will be M-5, M-6, S-7 and B-2. In anticipation of development of these sites, the following infrastructure improvements are being proposed:

1. Road widening of Makena Alanui and Honoiki Street to provide a 60-foot County Collector Road. Road widening of Makena Keoneoio Road on the mauka side only to provide for future 56-foot County Road. The improvements will consist of new concrete curb, gutter and sidewalk, adding fire hydrants and light poles, landscape work and underground utilities such as water, sewer, drainage, electrical and irrigation.

2. Construction of two service driveways. Driveway "C" which has an access from Makena Alanui and extends east for approximately 1,900 feet. Driveway "D" which begins at the end of Driveway "C" and extends north for about 1,400 feet. Included in the driveway construction are catch basins, inlet structures and underground utilities consisting of drainage and waterlines. Sewerlines will also be constructed under a separate contract. Refer to Exhibit 3.

3. Construction of an offsite sewerline connecting the Makena Golf Clubhouse and Tennis Pro Shop to a manhole in Makena Alanui. The remainder of the sewerline will be constructed under a separate contract. Refer to Exhibit 3.

IV. FLOOD AND TSUNAMI HAZARD

According to the flood insurance rate map, for the County of Maui, the majority of the resort's property is located on land designated as Zone "C". Areas with this designation may be subject to minimal flooding. Sites M-5, M-6, S-5, S-7 and B-2 fall within Zone "C".

A small portion of the resort, those properties makai of Makena Keoneoio Road, lie partially within Zones "A-4" and "V-14". However, there are no plans to develop these areas at this time, refer to Exhibit 4.

V. METHOD OF HYDROLOGIC COMPUTATIONS

Two methods for determining storm runoff were used for this report. The Rational Method was used for watersheds with areas less than 100 acres, while the Soils Conservation Service (SCS) method was used for watersheds with areas greater than 100 acres. When using the SCS method, a design storm of with a recurrence interval of 100 years and a duration of 24 hours was used. For the Rational Method, the design storm had a recurrence interval of 50 years and a duration of 1 hour. Runoff coefficients for each watershed were chosen with consideration given to pre and post construction conditions.

Existing hydrologic calculations were based on current land uses and soil classifications. Included land uses are pasture, woods, golf course, roadway and hotel. Each of the five watersheds also cross different soil groups which have varying runoff characteristics. Hydrologic calculations take into consideration the soil group, it's hydrologic condition, and the area of land use. The result is a weighted Curve Number (CN).

Developed hydrologic calculations were based on the same land used mentioned above. The difference is in the area included in roadway land use. For the developed conditions, the entire right-of-way width was defined as roadway. Refer to Exhibits 5, 6, and 7.

For the proposed culvert crossing at Keoneoio Road, the flow rate was based on the peak outflow rate of the retention basin plus the peak runoff rate of the watershed below the retention basin, with consideration given to the change in time of concentration.

Hydrologic calculations for roadway drainage systems in Driveways "C" & "D" were based on a 50-Year, 1-Hour storm. Both onsite and offsite areas were analysized. See Exhibits 8 & 9.

VI. METHOD FOR HYDRAULIC ANALYSIS

Catch basin and inlet spacing, interception capacities, flooded road widths and hydraulic grade line (HGL) calculations were based on the Storm Drainage Standards, City and County of Honolulu and the County of Maui's Rules for the Design of Storm Drainage Facilities in the County of Maui. Refer to Appendices G and F.

VII. EXISTING HYDROLOGIC CONDITIONS

The existing hydrologic conditions for each offsite watershed are summarized in the following paragraphs. Each summary includes a general description of location, size, listing of soil classifications and estimated amount of runoff; refer to Exhibits 5 and 6. For a description of each soil classification, refer to Appendix B.

Watershed 1 is the northern most watershed, located near the beginning of improvements on Makena Alanui. It's size is approximately 487 acres and extends 20,700 feet mauka from the ocean. It encompasses five soil classifications: ISD, MXC, OAD, ULD and UMF. Existing runoff is estimated to be 1,265 cfs.

Watershed 2 is located just south of Watershed 1. It's size is approximately 220 acres and extends 11,500 feet mauka from the ocean. It encompasses three soil classifications: MXC, OAD and ISD. Existing runoff is estimated to be 744 cfs.

Watershed 3 is located south of Watershed 2 and is generally centered on Honoiki Street. It's size is approximately 946 acres and extends 19,800 feet mauka from the ocean. It encompasses seven soil classifications: MXC, OAD, OED, KxbE, ISD, UMF and ULD. Existing runoff is estimated to be 2,600 cfs.

Watershed 4 is located south of Watershed 3 and is generally centered on proposed Driveway "C". It's size is approximately 110 acres and extends 4,300 feet mauka from the ocean. It encompasses two soil classifications: MXC and OED. Existing runoff is estimated to be 1,210 cfs.

Watershed 5 is the last watershed, located south of Watershed 4. It's size is approximately 110 acres and extends 5,100 feet mauka from the ocean. It encompasses two soil classifications: MXC and OED. Existing runoff is estimated to be 627 cfs.

Storm flows from these basins generally run east to west via natural gullies and gulches. Existing culverts in Makena Alanui allow runoff to pass under the road where it then sheet flows to the ocean.

VIII. DEVELOPED HYDROLOGIC CONDITIONS

Proposed infrastructure improvements extend across the five watersheds described previously. Construction of Driveways "C" and "D" are located in Watersheds 3 and 4. Road widening improvements to Makena Alanui, Honoiki Street and Makena-Keoneoio Road stretch across all five watersheds, refer to Exhibit 7 and Appendix B.

As a result of the proposed improvements Watersheds 1 through 5 will have negligible increases of runoff, refer to Appendix A. As Makena Resort Corporation develops areas within the resort, additional drainage studies shall be done to avoid potential negative impacts. As a guide for planning development, the Master Drainage Plan, by Muroda & Associates, Inc., 1983, should be referenced.

New catch basins will be installed in Driveways "C" and "D", in anticipation of future road widening and development. The drainage system for Driveways "C" and "D" will accommodate existing runoff flowing on to roadway and flows from the roadway itself. Refer to Exhibits 8 and 9 and Appendix C. The existing storm drain manholes in Makena Alanui and Honoiki Street will be modified to Type "B" or "F" catch basins. Additional catch basins will be added as required.

To accommodate existing flows from Watershed 3, two 16' wide by 5' high conspans are proposed at Keoneoio Road. These culverts will accommodate the peak outflow rate from the proposed retention basin plus the existing peak runoff rate from the watershed below the retention basin, refer to Appendix D. The culverts will allow 1,000 cfs of runoff to pass under Keoneoio Road.

IX. SOIL EROSION CONTROL MEASURES

A. EXISTING SOIL CONDITION:

The existing soil types at the project site are classified by the "Soil Survey of Island of Kauai, Oahu, Molokai and Lanai; State of Hawaii, August 1972 as Makena loam, stony complex, 3 to 15 percent slopes (MXC) and Oanapuka extremely stony silt loan, 7 to 25 percent slopes (OED). The characteristics of the MXC soil is well draining with moderate to rapid permeability and soil erosion hazard is slight to none. The characteristics of the OED soil is well draining with maderate to rapid permeability and soil erosion hazard slight to moderate.

B. SOIL EROSION CALCULATIONS:

Estimated soil loss was calculated using the Universal Soil Loss Equation in accordance with the County of Maui Grading Ordinance (Refer to Appendix E).

Calculations show that grading of the entire project site will result in a total soil loss during construction of 138.2 tons/acre/year with a severity number of 16,717. The allowable erosion rate is 413.3 tons/acre/year and present standards allow for a maximum severity number of 50,000. Therefore normal erosion control measures (listed below), implemented during construction should be adequate to control soil loss from the project site.

C. EROSION CONTROL MEASURES:

The following procedures shall be implemented during construction of the project.

1. Leave natural vegetation undisturbed in areas not needed for immediate construction.

2. Use waterwagons and/or sprinklers to control dust.

3. Water down graded areas after construction activity has ceased for the day and during weekend and holidays.

4. Construct drainage improvements as soon as possible.

5. Grass or landscape exposed areas immediately after grading work is finished.

Other erosion control measures may be implemented if necessary.

X. CONCLUSION

Construction of the infrastructure improvements will not have significant adverse impacts on adjacent or downstream properties. Watersheds No.1 through 5 will have negligible increases of storm runoff, as a result of the proposed improvements.

Runoff generated by road improvements will be collected and transported to drainage way as described in the Master Drainage Plan, by Muroda & Associates, Inc., 1983. Finally, new culverts will be installed in Keoneoio Road.

XI. REFERENCES

1. Department of Public Works and Waste Management, County of Maui, Chapter 4 Rules for the Design of Storm Drainage Facilities in the County of Maui, July 1995.

2. Federal Emergency Management Agency, Federal Insurance Administration, "Flood Insurance Rate Map", Maui County, Hawaii, effective date: June 1, 1981.

3. Muroda and Associates, Inc., Master Drainage Plan - Proposed Developments for Seibu Hawaii, Inc., Honolulu, Hawaii 1983.

4. United States Department of Agriculture Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, August 1972.

5. United States Department of Agriculture Soil Conservation Service, Erosion and Sediment Control, Guide for Hawaii, March 1981.

6. County of Maui, "Guide for Computing Allowable Erosion Rate, Uncontrolled Erosion Rate and Reductions Needed to Meet the Standards".

7. Department of Public Works & Waste Management, City & County of Honolulu, Storm Drainage Standards.

IX. APPENDICES

APPENDIX A - RUNOFF SUMMARY

APPENDIX B - HYDROLOGIC CALCULATIONS - WATERSHEDS NO. 1 THROUGH 5, EXISTING AND DEVELOPED CONDITIONS

APPENDIX C - HYDROLOGIC CALCULATIONS - ONSITE AND OFFSITE AREAS, EXISTING AND DEVELOPED CONDITIONS

APPENDIX D - HYDROLOGIC CALCULATIONS - RETENTION BASIN

APPENDIX E - SOIL AND EROSION CONTROL CALCULATIONS

APPENDIX F - HYDRAULIC CALCULATIONS

APPENDIX G - CATCH BASIN AND INLET CAPACITY - RUNOFF SUMMARY

APPENDIX A

RUNOFF SUMMARY

APPENDIX A

RUNOFF SUMMARY
FOR A
DESIGN STORM OF 100 YEARS, 24 HOURS

WATERSHED NO.		CONDITIONS		
	AREA (Ac)	EXISTING (CFS)	*AREA OF IMPROVEMENTS (Ac)	INCREASE DUE TO DEVELOPMENT (CFS)
1	487	1,265	1.0	Negligible
2	220	744	1.5	Negligible
3	946	2,600	2.0	Negligible
4	110	1,210	4.0	Negligible
5	110	627	0.7	Negligible

*INCLUDES ENTIRE WIDTH OF RIGHT-OF-WAY

APPENDIX B

HYDROLOGIC CALCULATIONS - WATERSHEDS NO. 1 THROUGH 5, EXISTING AND DEVELOPED CONDITIONS

APPENDIX B

SOIL CLASSIFICATION SUMMARY

Makena Resort is situated on soils classified as Makena loam, stony land, complex (MXC), Oanapuka (OED & OAD), Ulupalakua silt loam (ULD), Uma Roam coarse sand (UFM), Io silt loam (ISD), Kula very rocky loam (KxbE), and Very Stony Land (rVS).

MXC is described as well drained, with moderately rapid permeability and runoff slow to medium; in stony land areas permeability is very rapid. Slopes range from 3 to 15 percent, and the erosion hazard is slight to none. The stony land occurs on low ridges and comprises 30 to 60 percent of the MXC complex. The Makena loam occurs as gently sloping areas between the low ridges of the stony land.

ISD soils are used for pasture and wild life habitat and occurs on smooth low mountain slopes. The Io series is considered well drained. This soil has moderately rapid permeability, runoff is slow to medium and the erosion hazard is slight to moderate.

OED occurs on the lower uplands. This complex is described as well drained, with moderately rapid permeability, runoff slow, and erosion hazard slight to moderate. Slopes range from 7 to 25 percent.

OAD soil is used for pasture and wild life habitat. The Oanapuka series is considered well drained. It occurs between 100 to 800 feet elevation. The soils permeability is moderately rapid, runoff is slow and erosion hazard slight to moderate.

KxbE soil is used for pasture and wild life habitat. The Kula series is considered well drained. It occurs between 2,000 to 3,500 feet elevations. The soils permeability is moderately rapid, runoff is medium and erosion hazard is moderate.

ULD soil is used for pasture and wild life habitat. The Ulupalakua series is considered well drained and occur between 2,400 to 4,500 feet elevation. The soils permeability is moderately rapid, runoff is slow and erosion hazard slight.

UFM soil is used for pasture and wild life habitat. The Uma series is considered very well drained. It occurs between 2,500 to 6,600 feet elevation. The soils permeability is very rapid, runoff is slow to medium and erosion hazard is severe.

rVS occurs where areas are 50 to 90 covered with rocks and boulders. Slopes range from 7 to 30 percent. This soil complex is located at the most northern boundary of Makena Resort.

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: 5/6/93
Chkd. by: ____ Date: ____

PROJECT: MAKENA INFRASTRUCTURE

EXISTING CONDITIONS

BASIN NUMBER: 1
WATERSHED AREA: ~187 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY	
ISD	B	188 - 69				12,972
MXC	B	0	113 - 60	37.5 - 74	0.5 - 84	9,597
OAD	B	11 - 69	91 - 60			6,219
ULD	B	37 - 69				2,553
UMF	A	8 - 49				392

Σ (A x CN) 31,733

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

$$\text{WEIGHTED CN} = \frac{\Sigma \text{A x CN}}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{31,733}{487}$$

WEIGHTED CN = 65

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: ____
Chkd. by: ____ Date: ____

PROJECT:

BASIN NO: 1 DRAINAGE AREA 487 (ACRES)

A.M.C II POINT RAINFALL 10 (100 YR., 24 HR)

LENGTH (l) 20,700 FT SLOPE (Y) 13.9 %

CURVE NUMBER (CN') 65 Q 5.60 IN

Tc 2.44 HR

$$T_c = \frac{L}{0.6}$$

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900(Y^{0.5})}$$

$$S = \frac{1000}{CN'} - 10$$

$$S = \frac{1000}{(65)} - 10$$

$$S = 5.38$$

$$L = \frac{(20{,}700)^{0.8}(5.38+1)^{0.7}}{1900(13.9^{0.5})} = 1.47$$

$$T_c = \frac{(1.47)}{0.6} = 2.44$$

T_p = 2.44 HR

$$T_p = \frac{\Delta D}{2} + L$$

$$\Delta D = 0.133(T_c)$$

$$\Delta D = 0.133(2.44)$$

$$\Delta D = (0.32)$$

$$T_p = \frac{(0.32)}{2} + (1.47) = 1.63$$

$$q_p = \frac{0.756 \times \text{DRAINAGE AREA}}{T_p} = \frac{0.756 \times (487)}{(1.63)} = 225.87 \text{ cfs}$$

PEAK DISCHARGE = $Q \times q_p$ = 5.60 × 225.87 = 1264.8 CFS

= 1265 CFS

APPENDIX E

Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

EXISTING CONDITIONS

BASIN NUMBER: 2
WATERSHED AREA: 220 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAYS	
MXC	B		96 - 60	28 - 74	1 - 84	7,546
OAD	B		72 - 60			4,320
ISD	B	27 - 69				1,863

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

$\Sigma (A \times CN) = 13,789$

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{13,789}{220}$$

WEIGHTED CN = 63

APPENDIX B

Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

BASIN NO: 2 DRAINAGE AREA 220 (ACRES)

A.M.C II POINT RAINFALL 10 (100 YR., 24 HR)

LENGTH (l) 11,500 SLOPE (Y) 12.35 % = $\frac{1400-42}{11,500} \times 100\%$

CURVE NUMBER (CN') 63 Q 5.1 IN

T_c 1.70 HR

$$T_c = \frac{L}{0.6}$$

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900(Y^{0.5})}$$

$$S = \frac{1000}{CN'} - 10$$

$$S = \frac{1000}{(63)} - 10$$

$$S = 5.87$$

$$L = \frac{(11,500)^{0.8}(5.87+1)^{0.7}}{1900(12.35^{0.5})} = \frac{6830.11}{6677.07} = 1.02$$

$$T_c = \frac{(1.02)}{0.6} = 1.70$$

T_p = 1.14 HR

$$T_p = \frac{\Delta D}{2} + L$$

$$\Delta D = 0.133(T_c)$$
$$\Delta D = 0.133(1.70)$$
$$\Delta D = (0.226)$$

$$T_p = \frac{(0.23)}{2} + (1.02) = 1.14$$

$$q_p = \frac{0.756 \times \text{DRAINAGE AREA}}{T_p} = \frac{0.756 \times (220)}{(1.14)} = 145.89 \text{ cfs}$$

PEAK DISCHARGE = $Q \times q_p$ = 5.1 × 145.89 = 744.0 CFS

= 744 CFS

APPENDIX E

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: [illegible] Date: 5/6/98
Chkd. by: ____ Date: ____

PROJECT:

EXISTING CONDITIONS

BASIN NUMBER: 3
WATERSHED AREA: 946 ACRES

SOIL		AREA ; CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY	
MXC	B		60 - [illegible]	[illegible] - 74	[illegible] - 84	5,990
OAD	B		17[illegible] - 60			10,440
OED	B	5 - 69	60 - 60			5,145
KxBE	B	10 - 69	10 - 60			1,290
ISD	B	[illegible] 69	29 - 60			32,286
UMF	A	50 - 49				2,450
ULD	B	6 - 69				414

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

Σ(AxCN) 61,015

$$\text{WEIGHTED CN} = \frac{\Sigma \text{AxCN}}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{61,015}{946}$$

WEIGHTED CN = 65

Sato & Associates, Inc.
Consulting Engineers

Sheet: ______ Of: ______
By: ______ Date: ______
Chkd. by: ______ Date: ______

PROJECT:

BASIN NO: E DRAINAGE AREA 946 (ACRES)

A.M.C II POINT RAINFALL 10 (100 YR., 24 HR)

LENGTH (ℓ) 19,500 SLOPE (Y) 14.54 % $\frac{2910-43}{19,800}$ =

CURVE NUMBER (CN') 65 Q 5.6 IN

Tc 2.30 HR

$$T_c = \frac{L}{0.6}$$

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1900(Y^{0.5})}$$

$$S = \frac{1000}{CN'} - 10$$

$$S = \frac{1000}{(65)} - 10$$

$$S = 5.38$$

$$L = \frac{(19,800)^{0.8}(5.38+1)^{0.7}}{1900(14.54^{0.5})} = \frac{10,016.28}{7,244.96} = 1.38$$

$$T_c = \frac{(1.38)}{0.6} = 2.3$$

Tp = 1.54 HR

$$T_p = \frac{\Delta D}{2} + L$$

$$\Delta D = 0.133(T_c)$$

$$\Delta D = 0.133(2.30)$$

$$\Delta D = (0.31)$$

$$T_p = \frac{(0.31)}{2} + (1.38) = 1.54$$

$$q_p = \frac{0.756 \times \text{DRAINAGE AREA}}{T_p} = \frac{0.756 \times (946)}{(1.54)} = 464.40 \text{ cfs}$$

PEAK DISCHARGE = $Q \times q_p$ = 5.6 × 464.40 = 2600.6 CFS

= **2600 CFS**

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: [illegible] Date: 5/6/98
Chkd. by: ____ Date: ____

PROJECT:

EXISTING CONDITIONS

BASIN NUMBER: 4
WATERSHED AREA: 110 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	HOTEL	WOODS	GOLF COURSE	ROADWAY	
MXC	B	82 - 92	- 60	67 - 74	7 - 81	6,682
OED	B		22 - 60			1,320

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		
HOTEL		72	82		

$\Sigma (A \times CN) = 8,002$

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{8002}{110}$$

WEIGHTED CN = 73

Saco & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: ____
Chkd. by: ____ Date: ____

PROJECT:

BASIN NO: 1 DRAINAGE AREA 110 (ACRES)

A.M.C I POINT RAINFALL 10 (100 YR., 24 HR)

LENGTH (l) 4,300 SLOPE (Y) 11.2 % $\frac{520-110}{4,300} \times 100\%$

CURVE NUMBER (CN') 73 Q 6.4 IN

Tc 0.67 HR

$$T_c = \frac{L}{0.6}$$

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900(Y^{0.5})}$$

$$S = \frac{1000}{CN'} - 10$$

$$S = \frac{1000}{(73)} - 10$$

$$S = 3.7$$

$$L = \frac{(4,300)^{0.8}(3.7+1)^{0.7}}{1900(11.2^{0.5})} = \frac{2383.7}{6,358.6} = 0.4$$

$$T_c = \frac{(0.4)}{0.6} = 0.67$$

$T_p = 0.44$ HR.

$$T_p = \frac{\Delta D}{2} + L$$

$$\Delta D = 0.133(T_c)$$
$$\Delta D = 0.133(0.67)$$
$$\Delta D = (0.09)$$

$$T_p = \frac{(0.09)}{2} + (0.40) = 0.44$$

$$q_p = \frac{0.756 \times \text{DRAINAGE AREA}}{T_p} = \frac{0.756 \times (110)}{(0.44)} = 189.0 \text{ cfs}$$

PEAK DISCHARGE = $Q \times q_p$ = 6.4 × 189 = 1209.6 CFS

= 1210 CFS

APPENDIX 3

Sato & Associates, Inc.
Consulting Engineers

Sheet: 8 Of:
By: CHS Date: 5/6/98
Chkd. by: Date:

PROJECT:

EXISTING CONDITIONS

BASIN NUMBER: 5
WATERSHED AREA: 110 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY	
MXC	B		7-60	25 74	0.3-84	2,637
OED	B		73-60			4,380

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

Σ(AxCN) 7017.

WEIGHTED CN = $\frac{\Sigma AxCN}{AREA}$

WEIGHTED CN = $\frac{7017}{110}$

WEIGHTED CN = 64

DOCUMENT CAPTURED

Sato & Associates, Inc.
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Sheet: ____ Of: ____
By: ____ Date: ____
Chkd. by: ____ Date: ____

PROJECT:

BASIN NO: 5 DRAINAGE AREA 110 (ACRES)

A.M.C II POINT RAINFALL 10 (100 YR., 24 HR)

LENGTH (l) 5,100 SLOPE (Y) 8.6 % $\frac{490-40}{5,100} \times 100\%$

CURVE NUMBER (CN') 64 Q 5.2 IN

Tc 1.03 HR

$$T_c = \frac{L}{0.6}$$

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900(Y^{0.5})}$$

$$S = \frac{1000}{CN'} - 10$$

$$S = \frac{1000}{(64)} - 10$$

$$S = 5.6$$

$$L = \frac{(5,100)^{0.8}(5.6+1)^{0.7}}{1900(8.6^{0.5})} = \frac{3,465.2}{5,571.9} = 0.62$$

$$T_c = \frac{(0.62)}{0.6} = 1.03$$

T_p = 0.69 HR

$$T_p = \frac{\Delta D}{2} + L$$

$$\Delta D = 0.133(T_c)$$
$$\Delta D = 0.133(1.03)$$
$$\Delta D = (0.14)$$

$$T_p = \frac{(0.14)}{2} + (0.62) = 0.69$$

$$q_p = \frac{0.756 \times \text{DRAINAGE AREA}}{T_p} = \frac{0.756 \times (110)}{(0.69)} = 120.5 \text{ cfs}$$

PEAK DISCHARGE = $Q \times q_p$ = 5.2 × 120.5 = 626.7 CFS

= 627 CFS

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: [illegible] Date: 5/6/98
Chkd. by: ____ Date: ____

PROJECT: MAZENA INTERCHANGE - M9703.00

DEVELOPED CONDITIONS

BASIN NUMBER: 1

WATERSHED AREA: 487 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY*	
ISD	B	188-69				12,972
MXC	B		115-60	66.5-74	1.5-84	9,607
CAD	B	11-69	91-60			6,219
ULD	B	37-69				2,553
UMF	A	8-49				392

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

$\Sigma(A \times CN) = 31,743$

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{31,743}{487}$$

WEIGHTED CN = 65

* INCLUDES ENTIRE RIGHT-OF-WAY

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: 5/6/98
Chkd. by: ____ Date: ____

PROJECT:

DEVELOPED CONDITIONS

BASIN NUMBER: 2
WATERSHED AREA: 220 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY*	
MXC	B		96-60	21.5-74	2.5-84	7,541
OAD	B		73-60			4,380
ISD	B	27-69				1863

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

$\Sigma (A \times CN) = 13,804$

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{13,804}{220}$$

WEIGHTED CN = 63

* INCLUDES ENTIRE RIGHT-OF-WAY.

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: ____
Chkd. by: ____ Date: ____

PROJECT:

DEVELOPED CONDITIONS

BASIN NUMBER: 3
WATERSHED AREA: 946 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY*	
MXC	B		88-60	47-74	5-[illegible]	9,010
CAD	B		174-60			10,440
CED	B	5-69	80-60			5,145
KxBE	B	10-69	10-60			1,290
ISD	B	934-69	39-60			32,286
UMF	A	50-49				2,450
ULD	B	6-69				414

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

Σ(AxCN) 61,035

WEIGHTED CN = $\frac{\Sigma A \times CN}{AREA}$

WEIGHTED CN = $\frac{61,035}{946}$

WEIGHTED CN = 65

* INCLUDES ENTIRE RIGHT-OF-WAY.

[illegible]

APPENDIX B

Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

DEVELOPED CONDITIONS

BASIN NUMBER: 4
WATERSHED AREA: 110 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	HOTEL	WOODS	GOLF COURSE	ROADWAY*	
MXC	B	38-82	11-60	33-74	6-84	6722
CED	B		22-60			1320

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		
HOTEL		72	82		

* INCLUDES ENTIRE RIGHT-OF-WAY.

Σ(A x CN) 8042

WEIGHTED CN = $\frac{\Sigma A \times CN}{AREA}$

WEIGHTED CN = $\frac{8042}{110}$

WEIGHTED CN = 73

APPENDIX

Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

DEVELOPED CONDITIONS

BASIN NUMBER: 5
WATERSHED AREA: 110 ACRES

SOIL		AREA - CN				A x CN
CLASS.	GROUP	PASTURE	WOODS	GOLF COURSE	ROADWAY	
MXC	B		9-60	27.3-74	1-84	2,644
OED	B		73-60			4380

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		
GOLF COURSE	GOOD	59	74		
ROADWAY		74	84		

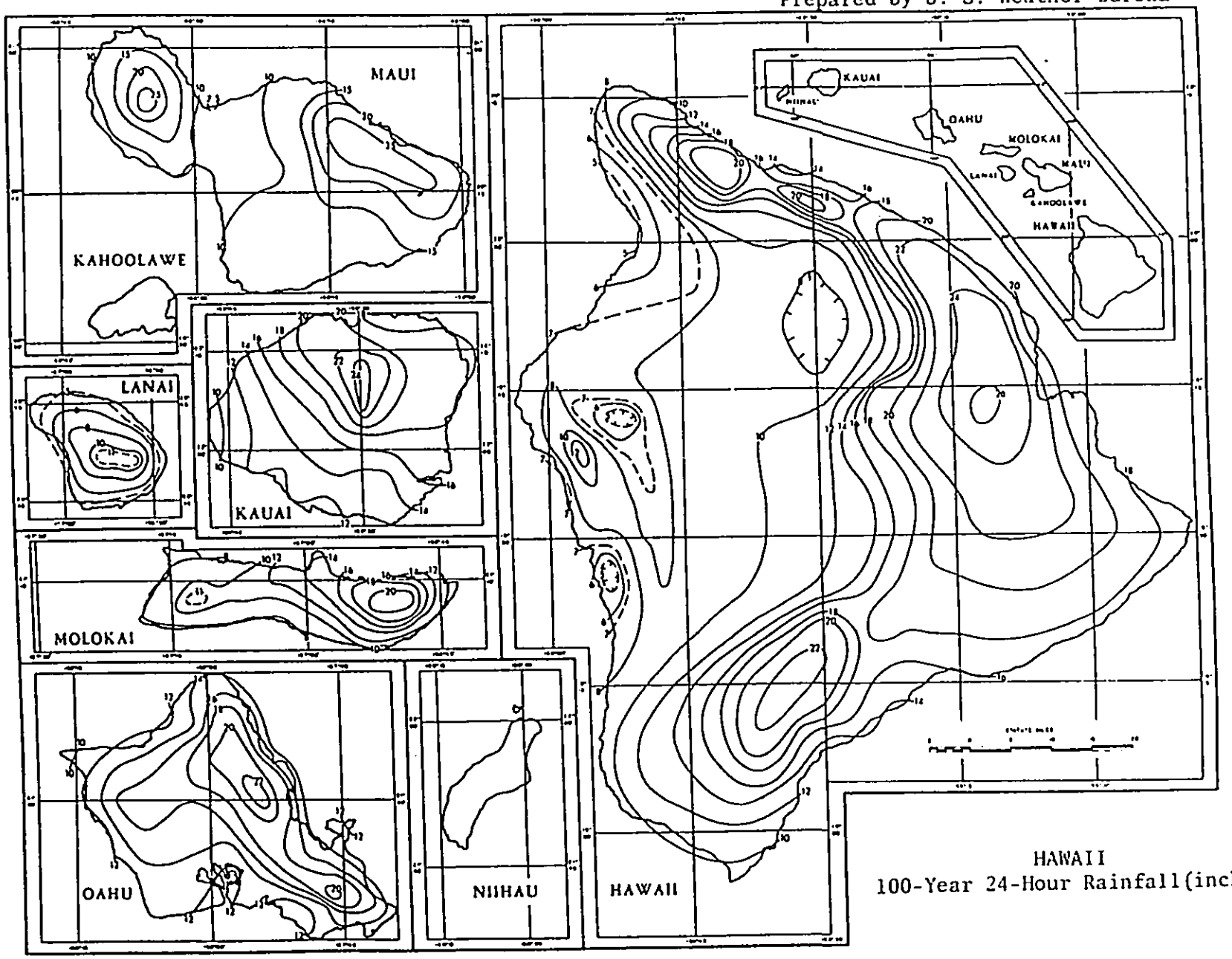
$\Sigma(A \times CN)$ 7,024

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{7024}{110}$$

WEIGHTED CN = 64

Prepared by U. S. Weather Bureau



HAWAII
100-Year 24-Hour Rainfall(inches)

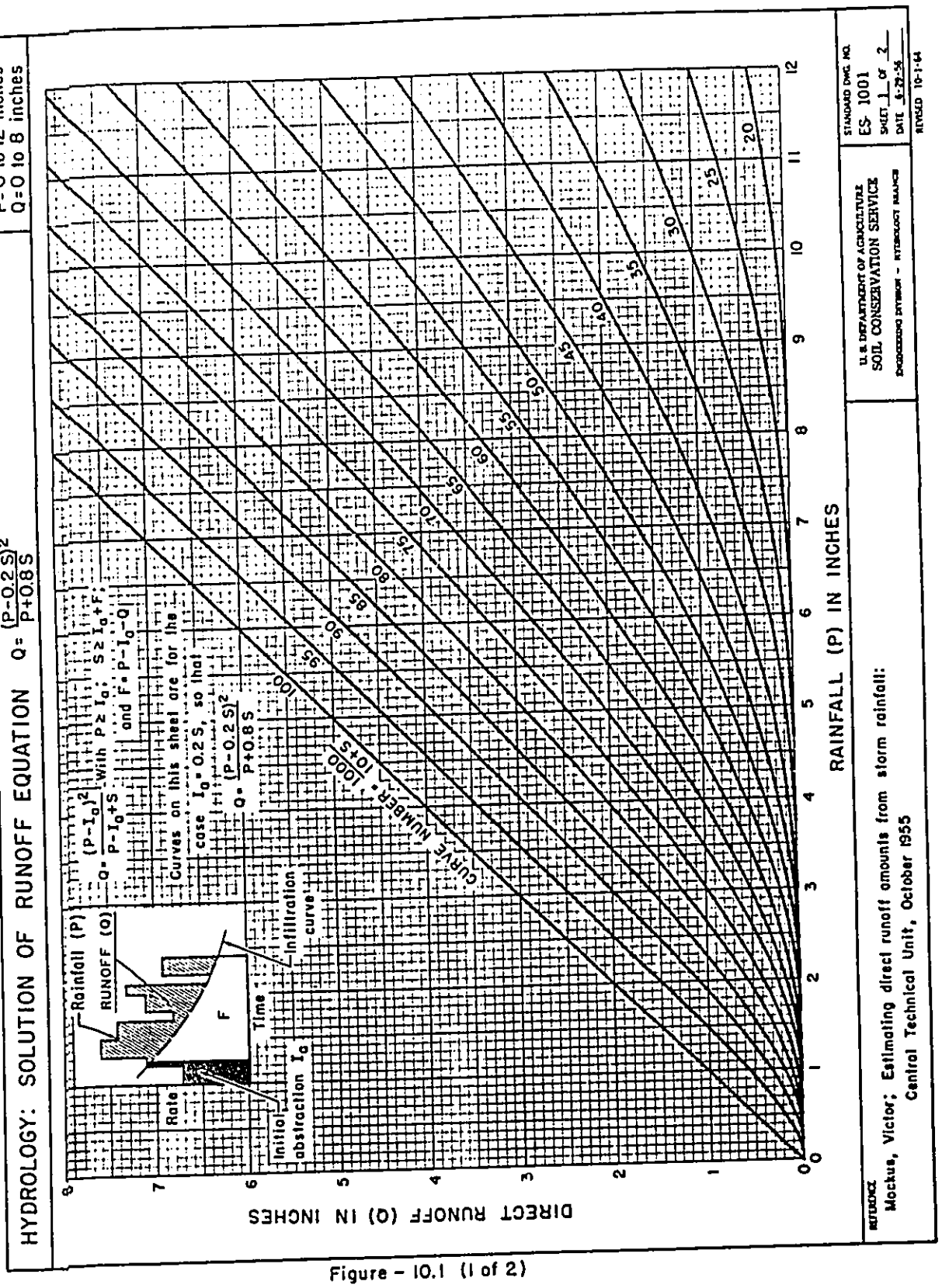


Figure – 10.1 (1 of 2)

Table 7.1--Continued

TURNBOW	C	USENE	B	VERDUN	D	WADDELL	B	WARDEN	B		
TURNER	B	USKA	D	VERGENNES	D	WADDOUPS	B	WARDWELL	C		
TURNERVILLE	B	UTALIAE	B	VERHALEN	D	WADELL	B	WARE	B		
TURNEY	B	UTE	C	VERMEJO	D	WADENA	B	WAREHAM	C		
TURRAH	D	UTICA	A	VERNAL	B	WADESBORO	B	WARMAN	D		
TURRET	B	UTLEY	B	VERNALIS	B	WADLEIGH	D	WARM SPRINGS	C		
TURRIA	C	UTUADO	B	VERNIA	A	WADMALAW	D	WARNERS	A/D		
TURSON	B/C	UVADA	D	VERNON	D	WADSWORTH	C	WARREN			
TUSCAN	D	UVALDE	C	VERONA	C	WAGES	B	WARRENTON	B/D		
TUSCARAWAS	C	UWALA	B	VESSER	C	WAGNER	D	WARRIOR			
TUSCARORA	C			VESTON	D	WAGRAM	A	WARSAW	B		
TUSCOLA	B	VACHERIE	C	VETAL	A	WAHA	C	WARSING	B		
TUSCUMBIA	D	VADER	B	VETERAN	B	WAHEE	D	WARWICK	A		
TUSEL	C	VADO	B	VEYO	D	WAHIAWA	B	WASATCH	A		
TUSKEEGO	C	VAIDEN	D	VIA	B	WAHIKULI	B	WASEPI	B		
TUSLER	B	VAILTON	B	VIAN	B	WAHKEENA	B	WASHBURN			
TUSQUITEE	B	VALBY	C	VIBORAS	D	WAHKIACUS	B	WASHINGTON	B		
TUSTIN	B	VALCO	C	VIBORG	B	WAHLUKE	B	WASHOE	C		
TUSTUMENA	B	VALDEZ	B/C	VICKERY	C	WAHMONIE	D	WASHOUGAL	B		
TUTHILL	B	VALE	B	VICKSBURG	B	WAHPETON	C	WASHTENAW	C/D		
TUTNI	B	VALENCIA	B	VICTOR	A	WAHTIGUP	B	WASILLA	D		
TUTWILER	B	VALENT	A	VICTORIA	D	WAHTUM	D	WASIOJA	B		
TUXEDO		VALENTINE	A	VICTORY	B	WAIAHA	D	WASSAIC	B		
TUXEKAN	B	VALERA	C	VICU	D	WAIAKOA	C	WATAB	C		
TWIN CREEK	B	VALKARIA	B/D	VIDA	B	WAIALEALE	D	WATAUGA	B		
TWINING	C	VALLAN	D	VIDRINE	C	WAIALUA	B	WATCHAUG	D		
TWISP	B	VALLECITOS	C/D	VIEJA	D	WAIAWA	D	WATCHUNG	D		
TWO DOT	C	VALLEGNO	B	VIENNA	B	WAIHUNA	D	WATERBORO	B		
TYBO	D	VALLERS	C	VIEQUES	B	WAIKALOA	B	WATERBURY	D		
TYEE	D	VALMONT	C	VIEW	C	WAIKANE	B	WATERINO	C		
TYGART	D	VALMY	B	VIGAR	C	WAIKAPU	B	WATERS	C		
TYLER	D	VALOIS	B	VIGO	D	WAIKOMO	D	WATKINS	B		
TYNDALL	B/C	VANER	D	VIGUS	C	WAILUKU	B	WATKINS RIDGE	B		
TYNER	A	VANAJO	D	VIKING	D	WAIMEA	B	WATO	B		
TYRONE	C	VANANDA	D	VIL	D	WAINEE	B	WATOPA	B		
TYSON	C	VAN BUREN		VILAS	A	WAINOLA	A	WATROUS	B		
		VANCE	C	VILLA GROVE	B	WAIPAHU	C	WATSEKA	C		
UANA	D	VANDA	C	*VILLARS*	B	WAISKA	B	WATSON	C		
UBAR	C	VANDALIA	C	VILLY	D	WAITS	B	WATSONIA	D		
UBLY	B	VANDERDASSON	D	VINA	B	WAKE	D	WATSONVILLE	B		
UCOLA	D	VANDERGRIFT	C	VINCENNES	C	WAKEEN	B	WATT	D		
UCOLO	C	VANDERHOFF	C	VINCENT	C	WAKEFIELD	B	WATTON	C		
UCOPIA	B	VANDERLIP	A	VINEYARD	C	WAKELAND	B/D	WAUBAY	B		
UDEL	D	VAN DUSEN	B	VINGO	B	WAKONDA	C	WAUBEEK	B		
UDOLPHO	C	VANET	D	VINING	C	WAKULLA	A	WAUBONSIE	B		
UFFENS	D	VANG	B	VINITA	C	WALCOTT	B	WAUCHULA	B/D		
UGAK	D	VANHORN	B	VINLAND	C	WALDECK	C	WAUCOMA	B		
UHLAND	B	VAN NOSTERN	B	VINSAD	C	WALDO	D	WAUCONDA	B		
UHLIG	B	VANNOY	B	VINT	B	WALDRON	D	WAUKEE	B		
UINTA	B	VANOSS	B	VINTON	B	WALDROUP	D	WAUKEGAN	B		
UKIAH	C	VANTAGE	C	VIRA	C	WALES	B	WAUKENA	D		
ULEN	B	VAN WAGONER	D	VIRATON	C	WALFORD	C	WAUKON	B		
ULLOA	B	VARCO	C	VIRDEN	C	WALKE	C	WAUMBEK	B		
ULM	B	VARELUM	C	VIRGIL	B	WALL	B	WAURIKA	D		
ULRICHER	B	VARICK	D	VIRGIN PEAK	D	WALLACE	B	WAUSEON	B/D		
ULUPALAKUA	B	VARINA	C	VIRGIN RIVER	D	WALLA WALLA	B	WAVERLY	B/D		
ULY	B	VARNA	C	VIRTUE	C	WALLER	B/D	WAWAKA	C		
ULYSSES	B	VARRO	B	VISALIA	B	WALLINGTON	C	WAYCUP	B		
UMA	A	VARYSBURG	B	VISTA	C	WALLIS	B	WAYDEN	D		
UNAPINE	B/C	VASHTI	C	VIVES	B	WALLKILL	C/D	WAYLAND	C/D		
UNIAT	D	VASQUEZ	B	VIVI	B	WALLMAN	C	WAYNE	B		
UNIKOA	B	VASSALBORO	D	VLASATY	C	WALLOWA	C	WAYNESBORO	B		
UNIL	D	VASSAR	B	VOCA	C	WALLPACK	C	WAYSIDE			
UNNAK	B	VASTINE	C	VODERMAIER	B	WALLROCK	B/C	WEA	B		
UNPA	B	VAUCLUSE	C	VOLADORA	B	WALLSBURG	D	WEAVER	C		
UMPQUA	B	VAUGHNSVILLE	C	VOLCO	D	WALLSON	B	WEBB	C		
UNA	D	VAYAS	D	VOLENTE	C	WALPOLE	C	WEBER	D		
UNADILLA	B	VEAL	B	VOLGA	D	WALSH	B	WEBSTER	C		
UNAWEEP	B	VEAZIE	B	VOLIN	B	WALSHVILLE	D	WEDEKIND	C		
UNCOM	B	VEBAR	B	VOLINIA	B	WALTERS	A	WEDERTZ	C		
UNCOMPAHGRE	D	VECONT	D	VOLKE	C	WALTON	C	WEDGE	A		
UNEEDA	B	VEGA	C	VOLKMAR-	B	WALUM	B	WEDOWEE	D		
UNGERS	B	VEGA ALTA	C	VOLMER	D	WALVAN	B	WEED	B		
UNION	C	VEGA BAJA	C	VOLNEY	B	WAMBA	B/C	WEEDING	A/C		
UNIONTOWN	B	VEKOL	D	VOLPERIE	C	WAMIC	B	WEEDMARK	B		
UNIONVILLE	C	VELDA	B	VOLTAIRE	D	WAMPSVILLE	B	WEEKSVILLE	B/D		
UNISUN	C	VELMA	B	VOLUSIA	C	WANATAH	B	WEEPON	D		
UPOIKE	D	VELVA	B	VONA	B	WANBLEE	D	WEHADKEE	D		
UPSAL	C	VENA	C	VORE	B	WANDO	A	WEIKERT	C/D		
UPSATA	A	VENANGO	C	VROOMAN	B	WANETTA	A	WEIMER	D		
UPSHUR	C	VENATOR	D	VULCAN	C	WANILLA	C	WEINBACH	C		
UPTON	C	VENETA	C	VYLACH	D	WANN	A	WEIR	D		
URACCA	B	VENEZIA	D			WAPAL	B	WEIRMAN	B		
URBANA	C	VENICE	D	WABANICA	D	WAPATO	C/D	WEISER	C		
URBO	D	VENLO	D	WABASH	D	WAPELLO	B	WEISHAUPT	D		
URICH	D	VENUS	B	WABASHA	D	WAPINITIA	B	WEISS	A		
URNE	B	VERBOORT	D	WABASSA	B/D	WAPPING	B	WEITCHPEC	B		
URSINE	D	VERDI	C	WABEK	B	WAPSIE	B	WELAKA	A		
UNTAH	C	VERDEL	D	WACA	C	WARBA	B	WELBY	B		
URWIL	D	VERDELLA	D	WACOTA	B	WARD	D	WELCH	C		
USAL	B	VERDICO	D	WACOUSTA	C	WARDBORO	A	WELD	C		
USHAR	B	VERDIGRIS	B	WADAMS	B	WARDELL	D	WELDA	C		

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table 7.1--Continued

NEWTOWN	C	NORTON	C	OKAW	D	ORELLA	D	PACK	C
NEWVILLE	C	NORTONVILLE	C	OKAY	B	OREN	A	PACKARD	B
NEZ PERCE	C	NORTUNE	D	OKEECHOBEE	A/D	ORESTIMBA	C	PACKER	C
NIAGARA	C	NORWALK	B	OKEELANTA	A/D	ORFORD	C	PACKHAM	B
NIART	B	NORWAY FLAT	B	OKEMAH	C	ORIDIA	C	PACKSADDLE	B
NIBLEY	C	NORWELL	C	OKLARED	B	ORIF	A	PACKWOOD	D
NICHOLSON	C	NORWICH	D	OKLAWAHA	A/D	ORIO	C	PACOLET	B
NICHOLVILLE	C	NORWOOD	B	OKMOK	B	ORION	B	PACTOLUS	C
NICKEL	B	NOTI	D	OKO	D	ORITA	B	PADEN	C
NICODEMUS	B	NOTUS	A/C	OKOBOJI	C	ORLAND	B	PADRONI	B
NICOLAUS	C	NOUQUE	D	OKOLONA	D	ORLANDO	A	PADUCAH	B
NICOLLET	B	NOVARA	B	OKREEK	D	ORMAN	C	PADUS	B
NIELSEN	D	NOVARY	B	OKTIBBEHA	D	ORMSBY	B/C	PAESL	B
NIGHTHAWK	B	NOWOOD	C	OLA	C	ORODELL	C	PAGET	B
NIHILL	B	NOYO	C	OLAA	A	ORO FINO	B	PAGODA	C
NIKABUNA	D	NOYSON	C	OLALLA	C	ORO GRANDE	C	PAHRANAGAT	C
NIKEY	B	NUBY	C/D	OLANTA	B	ORONO	C	PAHREAH	D
NIKISHKA	A	NUCKOLLS	C	OLATHE	C	OROVADA	C	PAHROC	D
NIKLASON	B	NUCLA	B	OLD CAMP	D	ORPHANT	D	PAIA	C
NIKOLAI	D	NUECES	C	OLDHAM	C	ORR	C	PAICE	C
NILAND	C	NUGENT	A	OLOS	D	ORRVILLE	C	PAINESVILLE	C
NILES	C	NUGGET	C	OLDSMAR	B/D	ORSA	A	PAINTROCK	C
NIMROD	C	NUMA	C	OLDWICK	B	ORSINO	A	PAIT	B
NINCH	C	NUNDA	C	OLELO	B	ORTELLO	A	PAJARITO	B
NINEMILE	D	NUNICA	C	OLENA	B	ORTIGALITA	C	PAJARO	C
NINEVEH	B	NUNN	C	OLEQUA	B	ORTING	C	PAKA	B
NINIGRET	B	NUSS	D	OLETE	C	ORTIZ	C	PAKALA	B
NININGER	B	NUTLEY	C	OLEX	B	ORTLEY	B	PAKINI	B
NINNESCAH	C	NUTRAS	C	OLGA	C	ORWET	A	PALA	B
NIOBELL	C	NUTRIOSO	B	OLI	B	ORWOOD	B	PALACIO	B
NIOTA	D	NUVALDE	C	OLIAGA	B/D	OSAGE	D	PALAPALAI	B
NIPE	B	NYALA	D	OLINDA	B	OSAKIS	B	PALATINE	B
NIPPERSINK	B	NYMORE	A	OLIPHANT	B	OSCAR	D	PALESTINE	D
NIPPT	A	NYSSA	C	OLIVENHAIN	D	OSCURA	C	PALISADE	B
NIPSUM	C	NYSSATON	B	OLIVER	B	OSGOOD	B	PALMA	B
NIRA	B	NYSTROM	C	OLIVIER	C	OSHA	B	PALMAREJO	C
NISHNA	C			OLJETO	A	OSHAWA	D	PALM BEACH	A
NISHON	D	OAHE	B	OLMITO	D	O'SHEA	C	PALMER	D
NISQUALLY	A	OAKDALE	B	OLMITZ	B	OSHKOSH	C	PALMER CANYON	B
NISSWA	B	OAKDEN	D	OLMOS	C	OSHTEMO	B	PALMICH	B
NIU	B	OAKFORD	B	OLMSTED	B/D	OSIER	B/D	PALMS	D
NIULII	C	OAK GLEN	B	OLNEY	B	OSKA	C	PALMYRA	B
NIVLOC	D	OAK GROVE	C	OLOKUI	D	OSMUND	B	PALO	B
NIWOT	C	OAK LAKE	B	OLPE	C	OSO	B	PALODURO	B
NIXA	C	OAKLAND	C	OLSON	D	OSOBB	D	PALOMAS	B
NIXON	B	OAKS RIDGE	C	OLTON	C	OSORIDGE	D	PALOMINO	D
NIXONTON	B	OAKVILLE	A	OLUSTEE	B/D	OSOTE	B	PALOS VERDES	B
NIZINA	A	OAKWOOD	D	OLYIC	B	OSSIAN	C	PALOUSE	B
NOBE	D	OANAPUKA	B	OLYMPIC	B	OST	B	PALSGROVE	B
NOBLE	B	OASIS	B	OMADI	B	OSTRANDER	B	PAMLICO	D
NOBSCOTT	A	OATMAN	B	OMAHA	B	OTERO	B	PANDA	C
NOCKEN	C	OBAN	C	OMAK	C	OTHELLO	D	PAMSDEL	D
NODAWAY	B	OBARC	B	OMEGA	A	OTIS	C	PAMUNKEY	C
NOEL	D	OBEN	C	OMENA	B	OTISCO	A	PANA	B
NOHILI	D	OBRAST	D	OMNI	C	OTISVILLE	A	PANACA	D
NOKASIPPI	D	OBRAY	D	ONA	A/D	OTLEY	B	PANAEWA	D
NOKAY	C	OBURN	D	ONALASKA	B	OTSEGO	C	PANASOFFKEE	D
NOKOMIS	B	OCALA	D	ONAMIA	B	OTTER	B/D	PANCHERI	B
NOLAM	B	OCEANET	D	ONARGA	B	OTTERBEIN	C	PANCHUELA	C
NOLICHUCKY	B	OCEANO	A	ONAWA	D	OTTERHOLT	B	PANDO	B
NOLIN	B	OCHEYEDAN	B	ONAWAY	B	OTTOKEE	A	PANDOAH	C
NOLO	B	OCHLOCKONEE	B	ONDAWA	B	OTWAY	D	PANDORA	D
NOME	D	OCHO	D	ONEIDA	B	OTWELL	C	PANDURA	D
NONDALTON	B	OCHOCO	C	O'NEILL	B	OUACHITA	C	PANE	B
NONOPAHU	D	OCHOPEE	B/D	ONEONTA	B	OURAY	A	PANGUITCH	B
NOOKACHAMPS	C/D	OCILLA	C	ONITA	C	OUTLET	C	PANHILL	B
NOOKSACK	B	OCKLEY	B	ONITE	B	OVALL	C	PANIOGUE	B
NOONAN	D	OCOEE	A/D	ONOTA	C	OVERGAARD	C	PANKY	C
NORA	B	OCONEE	C	ONOVA	D	OVERLAND	C	PANOCHE	B
NORAD	B	OCONTO	B	ONRAY	C	OVERLY	C	PANOLA	D
NORBERT	D	OCOSTA	D	ONSLOW	B	OVERTON	D	PANSEY	D
NORBORNE	B	OCQUEOC	B	ONTARIO	B	OVID	C	PANTEGO	D
NORBY	B	OCTAGON	B	ONTKO	B/D	OVINA	B	PANTHER	D
NORD	B	ODEE	D	ONTONAGON	D	OWEGO	D	PANTON	D
NORDBY	B	ODELL	B	ONYX	B	OWEN CREEK	C	PAOLA	A
NORDEN	B	ODEM	A	OOKALA	A	OWENS	D	PAOLI	B
NORDNESS	B	ODERMOTT	C	OPAL	D	OWHI	B	PAONIA	C
NORFOLK	B	ODESSA	D	OPEQUON	C/D	OWOSSO	B	PAPAA	D
NORGE	B	ODIN	C	OPHIR	C	OWYHEE	B	PAPAI	A
NORKA	B	ODNE	C	OPINIKAO	D	OXALIS	C	PAPAKATING	D
NORMA	B/C	O'FALLON	D	OPPIO	D	OXBOW	C	PAPOOSE	C
NORMANGEE	D	OGDEN	D	OQUAGA	C	OXERINE	C	PARADISE	C
NORREST	C	OGEECHEE	C	ORA	C	OXFORD	D	PARADOX	B
NORRIS	C	OGEMAW	C	ORAN	B	OZAMIS	B/D	PARALOMA	C
NORRISTON	B	OGILVIE	C	ORANGE	D	OZAN	D	PARAMORE	D
NORTE	B	OGLALA	B	ORANGEBURG	B	OZAUKEE	C	PARASOL	B
NORTHDALE	C	OGLE	B	ORCAS	D			PARCELAS	D
NORTHFIELD	B	OHAYSI	D	ORCHARD	B	PAAIKI	B	PARDEE	D
NORTHMORE	C	OHIA	A	ORD	A	PAALOA	B	PAREHAT	C
NORTHPORT		OJAI	B	ORDNANCE	C	PAAUHAU	A	PARENT	C
NORTH POWDER	C	OJATA	D	ORDWAY	D	PACHAPPA	B	PARIETTE	C
NORTHUMBERLAND	C/D	OKANOGAN	B	ORELIA	D	PACHECO	B/C	PARIS	

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Table 7.1--Continued

LYMAN	C/D	MALIN	C/D	MARLETTE	B	MAY DAY	D	MCPHERSON	C		
LYMANSON	C	MALJAMAR	B	MARLEY	C	MAYER	D	MCPHIE	B		
LYNCH	D	MALLOT	A	MARLIN	D	MAYES	D	MCQUARRIE	D		
LYNCHBURG	B/D	MALM	C	MARLOW	C	MAYFIELD	B	MCQUEEN	C		
LYNDEN	A	MALO	B	MARLTON	C	MAYFLOWER	C	MCRAE	B		
LYNNDYL	A	MALONE	B	MARMARTH	B	MAYHEW	D	MCTAGGART	B		
LYNN HAVEN	B/D	MALOTERRE	D	MARNA	D	MAYLAND	C	MCVICKERS	C		
LYNNVILLE	C	MALPAIS	C	MARPA	B	MAYMEN	D	MEAD	D		
LYNX	B	MALPOSA	C	MARPLEEN	D	MAYNARD LAKE	B	MEADIN	A		
LYONMAN	C	MALVERN	C	MARQUETTE	A	MAYO	B	MEADOWVILLE	B		
LYONS	D	MAMALA	D	MARR	B	MAYODAN	B	MEADVILLE	C		
LYONSVILLE	B	MAMOU	C	MARRIOTT	B	MAYOWORTH	C	MEANDER	D		
LYSINE	D	MANAHAA	C	MARSDEN	C	MAYSDORF	B	MECAN	B		
LYSTAIR	B	MANALAPAN		MARSELL	B	MAYSVILLE		MECCA	B		
LYTELL	B	MANANA	C	MARSHALL	B	MAYTOWN	C	MECKESVILLE	C		
		MANASSA	C	MARSHAN	D	MAYVILLE	B	MECKLENBURG	C		
MABANK	D	MANASSAS	B	MARSHDALE	C	MAYWOOD	B	MEDA	B		
MABEN	C	MANASTASH	C	MARSHFIELD	C	MAZEPPA	B	MEDANO	C		
MABI	D	MANATEE	B/D	MARSING	B	MAZON	C	MEDARY	C		
MABRAY	D	MANAWA	C	MART	C	MAZUMA	C	MEDFORD	B		
MACAR	B	MANCELONA	A	MARTELLA	B	MCAFEE	C	MEDFRA	U		
MACEDONIA	C	MANCHESTER	A	MARTIN	C	MCALLEN	B	MEDICINE LODGE	B		
MACFARLANE	B	MANDAN	B	MARTINA	A	MCALLISTER	C	MEDINA	B		
MACHETE	C	MANDERFIELD	B	MARTINECK	D	MCALPIN	C	MEDLEY	B		
MACHIAS	B	MANDEVILLE	B	MARTINEZ	D	MCBEE	B	MEDWAY	B		
MACHUELO	D	MANFRED	D	MARTINI	B	MCBETH	D	MEEKS	A		
MACK	C	MANGUM	D	MARTINSBURG	B	MCBRIDE	B	MEETEETSE	D		
MACKEN	D	MANHATTAN	A	MARTINSDALE	B	MCCABE	B	MEGGETT	D		
MACKINAC	B	MANHEIM	C	MARTINSON	D	MCCAFFERY	A	MEGON	C		
MACKSBURG	B	MANI	C	MARTINSVILLE	B	MCCAIN	C	MEHL	C		
MACOMB	B	MANILA	C	MARTINTON	C	MCCALEB	B	MEHLHORN	C		
MACONBER	B	MANISTEE	B	MARTY	B	MCCALLY	D	MEIGS			
MACON	B	MANITOU	C	MARVAN	D	MCCAMMON	D	MEIKLE	D		
MACY	B	MANLEY	B	MARVELL	B	MCCANN	C	MEISS	D		
MADALIN	D	MANLIUS	C	MARVIN	C	MCCARRAN	D	MELBOURNE	B		
MADAWASKA	B	MANLOVE	B	MARY	C	MCCARTHY	B	MELBY	C		
MADDOCK	A	MANNING	B	MARYDEL	B	MCCLAVE	C	MELITA	B		
MADDOX		MANOGUE	D	MARYSLAND	D	MCCLEARY	C	MELLENTHIN	D		
MADELIA	C	MANOR	B	MASADA	C	MCCLELLAN	B	MELLOR	D		
MADELINE	D	MANSFIELD	D	MASCAMP	D	MCCLOUD	C	MELLOTT	B		
MADERA	D	MANSIC	B	MASCHETAH	B	MCCOIN	D	MELOLAND	C		
MADISON	B	MANSKER	B	MASCOTTE	D	MCCOLL	D	MELROSE	C		
MADONNA	C	MANTACHIE	C	MASHEL	C	MCCONNEL	B	MELSTONE	A		
MADRAS	C	MANTEO	C/D	MASHULAVILLE	B/D	MCCOOK	B	MELTON	B		
MADRID	B	MANTER	B	MASON	B	MCCORNICK	C	MELVILLE	B		
MADRONE	C	MANTON	B	MASONVILLE	C	MCCOY	C	MELVIN	D		
MADUREZ	B	MANTZ	B	MASSACK	B	MCCREE	B	MEMALOOSE	D		
MAFURT	B	MANU	C	MASSENA	C	MCCRORY	D	MEMPHIS	B		
MAGALLON	B	MANVEL	C	MASSILLON	B	MCCROSKIE	D	MENAHGA	A		
MAGENS	B	MANWOOD	D	MASTERSON	B	MCCULLOUGH	C	MENAN	C		
MAGGIE	D	MANZANITA	C	MATAGORDA	D	MCCULLY	C	MENARD	B		
MAGINNIS	C	MANZANO	C	MATAMOROS	C	MCCUNE	D	MENCH	C		
MAGNA	D	MANZANOLA	C	MATANUSKA	C	MCCUTCHEN	C	MENDEBOURE	C		
MAGNOLIA	B	MAPES	C	MATANZAS	B	MCDOLE	B	MENDOCINO	B		
MAGNUS	C	MAPLE MOUNTAIN	B	MATAPEAKE	B	MCDONALD	B	MENDON	B		
MAGOTSU	D	MAPLETON	C/D	MATAWAN	C	MCDONALDSVILLE	C	MENDOTA	B		
MAGUAYO	D	MARAGUEZ	B	MATCHER	A	MCEWEN	B	MENEFEE	D		
MAHAFFEY	C/D	MARATHON	B	MATFIELD	C	MCFADDEN	B	MENFRO	B		
MAHAFFY	C/D	MARBLE	A	MATHERS	B	MCFAIN	C	MENLO	D		
MAHALA	C	MARBLEMOUNT	B	MATHERTON	B	MCFAUL	C	MENO	C		
MAHALASVILLE	B/D	MARCELINAS	D	MATHESON	B	MCGAFFEY	B	MENOKEN	C		
MAHANA	B	MARCETTA	A	MATHEWS		MCGARR	C	MENOMINEE	B		
MAHASKA	B	MARCIAL	D	MATHIS	A	MCGARY	C	MENTO	C		
MAHER	C	MARCUM	B	MATHISTON	C	MCGEHEE	C	MENTOR	B		
MAHONING	D	MARCUS	C	MATLOCK	D	MCGILVERY	D	MEQUON	C		
MAHUKONA	B	MARCUSE	D	MATMON	D	MCGINTY	B	MERCED	C/D		
MAIDEN	B	MARCY	D	MATTAPEX	C	MCGIRK	C	MERCEDES	D		
MAILE	A	MARDEN	C	MATTOLE	C	MCGOWAN	B	MERCER	C		
MAINSTAY	D	MARDIN	C	MAU	D	MCGRATH	B	MERCEY	C		
MAJADA	B	MARENGO	C/D	MAUDE	B	MCGREW	A	MEREDITH	B		
MAKAALAE	B	MARESUA	B	MAUGHAN	C	MCHENRY	B	MERETA	C		
MAKALAPA	D	MARGERUM	B	MAUKEY	C	MCILWAINE	A	MERGEL	B		
MAKAPILI	A	MARGUERITE	B	MAUMEE	A/D	MCINTOSH	B	MERIDIAN	B		
MAKAWAO	B	MARIA	B/C	MAUNABO	D	MCINTYRE	B	MERINO	D		
MAKAWELI	B	MARIANA	C	MAUPIN	C	MCKANIE	D	MERKEL	B		
MAKENA	B	MARIAS	D	MAUREPAS	D	MCKAY	D	MERLIN	D		
MAKIKI	B	MARICAO	B	MAURICE	A	MCKENNA	C/D	MERMILL	B/D		
MAKLAK	A	MARICOPA	B	MAURINE	D	MCKENZIE	D	MERNA	D		
MAKOTI	C	MARIETTA	C	MAURY	B	MCKINLEY	B	MEROS	A		
MAL	B	MARILLA	C	MAVERICK	C	MCKINNEY	D	MERRIFIELD	B		
MALA	B	MARINA	A	MAVIE	D	MCLAIN	C	MERRILL	C		
MALABAR	A/D	MARION	D	MAWAE	A	MCLAURIN	B	MERRILLAN	C		
MALABON	C	MARIPOSA	C	MAX	B	MCLEAN	C	MERRIMAC	A		
MALACHY	B	MARISSA	C	MAXEY	C	MCLEOD	B	MERRITT	B/C		
MALAGA	B	MARKES	D	MAXFIELD	C	MCMAHON	C	MER ROUGE	B		
MALAKA	A	MARKEY	D	MAXSON	A	MCMEEN	C	MERTON	B		
MALAYA	D	MARKHAM	C	MAXTON	B	MCMULLIN	D	MERTZ	B		
MALBIS	B	MARKLAND	C	MAXVILLE	A	MCMURDIE	C	MESA	B		
MALCOLM	B	MARKSBORO	C	MAXWELL	D	MCMURPHY	B	MESCAL	B		
MALETTI	C	MARLA	A	MAY	B	MCMURRAY	D	MESCALERO	C		
MALEZA	B	MARLBORO	B	MAYBERRY	C	MCNARY	D	MESITA	C		
MALIBU	D	MARLEAN	B	MAYBESO	D	MCPAUL	B	MESKILL	C		

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Table 7.1--Continued

HENLEY	C	HOBOG	D	HORD	B	HYAT	A	IZAGORA	C		
HENLINE	C	HOBSON	C	HOREB	B	HYATTVILLE	C	IZEE	C		
HENNEKE	D	HOCHHEIM	B	HORNE	D	HYDABURG	D				
HENNEPIN	B	HOCKING	B	HORNELL	D	HYDE	D	JABU	C		
HENNINGSEN	C	HOCKINSON	C	HORNING	A	HYDRO	C	JACAGUAS	B		
HENRY	D	HOCKLEY	C	HORNITOS	D	HYMAS	D	JACANA	D		
HENSEL	B	HODGE	B	HORROCKS	B	HYRUM	B	JACINTO	B		
HENSHAW	C	HODGINS	C	HORSESHOE	B	HYSHAM	D	JACK CREEK	A		
HENSLEY	D	HODGSON	C	HORTON	B			JACKLIN	B		
HEPLER	D	HOEBE	B	HORTONVILLE	B	IAO	C	JACKNIFE	C		
HERBERT	B	HOELZLE	C	HOSKIN	C	IBERIA	D	JACKPORT	D		
HEREFORD	B	HOFFMAN	C	HOSKINNINI	D	ICENE	C	JACKS	C		
HERKIMER	B	HOFFMANVILLE	C	HOSLEY	D	IDA	B	JACKSON	B		
HERLONG	D	HOGANSBURG	B	HOSMER	C	IDABEL	B	JACKSONVILLE	C		
HERMISTON	B	HOGELAND	B	HOTAW	C	IDAK	B	JACOB	D		
HERMON	A	HOGG	C	HOT LAKE	C	IDANA	C	JACOBSEN	D		
HERNDON	B	HOGRIS	B	HOUDEK	B	IDEON	D	JACOBY	C		
HERO	B	HOH	B	HOUGHTON	A/D	IDMON	B	JACQUES	C		
HERRERA	A	HOHMANN	C	HOUK	C	IGNACIO	C	JACQUITH	C		
HERRICK	C	HOKO	C	HOULKA	D	IGO	D	JAEWIN	B		
HERRON	B	HOLBROOK	B	HOULTON	C/D	IGUALDAD	D	JAFFREY	A		
HERSH	A	HOLCOMB	D	HOUNDBY	D	IHLEN	D	JAGUEYES	B		
HERSHAL	B/D	HOLDAWAY	D	HOURGLASS	B	IJAM	D	JAL	B		
HESCH	B	HOLDEN	A	HOUSATONIC	D	ILDEFONSO	B	JALMAR	A		
HESPER	C	HOLDER	B	HOUSE MOUNTAIN	D	ILKA	B	JAMES CANYON	B/C		
HESPERIA	B	HOLDERMAN	C	HOUSEVILLE	C	ILLION	B/D	JAMESTOWN	C		
HESPERUS	B	HOLDERNESS	C	HOUSTON	D	IMA	B	JANE	C		
HESSE	C	HOLDREGE	B	HOUSTON BLACK	D	IMBLER	B	JANISE	C		
HESSEL	D	HOLLAND	B	HOVDE	A/C	IMLAY	C	JANSEN	A		
HESSELBERG	D	HOLLINGER	B	HOVEN	D	INMOKALEE	B/D	JARAB	D		
HESSELTINE	B	HOLLIS	C/D	HOVENWEEP	C	*INPERIAL*	*D*	*JARBOE*	C		
HESSLAN	C	HOLLISTER	D	HOVERT	D	INAVALE	A	JARITA	C		
HESSON	C	HOLLOMAN	C	HOVEY	C	INDART	B	JARRE	B		
HETTINGER	D	HOLLOWAY	A	HOWARD	B	INDIAHOMA	D	JARVIS	B		
HEXT	B	HOLLY	D	HOWELL	C	INDIAN		JASPER	B		
HEZEL	B	HOLLY SPRINGS	D	HOWLAND	C	INDIAN CREEK	D	JAUCAS	A		
HIALEAH	D	HOLLYWOOD	D	HOYE	B	INDIANO	C	JAVA	B		
HIAWATHA	A	HOLMDEL	C	HOYLETON	C	INDIANOLA	A	JAY	C		
HIBBARD	D	HOLMES	B	HOYPUS	A	INDIO	B	JAYEM	B		
HIBBING	C	HOLOHUA	B	HOYTVILLE	D	INGA	B	JAYSON	D		
HIBERNIA	C	HOLOPAW	B/D	HUBBARD	A	INGALLS	B	JEAN	A		
HICKORY	C	HOLROYD	B	HUBERLY	D	INGARD	B	JEANERETTE	D		
HICKS	B	HOLSINE	B	HUBERT	B	INGENIO	C	JEAN LAKE	B		
HIDALGO	B	HOLST	B	HUBLERSBURG	C	INGRAM	D	JEDD	C		
HIDEAWAY	D	HOLSTON	B	HUCKLEBERRY	C	INKLER	B	JEDDO	C		
HIDEWOOD	C	HOLT	B	HUDSON	C	INKS	D	JEFFERSON	B		
HIERRO	C	HOLTLE	B	HUECO	C	INMACHUK	D	JEKLEY	C		
HIGHAMS	D	HOLTVILLE	C	HUEL	A	INMAN	C	JELM	D		
HIGHFIELD	B	HOLYOKE	C/D	HUENEME	B/C	INMO	A	JENA	B		
HIGH GAP	C	HOMA	C	HUERHUERO	D	INNESVALE	D	JENKINS	B		
HIGHLAND	B	HOME CAMP	C	HUEY	D	INSKIP	C	JENKINSON	D		
HIGHMORE	B	HOMELAKE	B	HUFFINE	A	INVERNESS	D	JENNESS	B		
HIGH PARK	B	HOMER	C	HUGGINS	C	INVILLE	B	JENNINGS	C		
HIHIMANU	A	HOMESTAKE	D	HUGHES	B	INWOOD	C	JENNY	D		
HIIBNER	C	HOMESTEAD	B	HUGHESVILLE	B	IO	B	JERAULD	D		
HIKO PEAK	B	HONAUNAU	C	HUGO	B	IOLA	A	JERICHO	C		
HIKO SPRINGS	D	HONCUT	B	HUICHICA	C/D	IOLEAU	C	JEROME	C		
HILDRETH	D	HONDALE	D	HUIKAU	A	IONA	B	JEARY	C		
HILEA	D	HONDO	C	HULETT	B	IONIA	B	JESBEL	D		
HILES	B	HUNDOMO	B	HULLS	C	IOSCO	B	JESSE CAMP	D		
HILGER	B	HONEOYE	B	HULLT	B	IPAVA	B	JESSUP	C		
HILGRAVE	B	HONEY	D	HULUA	D	IRA	C	JETT	B		
HILLEMANN	C	HONEYGROVE	C	HUM	B	IREDELL	D	JIGGS	C		
HILLERY	D	HONEYVILLE	C	HUMACAO	B	IRETEBA	C	JIM	C		
HILLET	D	HONN	B	HUMATAS	C	IRIM	C	JIMENEZ	C		
HILLFIELD	B	HONOKAA	A	HUMBARGER	B	IROCK	B	JIMTOWN	C		
HILLGATE	D	HONOLUA	B	HUMBIRD	C	IRON BLOSSOM	D	JOB	C		
HILLIARD	B	HONOMANU	B	HUMBOLDT	D	IRON MOUNTAIN	D	JOBOS	C		
HILLON	B	HONOULIULI	D	HUMDUM	B	IRON RIVER	B	JOCITY	B		
HILLSBORO	B	HONUAULU	A	HUME	C	IRONTON	C	JOCKO	A		
HILLSDALE	B	HOOD	B	HUMESTON	C	IRRIGON	C	JODERO	B		
HILMAR	C/D	HOODLE	B	HUMMINGTON	C	IRVINGTON	C	JOEL	B		
HILO	A	HOODSPORT	C	HUMPHREYS	B	IRWIN	D	JOES	B		
HILT	B	HOODVIEW	B	HUMPTULIPS	B	ISAAC	C	JOHNS	C		
HILTON	B	HOOKTON	C	HUNSAKER	B/C	ISAAQUAH	B/C	JOHNSBURG	D		
HINCKLEY	A	HOOLEHUA	B	HUNTERS	B	ISAN	D	JOHNSON	B		
HINDES	C	HOOPAL	D	HUNTING	C	ISANTI	D	JOHNSTON	B/D		
HINESBURG	C	HOOPER	D	HUNTINGTON	B	ISBELL	C	JOHNSWOOD	B		
HINKLE	D	HOOPESTON	B	HUNTSVILLE	B	ISHAM	C	JOICE	D		
HINMAN	C	HOOSIC	A	HUPP	B	ISHI PISHI	C	JOLAN	C		
HINSDALE		HOOT	D	HUROS	B	ISLAND	B	JOLIET	C		
HINTZE	D	HOOTEN	D	HURLEY	D	ISOM	B	JONESVILLE	A		
HIPPLE	C	HOOVER	B	HURON	C	ISSAQUAH	B/C	JONUS	B		
HISLE	D	HOPEKA	D	HURST	D	ISTOKPOGA	D	JOPLIN	B		
HITT	B	HOPETON	C	HURWAL	B	ITCA	D	JOPPA	B		
HI VISTA	C	HOPEWELL		HUSE	C	ITSWOOT	B	JORDAN	D		
HIWASSEE	B	HOPGOOD	C	HUSSA	B/D	IUKA	C	JORGE	B		
HIWOOD	A	HOPKINS	B	HUSSMAN	D	IVA	C	JORNADA	C		
HIXTON	B	HOPLEY	B	HUTCHINSON	C	IVAN	B	JORY	C		
HOBACKEN	B	HOPPER	B	HUTSON	B	IVES	B	JOSE	C		
HOBAN	C	HOQUIAM	B	HUXLEY	D	IVIE	A	JOSEPHINE	B		
HOBBS	B	HORATIO	D	HYAM	D	IVINS	C	JOSIE	B		

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Table 7.1--Continued

JOY	B	KARNAK	D	KEOWNS	D	KIPP	C	KOVICH	D
JUANA DIAZ	B	KARNES	B	KEPLER	C	KIPPEN	A	KOYEN	B
JUBILEE	C	KARRO	B	KERBY	B	KIPSON	C	KOYUKUK	B
JUDD	D	KARS	A	KERMEL	B	KIRK	B/D	KRADE	B
JUDITH	B	KARSHNER	D	KERMIT	A	KIRKHAM	C	KRANZBURG	B
JUDKINS	C	KARTA	C	KERMO	A	KIRKLAND	D	KRATKA	C
JUDSON	B	KARTAR	B	KERR	B	KIRKTON	B	KRAUSE	A
JUDY	C	KASCHMIT	D	KERRICK	B	KIRKVILLE	C	KREAMER	C
JUGET	D	KASHWITNA	B	KERRTOWN		KIRTLEY	C	KREMLIN	B
JUGHANDLE	B	KASILOF	A	KERSHAW	A	KIRVIN	C	KRENTZ	C
JULES	B	KASKI	B	KERSICK	D	KISRING	D	KRESSON	C
JULESBURG	A	KASOTA	C	KERSTUN	A/D	KISSICK	D	KRUM	D
JULIAETTA	B	KASSLER	A	KERT	C	KISTLER	C/D	KRUSE	B
JUMPE	B	KASSON	C	KERWIN	C	KITCHELL	B	KRUZOF	B
JUNCAL	C	KATAMA	B	KESSLER	C	KITCHEN CREEK	B	KUBE	B
JUNCOS	D	KATEMCY	C	KESWICK	D	KITSAP	C	KUBLER	C
JUNCTION	B	KATO	C	KETCHLY	B	KITTANNING		KUBLI	C
JUNEAU	B	KATRINE	B	KETTLE	B	KITTITAS	D	KUCERA	B
JUNIATA		KATULA	B	KETTLEMAN	B	KITTREDGE	C	KUCK	C
JUNIPERO	B	KATY	C	KETTNER	C	KITTSON	C	KUGRUG	D
JUNIUS	C	KAUFMAN	D	KEVIN	C	KIUP	B	KUHL	D
JUNO	B	KAUPO	A	KEWAUNEE	C	KIVA	B	KUKAIAU	A
JUNQUITOS	C	KAVETT	D	KEWEENAW	A	KIWANIS	A	KULA	B
JURA	C	KAWAIHAE	C	KEYA	B	KIZHUYAK	B	KULAKALA	B/C
JUVA	B	KAWAIHAPAI	B	KEYES	D	KJAR	D	KULLIT	B
JUVAN	D	KAWBAWGAM	C	KEYNER	D	KLABER	C	KUMA	B
		KAWICH	A	KEYPORT	C	KLAMATH	B/D	KUNIA	B
KAALUALU	A	KAWKAWLIN	C	KEYSTONE	A	KLAUS	A	KUNUWEIA	C
KACHEMAK	B	KEAAU	D	KEYTESVILLE	D	KLAWASI	D	KUPREANOF	B
KADAKE	D	KEAHUA	B	KEZAR	B	KLEJ	B	KUREB	A
KADASHAN	B	KEALAKEKUA	C	KIAWAH	C	KLICKER	C	KURO	D
KADE	C	KEALIA	D	KIBBIE	B	KLICKITAT	C	KUSKOKWIM	D
KADIN	B	KEANSBURG	D	KICKERVILLE	B	KLINE	B	KUSLINA	D
KADOKA	B	KEARNS	B	KIDD	D	KLINESVILLE	C/D	KUTCH	D
KAENA	D	KEATING	C	KIDMAN	B	KLINGER	B	KUTZTOWN	B
KAHALUU	D	KEAUKAHA	D	KIEHL	A	KLONDIKE	D	KVICHAK	B
KAHANA	B	KEAWAKAPU	B	KIETZKE	D	KLONE	B	KWETHLUK	A
KAHANUI	B	KEBLER	B	KIEV	B	KLOOCHMAN	C	KYLE	D
KAHLER	B	KECH	D	KIKONI	B	KLOTEN	B	KYLER	D
KAHOLA	B	KECKO	B	KILARC	D	KLUTINA	B		
KAH SHEETS	D	KEDRON	C	KILAUEA	B	KNAPPA	B	LA BARGE	B
KAHUA	D	KEEFERS	C	KILBOURNE	A	KNEELAND	C	LABETTE	C
KAIKLI	D	KEEGAN		KILBURN	B	KNIFFIN	C	LABISH	D
KAILUA	A	KEEI	D	KILCHIS	D	KNIGHT	C	LABOU	D
KAIMU	A	KEEKEE	B	KILDOR	C	KNIK	B	LABOUNTY	C
KAINALIU	A	KEELDAR	B	KILGORE	B/D	KNIPPA	D	LA BOUNTY	C
KAIPOIDI	B	KEENE	C	KILKENNY	B	KNOB HILL	B	LA BRIER	C
KAIWIKI	A	KEENO	C	KILLBUCK	C/D	KNOWLES	B	LABSHAFT	D
KALAE	B	KEESE	D	KILLEY	D	KNOX	B	LACAMAS	C/D
KALALOCH	B	KEG	B	KILLINGWORTH		KNULL	C	LA CASA	C
KALAMA	C	KEHENA	C	KILLPACK	C	KNUTSEN	B	LACITA	B
KALAMAZOO	B	KEIGLEY	C	KILMERQUE	C	KOBAR	C	LACKAWANNA	C
KALAPA	B	KEISER	B	KILN	D	KOBEH	B	LACONA	C
KALAUPAPA	D	KEITH	B	KILOA	A	KOCH	C	LACOTA	D
KALIFONSKY	D	KEKAHA	B	KILOHANA	A	KODAK	C	LACY	D
KALIHI	D	KEKAKE	D	KILWINNING	C	KODIAK	B	LADD	B
KALISPELL	A	KELLER	C	KIM	B	KOEHLER	C	LADDER	D
KALKASKA	A	KELLY	D	KIMAMA	B	KOELE	B	LADELLE	B
KALNIA	B	KELN	C	KIMBALL	C	KUEPKE	B	LADOGA	C
KALOKO	D	KELSEY	D	KIMBERLY	B	KOERLING	B	LADUE	B
KALOLOCH	B	KELSO	C	KIMBROUGH	D	KOGISH	D	LADYSMITH	D
KALSIN	D	KELTNER	B	KIMMERLING	D	KOHALA	A	LA FARGE	B
KAMACK	B	KELVIN	C	KIMMONS	C	KOKEE	B	LAFE	D
KAMAKOA	A	KEMMERER	C	KIMO	C	KOKERNOT	C	LAFITTE	D
KAMAOA	B	KEMOO	B	KINA	D	KOKO	B	LA FONDA	B
KAMAOLE	B	KEMPSVILLE	B	KINCO	A	KOKOKAMI	D	LAFONT	B
KAMAY	D	KEMPTON	B	KINESAVA	C	KOKOMO	B/D	LAGLORIA	B
KAMIE	B	KENAI	C	KINGFISHER	B	KOLBERG	B	LAGONDA	C
KAMRAR	B	KENANSVILLE	A	KINGHURST	B	KOLEKOLE	C	LA GRANDE	C
KANABEC	B	KENDAIA	C	KINGMAN	D	KOLLS	D	LAGRANGE	D
KANAKA	B	KENDALL	B	KINGS	C/D	KOLLUTUK	D	LAHAINA	B
KANAPAHA	A/D	KENDALLVILLE	B	KINGSBURY	D	KOLOA	C	LA HOGUE	B
KANDIK	B	KENESAW	B	KINGSLEY	B	KOLOB	C	LAHONTAN	D
KANE	B	KENMOOR	B	KINGS RIVER	C	KOLOKOLO	B	LAHREITY	A
KANEOHE	B	KENNALLY	B	KINGSTON	B	KONA	D	LAIDIG	C
KANEPUU	B	KENNAN	B	KINGSVILLE	C	KONAWA	B	LAIDLAW	B
KANIMA	C	KENNEBEC	B	KINKEAD	C	KONNER	D	LAIL	C
KANLEE	B	KENNEDY	B/C	KINKEL	B	KONORTI	C	LAIRDSVILLE	D
KANOSH	C	KENNER	D	KINKOMA	D	KOOLAU	C	LAIREP	D
KANZA	D	KENNEWICK	B	KINMAN	C	KOOSKIA	C	LAJARA	D
KAPAA	A	KENNEY	A	KINNEAR	B	KOOTENAI	A	LAKE	A
KAPAPALA	B	KENNEY LAKE	C	KINNEY	B	KOPIAH	D	LAKE CHARLES	D
KAPOO	B	KENO	D	KINNICK	C	KOPP	B	LAKE CREEK	C
KAPONSIN	C	KENOMA	D	KINREAD	D	KOPPES	B	LAKEHELEN	B
KAPUNIKANI	D	KENSAL	B	KINROSS	D	KORCHEA	B	LAKEHURST	A
KARAMIN	B	KENSPUR	A	KINSTON	D	KURNMAN	B	LAKE JANEE	B
KARDE	B	KENT	D	KINTA	D	KJSMOS	D	LAKELAND	A
KARHEEN	D	KENYON	C	KINTON	C	KOSSE	D	LAKEMONT	D
KARLAN	C	KEO	B	KINZEL	B	KUSTER	C	LAKEPORT	B
KARLIN	A	KEOLDAR	B	KIOMATIA	A	KUSZTA	B	LAKESHORE	D
KARLO	D	KEOMAH	C	KIONA	B	KOTEDO	D	LAKESOL	B
KARLUK	D	KEOTA	C	KIPLING	D	KOUTS	B	LAKETON	B

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table 9.1.--Runoff curve numbers for hydrologic soil-cover complexes

(Antecedent moisture condition II, and $I_a = 0.2\ S$)

Land use	Cover: Treatment or practice	Cover: Hydrologic condition	Hydrologic soil group: A	B	C	D
Fallow	Straight row	----	77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	"and terraced	Poor	66	74	80	82
	" " "	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	"and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes 1/ or rotation meadow	Straight row	Poor	66	77	85	89
	" "	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	"	Good	55	69	78	83
	"and terraced	Poor	63	73	80	83
	"and terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	"	Fair	25	59	75	83
	"	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) 2/		----	72	82	87	89
(hard surface) 2/		---	74	84	90	92

1/ Close-drilled or broadcast.
2/ Including right-of-way.

APPENDIX C

HYDROLOGIC CALCULATIONS - ONSITE AND OFFSITE AREAS, EXISTING AND DEVELOPED CONDITIONS

Sato & Associates, Inc.
Consulting Engineers

Sheet: 1 Of: 11
By: [illegible] Date: 5/5/97
Chkd. by: _____ Date: _____

PROJECT: MAUKA INFRASTRUCTURE - [illegible]

I. OFFSITE & ONSITE RUNOFF CALCULATIONS

A. RUNOFF COEFFICIENTS

OFFSITE AREAS

INFILTRATION HIGH	0.00	(SOIL MXC)
RELIEF (15-20%) HILLY	0.06	
VEGETAL COVER GOOD	0.03	
DEVELOPMENT TYPE RES.	0.40	
COEFFICIENT	C = 0.49	

ONSITE

ROADWAY C = 0.95.

B. OFFSITE AREAS

AREA 4-A:

$Q = CIA$

$I = f(T_c, i)$ $i_{10} = 2.0$ $i_{50} = 2.5$

$T_c = f(L, S)$

$L = 590$

$S = \frac{150 - 100}{590} 100\% = 8.47\%$

$T_c = 18.5$ MIN

$I_{10} = 3.4$

$I_{50} = 4.2$

$A = 0.87\ A_c$

$Q_{10} = 0.49 \cdot 3.4 \cdot 0.87 = 1.45$ CFS

$Q_{50} = 0.49 \cdot 4.2 \cdot 0.87 = 1.79$ CFS

Sato & Associates, Inc. Consulting Engineers	Sheet: 2	Of: 11
	By:	Date:
	Chkd. by:	Date:
PROJECT: MAKENA		

AREA 4-C :

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L,S)$

$L = 1300$ FT

$S = \frac{315 - 135}{1300} 100\% = 13.8\%$

$T_c = 25$ MIN

$I_{10} = 3.0$

$I_{50} = 3.7$

$A = 3.86$ Ac

$Q_{10} = 0.49 \times 3.0 \times 3.86 = 5.67$ CFS

$Q_{50} = 0.49 \times 3.7 \times 3.86 = 7.00$ CFS

AREA 4-D

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L,S)$

$L = 1220$

$S = \frac{315 - 170}{1220} 100\% = 11.9\%$

$T_c = 26$

$I_{10} = 2.9$

$I_{50} = 3.6$

$A = 6.54$ Ac

$Q_{10} = 0.49 \times 2.9 \times 6.54 = 9.29$ CFS

$Q_{50} = 0.49 \times 3.6 \times 6.54 = 11.54$ CFS

AREA 4-E :

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 400$

$S = (265-200)/400 = 16.25\%$

$T_c = 14.5$ MIN

$I_{10} = 3.6$

$I_{50} = 4.6$

$A = 0.81$ Ac

$Q_{10} = 0.49 \times 3.6 \times 0.81 = 1.42$ CFS

$Q_{50} = 0.49 \times 4.6 \times 0.81 = 1.83$ CFS

AREA 4-F :

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 570$

$S = \frac{295-215}{570} 100\% = 14\%$

$T_c = 17$ MIN

$I_{10} = 3.55$

$I_{50} = 4.35$

$A = 1.93$ Ac

$Q_{10} = 0.49 \times 3.55 \times 1.93 = 3.35$ CFS

$Q_{50} = 0.49 \times 4.35 \times 1.93 = 4.11$ CFS

ACEA 4-G:

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 550$

$S = (310 - 245)/550 \times 100\% = 11.8\ \%$

$T_c = 17$

$I_{10} = 3.55$

$I_{50} = 4.35$

$A = 2.20\ AC$

$Q_{10} = 0.49 \times 3.55 \times 2.2 = 3.83\ CFS$

$Q_{50} = 0.49 \times 4.35 \times 2.2 = 4.69\ CFS$

AREA 4-H:

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 700$

$S = \frac{305 - 295}{700} 100\% = 10\%$

$T_c = 20\ MIN$

$I_{10} = 3.3$

$I_{50} = 4.1$

$A = 1.63$

$Q_{10} = 0.49 \times 3.3 \times 1.63 = 2.64\ CFS$

$Q_{50} = 0.49 \times 4.1 \times 1.63 = 3.27\ CFS$

AREA 4-I ;

$Q = CIA$

$I = f(T_c, L)$

$T_c = f(L, S)$

$L = 1700$

$S = \frac{1410 - 290}{1700} \times 100\% = 9\%$

$T_c = 30$ MIN.

$I_{10} = 2.8$

$I_{50} = 3.5$

$A = 5.49$

$Q_{10} = 0.49 \times 2.8 \times 5.49 = 7.53$ CFS

$Q_{50} = 0.49 \times 3.5 \times 5.49 = 9.41$ CFS

AREA 4-B ;

$Q = CIA$

$I = f(T_c, L)$

$T_c = f(L, S)$

$L = 490$ FT

$S = (225 - 130)/490 = 19.4\%$

$T_c = 15$ MIN

$I_{10} = 3.6$

$I_{50} = 4.5$

$A = 0.74$ Ac

$Q_{10} = 0.49 \times 3.6 \times 0.74 = 1.30$ CFS

$Q_{50} = 0.49 \times 4.5 \times 0.74 = 1.63$ CFS

AREA 4-J:

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 420$

$S = (240 - 195)/420 = 10.7\ \%$

$T_c = 17$

$I_{10} = 3.55$

$I_{50} = 4.35$

$A = 2.01$ Ac

$Q_{10} = 0.49 \times 3.55 \times 2.01 = 3.49$ CFS

$Q_{50} = 0.49 \times 4.35 \times 2.01 = 4.28$ CFS

AREA 4-K:

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 330$ FT

$S = (310 - 280)/330 = 9\ \%$

$T_c = 15$

$I_{10} = 3.6$

$I_{50} = 4.5$

$A = 0.73$ Ac

$Q_{10} = 0.49 \times 3.60 \times 0.73 = 1.29$ CFS

$Q_{50} = 0.49 \times 4.50 \times 0.73 = 1.61$ CFS

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Sheet: 7 Of: 11
By: [illegible] Date: 5/11/93
Chkd. by: _____ Date: _____

PROJECT: MAUI [illegible]

AREA A-L :

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 1620$

$S = (440 - 315)/1620 = 7.7\%$

$T_c = 28$ MINI

$I_{10} = 2.85$

$I_{50} = 4.20$

$A = 6.17$ Ac

$Q_{10} = 0.49 \times 2.85 \times 6.17 = 8.62$ CFS

$Q_{50} = 0.49 \times 4.20 \times 6.17 = 12.70$ CFS

AREA A-M :

$Q = CIA$

$I = f(T_c, i)$

$T_c = f(L, S)$

$L = 610$ FT

$S = (195 - 100)/610 = 15.6\%$

$T_c = 17.5$

$I_{10} = 3.5$

$I_{50} = 4.5$

$A = 1.78$ Ac

$Q_{10} = 0.49 \times 3.5 \times 1.78 = 3.05$ CFS

$Q_{50} = 0.49 \times 4.5 \times 1.78 = 3.92$ CFS

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Sheet: 8 Of: 11
By: Date:
Chkd. by: Date:

PROJECT: MAILLIE INFRASTRUCTURE

I. OFFSITE & ONSITE RUNOFF CALCULATION (CONTINUED)

1. ONSITE AREAS

RUNOFF COEFFICIENT C = 0.95 (PAVED)
RUNOFF COEFFICIENT C = 0.30 (UNPAVED)
TIME OF CONCENTRATION = 5.0 MIN.

I_{50} = 6.2 INCHES

1. DRIVEWAY "C":

AREA 1:

A = 140 x 30/43560 = 0.10 Ac

Q = 0.30 x 6.2 x 0.08 = 0.15 CFS (EXISTING)

Q_{50} = 0.95 x 6.2 x 0.08 = 0.60 CFS (DEVELOPED)

AREA 2:

A = (120 x 30)/43560 = 0.08 Ac

Q = 0.30 x 6.2 x 0.08 = 0.15 CFS (EXISTING)

Q_{50} = 0.95 x 6.2 x 0.08 = 0.47 CFS (DEVELOPED)

AREA 3:

A = 220 x 30/43560 = 0.15 Ac

Q = 0.30 x 6.2 x 0.15 = 0.28 CFS (EXISTING)

Q_{50} = 0.95 x 6.2 x 0.15 = 0.88 CFS (DEVELOPED)

AREA 4:

A = 220 x 30/43560 = 0.15 Ac

Q = 0.28 CFS (EXISTING)

Q_{50} = 0.88 CFS (DEVELOPED)

1. ONSITE RUNOFF

RUNOFF COEFFICIENT $C = 0.95$ (PAVED, DEVELOPED)
TIME OF CONCENTRATION $T_c = 5.0$ MIN
RUNOFF COEFFICIENT $C = 0.30$ (UNPAVED, EXISTING)

$I_{50} = 6.2$ INCHES

2, DRIVEWAY "D"

AREA 12:

$A = 500 \times 30 / 43560 = 0.34$ Ac
$Q = 0.30 \times 6.2 \times 0.34 =$ CFS (EXISTING)
$Q_{50} = 0.95 \times 6.2 \times 0.34 = 2.00$ CFS (DEVELOPED)

AREA 13:

$A = 0.34$ Ac
$Q =$ CFS (EXISTING)
$Q_{50} = 2.00$ CFS (DEVELOPED)

AREA 16:

$A = 275 \times 30 / 43560 = 0.19$ Ac
$Q = 0.30 \times 6.2 \times 0.19 =$ ~~0.35~~ CFS
$Q_{50} = 0.95 \times 6.2 \times 0.19 = 1.12$ CFS

AREA 14:

$A = 140 \times 30 / 43560 = 0.10$ Ac
$Q = 0.30 \times 6.2 \times 0.10 =$ CFS (EXISTING)
$Q_{50} = 0.95 \times 6.2 \times 0.10 = 0.59$ CFS (DEVELOPED)

AREA 15:

$A = 426 \times 30 / 43560 = 0.29$
$Q = 0.30 \times 6.2 \times 0.29 =$ CFS (EXISTING)
$Q_{50} = 0.95 \times 6.2 \times 0.29 = 1.71$ CFS (DEVELOPED)

AREA 17:

$A = (30^2 + 134 \times 30) / 43560 = 0.11$ Ac
$Q = 0.30 \times 6.2 \times 0.11 =$ CFS (EXISTING)
$Q_{50} = 0.95 \times 6.2 \times 0.11 = 0.64$ CFS (DEVELOPED)

AREA 5:

A = 300 x 30/43560 = 0.21 Ac

Q = 0.30 . 6.2 x 0.34 = 0.63 CFS (EXISTING)

Q_{50} = 0.95 x 6.2 x 0.34 = 2.00 CFS (DEVELOPED)

AREA 6:

A = 245 x 30/43560 = 0.17 Ac

Q = 0.30 x 6.2 x 0.34 = 0.63 cfs (EXISTING)

Q_{50} = 0.95 x 6.2 x 0.34 = 1.00 CFS (DEVELOPED)

AREA 7:

A = 300 x 30/43560 = 0.21 Ac

Q = 0.30 x 6.2 x 0.21 = 0.39 CFS (EXISTING)

Q_{50} = 0.95 x 5.2 x 0.21 = 1.24 CFS (DEVELOPED)

AREA 8:

A = 265 x 30/43560 = 0.18 Ac

Q = 0.30 x 6.2 x 0.18 = 0.33 CFS (EXISTING)

Q_{50} = 0.95 x 62 x 0.18 = 1.06 CFS (DEVELOPED)

AREA 9:

A = 450 x 30/43560 = 0.31 Ac

Q = 0.30 x 6.2 x 0.31 = 0.58 CFS (EXISTING)

Q_{50} = 0.95 x 62 x 0.31 = 1.83 CFS (DEVELOPED)

AREA 10:

A = 345 x 30/43560 + 30²/43560 = 0.27 Ac

Q = 0.30 x 6.2 x 0.27 = 0.50 CFS (EXISTING)

Q_{50} = 0.95 x 6.2 x 027 = 1.59 CFS (DEVELOPED)

Sato & Associates, Inc.
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Sheet: 10 Of: 11
By: [illegible] Date: 5/2/23
Chkd. by: _____ Date: _____

PROJECT: MALENA INFRASTRUCTURE - MAP 5.00

AREA 1' :

A = [illegible] = 0.25 Ac

Q = 0.30 × 6.2 × 0.25 = 0.47 CFS (EXISTING)

Q_{50} = 0.95 × 6.2 × 0.25 = 1.47 CFS (DEVELOPED)

APPENDIX C

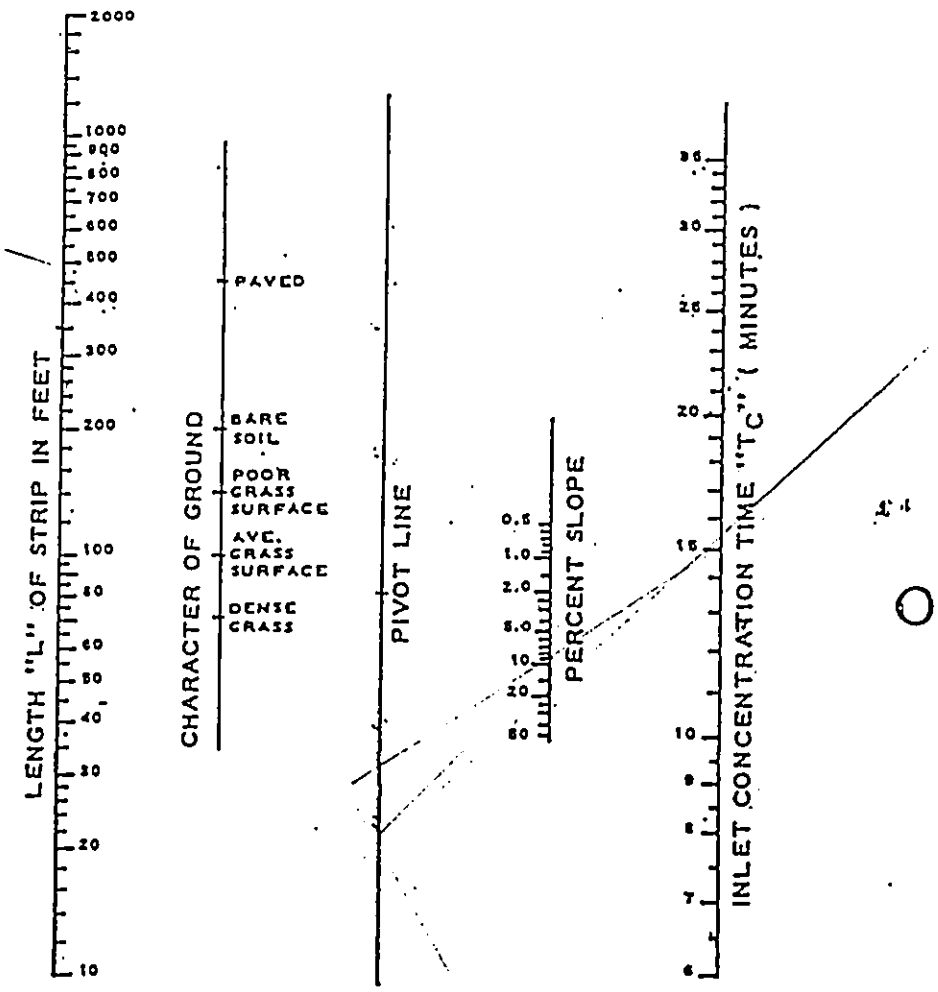
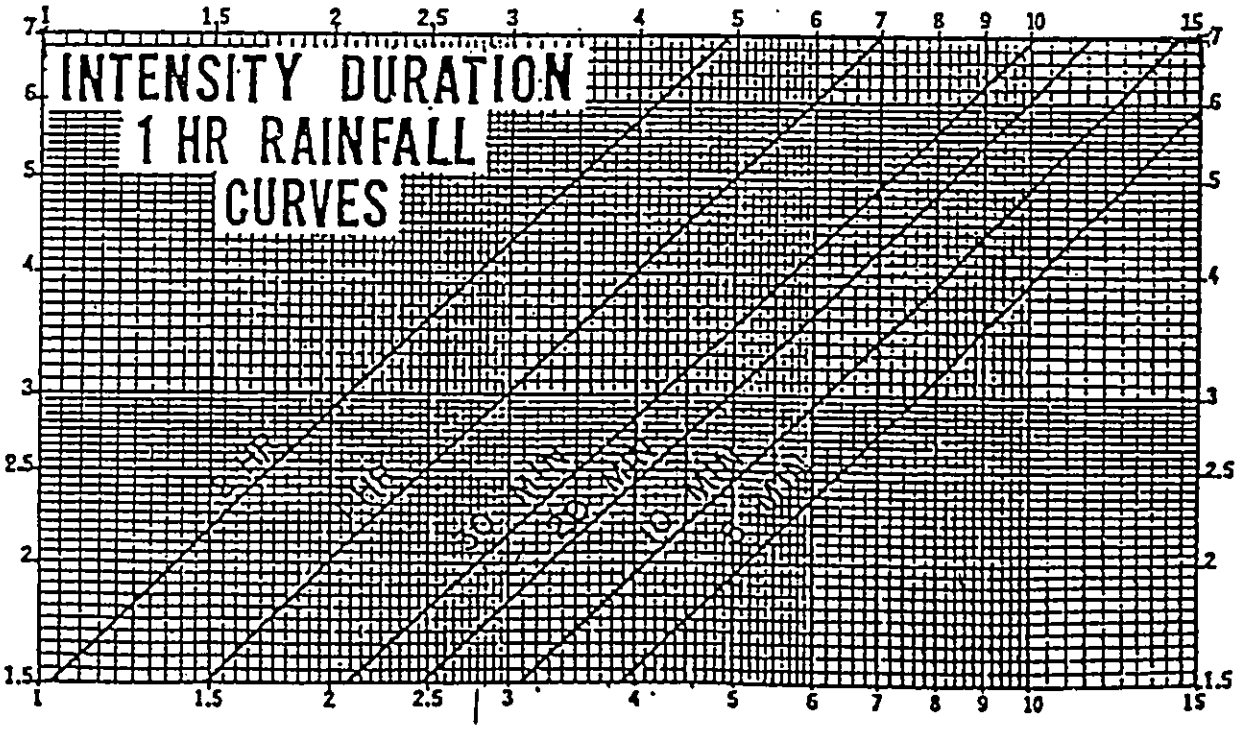


Plate 1

Overland Flow Chart

Plate 2



APPENDIX C

APPENDIX D

HYDROLOGIC CALCULATIONS - RETENTION BASIN

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: ____
Chkd. by: ____ Date: ____

PROJECT: MARINA [illegible]

RETENTION POND

SUMMARY OF RUNOFF VALUES

24 Hr Design Storm (YR)	EXISTING		DEVELOPED			
	Qpeak AT OCEAN OUTFALL (CFS)	TOTAL HYDROGRAPH VOLUME (Ac. Ft)	Qpeak INTO POND (CFS)	TOTAL HYDROGRAPH VOLUME (AC. FT)	Qpeak (1) OUT OF POND (CFS)	DETENTION VOLUME (Ac Ft)
100	1028	442.8	1037.9	403.91	722.4	45.32
50	859	375.7	868.5	342.38	765.6	37.05
25	615	278.8	625.3	253.60	510.0	31.87
10	392	188.2	399.5	170.66	332.2	23.07
5	258	132.7	264.7	120.02	209.1	17.20
2	141	83.0	147.0	74.65	102.6	15.15

(1) Qpeak out of pond for developed conditions takes into account future development of sites M-7, M-1 and portions of site M-5, M-6 & S-1; this maximum Qpeak out of pond maintains pre-developed runoff rates at the outfall point at the ocean. This provides a baseline for designing the pond's outlet structure.

(1)

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Consulting Engineers

Sheet:	Of:
By: [illegible]	Date: [illegible]
Chkd. by:	Date:

PROJECT: MAKENA INFRASTRUCTURE · M19703.00
RETENTION BASIN CALCS.

BASIN NUMBER: 3A (Above Retention Basin)
WATERSHED AREA: 871 Ac

SOIL		AREA - CN				A×CN
CLASS.	GROUP	PASTURE	WOODS			
UMF	A	6 - 69				414
ULD	B	50 - 49				2,450
ISD	B	434 - 69	39 - 60			32,286
KxbE	B	10 - 69	10 - 60			1,290
OED	B	5 - 69	80 - 60			5,115
OAD	B		174 - 60			10,440
MXC	B		71 60			4260

$\Sigma(A \times CN)$ 56,285

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP A	B	C	D
PASTURE	FAIR	49	69		
WOODS	FAIR	36	60		

$$\text{WEIGHTED CN} = \frac{\Sigma A \times CN}{\text{AREA}}$$

$$\text{WEIGHTED CN} = \frac{56{,}285}{871}$$

WEIGHTED CN = 65

APPENDIX D

Sato & Associates, Inc.
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Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

FUTURE
DEVELOPED CONDITIONS
BASIN NUMBER: [illegible] per M-5, M-6, S-4, All [illegible]
WATERSHED AREA: 75 Acres (Federal Property Boundary)

SOIL		AREA - CN				A x CN
CLASS.	GROUP	Apt/Lots	Woods	Golf Course	[illegible]	
MYC		19.82	1.60	15.71	17.87	[illegible]

Σ (A x CN) 5991

WEIGHTED CN = $\frac{\Sigma A \times CN}{AREA}$

WEIGHTED CN = $\frac{5991}{75}$

WEIGHTED CN = 80

LAND USE	HYDROLOGIC CONDITION	SOIL GROUP			
		A	B	C	D
Pasture	FAIR	49	69		
Woods	FAIR	36	60		
Golf Course	GOOD	59	74		
Roadway (1)		89	89		
Apt/Lots		77	82		

(1) Including [illegible] right-of-ways of [illegible] roads.

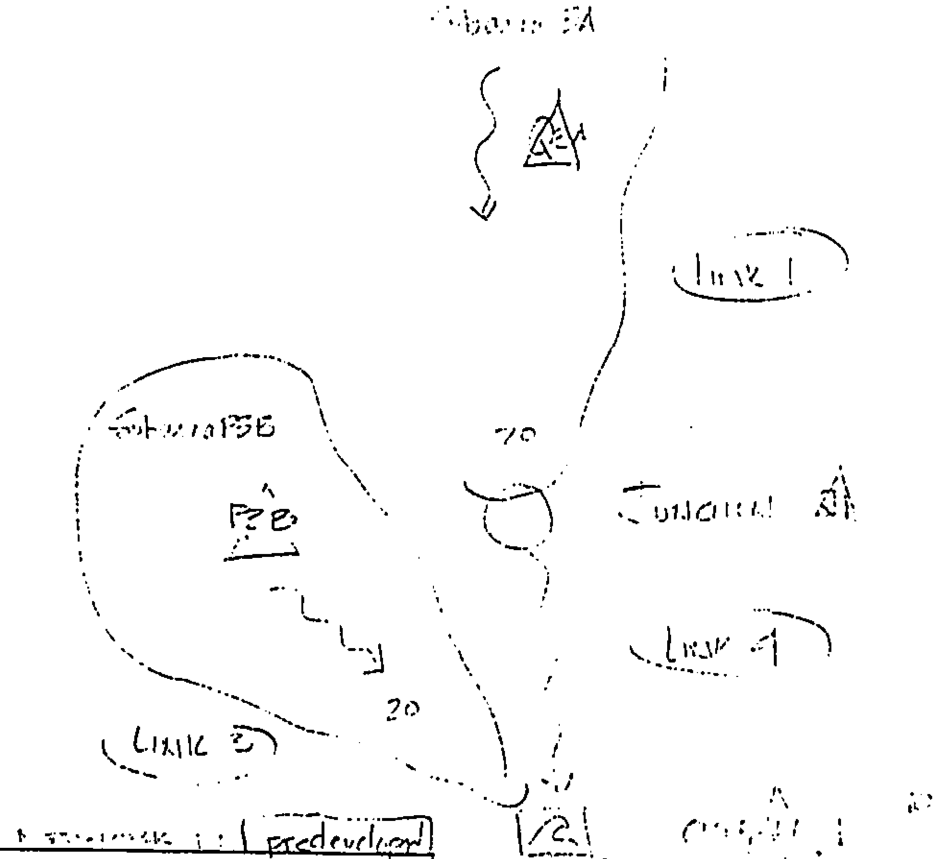
APPENDIX D

RICHARD M. SATO & ASSOCIATES, INC.
CONSULTING ENGINEERS • CIVIL & STRUCTURAL

BY: ______ DATE: ______
CHK. BY: ______ DATE: ______
SHEET ______ OF ______

PROJECT: [illegible]

POND PACK V.6.0 Network: Predeveloped Net



Tc: OUTFALL				SUBAREA PB (Predeveloped)		
PEAK Q (CFS)	HYDROGRAPH VOLUME (AC-FT)	Time to PEAK Tp (HR)	STORM (YR)	PEAK Q (CFS)	[illegible] VOL. (AC-FT)	(Tp) Time to Peak (HR)
1028	412.8	11.05	100	189.5		[illegible]
859	375.7	11.05	50	161.2	33.3	[illegible]
615	278.8	11.05	25	119.5	25.2	[illegible]
392	188.2	11.25	10	79.8	17.5	[illegible]
258	132.7	11.25	5	55.4	[illegible]	10.5
141	82.0	11.5	2	33.2	[illegible]	11

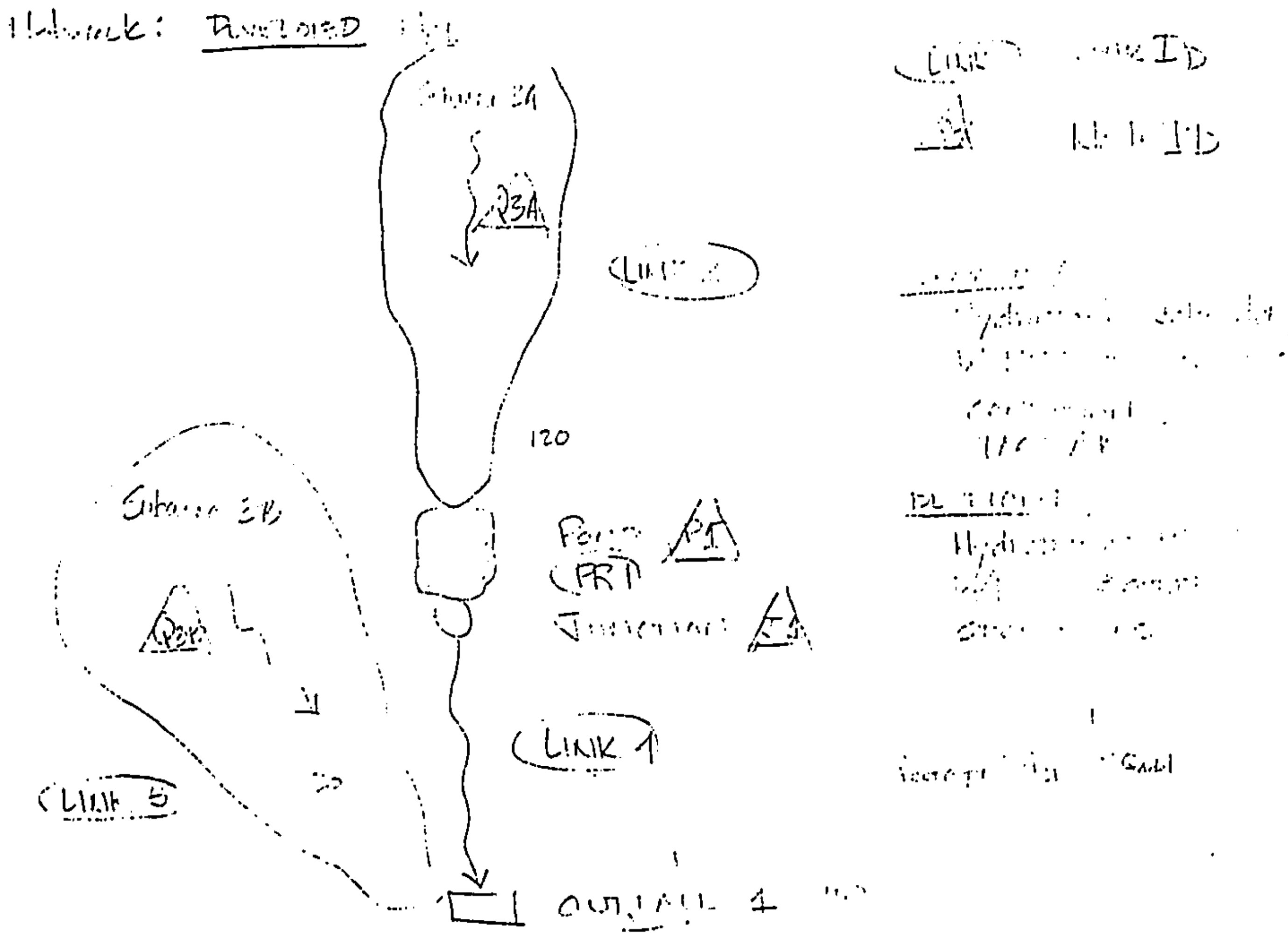
MAX ALLOWABLE Q AT OUTFALL FOR DEVELOPED CONDITIONS.

APPENDIX D

RICHARD M. SATO & ASSOCIATES, INC.
CONSULTING ENGINEERS • CIVIL & STRUCTURAL

BY: ________ DATE: ________
CHK. BY: ________ DATE: ________
SHEET ________ OF ________

PROJECT: [illegible]



24 Hr Storm (YRS)	OUTFALL Qp (CFS)	Hyd Vol (Ac-Ft)	Tp (Hr)	SUBAREA 3B Qp (CFS)	Hyd Vol Ac-Ft	Tp (Hr)
100	1037.7	450.9	11.05	232.6	47.0	10.25
50	868.5	383.4	11.05	203.1	41.1	10.25
25	625.3	285.2	11.05	159.0	32.2	10.25
10	399.5	194.3	11.25	115.4	23.6	10.25
5	264.7	138.1	11.30	87.0	18.1	10.25
2	147.0	87.11	11.30	59.6	12.5	10.25

APPENDIX E

SOIL AND EROSION CONTROL CALCULATIONS

APPENDIX E

SOIL AND EROSION CONTROL CALCULATIONS

A. ESTIMATED SOIL LOSS

In accordance with the County of Maui's Grading Ordinance the Universal Soil Loss Equation was used for estimating soil loss. The equation is as follows:

E = R K Ls C P

Where:

E = Soil Loss in Tons/Acre/Year
R = Rainfall Factor = 150 Tons/Acre/Year
K = Soil Erodibility Factor = 0.17 (Both Soil Types)
Ls = Topographic Factor = 5.42
Slope Length (L) = 1,800
Average Slope (S) = 9.5%
C = Cover Factor = 1.0 (Bare Soil)
P = Erosion Control Practice Factor 1.0
(For Non-Agricultural Lands)
E = 150 x 0.17 x 5.42 x 1 x 1 = 138.2 Tons/Acre/Year

B. ALLOWABLE SOIL LOSS

Coastal Water Hazard (D) = 2 (Class "A" Water)
Downstream Hazard (F) = 4
Time Duration of Project (T) = 1.0 Year
Maximum Allowable Construction Area x Erosion Rate = 3,571 Tons/Acre
Area of Disturbance (A) = 8.64 Acres
Maximum Allowable Erosion Rate = 3,571/5.24 = 1,412.4 Tons/Acre/Year

C. SEVERITY RATING

Allowable Rating = 50,000

Calculated Severity Rating (H) = (2Ft. + 3D)AE

WHERE:

Downstream Hazard (F) = 4
Time Duration of Project (T) = 1.0 Year
Potential Sediment Damage (D) = 2 (Class "A" Water)
Area of Disturbance (A) = 5.24
Annual Soil Loss (E) = 138.2 Tons/Acre/Year

H = (2 x 4 x 1.0 + 3 x 2) (8.64) (138.2) = 16,717 < 50,000 allowable rating

APPENDIX F

HYDRAULIC CALCULATIONS

HGL-REPORT

Hydraulic Gradient Calculations

Project:	Makena Infrastructure															Date:	5/29/98 4:46 PM		
Drainline:	"C1"																		
Number:	M9703.00															Checked By:			
By:	MS																		
Structure	Type	Size (in)	Q (CFS)	Slope Ft/Ft	Length Ft.	Vel. Full FPS	Inv (DS)	Inv (US)	Dn Ft	Sf	Hf	DS Elev.	Manhole Losses					US Elev.	Elev Top Pipe	Cont. Elev.
													A	B	C	D	Ent Cont			
utlet "C1"								89.20										91.20	92.20	96.00
	P	36	30.86	0.2640	20.00	4.37			0.61	0.0021	0.043									
CB "C-1"							92.41	92.41				93.02	0.05	0.06	0.05	0.00	0.00	93.18	95.41	97.77
	P	36	27.72	0.0150	41.00	3.92			1.21	0.0017	0.071									
CB "C-2"							93.07	93.07				95.48	0.04	0.13	0.04	0.00	2.25	95.69	96.07	97.77
	P	36	18.90	0.0460	223.00	2.67			0.74	0.0008	0.179									
CB "C-3"							103.33	103.33				104.07	0.12	0.00	0.12	0.00	2.00	105.45	105.33	110.25
	P	24	14.00	0.0947	222.00	4.46			0.61	0.0038	0.850									
CB "C-4"							124.35	124.35				124.96	0.12	0.25	0.12	0.15	1.10	125.72	126.35	129.24
	P	24	6.00	0.1190	247.00	1.91			0.38	0.0007	0.174									
CB "C-6"							153.74	153.74				154.12						154.12	153.74	158.74

N: 0.013 FOR ALL PIPES.
24" & 36" HDPE PIPE.

APPENDIX F

HGL-REPORT

Hydraulic Gradient Calculations

Project:	Makena Infrastructure															Date:	5/29/98 4:46 PM		
Drainline:	"C2"																		
Number:	M9703.00														Checked By:				
By:	MS																		
Structure	Type	Size (in)	Q (CFS)	Slope Ft/Ft	Length Ft.	Vel. Full FPS	Inv (DS)	Inv (US)	Dn Ft	Sf	Hf	DS Elev.	Manhole Losses					US Elev.	Elev Top Pipe	Cont. Elev.
													A	B	C	D	Ent Cont			
utlet "C2"								182.00										185.00	185.00	
	P	36	28.43	0.1302	43.00	4.02			0.70	0.0018	0.078									
CB "C-7"							187.60	187.60				188.30	0.04	0.03	0.04	0.00	2.25	189.89	190.60	191.80
	P	36	26.60	0.0533	45.00	3.76			0.85	0.0016	0.072									
CB "C-8"							190.00	190.00				190.85	0.03	0.03	0.03	0.00	2.25	192.28	193.00	194.20
	P	36	24.77	0.1238	160.00	3.50			0.66	0.0014	0.221									
SDMH "C-9"							209.80	209.80				210.46	0.03	0.10	0.03	0.10	1.80	211.73	211.80	214.00
	P	24	7.75	0.1114	263.00	2.47			0.43	0.0012	0.309									
CB "C-10"							239.10	239.10				239.53	0.01	0.09	0.01	0.10	1.80	241.01	241.10	244.87
	P	24	1.47	0.0098	41.00	0.47			0.35	0.0000	0.002									
CB "C-11"							239.50	239.50				241.10						241.10	239.50	244.87
		n= 0.013 FOR ALL PIPES																		
		24" & 36" HDPE PIPE																		

APPENDIX F

Hydraulic Gradient Calculations

Project: Makena Infrastructure | Date: 5/29/98 4:46 PM

Drainline: "D1" | Checked By:

Number: M9703.00

By: MS

Structure	Type	Size (in)	Q (CFS)	Slope Ft/Ft	Length Ft.	Vel. Full FPS	Inv (DS)	Inv (US)	Dn Ft	Sf	Hf	DS Elev.	Manhole Losses					US Elev.	Elev Top Pipe	Cont. Elev.
													A	B	C	D	Ent Cont			
								259.10										262.10	262.10	263.60
Outlet "D1"																				
	P	36	36.78	0.0085	120.00	5.20			1.67	0.0030	0.365									
							260.12	260.12				262.46	0.08	0.10	0.08	0.00	2.25	262.81	263.12	265.91
CB "D-6"																				
	P	36	27.67	0.0560	134.00	3.91			0.85	0.0017	0.231									
							267.62	267.62				268.48	0.04	0.02	0.04	0.00	2.25	269.91	270.62	273.32
CB "D-5"																				
	P	36	26.55	0.0583	60.00	3.76			0.82	0.0016	0.095									
							271.12	271.12				271.95	0.23	0.00	0.23	0.10	1.95	273.40	273.12	276.06
CB "D-4"																				
	P	24	20.56	0.0840	230.00	6.54			0.77	0.0083	1.900									
							290.44	290.44				291.21	0.23	0.23	0.23	0.00	2.20	292.87	292.44	294.46
CB "D-3"																				
	P	24	16.70	0.0760	147.00	5.32			0.71	0.0055	0.801									
							301.61	301.61				302.32	0.16	0.43	0.16	0.15	0.00	303.23	303.61	306.42
CB "D-2"																				
	P	24	2.00	0.0100	40.00	0.64			0.40	0.0001	0.003									
							302.40	302.40				303.62						303.62	302.40	306.42
CB "D-1"																				

PIPELINE

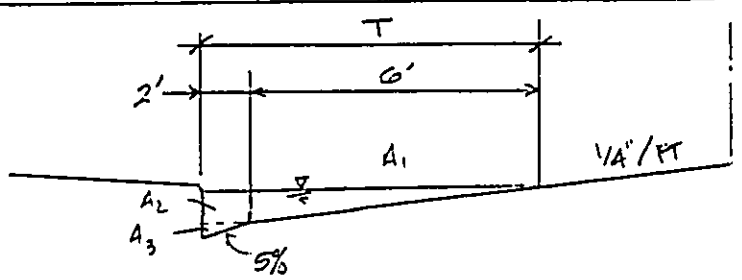
N= 0.013 FOR ALL PIPES 24" & 36" HDPE PIPE.

APPENDIX F

Sato & Associates, Inc. Consulting Engineers	Sheet: 1 Of: 2
	By: A.S. Date: 5/7/98
	Chkd. by: _____ Date: _____
PROJECT: MAKENA INFRASTRUCTURE - M9703.00	

PURPOSE: TO DETERMINE CATCH BASIN & INLET INTERCEPTION CAPACITY, FLOODED ROAD WIDTH, AND HYDRAULIC GRADE LINE FOR DRAINAGE SYSTEMS IN DRIVEWAYS "2" AND "3".

1. FLOODED ROAD WIDTH CALCULATIONS



GIVEN: T_{MAX} = 8.0 FEET
n = 0.015 PAVEMENT

A. FIND: Q_{MAX} for 8' FLOODED ROAD WIDTH:

$$Q_{MAX} = A_{MAX} V.$$

$$A_{MAX} = A_1 + A_2 + A_3$$

$$A_1 = 1/2(6)(2.08\% \times 6)$$
$$A_1 = 3 \times (0.125)$$
$$A_1 = 0.375 \text{ SF}$$
$$A_2 = 0.125 \times 2$$
$$A_2 = 0.25 \text{ SF}$$
$$A_3 = 2 \times (5\% \times 2)$$
$$A_3 = 2 \times (0.1)$$
$$A_3 = 0.2 \text{ SF}$$

$$A_{MAX} = 0.375 + 0.250 + 0.200$$
$$A_{MAX} = 0.825 \text{ SF}$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

$Q_{MAX} = A_{MAX} V$

$A_{MAX} = 0.825$ SF

$V = \frac{1.486}{n} R^{2/3} S^{1/2}$

$n = 0.015$

$R = A/P$

$P = \sqrt{6^2 + 0.125^2} + \sqrt{2^2 + 0.1^2} + 0.225$

$P = 6.001 + 2.005 + 0.225$

$P = 8.23$

$R = \frac{0.825}{8.23}$

$R = 0.10$

$V = \frac{1.486}{0.015}(0.10)^{2/3} S^{1/2}$

$V = 21.34\ S^{1/2}$

$Q_{MAX} = (0.825)(21.34\ S^{1/2})$

$Q_{MAX} = 17.61\ S^{1/2}$

DRIVEWAY "C"

S (%)	Q_{MAX} (CFS)
3.0	3.05
4.94	3.91
7.0	4.66
12.0	6.10

DRIVEWAY "D"

S (%)	Q_{MAX} (CFS)
1.0	1.76
3.0	3.05
6.0	4.31
8.0	4.98

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Sheet: 1 Of: 6
By: [illegible] Date: 5/11/93
Chkd. by: _____ Date: _____

PROJECT: MAKENA INFRASTRUCTURE - 179703.05

II INTERCEPTION CAPACITY

REFERENCE: "STORM DRAINAGE STANDARDS."
CITY & COUNTY OF HONOLULU.

A. CURB-OPENING INLETS

S (%)	Q (CFS)
1.0	5.7
3.0	4.6
4.14	4.7 *
6.0	4.5 *
7.0	4.9 *
8.0	5.0 *
12.0	6.0 *

* INTERCEPTION CAPACITY WITH DEFLECTOR INLET

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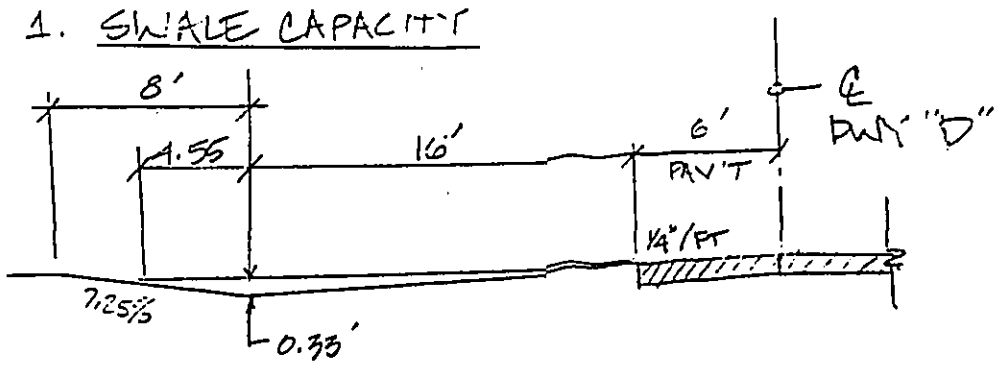
Sheet: 2 Of: 6
By: [illegible] Date: 5/1/98
Chkd. by: _____ Date: _____

PROJECT: MALENIA UNDERCROSSING - M1990

II INTERCEPTOR CAPACITY (CONTINUED)

B. GRATE INLETS AT GRADE.

1. SWALE CAPACITY



$Q = AV$

$A = \frac{1}{2}(0.33)(16) + \frac{1}{2}(0.33)4.4 = \frac{1}{2}(0.33)(16+4.55)$

$A = 3.39$ SF

$V = \frac{1.486}{n}(R^{2/3})S^{1/2}$

$n = 0.035$ grass

$R = A/P$

$A = 3.39$

$P = \sqrt{4.55^2 + 0.33^2} + \sqrt{16^2 + 0.33^2}$

$P = 4.56 + 16.003$

$P = 20.56$

$R = 3.39/20.56$

$R = 0.16$

$V = \frac{1.486}{0.035}(0.16^{2/3})(S^{1/2})$

$V = 12.51\, S^{1/2}$

$Q = 3.26 \times (12.51\, S^{1/2})$

$Q = 40.79\, S^{1/2}$

II INTERCEPTION CAPACITY (CONTINUED)

1. SWALE CAPACITY

$$Q = 40.79\, S^{1/2}$$

S (%)	Q (CFS)
1.0	4.08
3.0	7.07
6.0	10.00
8.0	11.54

2. INLET CAPACITY

GIVEN:

$W = 3.0'$ $\quad S_x = 1/4"/FT = 2.083\ \%$
$L = 3.0'$ $\quad$ grate type = P-1-7/8
$T = 16.0'$ $\quad S$ = Longitudinal Slope

$$E_o = Q_w/Q = 1 - (1 - W/T)^{2.67}$$
$$= 1 - (1 - 3/16)^{2.67}$$
$$= 0.43$$

$$Q_i = Q[R_f E_o + E_s (1 - E_o)]$$

II INTERCEPTION CAPACITY (CONTINUED)

2. INLET CAPACITY

$Q_i = Q[R_f E_o + R_s(1 - E_o)]$; $E_o = 0.43$

$V = 12.51\ S^{1/2}$

$Q = AV$; $A = 3.39$ SF

S (%)	V (FPS)	Q (CFS)	R_f (CHART 7)	R_s (CHART 8)	Q_i (CFS)
1.0	1.25	4.05	1.0	0.60	3.15
3.0	2.17	7.07	1.0	0.32	2.50
6.0	3.06	10.00	1.0	0.20	2.22
8.0	3.54	11.54	1.0	0.16	2.13

APPENDIX F

II INLET CAPACITY (CONTINUED)

C. GRATE INLETS AT SAG

$Q_i = C_w P d^{1.5}$ $d \leq 0.4$ (WEIR)

$Q_i = C_o A (2gd)^{1/2}$ $d > 0.4$ (ORIFICE)

1. INLET OPERATES AS WEIR

$Q_i = C_w P d^{1.5}$

$C_w = 3.0$

P = Perimiter of Grate (3 FT Grate)
= 4x3 = 12'

d = 0.4

$Q_i = 3.0(12)(0.4)^{1.5} = 9.11$ CFS

2. INLET OPERATES AS ORIFICE

$Q_i = C_o A (2gd)^{1/2}$

$C_o = 0.67$

A = Clear Opening Area, P-1-7/8 grate
= $A_{TOTAL} - A_b$.

$A_T = 3 \times 3 = 9$ SF

A_b = No bars x 1/4" x 36" / 144 SQ/SF
No bars = 3x12/(1 7/8")
No bars = 19
$A_b = 19 \times 1/4 \times 36"/144 = 1.2$

$A = 9 - 1.2 = 7.8$ SF

d = 1.5 FT

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Consulting Engineers

Sheet: 6 Of: 6

By: [signature] Date: 5/11/92

Chkd. by: Date:

PROJECT: MAKENA INFRASTRUCTURE M9763.00

$$Q_i = C_o A (2gd)^{1/2}$$

$C_o = 0.67$

$A = 7.8$ SF

$d = 1.5$

$g = 32.16\ FT/S^2$

$$Q_i = 0.67(7.8)(2 \times 32.16 \times 1.5)^{1/2}$$

$$Q_i = 51.3\ cfs$$

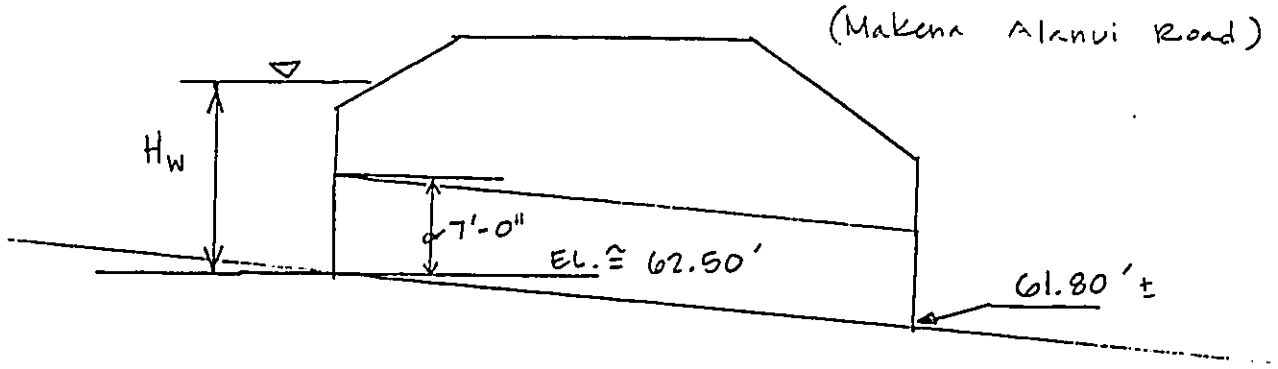
Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

INLET CONTROL

Aprox. Center of Road
EL. ≅ 74.63'
(Makena Alanui Road)



Existing Conditions:
3ea 7'-0" CMP

Per Muroda and Assoc. Master Drainage Report (5/16/83)
Assume Q ≅ 1000 cfs

L= length ≅ 90 feet
D= 7'-0" = 84 in.
s ≅ 0.78 %

Assume Q = 333.33 cfs

since there are 3ea 7'-0" CMP therefore used one third cfs in each pipe.

Using Plate 19
from the "Storm Drainage Standards"
Department of Public Works
City and County of Honolulu - March 1986

$\frac{H}{D} = 1.05$

$H = 1.05\ (D) = 1.05\ (7) = 7.35'$

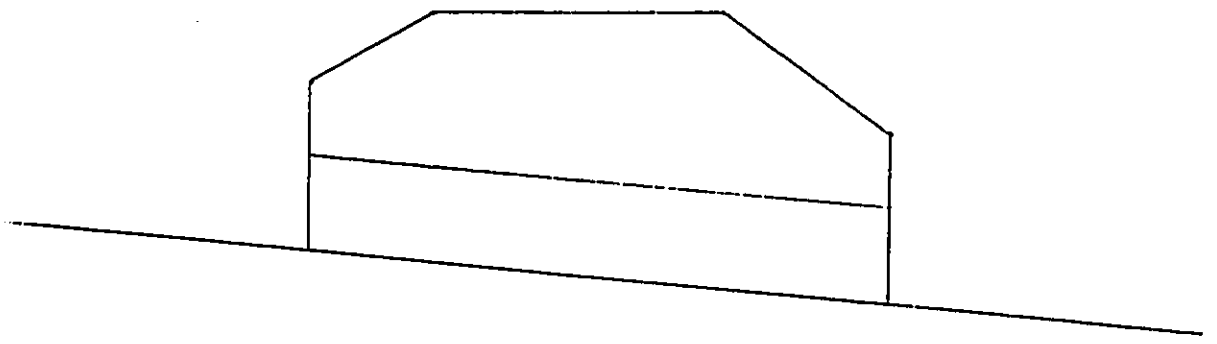
Depth of Entrance = 62.5' + 7.35' = 69.85'

APPROX =

Sato & Associates, Inc. Consulting Engineers	Sheet: ____ Of: ____ By: ____ Date: ____ Chkd. by: ____ Date: ____
PROJECT:	

Conclusion :

The Inlet Control Calculations show that Flood Level will reach an elevation of 69.85 feet. The Road Elevation is 74.63 feet.



APPENDIX F

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Sheet ____ Of ____
By: ____ Date ____
Chkd. by ____ Date: ____

PROJECT:

OUTLET CONTROL

a) Flowing Full, tailwater above outlet crown of pipe

$$H_w + \frac{V_a^2}{2g} + S_b L - T_w = \frac{V_c^2}{2g} + H_e + H_f + H_v$$

Assume V_a^2 & V_c^2 to be equal

S_b = Slope of Tunnel = 0.78 %

L = length of Tunnel = 90 ft.

Tw = 68.8' assume full flow $D_n = 7$

He = Entrance Loss

Hf = Friction Loss

Hv = Velocity Head

n = 0.024

Q = 333.33 cfs Since there are 3ea. 7'-0" CMP

$S_b L = (.0078)(90) = 0.702'$

$A = \pi r^2 = \pi (3.5)^2 = 38.48$ sf

$H_e = k_e \frac{V^2}{2g}$ where $k_e = 0.5$ from Table 12; Appendix D Hydraulic Design of Hwy Culverts.

$V = Q/A = 333.33/38.48 = 8.66$ ft/s

$H_e = \frac{1}{2} \frac{(8.66)^2}{2(32.2)} = 0.58'$

$H_f = \left[\frac{29 n^2 L}{R^{4/3}}\right] \frac{V^2}{2g}$ $R = A/P = 38.48/2(\pi)(3.5) = 1.75$

$= \left[\frac{29(.024)^2(90)}{(1.75)^{4/3}}\right] \frac{8.66^2}{2(32.2)} = 0.83$

$H_v = V^2/2g = \frac{(8.66)^2}{2(32.2)} = 1.16'$

Sato & Associates, Inc.
Consulting Engineers

Sheet: _____ Of: _____
By: _____ Date: _____
Chkd. by: _____ Date: _____

PROJECT:

$$H_w = H_e + H_f + H_v - S_b L + T_w$$

$$= 0.58 + 0.83 + 1.16 - 0.702 + 68.8$$

$$H_w = 70.67'$$

b) Flowing Full, tailwater below outlet crown of pipe.

$$h_o = \frac{d_c + D}{2}$$

$d_c = 4.8$ Chart 16 - Critical Depth (Bureau of public Roads)

$$\text{So } h_o = \frac{4.8 + 7}{2} = 5.9$$

$5.9 < 7.0'$ so outlet un submerged

$h_o = .7 = T_W$

$H_w = .7 + 5.9 - .702$

$= 5.9$

$61.8 + 5.9 = 67.7'$

Sato & Associates, Inc.
Consulting Engineers

Sheet _____ Of _____
By: _____ Date _____
Chkd. by _____ Date _____

PROJECT:

Solve for Dn

S = 0.78 % = .0078

Q = 1000 cfs Assume Q = 333.33 cfs
Since there are 3ea 7'-0" CMP

n = .024 CMP (unpaved)

D = 7'-0" = 84 in

L = 90'

$V = Q/A = 333.33/38.48 = 8.66$

$S_f = (Q/K)^2 = (333.33/3460)^2 = 0.0093$

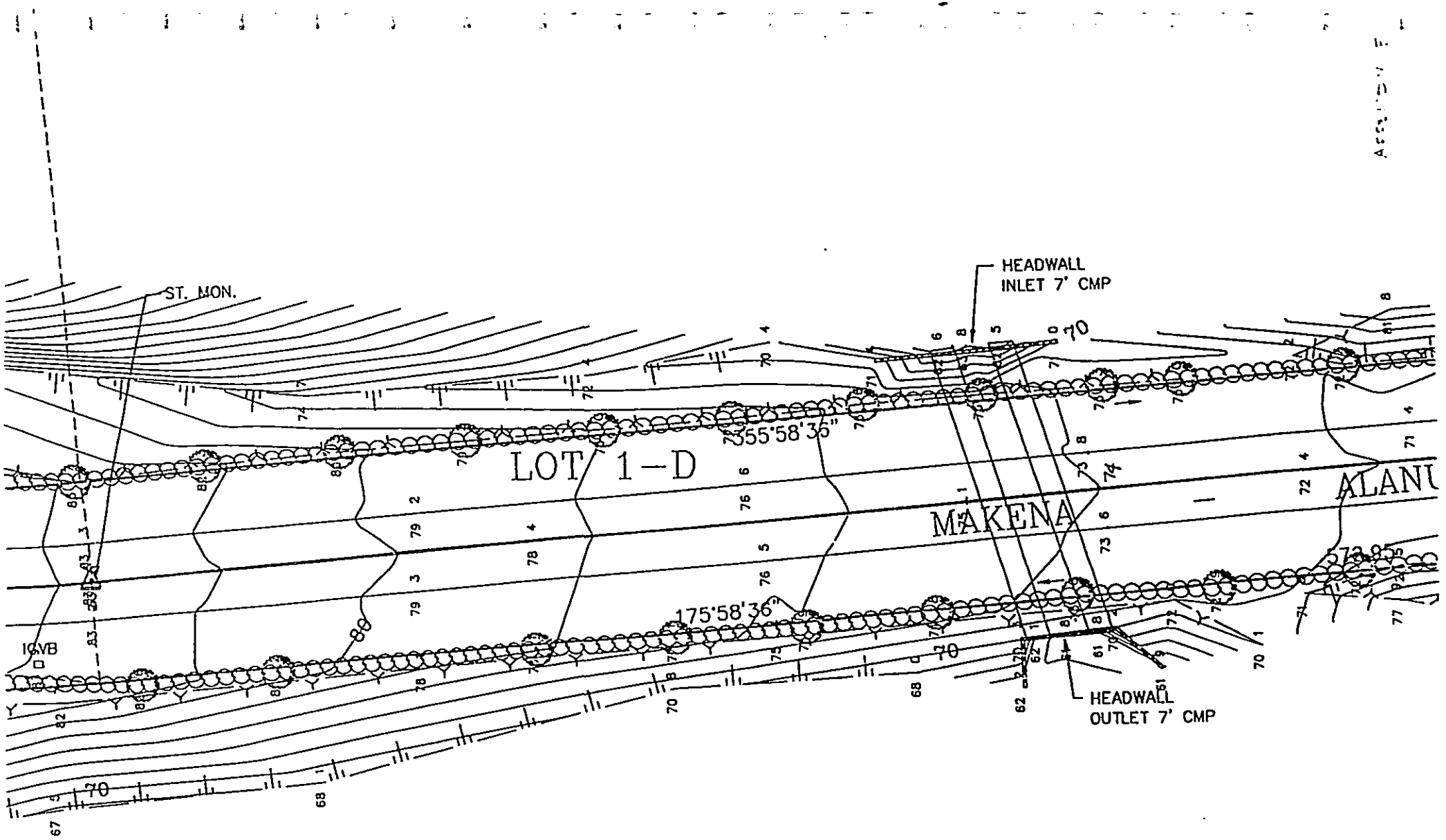
K = 3460

$Q_f = K S_o^{1/2} = (3460)(.0078)^{1/2} = 305.58$

Solve for D/D_f from Chart Q/Q_f

$Q/Q_f = 333.33/305.58 = 1.09 = D/D_F \cong 1$

$D_n = D \times (D/D_F) = (7)(1) = 7'$

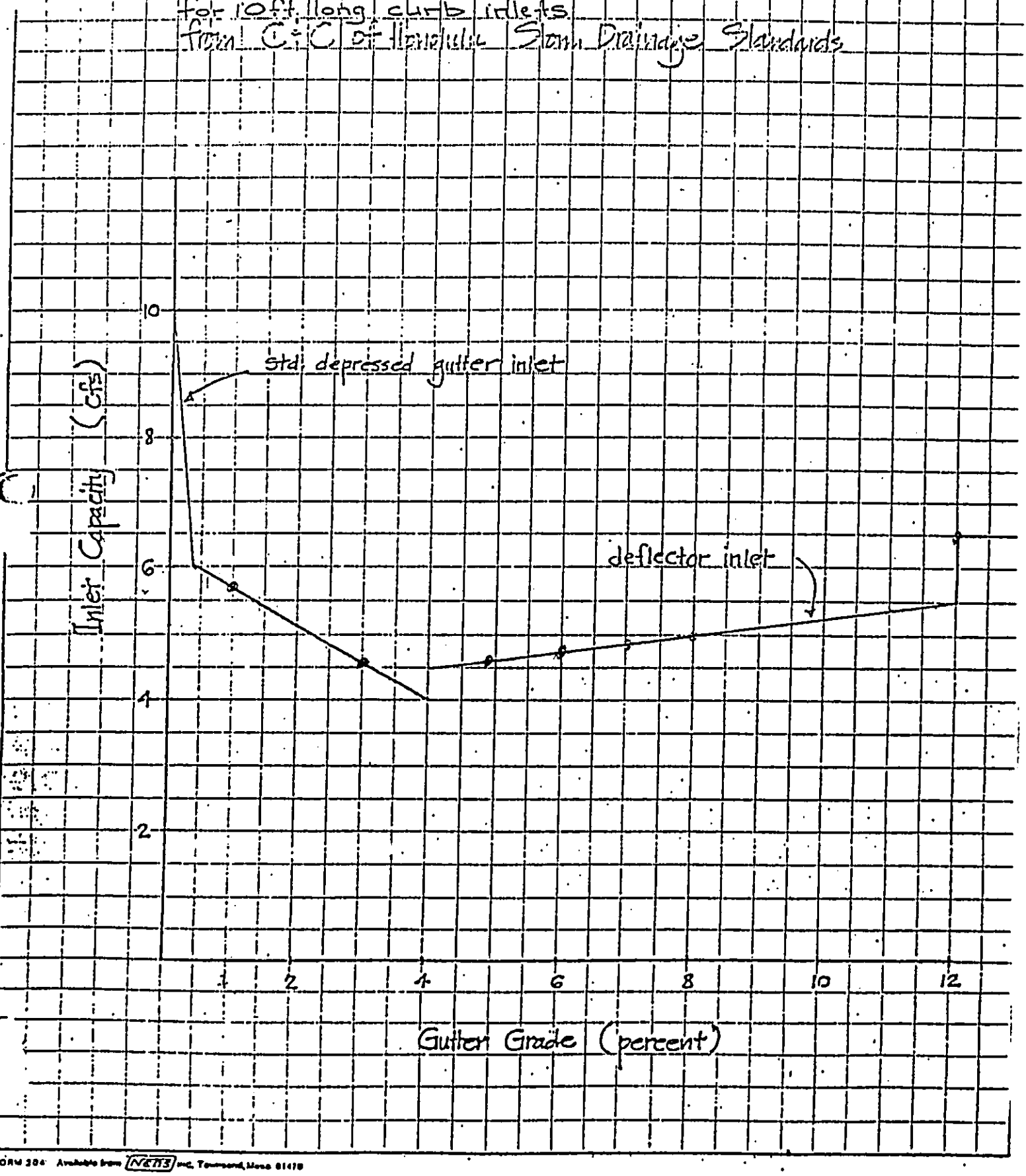

ST. MON.
HEADWALL
INLET 7' CMP
LOT 1-D
MAKENA
ALANI
175°58'36"
175°58'36"
HEADWALL
OUTLET 7' CMP
R=

NORMAN SAITO
ENGINEERING CONSULTANTS, INC.
P. O. Box 1887
KAHULUI, HAWAII 96732
Phone 877-7667

SHEET NO. 6 OF
CALCULATED BY DATE
CHECKED BY DATE
SCALE

CATCH BASIN INLET CAPACITIES

for 10 ft. long curb inlets
from C & C of Honolulu Storm Drainage Standards



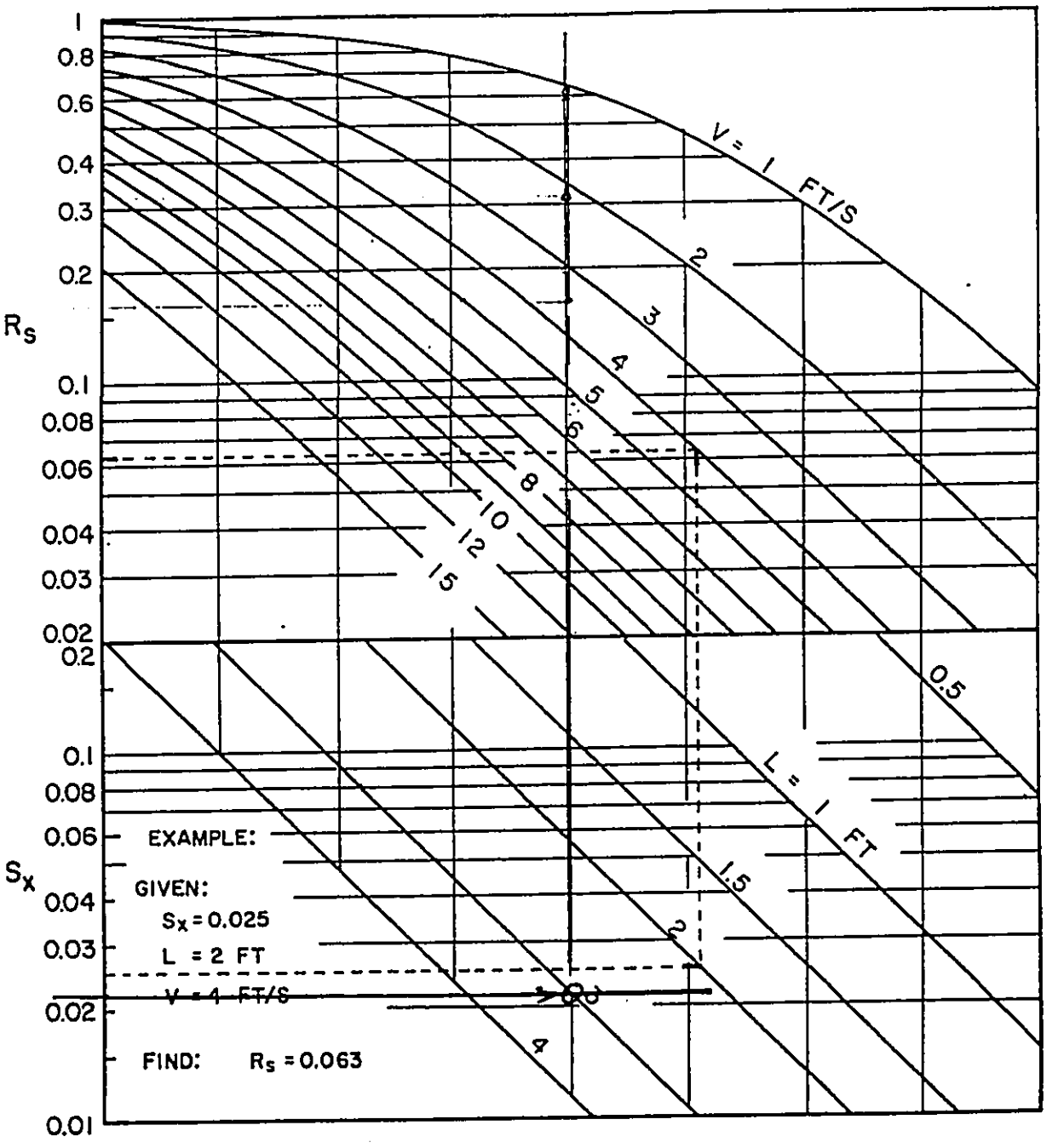


CHART 8. Grate inlet side flow interception efficiency.

APPENDIX =

CON/SPAN® BRIDGE SYSTEMS

Job No. [illegible] 03 00, Sh. 1 Of 9, Pg __

Project [illegible] INFRASTRUCTURE

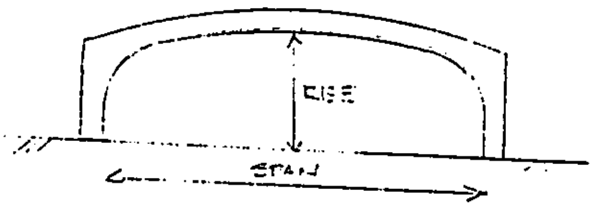
By [signature] Date ____

Subject ____

PURPOSE: DETERMINE HEADWATER DEPTH AT PROPOSED [illegible] CROSSING AT [illegible] ROAD

DESIGN DATA

SPAN: 16'-0" (2 EA)
RISE: 5'-0"
Q_{100}: 1000 CFS
TW: FREE OUTFALL (0)
LENGTH: 50.0'
STREAM BOTTOM:
CASE I: NATURAL
CASE II: CONCRETE



CONSPAN
1/8" = 1'-0"

HEADWATER CALCULATIONS

INLET CONTROL:

FROM CHART 1, GIVEN Q = 500 CFS
(2 EA ∴ 1000/2 = 500 CFS)

HW_i = 5.0 FT

ELEVATION OF HW_i = $HW_i + US_{INV}$

ELEV = 5.0 + 8.5

ELEV = 13.5'

APPENDIX F

CONSPAN® BRIDGE SYSTEMS

Job No. M9703.00 Sh. 2 of 9 Pg.
Project MAKENA INFRASTRUCTURE
By [illegible] Date

Subject

HEADWATER CALCULATIONS (CONTINUED)

OUTLET CONTROL

DETERMINE TW/D = 0.
(FREE OUTFALL TO OCEAN)

DETERMINE CRITICAL DEPTH:

$AD^{0.5} = 71.0 \times 5^{0.5} = 158.76$

$Q_{100}/AD^{0.5} = 500/158.76 = 3.15$

FROM CHART 2:

RISE/SPAN = 0.31

$d_c/d = 0.59$

$d_c = 0.59(5) = 2.95$ FT.

DETERMINE $(d_c+D)/2$

$(d_c+D)/2 = (2.95+5)/2 = 3.98$

DETERMINE ENTRANCE LOSS CO-EFFCIENT:

$K_e = 0.5$ No Wingwalls, Square Edges. (TABLE 3)

DETERMINE Headwater in OUTLET Control
TW or $(d_c+D)/2$ WHICHEVER IS GREATER. TW = 0 FREE OUTFALL

$h_o = 3.98$

APPENDIX F

CONSPAN® BRIDGE SYSTEMS

Job No. M9703.00, Sh. 3 Of 9, Pg.
Project MALENA INFRASTUCTURE
By _____ Date _____
Subject _____

HEADWATER CALCULATIONS (CONTINUED)

DETERMINE TOTAL HEAD LOSS

FIND MANNING'S n

For case I: $n_{eq} = \dfrac{(0.012)\,\text{Inside Perim.} + \text{Span}\,(n_{rocks})}{\text{TOTAL Wet. Perim.}}$

$n_{rocks} = 0.05$
Inside Perim = 22.4 (TABLE 2)
Span = 16.0 FT
TOTAL Perim = 22.4 + 16 = = 38.4

$$n_{eq} = \frac{(0.012)(22.4) + 16(0.05)}{38.4}$$

$$n_{eq} = \frac{1.0688}{38.4} = 0.028$$

For case II: $n = 0.012$ (Concrete)

FIND Equivalent Length

$$\text{I: } L_{eq} = \left(\frac{(n\text{ - proposed struct})}{(n\text{ - chart})}\right)^2 \times \text{Act. Length}$$

$$\text{I: } L_{eq} = \left(\frac{0.028}{0.033}\right)^2 50 = 35.97 = 36.0 \text{ FT}$$

$$\text{II: } L_{eq} = \left(\frac{0.012}{0.033}\right)^2 50 = 6.61 \text{ FT.}$$

I: H = 1.25 FT (CHART 6)
II: H = 1.75 FT. (CHART 6)

APPENDIX F

CONSPAN® BRIDGE SYSTEMS

Job No. M9703.00, Sh. 4 Of 9 Pg

Project MALENA INFRASTRUCTURE

By [illegible] Date

Subject

HEADWATER CALCULATIONS (CONTINUED)

DETERMINE ELEVATION OF HEADWATER IN OUTLET CONTROL.

$$EL_{HO} = EL_o + H + h_o$$

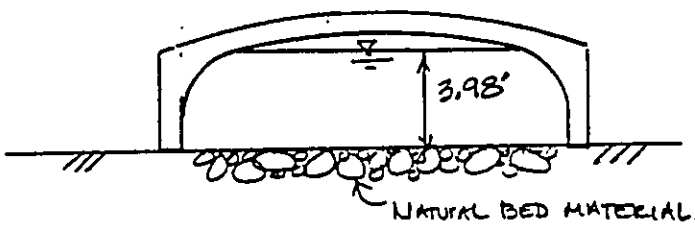
I: $EL_{HO} = 7.5 + 1.75 + 3.98$

$EL_{HO} = 13.23$ FT (WITH NATURAL BOTTOM - ROCK)

II $EL_{HO} = 7.5 + 1.25 + 3.98$

$EL_{HO} = 12.73$ FT (WITH CONC. LINED BOTTOM (INV))

DETERMINE OULET VELOCITY.



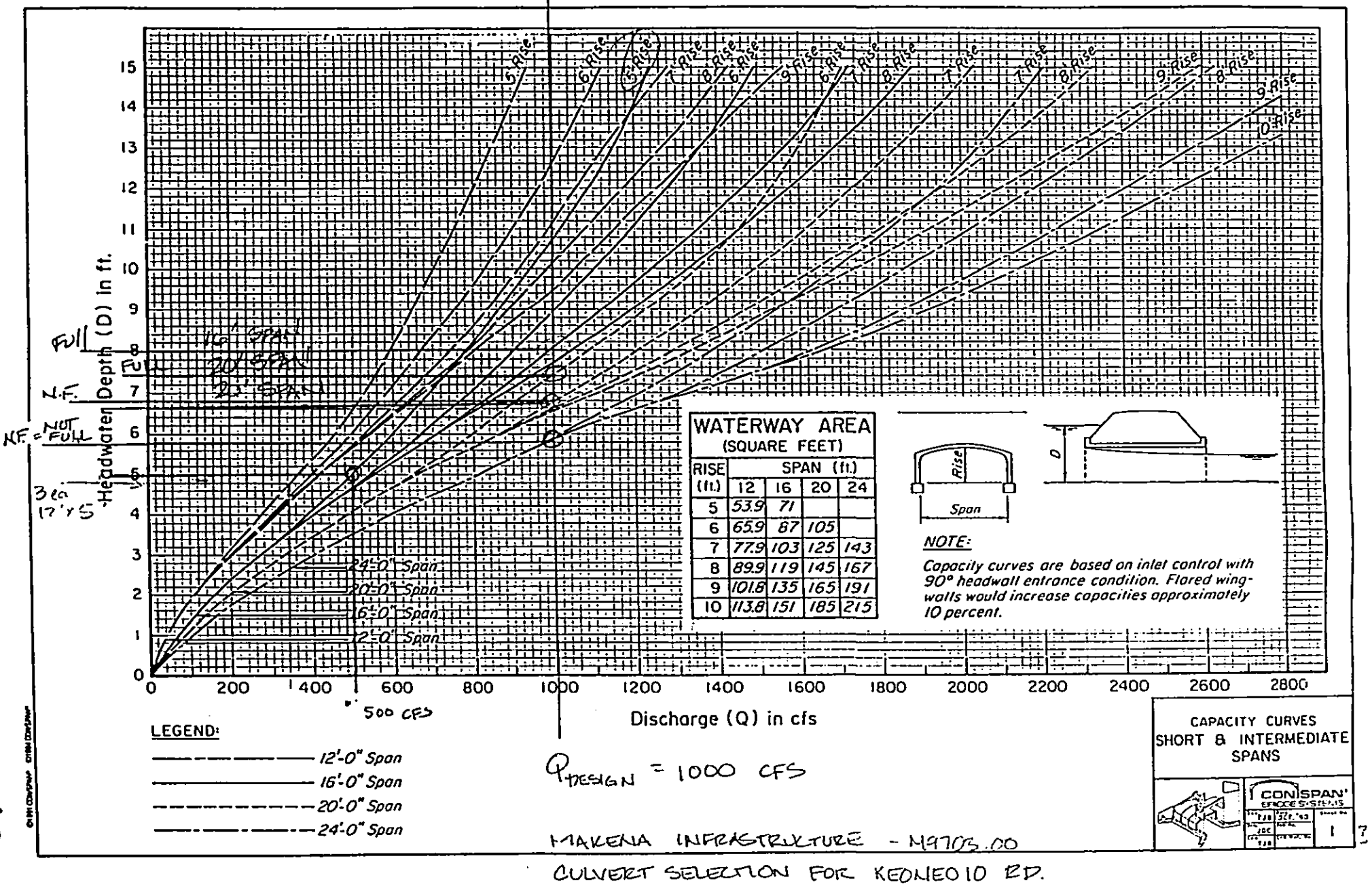
$Q = VA$ A = FLOW AREA = TOTAL AREA - AREA open AT TOP

$A = 71 - 7.1 = 63.9$ FT^2.

$Q = 500$ CFS

$V = Q/A = 500/63.9$

$V = 7.82$ FPS.



Q_{DESIGN} = 1000 CFS

MAKENA INFRASTRUCTURE - M9703.00

CULVERT SELECTION FOR KEONEO 10 RD.

CHART 1

CHART 2

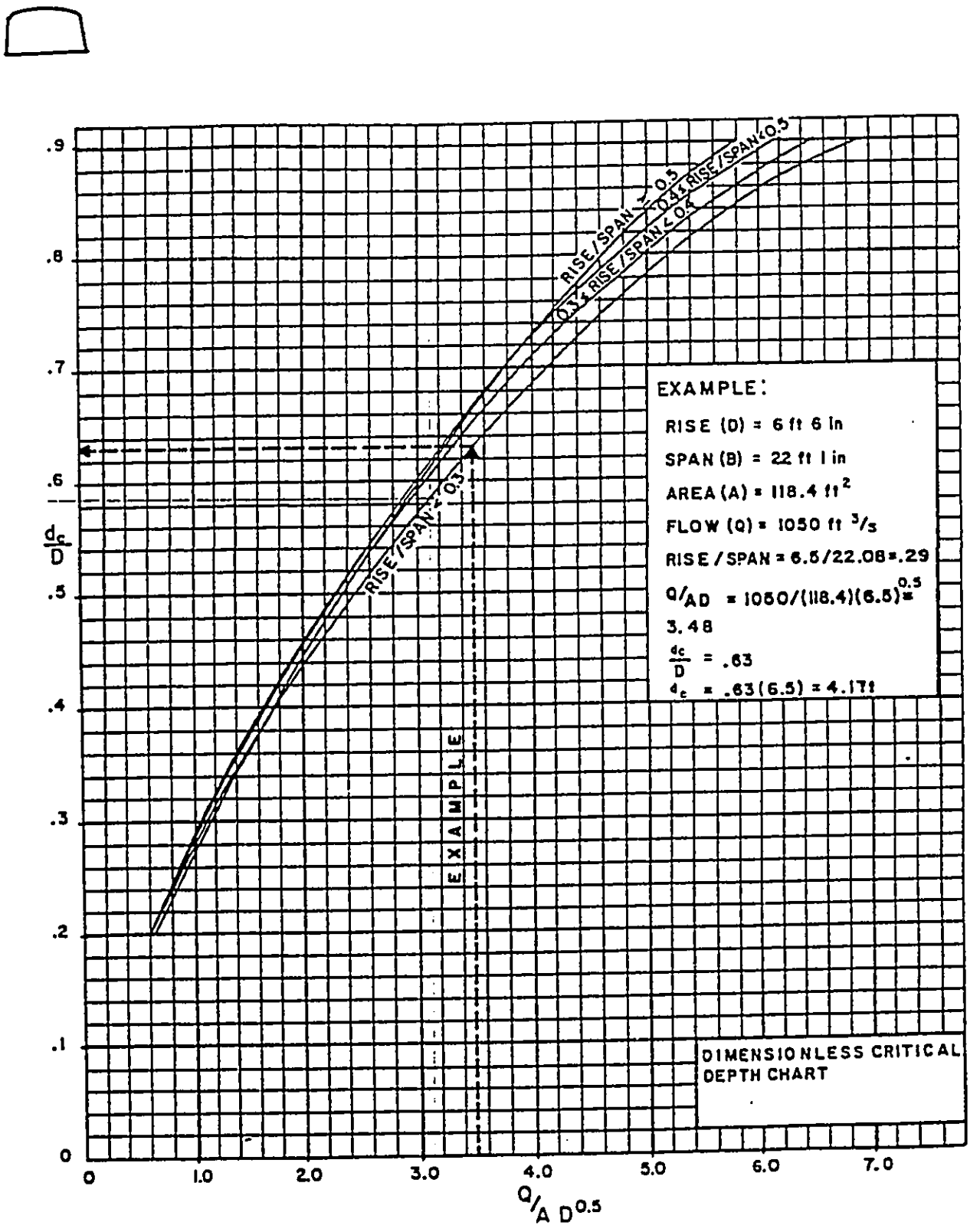


TABLE 3

D-12

MANNING n FOR SMALL NATURAL STREAM CHANNELS

(Surface width at flood stage less than 100 ft.)

1. Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030--0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035--0.05
c. Some weeds, light brush on banks	0.035--0.05
d. Some weeds, heavy brush on banks	0.05 --0.07
e. Some weeds, dense willows on banks	0.06 --0.08
f. For trees within channel, with branches submerged at high stage, increase all above values by	0.01 --0.02
2. Irregular sections, with pools, slight channel meander; increase values given above about	0.01 --0.02
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:	
a. Bottom of gravel, cobbles, and few boulders	0.04 --0.05
b. Bottom of cobbles, with large boulders	0.05 --0.07

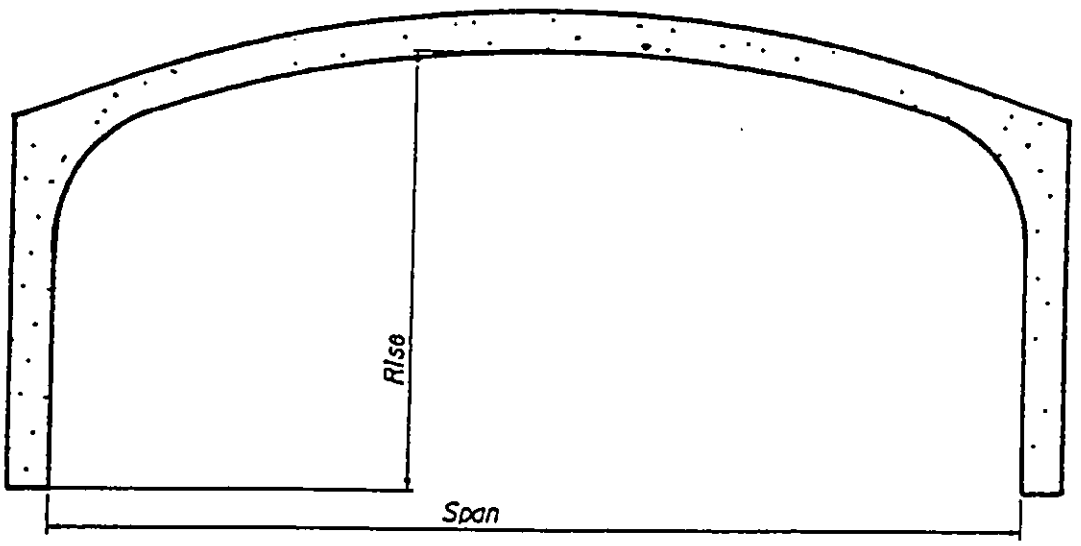
TABLE 4

ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

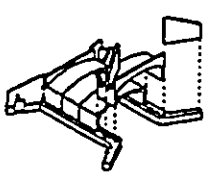
Type of Structure and Design of Entrance	Coefficient k_e
Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2



WATERWAY AREA (Square Feet)			
RISE (ft)	SPAN (ft)		
	16	20	24
5	71	85	
6	87	~~105~~	119
7	103	125	143
8	119	145	167
9	135	165	191
10		185	215

WETTED PERIMETER (NOT INCLUDING CHANNEL BOTTOM) (Feet)			
RISE (ft)	SPAN (ft)		
	16	20	24
5	22.4	25.4	
6	24.4	~~27.4~~	30.1
7	26.4	29.4	32.1
8	28.4	31.4	34.1
9	30.4	33.4	36.1
10		35.4	38.1

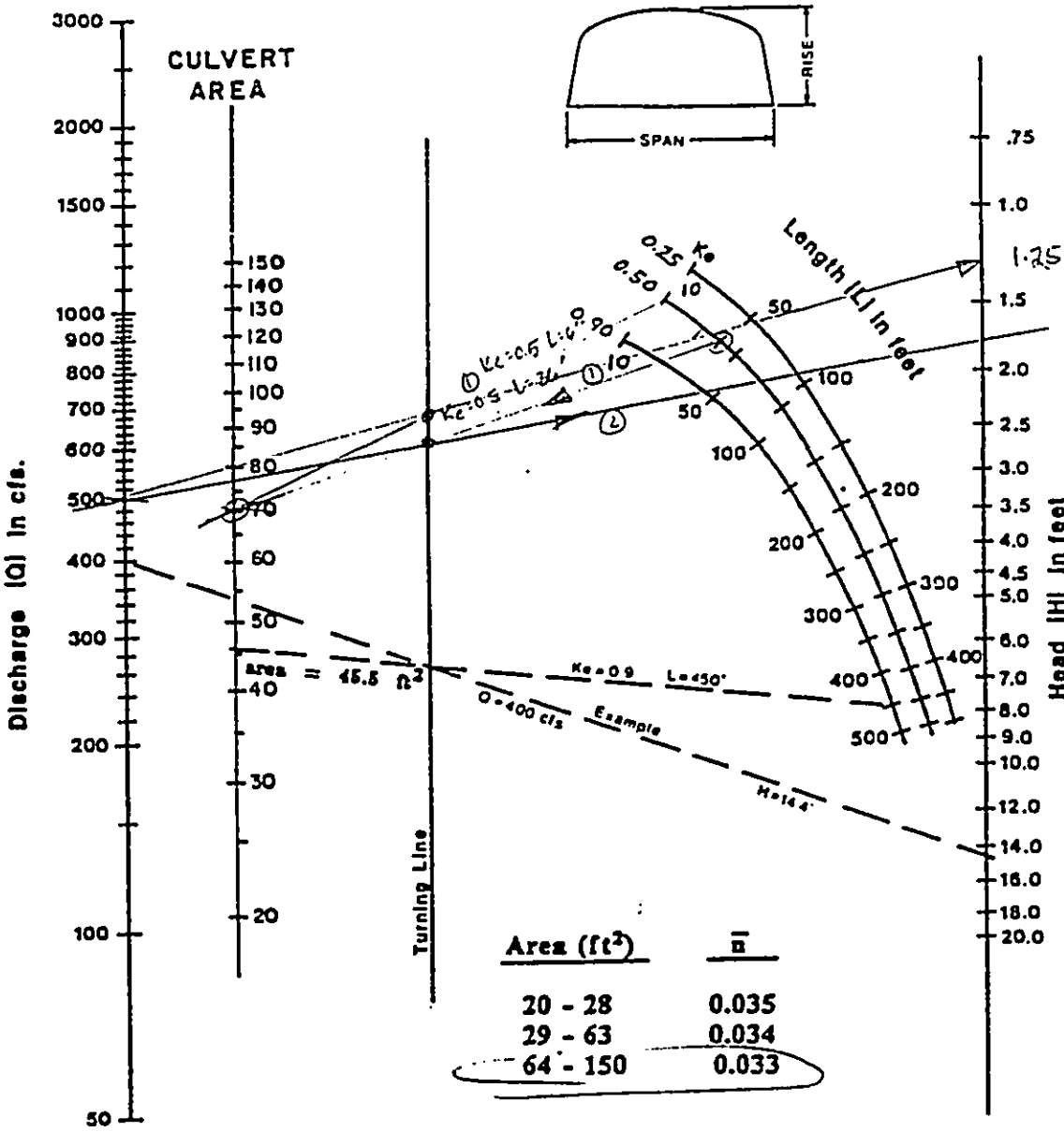
HYDRAULIC PROPERTIES



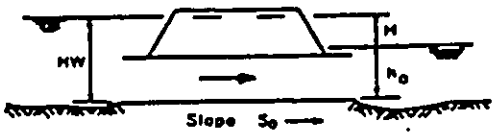
CONISPAN® BRIDGE SYSTEMS

 B-69

APPENDIX F Sheet No. ~~9 of 11~~



Area (ft^2)	$\bar{n}$
20 - 28	0.035
29 - 63	0.034
64 - 150	0.033



SUBMERGED OUTLET CULVERT FLOWING FULL

n=0.033

HEAD FOR
C.M. BOX CULVERTS
FLOWING FULL
CORRUGATED METAL BOTTOM
RISE/SPAN < 0.3

Nomographs adapted from material furnished by Kaiser Aluminum and Chemical Corporation

Duplication of this nomograph may distort scale

9 of 9

APPENDIX G

CATCH BASIN AND INLET CAPACITY - RUNOFF SUMMARY

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: ____ Date: 5/11/19
Chkd. by: ____ Date: ____

PROJECT: MALENA INFRASTRUCTURE

CATCH BASIN/INLET CAPACITY

RUNOFF SUMMARY

PER MAP "C"

CB/CDI NO	onsite + offsite Q CFS	Qi CFS	Q_{bypass} CFS	E (%)
CB C-10	1.59	6.00	0	100.0
CB C-9	1.47	6.00	0	100.0
CDI C-9A	4.69	9.11	0	100.0
CDI C-9A	17.02	51.3	0	100.0
CB C-8	1.83	6.00	0	100
C-7	1.83	6.00	0	100.0
C-6	12.78	6.00	6.78	46.9
C-5	2.00	6.00	0	100
C-4	14.78	6.00	8.78	40.6
C-3	9.66	4.90	4.76	50.7
C-2	5.36	4.90	0.46	91.4
C-1	3.14	4.60	0	100
INLET C1	3.92			

bypass to C-5

bypass to C-3

ATTENTION:

Sato & Associates, Inc.
Consulting Engineers

Sheet: ____ Of: ____
By: [illegible] Date: 5/11/98
Chkd. by: ____ Date: ____

PROJECT: MALENIA INFRASTRUCTURE

CATCH BASIN/INLET CAPACITY

RUNOFF SUMMARY

CB/CD1 NO	Q CFS	Qi CFS	Q bypass CFS	E (%)
CB D-1	5.00	11.54	0	100.0
CB D-2	3.00	11.54	0	100.0
CB D-3	0.59 + 3.37 5.96	11.54	0	100.0
INLET D-1	0 + 3.86 3.86	9.11	0	100.0
CB D-5	1.12 + 0 1.12	10.00	0	100.0
CB D-4	1.71 + 0.0 1.71	10.0	0	100.0
CB D-6	0.64 + 9.41 10.05	9.11	0.94	90.6
INLET (BY OTHERS)	12.70	(@ HW = 3.0 FT) 24.0	0	100
INLET D1	4.28	(@ HW = 3.0 FT) 24.0	0	100

APPENDIX G

XI. EXHIBITS

EXHIBIT 1 - ISLAND OF MAUI

EXHIBIT 2 - SITE LOCATION MAP

EXHIBIT 3 - PROPOSED INFRASTRUCTURE IMPROVEMENTS

EXHIBIT 4 - FLOOD INSURANCE RATE MAP

EXHIBIT 5 - WATERSHED MAP

EXHIBIT 6 - SOIL COMPLEX MAP

EXHIBIT 7 - EXISTING/DEVELOPED HYDROLOGIC CONDITIONS

EXHIBIT 8 - OFFSITE DRAINAGE AREA MAP

EXHIBIT 9 - ONSITE DRAINAGE AREA MAP

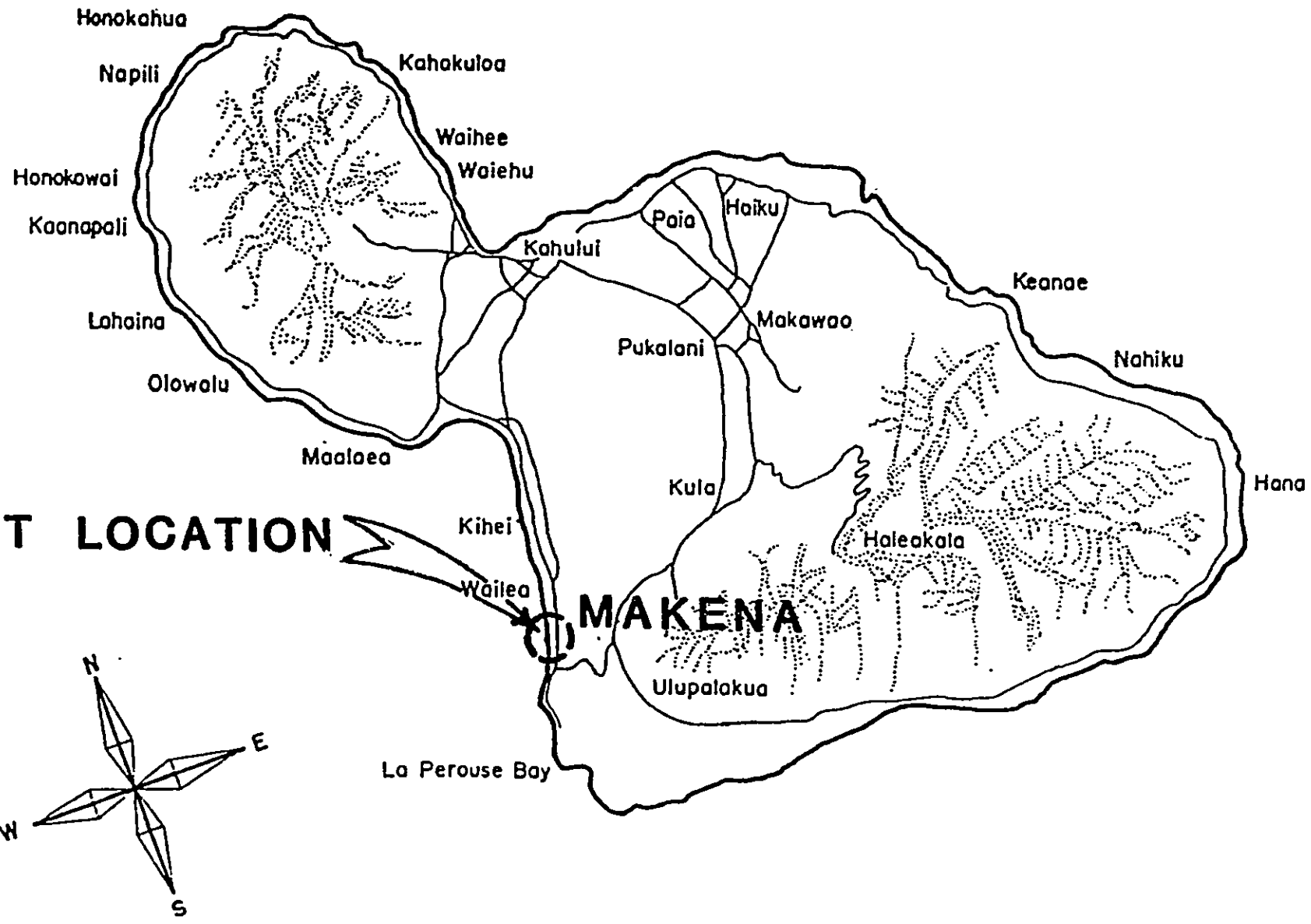
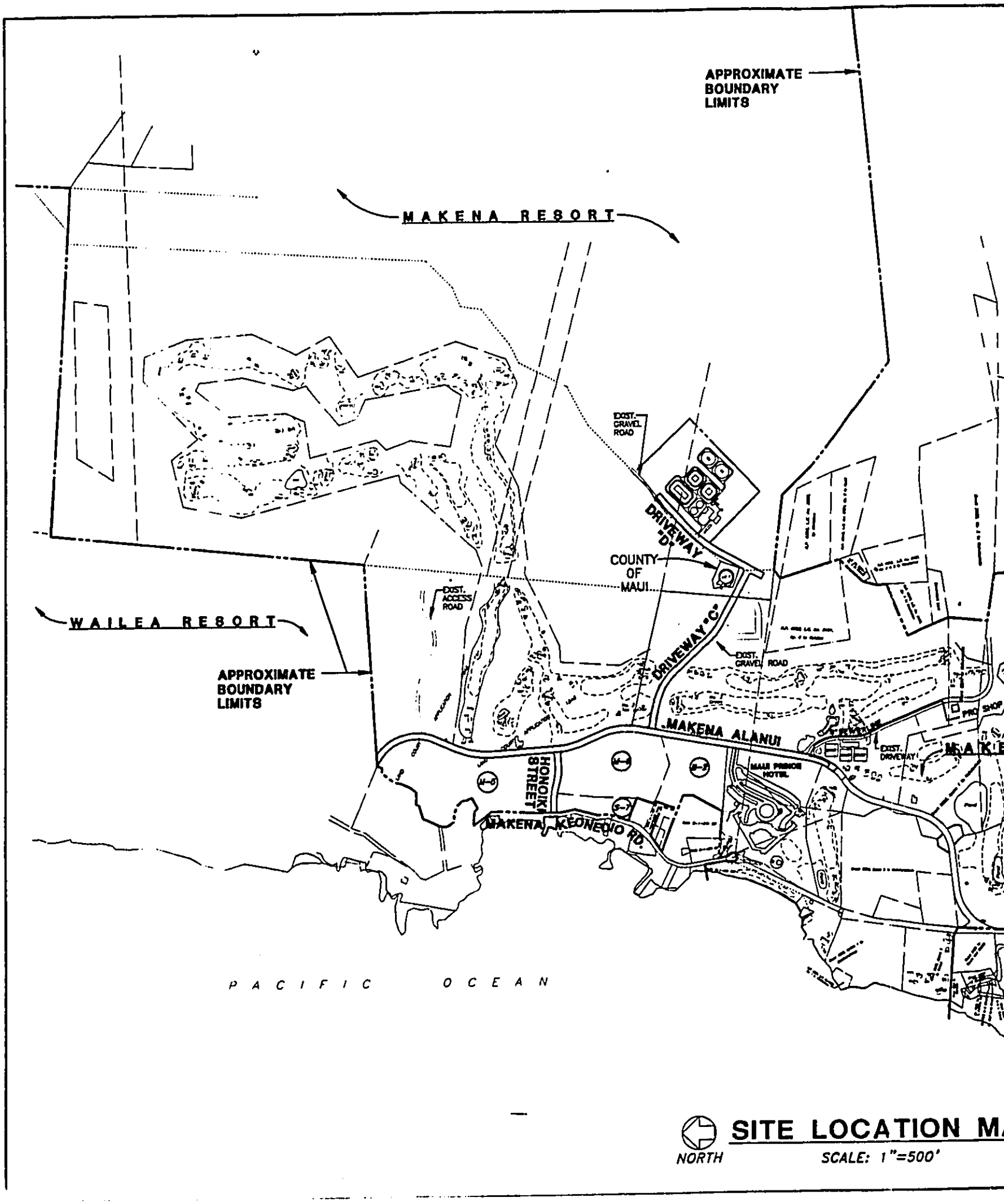


EXHIBIT 1
ISLAND OF MAUI

DOCUMENT CAPTURED AS RECEIVED



NORTH

SITE LOCATION MA

SCALE: 1"=500'

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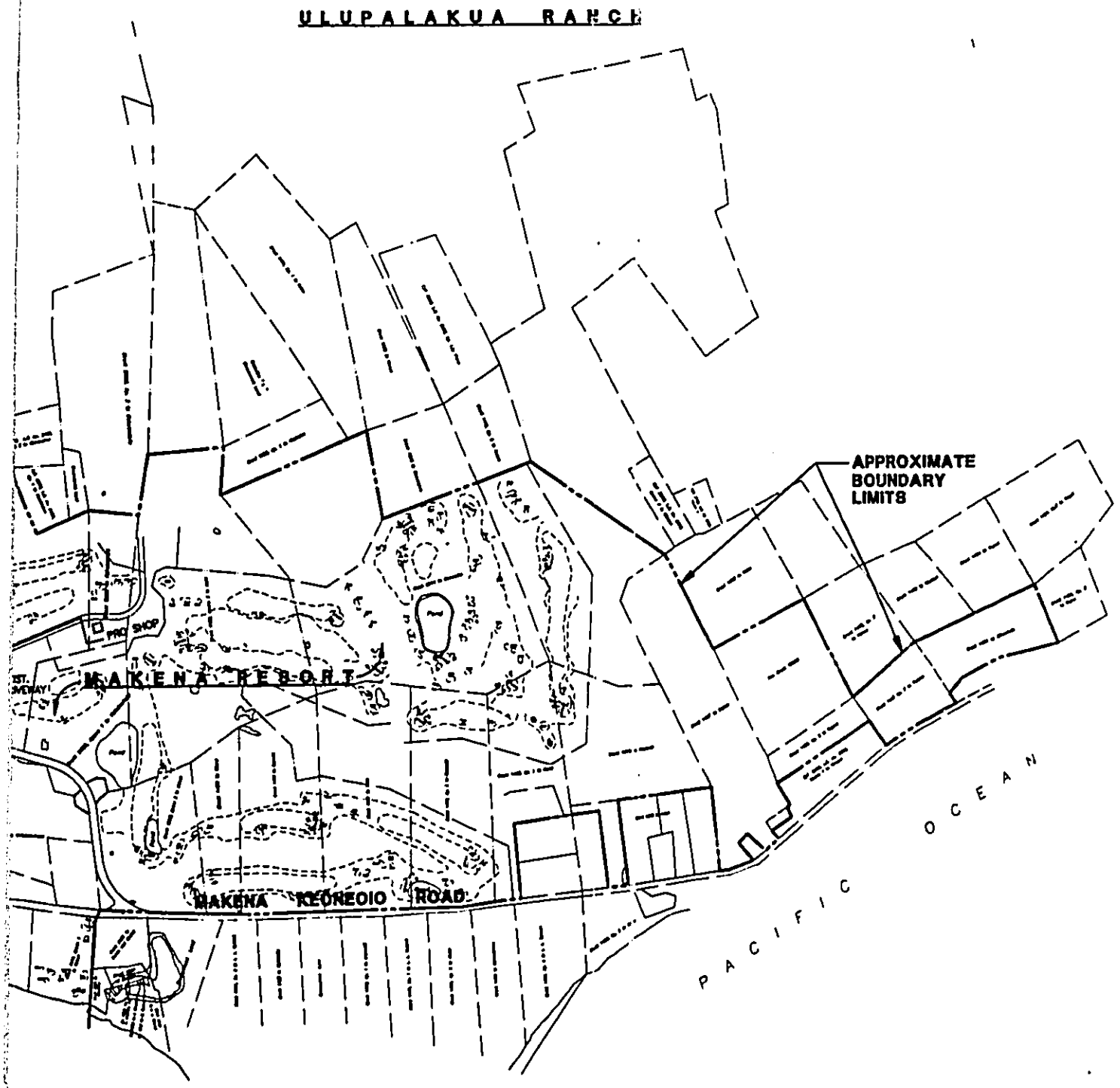
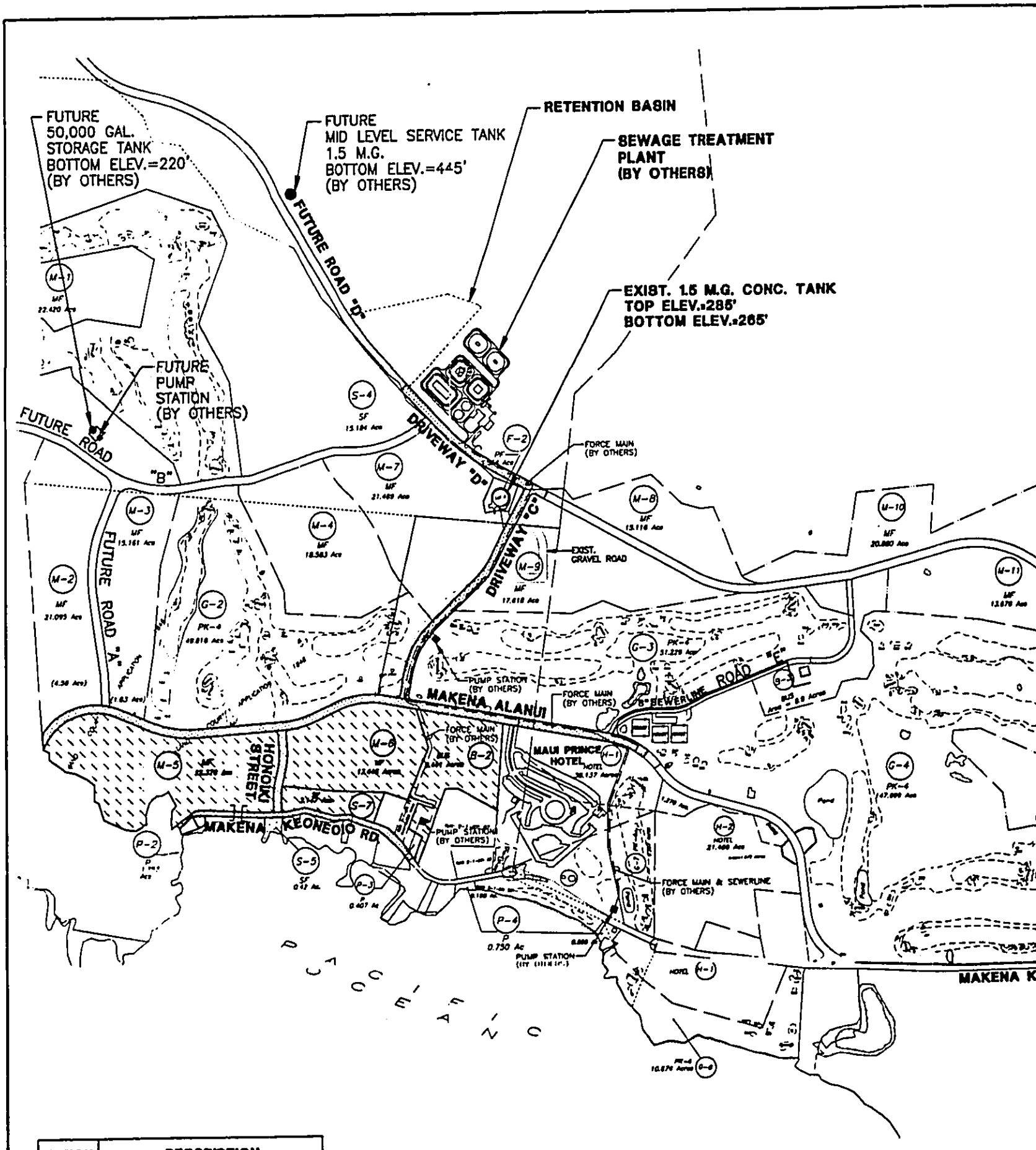


ATION MAP

"=500'

EXHIBIT 2



HATCH	DESCRIPTION
	AREA TO BE DEVELOPED
	AREA OF INFRASTRUCTURE IMPROVEMENTS

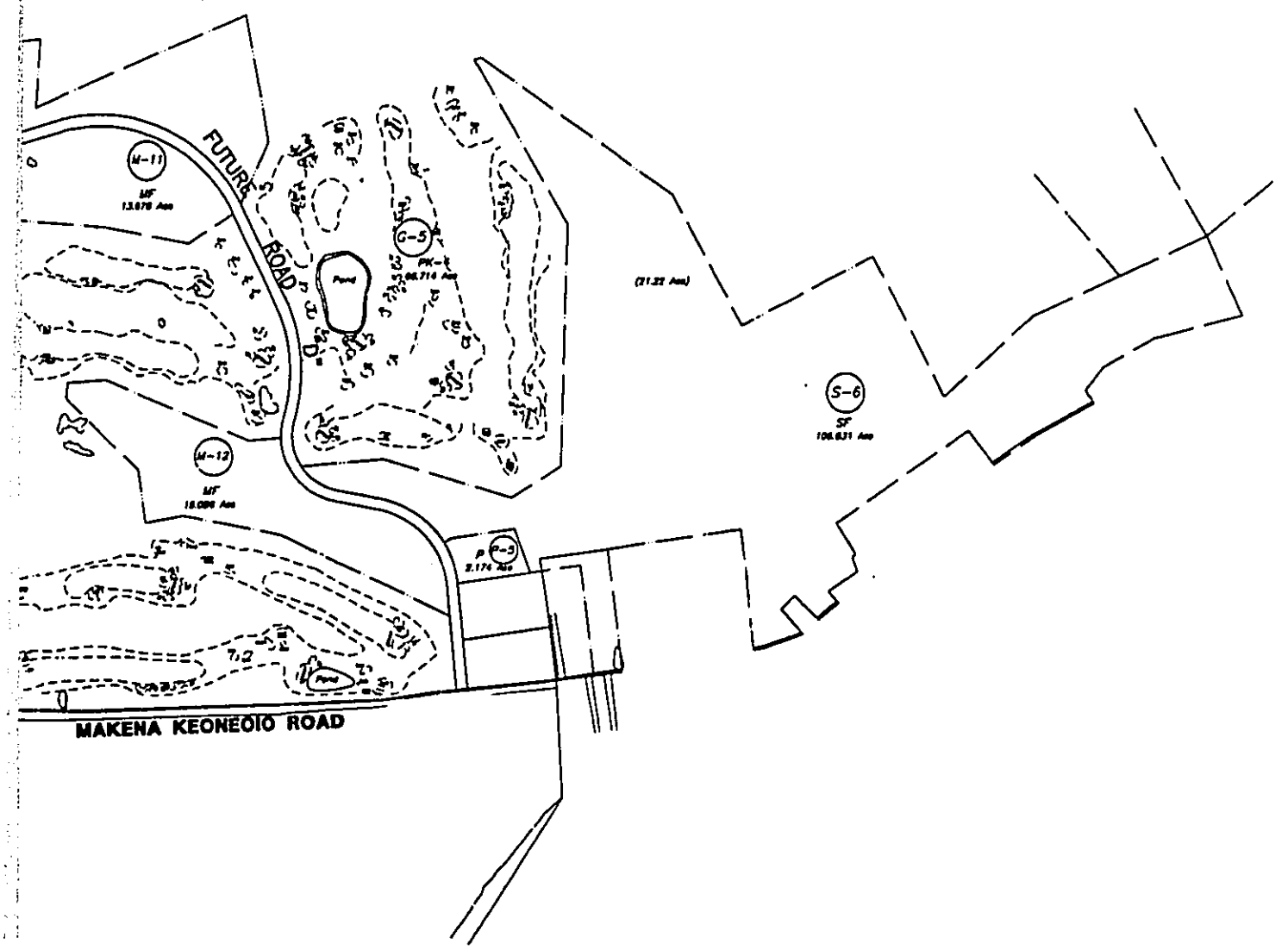
NORTH

PROPOSED INFRASTRUCTURE I

SCALE: 1"=400'

LEGEND

B – BUSINESS
F – PUBLIC/QUASI PUBLIC FACILITY
G – GOLF COURSE
H – HOTEL
M – MULTI–FAMILY
P – PARK
S – SINGLE FAMILY

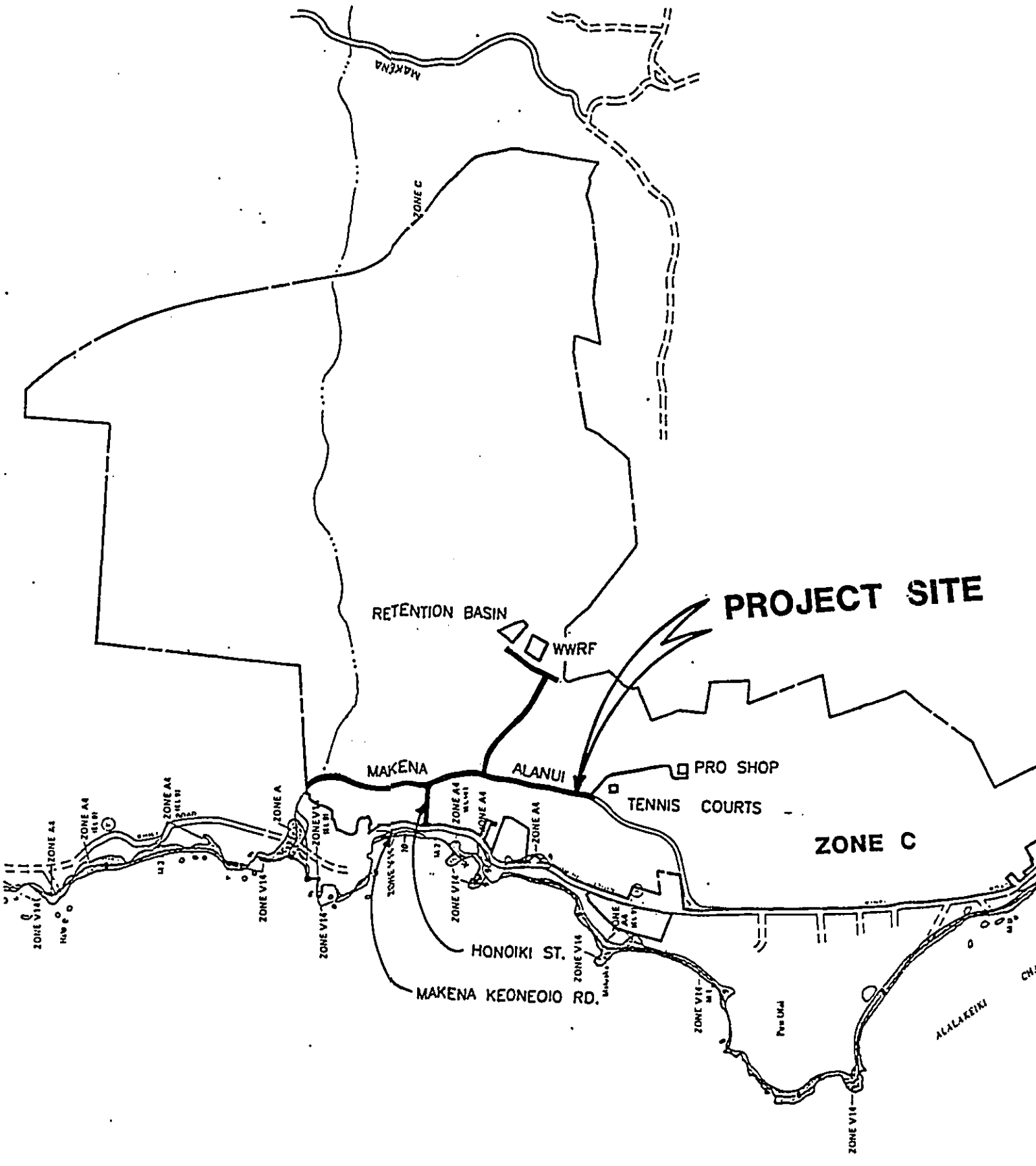


CTURE IMPROVEMENTS

'=400'

EXHIBIT 3

DOCUMENT CAPTURED AS RECEIVED



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MAUI COUNTY, HAWAII

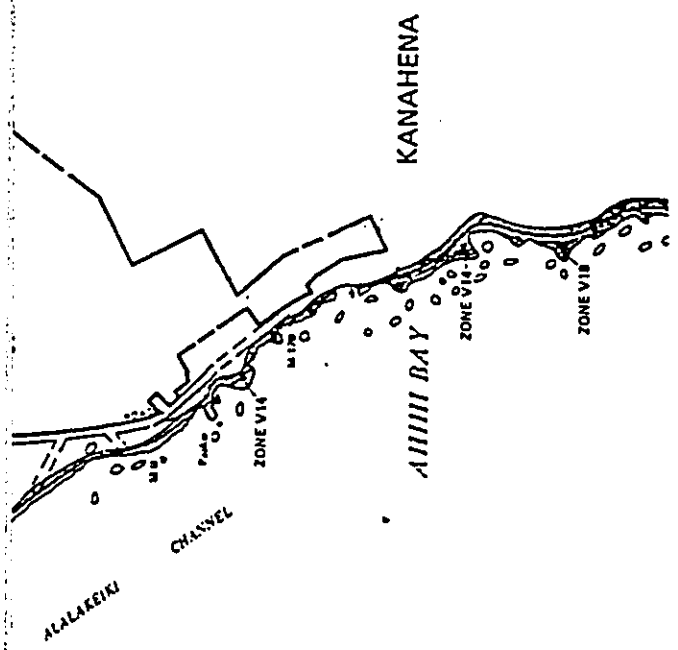
PANEL 330 OF 400
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
150003 0330 B

EFFECTIVE DATE:
JUNE 1, 1981

federal emergency management agency
federal insurance administration

SITE

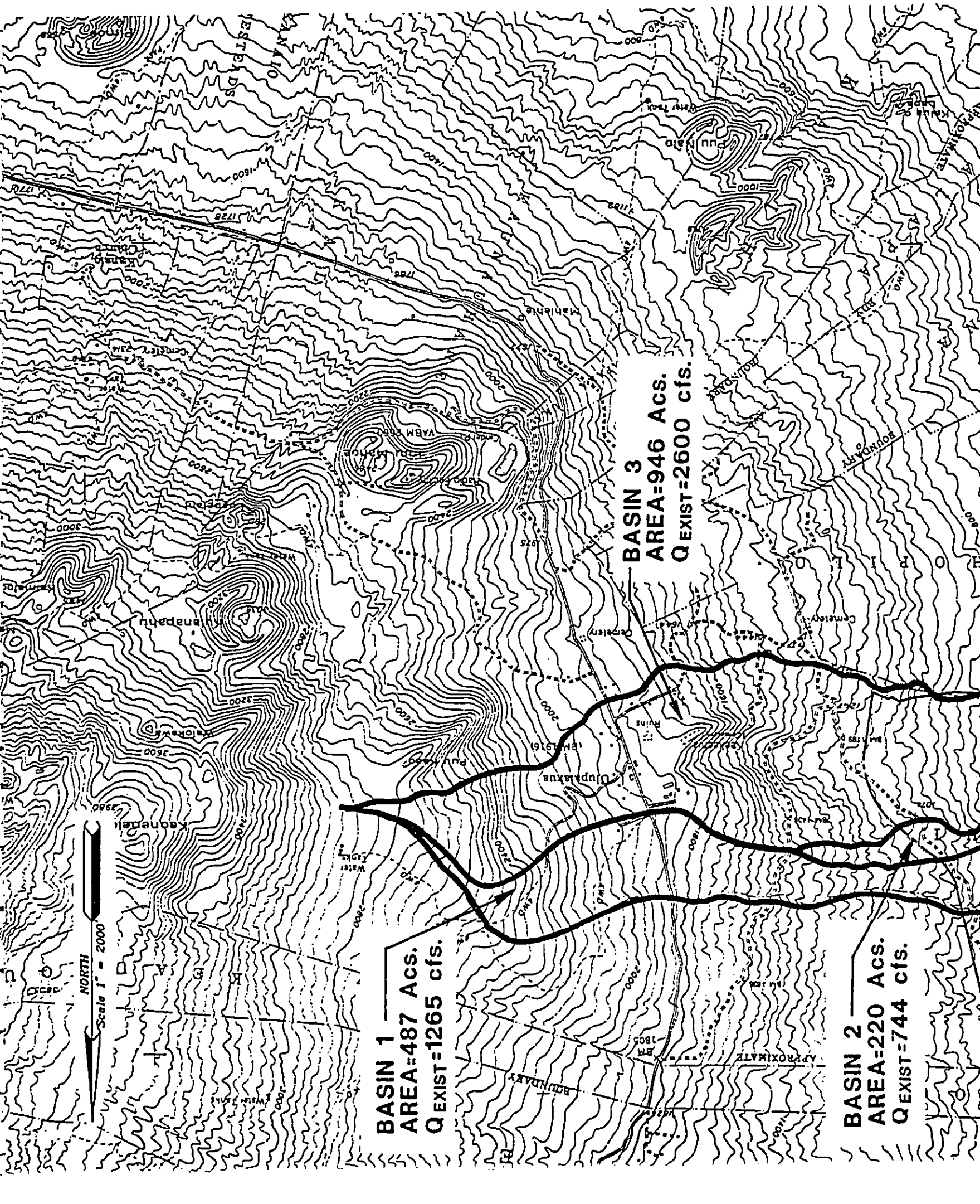


APPROXIMATE SCALE

EXHIBIT 4

FLOOD INSURANCE RATE MAP

DOCUMENT CAPTURED AS RECEIVED



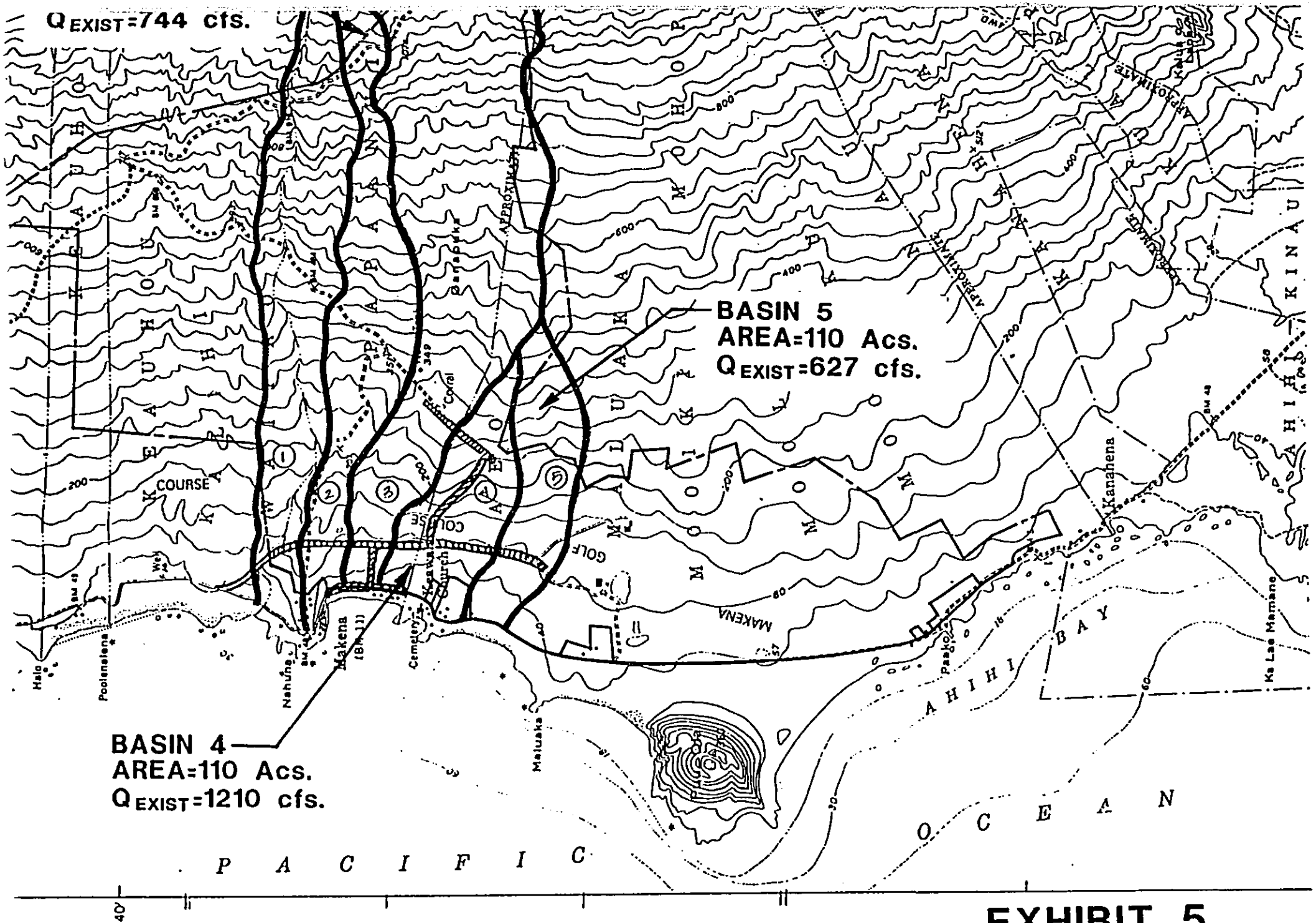
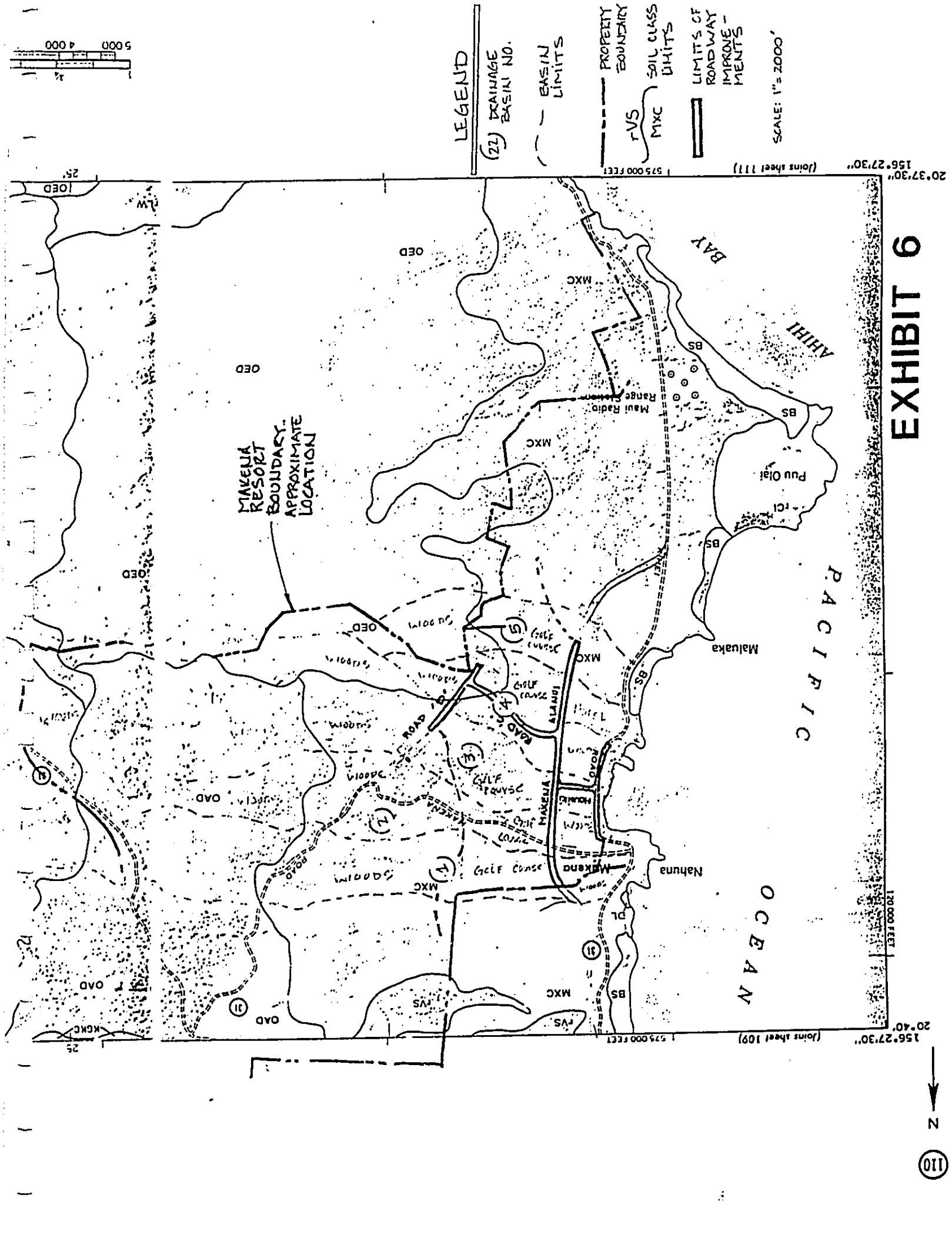
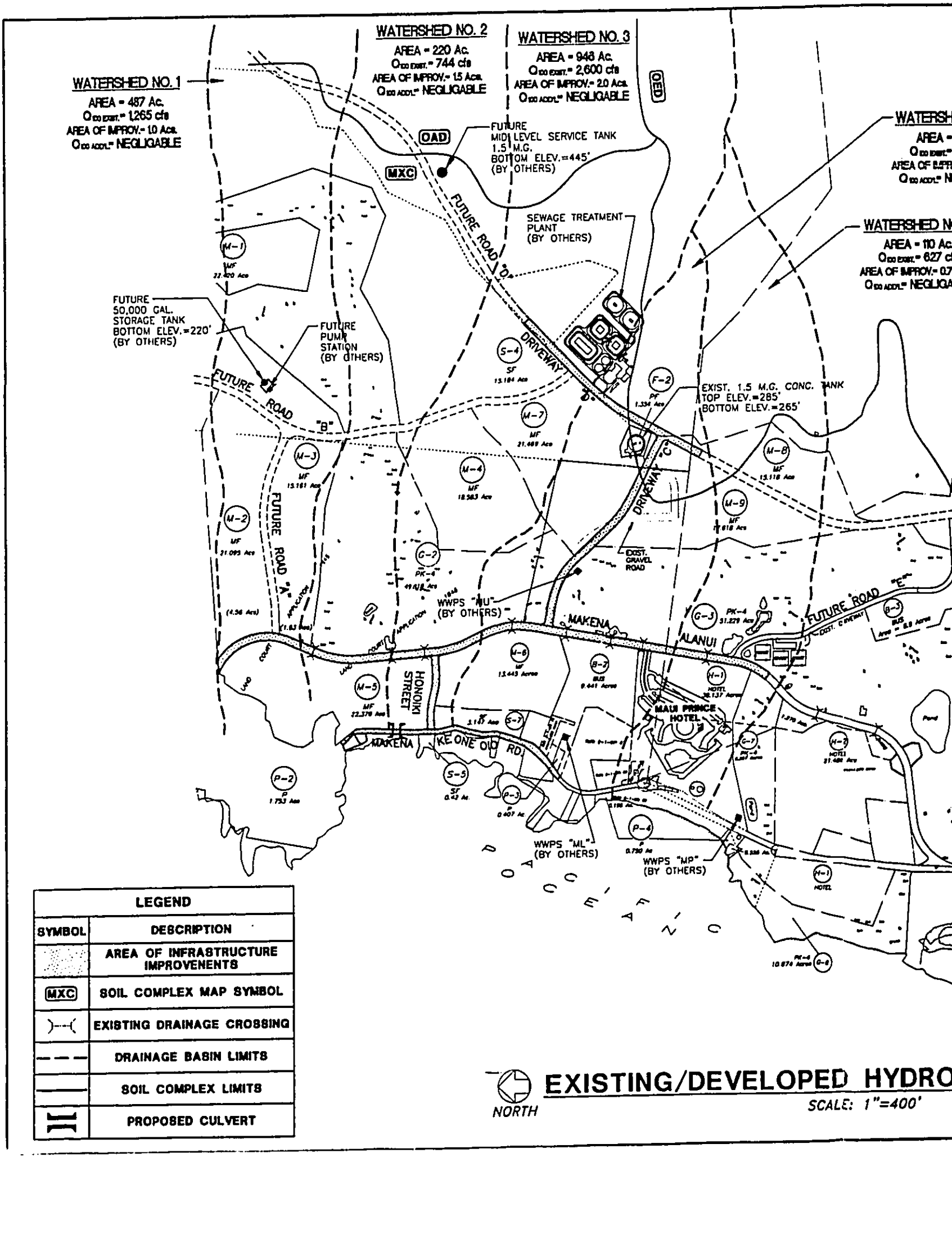


EXHIBIT 5

WATERSHED MAP





LEGEND	
SYMBOL	DESCRIPTION
	AREA OF INFRASTRUCTURE IMPROVEMENTS
MXC	SOIL COMPLEX MAP SYMBOL
)---(	EXISTING DRAINAGE CROSSING
- - -	DRAINAGE BASIN LIMITS
———	SOIL COMPLEX LIMITS
][	PROPOSED CULVERT

NORTH

EXISTING/DEVELOPED HYDRO

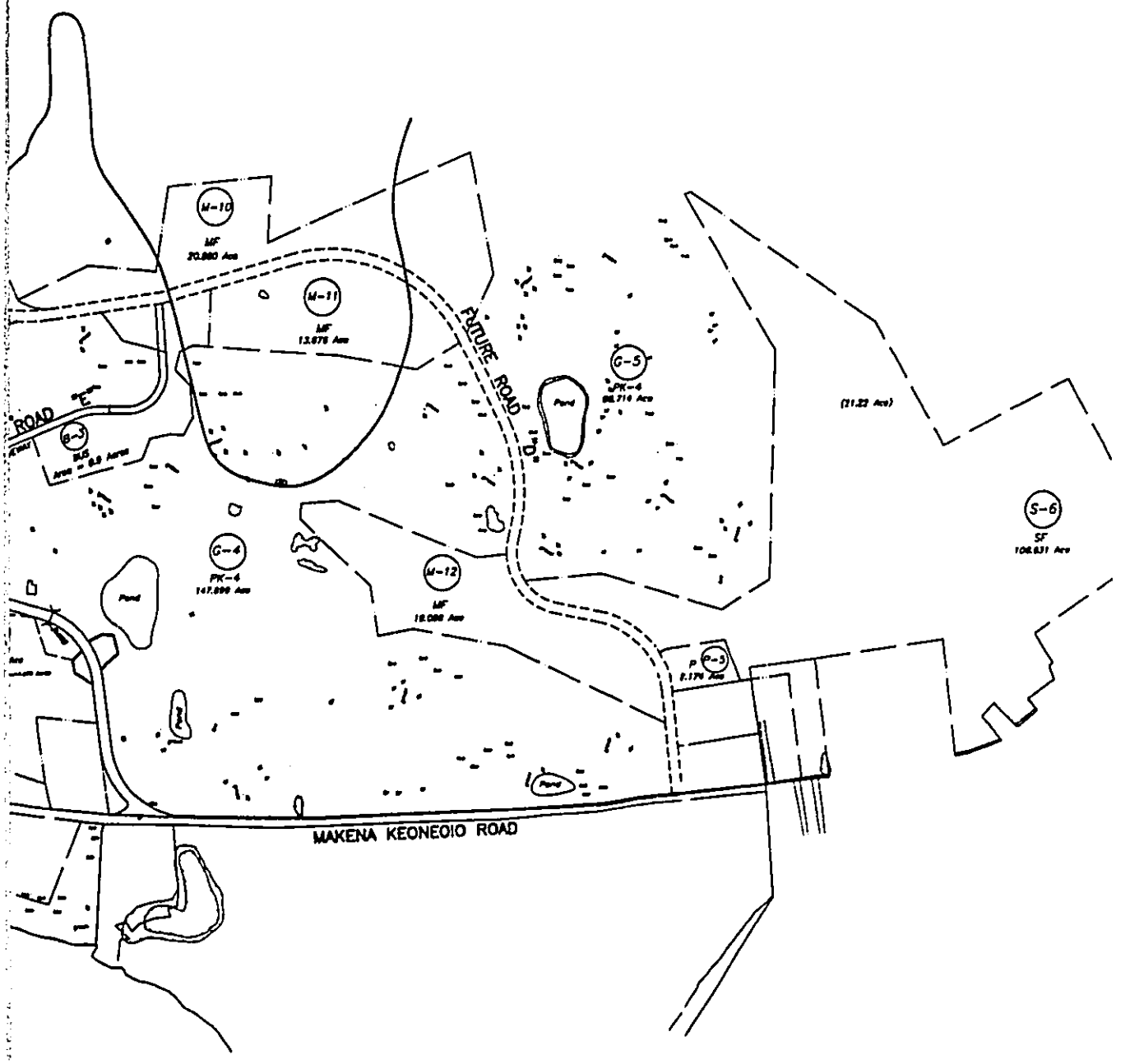
SCALE: 1"=400'

WATERSHED NO. 4

AREA = 110 Ac.
$Q_{100\ EXIST.}$ = 1,210 cfs
AREA OF IMPROV.= 4 Acs.
$Q_{100\ ADD'L.}$= NEGLIGIBLE

WATERSHED NO. 5

AREA = 110 Ac.
$Q_{100\ EXIST.}$ = 627 cfs
AREA OF IMPROV.= 0.7 Acs.
$Q_{100\ ADD'L.}$= NEGLIGABLE

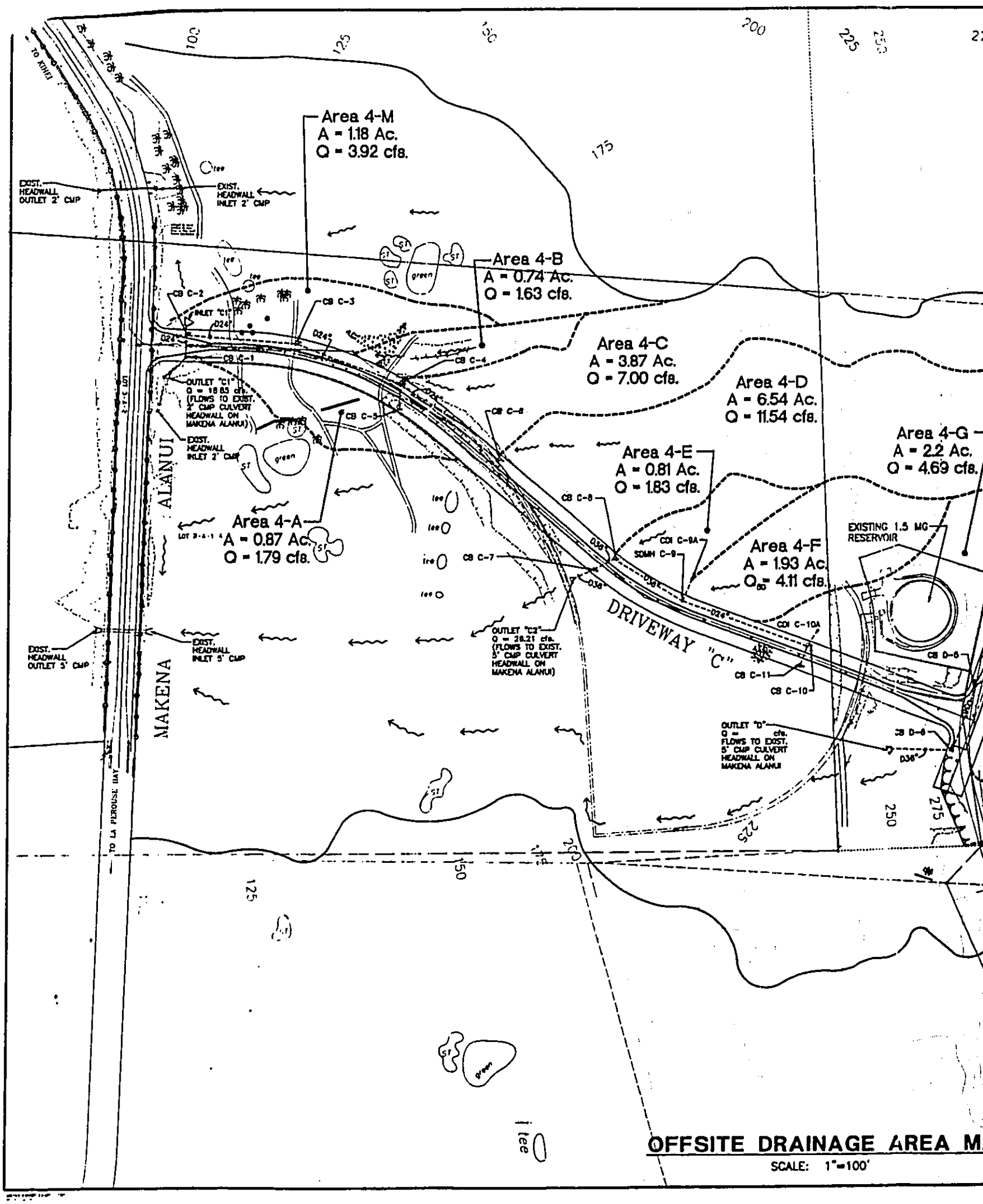


HYDROLOGIC CONDITIONS

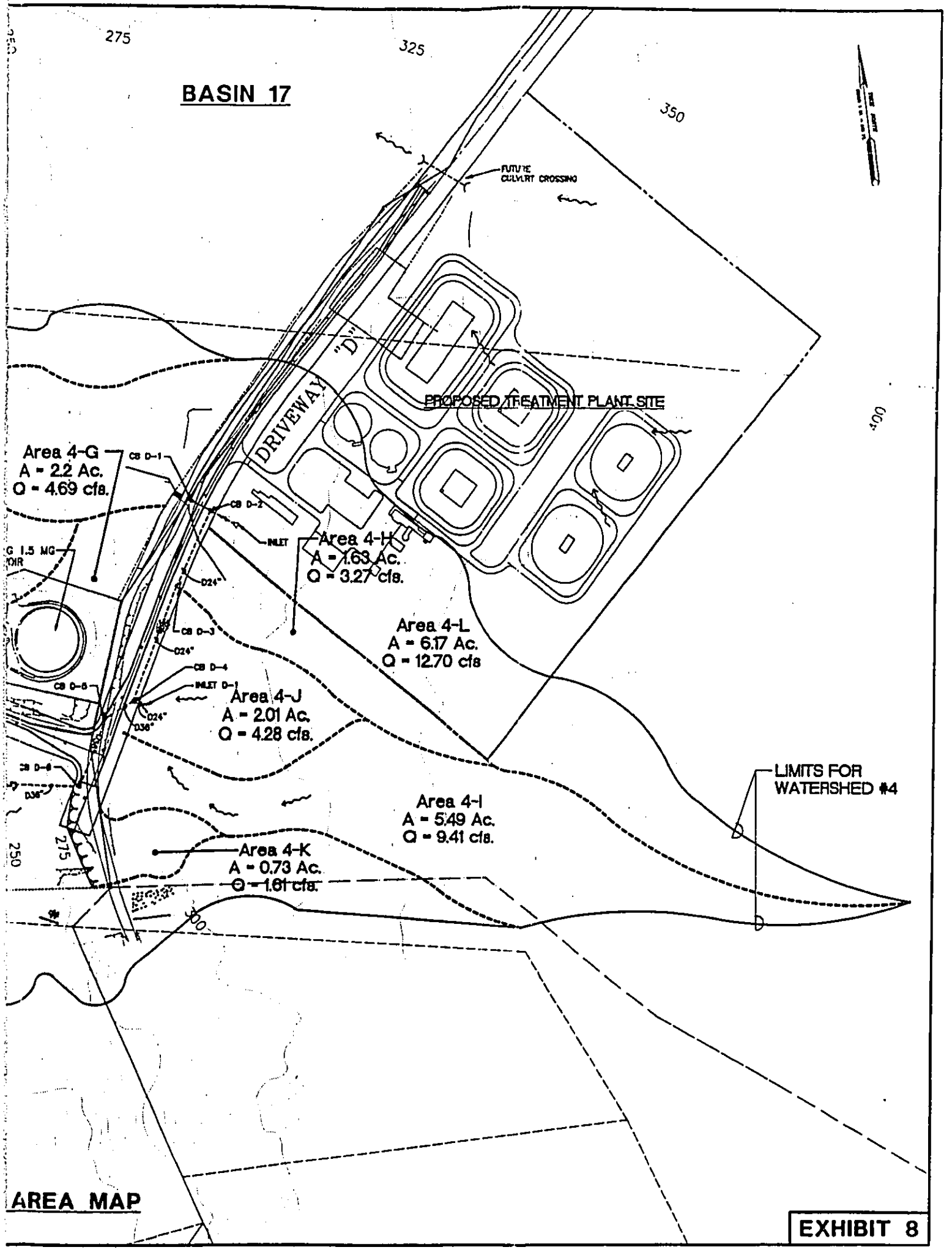
1"=400'

EXHIBIT 7

DOCUMENT CAPTURED AS RECEIVED



DOCUMENT CAPTURED AS RECEIVED



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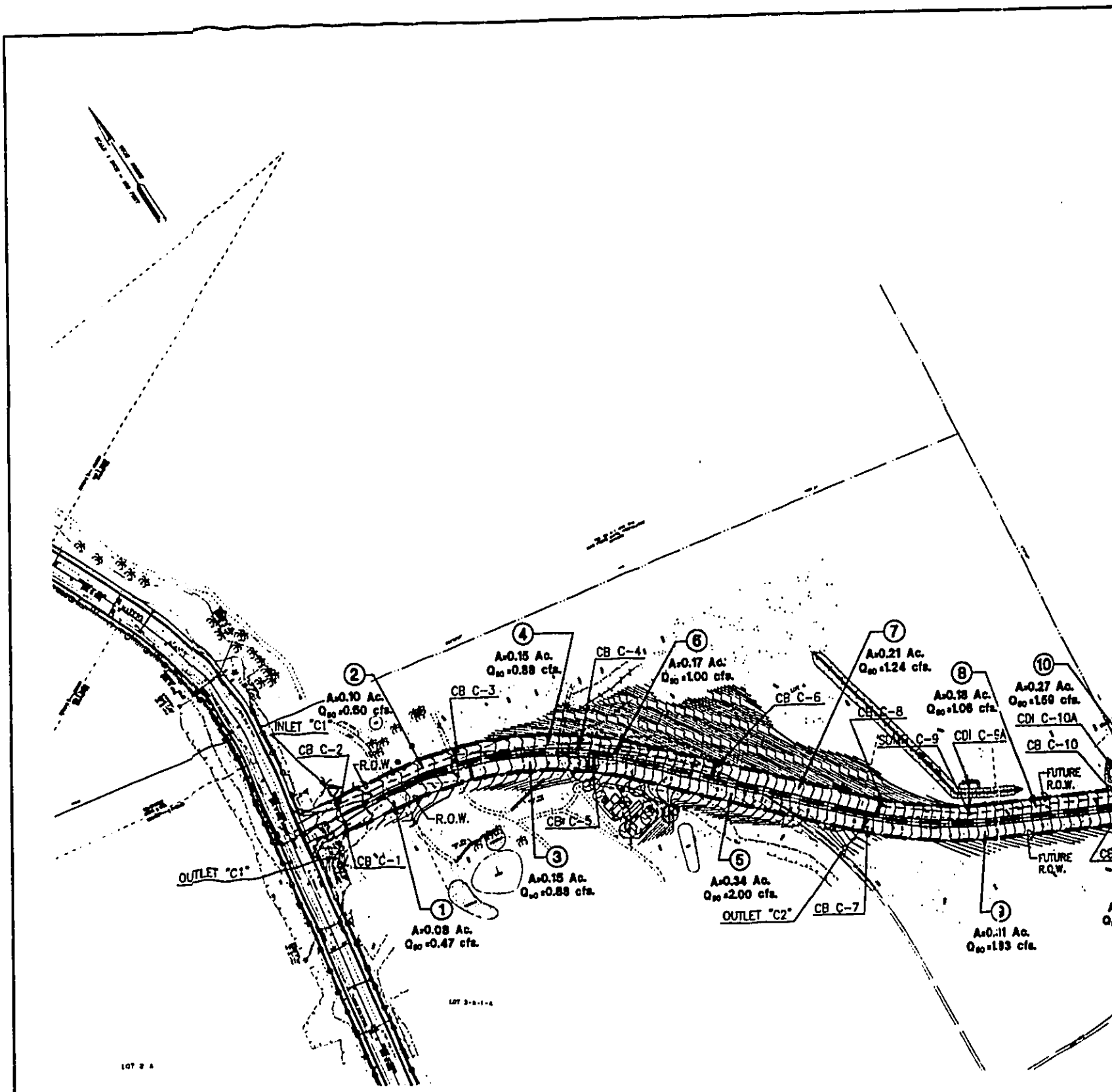
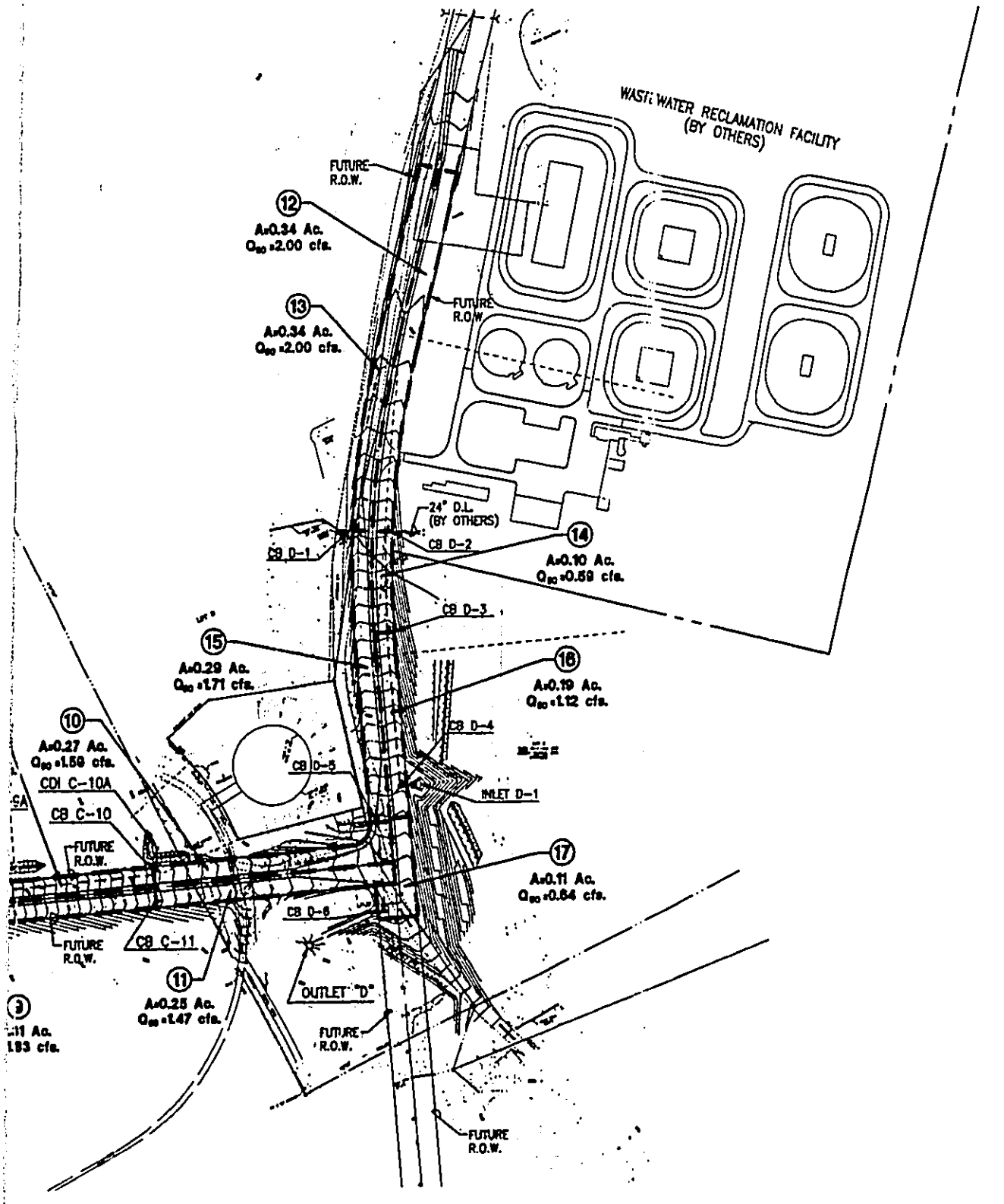


NORTH

ONSITE DRAINAGE

SCALE: 1"=100'



INAGE AREA MAP

CALE: 1"=100'

EXHIBIT 9