United States
Department of
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Soil
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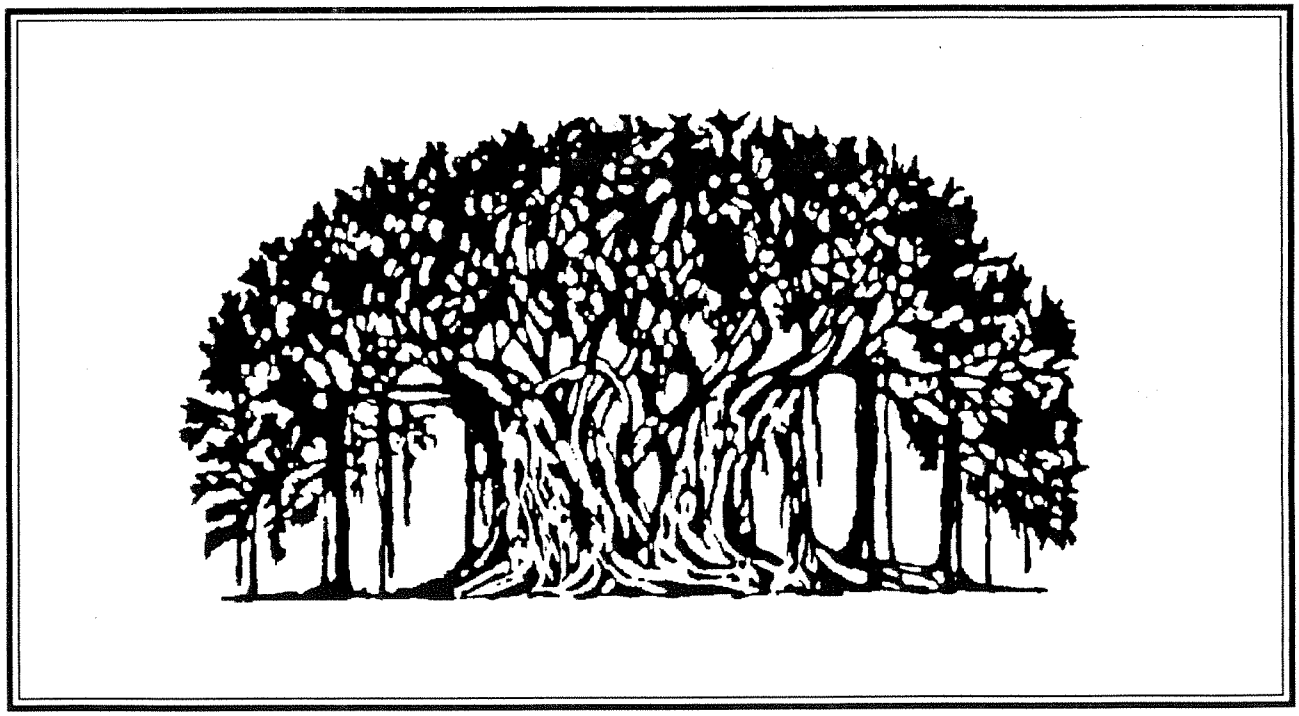
Honolulu,
Hawaii

August 1992

FINAL
Watershed Plan and Environmental Assessment

Lahaina Watershed

Maui County, Hawaii



LAHAINA WATERSHED
COUNTY OF MAUI, HAWAII

FINAL
WATERSHED PLAN AND ENVIRONMENTAL ASSESSMENT

AUGUST 1992

Prepared By:

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West Maui Soil and Water Conservation District
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ABSTRACT

This document describes a plan for flood protection. Alternatives considered during planning included no action, nonstructural, and structural measures. Except for the no action alternative, all of the alternative plans proposed installation of a flood water diversion channel to alleviate the flooding problem. Net economic benefits are maximized in the Recommended Plan. Annualized project costs are estimated to be $484,900. Environmental impacts include 100-year level of flood protection provided to the agricultural, residential, and commercial areas of the Lahaina Watershed including the Lahaina Historic District, a 1,320 ton per year reduction in total sediment discharge to the ocean, and diversion of most floodwater and sediment runoff to a second outlet. Annualized project benefits are estimated to total $614,500. This document fulfills the requirements of the National Environmental Policy Act, the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, and the Soil Conservation Service's National Watersheds Manual. The Plan also serves as a basis for authorization of Public Law 83-566 funding.

Prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 U.S.C. 1001-1008) and in accordance with the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 U.S.C. 4321 et seq.)

WATERSHED AGREEMENT

between the

COUNTY OF MAUI
and
WEST MAUI SOIL AND WATER CONSERVATION DISTRICT
State of Hawaii
(referred to herein as Sponsors)

and the

SOIL CONSERVATION SERVICE
United States Department of Agriculture
(referred to herein as SCS)

WHEREAS, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for the Lahaina Watershed, State of Hawaii, under the authority of the Watershed Protection and Flood Prevention Act (16 U.S.C. 1001-1008); and

WHEREAS, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to SCS; and

WHEREAS, there has been developed through the cooperative efforts of the Sponsors and SCS a plan for works of improvement for the Lahaina Watershed, State of Hawaii, hereinafter referred to as the Watershed Plan-Environmental Assessment, which plan is annexed to and made a part of this agreement;

NOW, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through SCS, and the Sponsors hereby agree on this plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this watershed plan and include the following:

1. Landrights: The County of Maui will acquire, with other than P.L. 566 funds, such landrights as will be needed in connection with the works of improvement.

Land Rights	County of Maui (percent)	SCS (percent)	Estimated Landrights Payment Costs (dollars)
	100	0	1,480,900

2. Relocation Payments and Assurances: The County of Maui hereby agrees that it will comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. 4601 et. seq. as implemented by 7 C.F.R. Part 21) when acquiring real property interests for this federally assisted project. If the County of Maui is legally unable to comply with the real property acquisition requirements of the Act, it agrees that, before any federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance. In any event, the County of Maui agrees that it will reimburse owners for necessary expenses as specified in 7 C.F.R. 21, 1006 (c) and 21.1007.

   The cost of relocation payments in connection with the displacements under the Uniform Act will be shared by the County of Maui and SCS as follows:

Relocation Payments	County of Maui (percent)	SCS (percent)	Estimated Relocation Payment Costs (dollars)
	26	74	0

   Investigation of the watershed project area indicates that no displacements will be involved under present conditions. However, in the event that displacement becomes necessary at a later date, the cost of relocation assistance and payments will be cost shared in accordance with the percentages shown.

3. Permits: The County of Maui will obtain all necessary federal, state, and local permits required by law, ordinance, or regulation for installation of works of improvement.

4. Construction Costs: The percentages of construction costs to be paid by the County of Maui and by SCS are as follows:

Works of Improvement	County of Maui (percent)	SCS (percent)	Estimated Construction Costs (dollars)
All Structural Measures	0	100	4,159,900

5. Engineering Services Costs: The percentages of the engineering services costs to be borne by the County of Maui and SCS are as follows:

Works of Improvement	County of Maui (percent)	SCS (percent)	Estimated Engineering Services Costs (dollars)
All Structural Measures (not including Inspection)	0	100	245,000
Construction Inspection. The County of Maui and SCS will bear the cost of construction inspection that each incurs.			171,000

6. Project Administration: The County of Maui and SCS will each bear the costs of project administration that each incurs, estimated to be $166,400 for each.

7. Land Treatment:

   (1) The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater retarding structure. These agreements state that the owners will carry out conservation farm or ranch plans on their land and ensure that 50 percent of the land is adequately protected before construction of any dam,

   (2) The sponsors will provide assistance to landowners and operators to ensure the installation of any land treatment measures shown in the watershed plan.

   (3) The sponsors will encourage landowners and operators to operate and maintain land treatment measures for the protection and improvement of the watershed.

8. Floodplain Management and Flood Insurance: The County of Maui agrees to participate in and comply with applicable Federal floodplain management and flood insurance programs before construction starts.

9. Operation, Maintenance, and Replacement: The County of Maui will be responsible for the operation, maintenance, and replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with agreements to be entered into before issuing invitations to bid for construction work. Average annual operation, maintenance, and replacement costs are estimated to be $40,000.

10. Costs: The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be actual costs incurred in the installation of works of improvement.

11. Funding: This agreement is not a fund-obligating document. Financial and other assistance to be furnished by SCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

12. Financial Agreements: A separate agreement will be entered into between SCS and the County of Maui before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. Plan Revision: This plan may be amended or revised only by mutual agreement of the parties hereto, except that SCS may deauthorize or terminate funding at any time it determines that the Sponsors have failed to comply with the conditions of this agreement. In this case, SCS shall promptly notify the Sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the Sponsors or recoveries by SCS shall be in accord with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between SCS and the sponsor(s) having specific responsibilities for the measure involved.

14. Conflict of Interest: No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporate for its general benefit.

15. Nondiscrimination: The program conducted will be in compliance with all requirements respecting nondiscrimination, as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 CFR 15), which provide that no person in the United States shall, on the grounds of race, color, national origin, sex, age, handicap, or religion, be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any program or activity conducted or assisted by the Department of Agriculture.

16. Drug-Free Workplace: By signing this watershed agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the SCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

A. The sponsors certify that they will or will continue to provide a drug-free workplace by:

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and

specifying the actions that will be taken against employees for violation of such prohibition;

(2) Establishing an ongoing drug-free awareness program to inform employees about --

(a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;

(c) Any available drug counseling, rehabilitation, and employee assistance programs; and

(d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1);

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will --

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(5) Notifying the SCS in writing, within ten calendar days after receiving notice under paragraph (4) (b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted --

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6)

B. The sponsors may provide a list of the site(s) for the performance of work done in connection with a specific project or other agreement.

C. Agencies shall keep the original of all disclosure reports in the official files of the agency.

17. Certification Regarding Lobbying:

(1) The sponsors certify to the best of their knowledge and belief, that:

(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The sponsors shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

(2) This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

18. Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

(1) The sponsors certify to the best of their knowledge and belief, that they and their principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one ore more public transactions (Federal, State, or local) terminated for cause or default.

(2) Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this agreement.

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COUNTY OF MAUI
200 S. High Street
Wailuku, Hawaii 96793

By: Linda Crockett Lingle
Linda Crockett Lingle
Mayor

Date: 2/19/93

The signing of this plan was authorized by an ordinance of the governing body of the County of Maui adopted at a meeting held on 1/04/93.

Name: Daryl Yamamoto

Title: County Clerk

Date: February 19, 1993

WEST MAUI SOIL AND WATER
CONSERVATION DISTRICT
P.O. Box 1170
Wailuku, Hawaii 96793

By: David Nobriga
David Nobriga
Chairman

Date: 2/24/93

The signing of this plan was authorized by a resolution of the governing body of the West Maui Soil and Water Conservation District adopted at a meeting held on Feb 24, 1993.

Espie Asuncion
Espie Asuncion, Secretary

Date: 2-24-93

SOIL CONSERVATION SERVICE
United States Department of Agriculture

Approved by: Nat Conner
Nathaniel R. Conner
State Conservationist

Date: 2/24/93

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SUMMARY

Project Name: Lahaina Watershed, County of Maui, Hawaii

Sponsors: County of Maui
West Maui Soil and Water Conservation District

Description of Recommended Plan:

The plan proposes the installation and maintenance of structural measures to reduce the adverse effects of flooding and sedimentation. The primary element is a floodwater diversion channel that starts at Lahainaluna Road, extends across the Lahaina subwatershed, and discharges at two ocean outlets. Accompanying measures include four sediment basins and one debris basin. The structures will provide a 100-year level of flood protection to a benefitted area which includes 197 homes, 35 condominium units, 157 businesses, two schools, two parks, and 80 acres of irrigated sugarcane.

Resource Information:

Watershed Size:		5,250 acres
Land Use:	Urban	588 acres
	Irrigated Sugarcane	1,262 acres
	Forest Reserve and Brush Land	3,400 acres
Highly Erodible Land (HEL Cropland)		591 acres
Land Ownership:	Private	77 percent
	State of Hawaii	23 percent

Number of Farms: 1, Pioneer Mill Company with 1,262 acres of its 9,000-acre sugar plantation located in the Lahaina Watershed.

Prime Farmland: 205 acres

Other Important Agricultural Land: 1100 acres

Project Beneficiary Profile: Commercial and service businesses supporting a visitor industry and one corporate sugar plantation operation. In the residential area, there is a broad mix of homeowners, homeowners on leasehold property, and renters.

Wetlands: None Identified

Floodplain Land Use:	Urban	130 acres
	Irrigated Sugarcane	80 acres

Threatened or Endangered Species: Green Sea Turtle (Chelonia mydas)
Humpback Whale (Megaptera novaeangliae)

Cultural Resources: Lahaina Historic District included on National Register and State Register of Historic Places

Problem Identification:

Flooding is the main problem in the Lahaina Watershed. Floodwater and sediment damage occurs to homes, businesses, and roads in Lahaina Town and to sugarcane crops, fields, roads, irrigation systems, and ditches. Average annual flood damage amounts to $605,500 for urban properties, $4,200 for infrastructure, and $10,700 for agriculture. Floodproofing costs for new construction is estimated to average $71,500 annually. Sediment-laden storm runoff turns the nearshore ocean waters a reddish-brown color resulting in income losses for ocean-front hotels and ocean-based businesses, reduced recreational opportunities, and reduced visitor appeal of the Lahaina area. Average annual income losses due to "red water" have been estimated at $107,900. Sedimentation and floodwater runoff are also recognized as a threat to the coral reef ecosystems and the habitat of the green sea turtle (Chelonia mydas).

Alternative Plans:

Several alternatives were considered to address the problems of flooding and sedimentation. The evaluation of these alternatives resulted in the formulation of Candidate Plans.

Candidate Plans Considered:

A structural alternative that utilizes a floodwater diversion channel and maximizes the National Economic Development account and a "no action" alternative were designated as candidate plans and considered by the sponsors before selection of a Recommended Plan.

Project Purpose:

The project purpose is flood prevention. The project will also reduce the adverse effects of land erosion and sedimentation.

Principal Project Measures of Recommended Plan:

Project installation will include:

1. Construction of a 6,831-foot long floodwater diversion channel from Lahainaluna Road to Kauaula Stream. 1,531 feet of the channel would be reinforced concrete and 5,300 feet would be earth

with grass lining. Associated structures include an inlet basin, an energy dissipating basin, and three sediment basins.

2. Construction of a debris basin at Kauaula Stream to capture cobble- to boulder-sized rocks and to divide floodwater discharge between two outlet channels.

3. Construction of a second outlet channel extending 3,600 feet to the south of Kauaula Stream with a sediment basin, highway culvert, and ocean outfall.

Project Costs:

Cost Item	PL-566 Funds $	PL-566 Funds %	Other Funds $	Other Funds %	Total $
Structural Measures for Flood Prevention	4,159,900	100	0	0	4,159,900
Engineering	416,000	100	0	0	416,000
Project Administration	166,400	50	166,400	50	332,800
Land Rights	0	0	1,480,900	100	1,480,900
Household Relocation	0	74	0	26	0
Total	4,742,300	74	1,647,300	26	6,389,600

Annual Project Benefits:

Agriculture	$ 10,700
Urban (includes Public Agency)	642,000
Red Water Pollution	73,100
Total	$725,800

Acres Benefitted:

Agriculture	80 acres
Urban	130 acres
Total	210 acres

Number of Buildings Fully Protected (100-Year Storm):

Residences	127
Commercial	51
Total	178

Number of Buildings Partially Protected (100-Year Storm):

Residences	70
Commercial	106
Public	2
Total	178

Impacts:

Land Use Changes: Approximately 31.6 acres of land will be required for installation of the diversion channel and related structures.

Natural Resources Changed or Lost: Total sediment discharge to the ocean from the watershed will be reduced. The quality of the nearshore marine environment fronting Lahaina Town and Puamana will be improved. Sediment discharge to fringing reef area by Lahaina Town will be nearly eliminated. Coarse sediment discharge at Kauaula Stream will be nearly eliminated. Fine sediment discharge at Kauaula Stream will be reduced by one-fourth.

Sediment discharge to the second outlet site, 0.7 miles south of Kauaula Stream, will increase by ten times on an average annual basis. The marine environment at the location has the least developed coral reef and the least species diversity for sites along the project area coastline and the most favorable current conditions to disperse fine sediments.

Approximately eighteen acres of Prime farmland and ten acres of Other Important farmland will be lost due to installation of the diversion channel.

Major Conclusions:

There is a potential for great economic loss from flooding and sedimentation in the Lahaina Watershed due to the high valuation of the watershed's resources. The alternative plan that alleviates the watershed's problems and results in the greatest amount of net benefits was selected as the recommended plan.

Areas of Potential Controversy:

None

Issues to be Resolved:

None

1. INTRODUCTION

1.1 General

The purpose of the Lahaina Watershed Plan and Environmental Assessment (Plan-EA) is to appraise the economic feasibility and environmental acceptability of providing flood protection to urban and agricultural properties in the Lahaina Watershed. The plan describes the watershed's problems and resources, the plan formulation process, the recommended plan, and the expected environmental and economic impacts. This plan also provides the basis for authorizing federal assistance for implementation.

This plan was prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566 (PL-566), as amended (16 U.S.C. 1001-1008) and is in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 U.S.C. 4321 et seq.). Responsibility for compliance with the National Environmental Policy Act rests with the U.S. Department of Agriculture Soil Conservation Service (SCS).

The Soil Conservation Service provided technical assistance to the Sponsors, the County of Maui and the West Maui Soil and Water Conservation District, in the development of this plan. Other federal, state, and local agencies, along with private groups and individuals, participated in the planning process by providing data, developing project concepts, and reviewing project alternatives.

1.2 Reader's Guide

The format of this plan is directed by the National Watersheds Manual (SCS, 1981). This reader's guide outlines the planning process and assists the reader in finding items of particular interest. Appendix D is the Project Map which can be used for reference while reviewing this plan.

Planning was initiated by the Sponsors' request for SCS assistance in solving the water and related land resource problems in the Lahaina Watershed. The SCS and the Sponsors followed a project planning process that involved six basic steps:

1. Identify problems and opportunities.
2. Inventory resources and forecast future conditions.
3. Formulate alternative plans.
4. Evaluate effects of the alternatives.
5. Compare the alternatives.
6. Select a recommended plan.

The project planning process will produce Technical Review, Draft, and Final copies of the Plan-EA. At each review step, reviewer comments were incorporated or reconciled.

An environmental evaluation was also conducted throughout the development of the Plan-EA to assess the significance of the plan's effects on the human environment. Environmental and social concerns of the community were identified through the public participation process.

The Watershed Agreement, included at the front of this report, is the culmination of the planning effort and serves as the formal acceptance of the Plan-EA by the Sponsors and SCS. Funding for project installation is not obligated by the Watershed Agreement.

The Contents lists the principal topics contained in this Plan-EA.

The Summary describes the Plan-EA in brief. It should not be used as the sole source of information if a complete understanding of the project is desired.

Project Setting begins the main body of the Plan-EA by describing the Lahaina Watershed and its resources in general terms.

Problem and Opportunity Identification describes and quantifies problems that need to be solved as well as opportunities for enhancing the quality of life in the project area based on public concerns. Table A - Problems and Opportunities provides a summary of this information.

Inventory and Forecasting identifies concerns significant in the formulation of alternatives, evaluates existing resources, and presents a forecast of future conditions without the project. Table B - Evaluation of Identified Concerns lists each concern and its degree of significance to decisionmaking.

Formulation of Alternatives describes the formulation of alternative plans and the rationale for selection of the recommended plan. Table E - Summary and Comparison of Candidate Plans presents a tabular comparison of the candidate plans.

The next two sections, Recommended Plan and Effects of the Recommended Plan, describe the plan proposed for implementation and its effect on the economy and human environment. The following tables present pertinent data covered in these two sections:

Table 1 - Installation Costs
Table 2 - Estimated Cost Distribution
Table 3 - Structural Data
Table 4 - Annualized Adverse National Economic Development Effects
Table 5 - Estimated Annualized Flood Damage Reduction Benefits
Table 6 - Comparison of NED Benefits and Costs.

Appendices contain Review Comments on the Draft Plan-EA (A), Support Maps (B), Investigation and Analyses Reports (C), and Project Map (D).

Questions and comments regarding this plan should be referred to:

Warren M. Lee, State Conservationist
U.S. Department of Agriculture, Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850
Telephone: (808) 541-2600.

1.3 Watershed Area

Since the watershed area must include all direct tributary drainageways and lands from which, after project installation, water and sediment could adversely affect any of the proposed structural measure, it became necessary during development of the alternative plan with two outlets to redefine the watershed area. The 317-acre subwatershed area draining directly into the diversion channel for the second outlet and the adjacent ocean frontage have been included. The result of this change increases the total Lahaina Watershed area from 4,920 acres to 5,250 acres.

2. PROJECT SETTING

2.1 Size and Location

The Lahaina Watershed is located in Maui County, Hawaii. The watershed is in the Lahaina District on the island of Maui, second largest of the eight major islands in the Hawaiian Archipelago. (Figure A - Watershed Map) The watershed is 5,250 acres in area and includes three subwatersheds, the 2,140-acre Lahaina subwatershed, the 2,780-acre Kauaula subwatershed, and the 330-acre subwatershed to the south of Kauaula Stream at he coastline.

2.2 Land Use and Ownership

Of the 5,250 acres in the watershed, 588 acres are in urban uses such as residential and commercial, 1,262 acres are used for the production of sugarcane, and 3,400 acres are in forest and brushland. (Figure B - Land Use Zoning) The major residential and commercial areas located along the coastline include the southern part of Lahaina Town and the Puamana subdivision. Sugarcane dominates the landscape from elevation 50 feet to 1,400 feet. The 1,262 acres used for the production of sugarcane is part of the 9,000 acre Pioneer Mill Company plantation which stretches along the coastline of West Maui from Papalaua to Kahana. The upper watershed area is forest reserve and brushland.

Approximately 4,040 acres or 77 percent of the land in the watershed is privately owned and 1,210 acres or 23 percent is owned by the State of Hawaii. (Figure C - Land Ownership) The major private landowners in the watershed are AMFAC/JMB, Inc., the parent company of Pioneer Mill Company, with 2,484 acres and the Bishop Estate with 1,185 acres.

2.3 Topography

The Lahaina subwatershed rises from the Pacific Ocean to 2,561 feet mean sea level (MSL) and the Kauaula subwatershed from the ocean to 5,220 feet MSL. (Figure A - Watershed Map) The coastal areas of both subwatershed are relatively flat and have been developed for residential and commercial uses. The area above the developed flatland to about the 1,400 foot elevation is gently sloping and is used for growing sugarcane. The sugarcane fields have an average slope of ten percent. The remaining upper area of the Lahaina subwatershed is steep and is used for sugarcane or pasture. The upper portion of the Kauaula subwatershed is mountainous with deeply incised canyons and is part of the West Maui Forest Reserve.

2.4 Drainage Patterns

There are no streams or large defined drainageways in the Lahaina subwatershed. Runoff generated in the sugarcane fields above Lahaina Town is conveyed by numerous small drainageways through sugarcane fields and roads, over Honoapiilani Highway, and into Lahaina Town where it ponds in low spots or drains into the Pacific Ocean. The storm drainage system within Lahaina Town consists of short, limited capacity culverts which outlet to the ocean. Runoff ponds in the low-lying area around

Maluuluolele Park and the commercial areas along Front Street and Wainee Street. The ponded runoff dissipates through infiltration and evaporation. Kauaula Stream is the major drainage through the Kauaula subwatershed. The stream, which originates on the western slopes of the West Maui mountains, follows a westerly course through the subwatershed discharging into the ocean at the Puamana subdivision located at Makila Point. The upper reaches of the stream are perennial. The Pioneer Mill Company maintains an irrigation water diversion at 1,500 feet MSL which collects all of the low flows in the stream. The lower reaches are dry, except during periods of heavy rainfall.

2.5 Climate

The watershed has a very steep rainfall gradient due to the proximity of the mountains to the ocean. Average annual rainfall varies from 15 inches at the coast to 300 inches in the mountains, only four miles inland. The heaviest rains are usually brought by winter storms, occurring between October and April.

Average annual temperature in Lahaina Town is about 75 degrees F. Average monthly temperatures vary by about nine degrees between the coolest and warmest months. Prevailing trade winds blow from the northeast throughout the year at an average speed of about ten miles per hour.

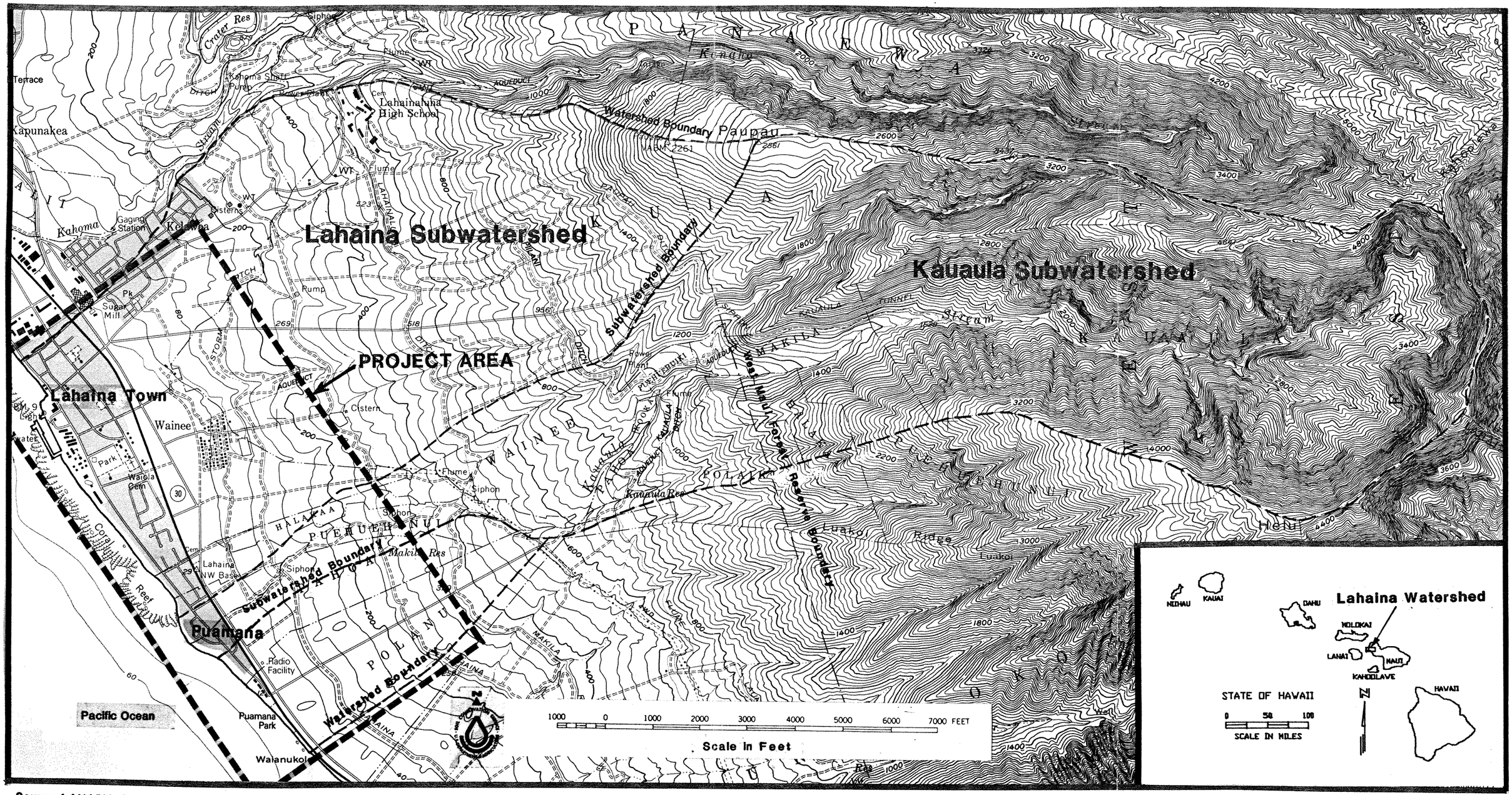
2.6 Geology

The island of Maui consists of two major volcanic mountains forming East and West Maui. Haleakala, on East Maui, is 10,025 feet high and 33 miles across. West Maui, the older volcano, is 5,788 feet high and 18 miles across. The Lahaina Watershed is part of the West Maui mountains.

Volcanic rocks of the West Maui volcano are divided into three series. The oldest series, the Wailuku Volcanic Series, is basaltic flows that built the major shield of the volcano. The Honolua Volcanic Series covered the Wailuku Series with thin andesitic and trachytic flows, domes and pyroclastic deposits. After a period of quiescence and erosion, eruptions produced the Lahaina Volcanic Series.

The major geologic units in the watershed consists of the Wailuku and Honolua volcanic series. (Figure D - Geologic Map) The Wailuku series is predominantly thin pahoehoe and aa lava flows. This shield reached a height of about 7,000 feet above sea level before the top collapsed, forming a caldera about two miles in diameter. Lavas of the Honolua Series are mostly aa, although some are pahoehoe.

The West Maui volcano is a "central" type where dikes radiate in all directions from the central vent at the summit, giving the volcano its nearly circular ground plan. Lava beds on this volcano poured out of the central vent and are relatively steep. The rift zones of this volcano are less pronounced than most other Hawaiian volcanoes. There is a concentration of dikes in two zones, one crossing the volcano in a north-south direction and the other trending northeast in the northeast part of the mountain.



Source: LAHAINA QUADRANGLE, U. S. Geological Survey

Figure A

WATERSHED MAP

Lahaina Watershed, Maui County, Hawaii

Figure B

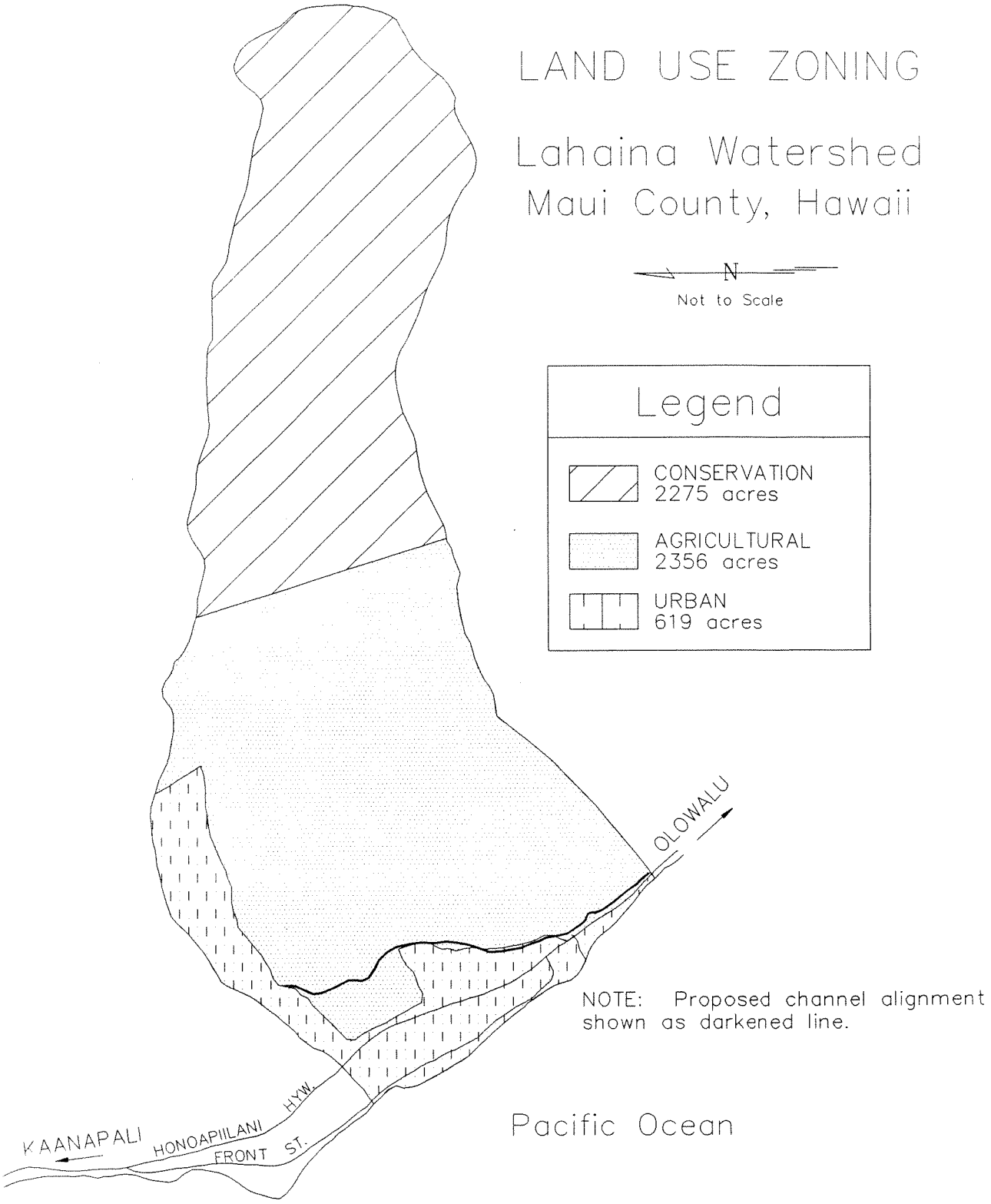

LAND USE ZONING
Lahaina Watershed
Maui County, Hawaii
N
Not to Scale
Legend
CONSERVATION
2275 acres
AGRICULTURAL
2356 acres
URBAN
619 acres
OLOWALU
NOTE: Proposed channel alignment shown as darkened line.
Pacific Ocean
KAANAPALI
HONOAPIILANI HYW.
FRONT ST.

Figure C

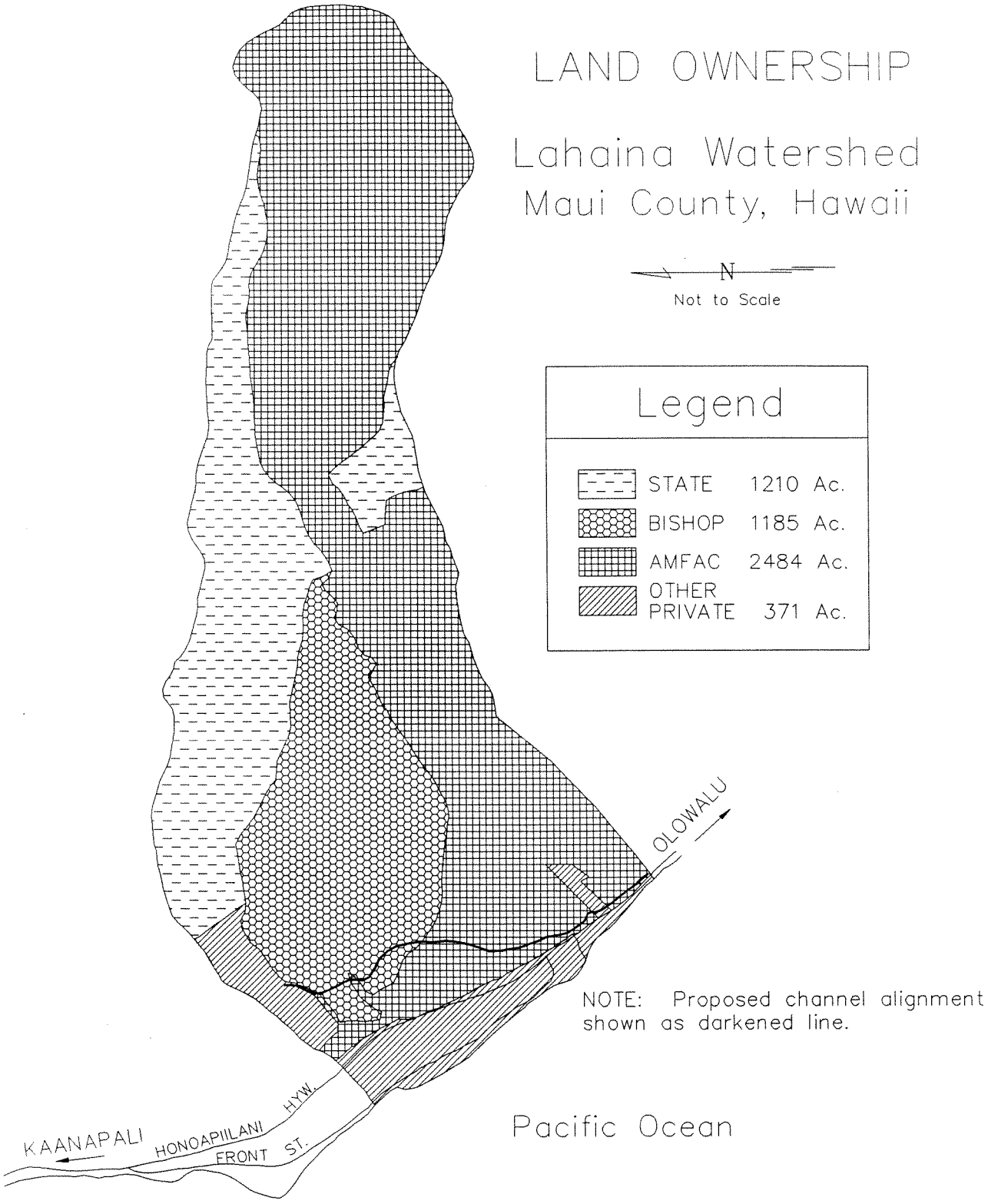

LAND OWNERSHIP
Lahaina Watershed
Maui County, Hawaii
N
Not to Scale
Legend
STATE 1210 Ac.
BISHOP 1185 Ac.
AMFAC 2484 Ac.
OTHER PRIVATE 371 Ac.
OLOWALU
NOTE: Proposed channel alignment shown as darkened line.
Pacific Ocean
KAANAPALI
HONOAPIILANI HYWY.
FRONT ST.

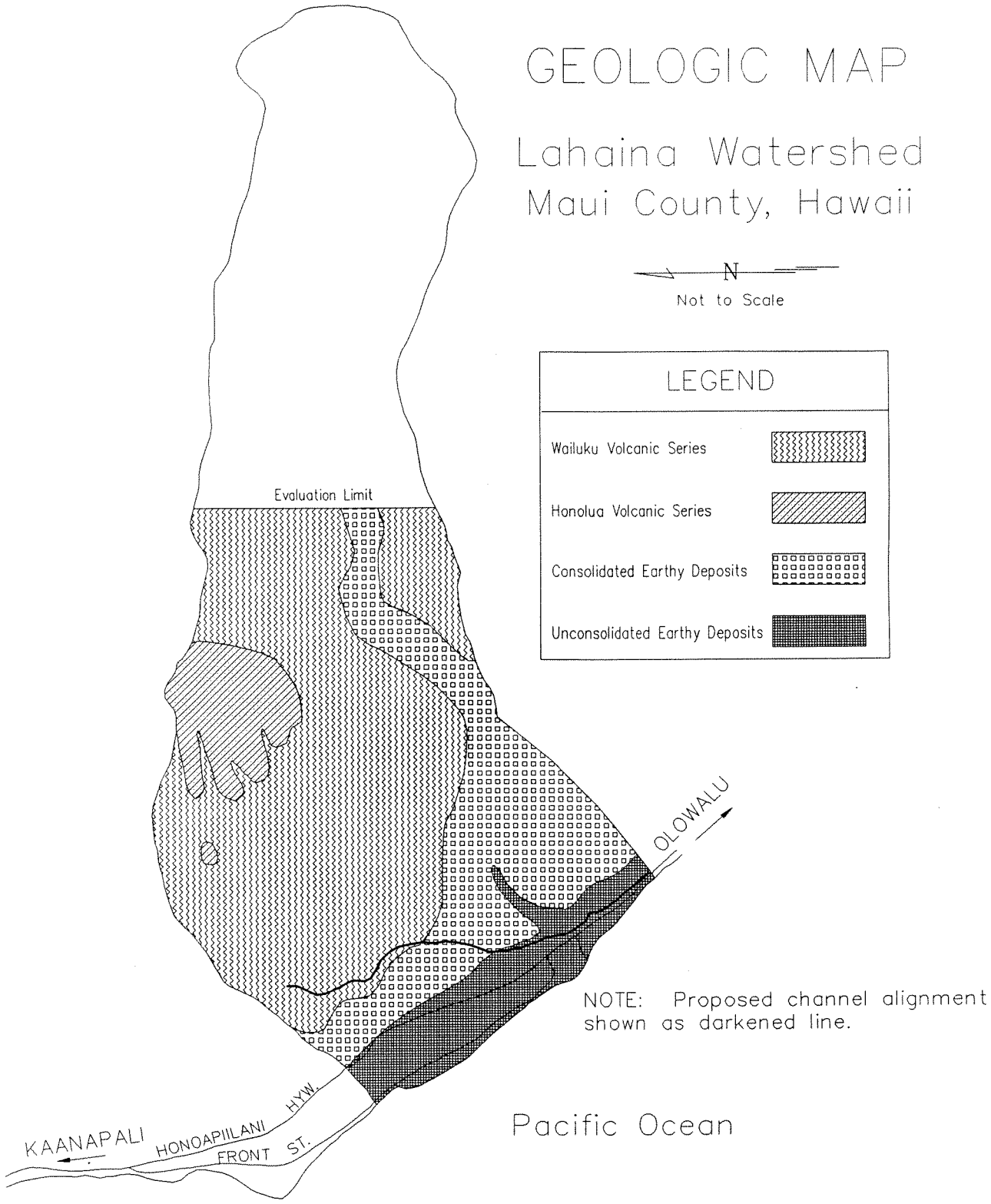
Figure D

GEOLOGIC MAP

Lahaina Watershed
Maui County, Hawaii

N

Not to Scale



NOTE: Proposed channel alignment shown as darkened line.

Figure E

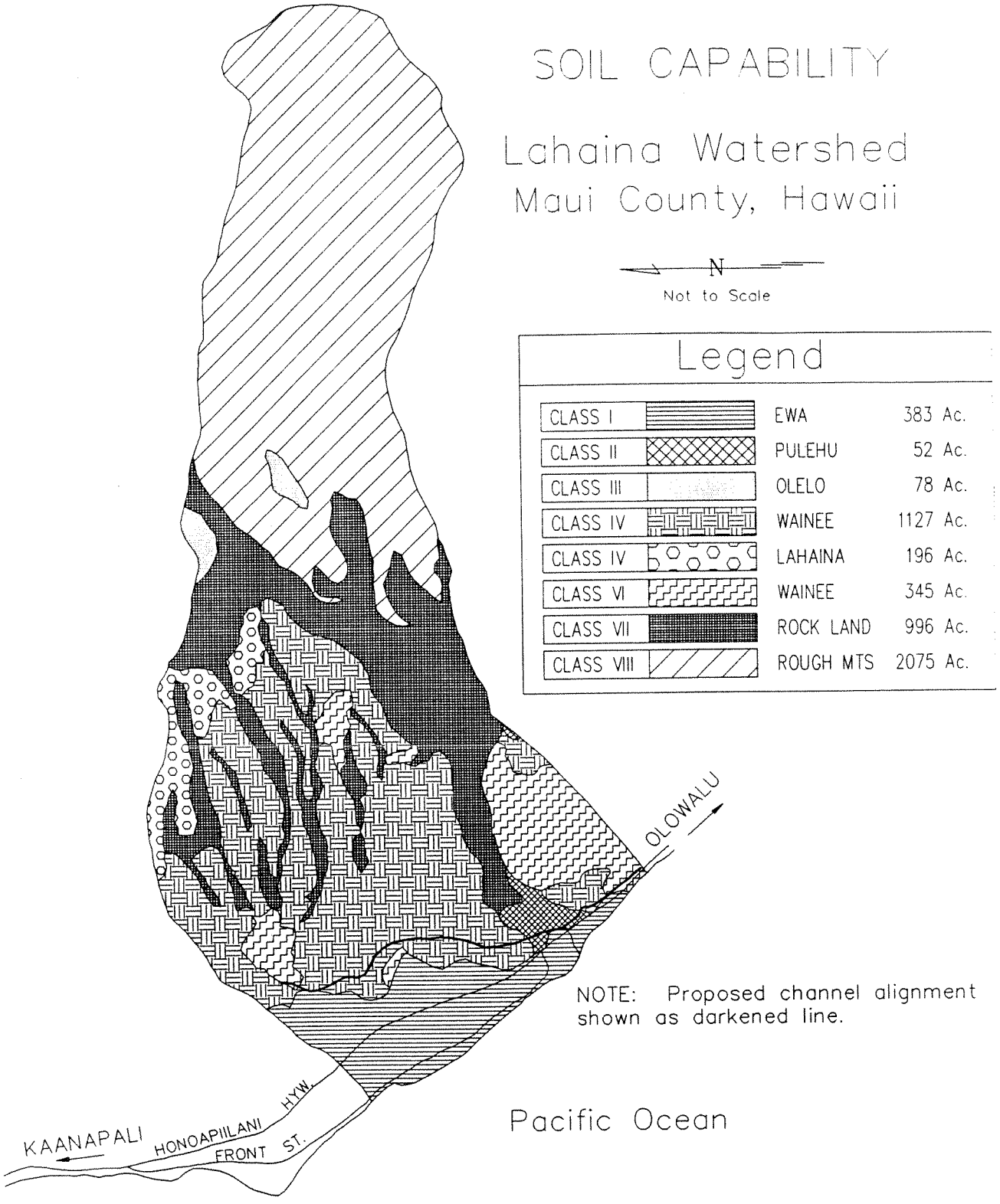
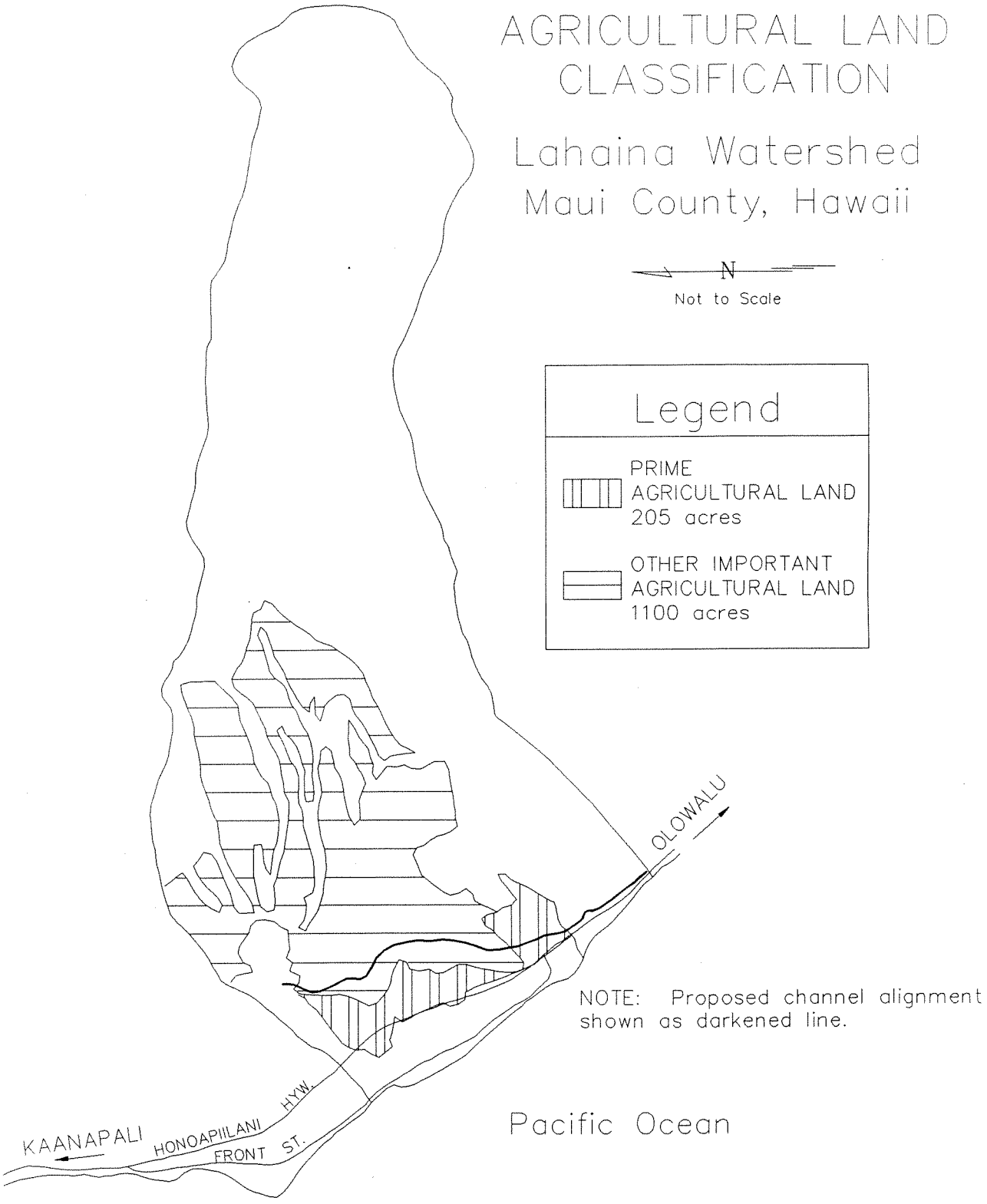

SOIL CAPABILITY
Lahaina Watershed
Maui County, Hawaii
N
Not to Scale
Legend
CLASS I EWA 383 Ac.
CLASS II PULEHU 52 Ac.
CLASS III OLELO 78 Ac.
CLASS IV WAINEE 1127 Ac.
CLASS IV LAHAINA 196 Ac.
CLASS VI WAINEE 345 Ac.
CLASS VII ROCK LAND 996 Ac.
CLASS VIII ROUGH MTS 2075 Ac.
OLOWALU
NOTE: Proposed channel alignment shown as darkened line.
KAANAPALI
HONOAPIILANI HYW.
FRONT ST.
Pacific Ocean

Figure F


AGRICULTURAL LAND CLASSIFICATION
Lahaina Watershed
Maui County, Hawaii
N
Not to Scale
Legend
PRIME AGRICULTURAL LAND 205 acres
OTHER IMPORTANT AGRICULTURAL LAND 1100 acres
OLOWALU
NOTE: Proposed channel alignment shown as darkened line.
Pacific Ocean
KAANAPALI
HONOAPIILANI HYW.
FRONT ST.

2.7 Soils

The major soils in the watershed are Ewa silty clay loam with zero to three percent slopes, various soils in the Wainee series, and Rough mountainous land. (Figure E - Soil Capability) The Ewa soil is located in the relatively flat coastline areas developed for residential and commercial uses. Most of the area planted in sugarcane consists of Wainee soils. The upper half of the watershed is mostly Rough mountainous land.
The Ewa soil is well-drained. Runoff on this soil is very slow and erosion hazard is slight.

The Wainee soils are well-drained extremely stony or very stony silty clay soils. Runoff on these soils is slow to medium and erosion hazard is slight to moderate.

Rough mountainous land consists of very steep land broken by numerous intermittent drainage channels. Over much of the area, the soil mantle is between one to 10 inches thick. The land surface is dominated by deep, V-shaped valleys that have extremely steep side slopes and narrow ridges between the valleys. In most places the local relief exceeds 500 feet. Rock land, rock outcrop, soil slips, and eroded spots make up 20 to 40 percent of the acreage.

2.8 Basic Social and Economic Conditions

Residential, commercial, and resort developments are gradually displacing agricultural land uses in the relatively flat coastal areas. From 1980 to 1990, the resident population in the town of Lahaina increased from 6,654 to 9,189, an increase of over 38 percent.

Tourism is the primary industry on Maui and in the Lahaina watershed. Lahaina Town is a major tourist destination with numerous clothing and food stores, gift shops, fast-food outlets, and restaurants targeting the visitor market. Several hotels and condominiums provide accommodations for visitors in the watershed. Many ocean recreation businesses base their operations around the Lahaina Boat Harbor.

The production of sugarcane and milling of raw sugar is the second most important industry in the watershed. The Pioneer Mill Company plantation which is about 9,000 acres in size, cultivates 1,080 acres located within the watershed.

The Pioneer Mill Company employs about 300 workers, most of whom live in or near Lahaina.

Lahaina Town is also regarded as the regional center of the Lahaina coast with commercial services, civic facilities and spaces, and residential neighborhoods.

Much of the commercial areas of Lahaina Town are included in the Lahaina Historic District which is listed on the National Register of Historic Sites. (Figure B-4)

3. PROBLEM AND OPPORTUNITY IDENTIFICATION

3.1 General

Lahaina is important to Maui County's economic growth and tourist industry. Natural environmental amenities, white sands, ideal temperatures, and sunny days characterize the tropical paradise. This idyllic setting is occasionally deluged by intense tropical rain storms causing soil erosion, sedimentation, and flooding.

Flooding is the main problem in the Lahaina Watershed. During intense rain storms, flood water and sediment cause damage to homes, businesses, streets, and park facilities. Sugarcane fields, roads, and irrigation systems are also damaged by flooding in the agricultural area. Average annual flood damage amounts to $691,860 for urban properties, $4,200 for public property and emergency services, and $10,700 for agriculture. An average of $71,500 is spent annually to elevate new construction above the 100-year flood level.

Sediment-laden storm runoff turns the nearshore ocean waters a reddish-brown color resulting in income losses for ocean-front hotels and ocean-based businesses, reduced recreational opportunities, and reduced visitor appeal of the Lahaina area. Average annual income losses due to "red water" have been estimated to be $107,900. Sediment deposition and uncontrolled runoff threaten the ecology of nearshore coral reef.

3.2 Flood Damage

Flooding in the Lahaina area usually occurs during intense storms which bring heavy rains of short duration. Over 25 damaging floods have been recorded in the Lahaina area since 1879.

The greatest flood of record occured in May 1960, when up to 21.7 inches of rain fell in one day on the upper Kahoma basin. Thirty-six homes and a pineapple cannery in Lahaina were flooded. Front Street and Honoapiilani Highway were overtopped by floodwaters and made unpassable. Streets and yards were covered with silt. Agricultural damage included extensive field erosion and damage to the irrigation system. Rock masonry channel walls were damaged. Total damage for this flood amounted to $320,000 in 1960. The Corps of Engineers estimated that a flood of similar magnitude occurring in 1974 would have caused an estimated $1.48 million in damage. Without adjusting for land use changes and increased development since 1974, the damage caused by such a storm in 1991 would be over $2.5 million. Flood damage analyses conducted for this plan indicate that floodwater losses inflicted by a 100-year storm would be approximately $5 million dollars in 1991.

TABLE A - PROBLEMS AND OPPORTUNITIES
Lahaina Watershed, Hawaii

Problems and Opportunities	Effects
Flood Damage	Floodwater and sediment damage to residential and commercial structures and contents are estimated to be $605,500 on an average annual basis.
	Lahaina Historic District is flooded.
	Floodproofing will be required for all new buildings. Estimated average annual cost is $71,500.
	Street surfaces are damaged and sediment and debris cleanup is required for streets and drainage systems. Damage and cleanup costs are estimated to be $4,200 on an average annual basis.
	Inundation of roadways result in road closures and traffic disruption.
	Access to emergency services is hampered.
	Human health and safety are threatened.
	Floodwater and sediment damage to sugarcane crops, fields, roads, irrigation systems, and ditches is estimated to be $10,700 on an average annual basis.
Sedimentation of nearshore ocean waters	An average of 5,560 tons of sediment enters the ocean yearly - 3,400 tons fronting Lahaina town, 1,850 at Kauaula Stream, and 310 tons fronting Puamana Park.
	Income losses for ocean-front hotels is estimated to be $107,900 on an average annual basis.
	Ocean recreational opportunities are reduced.
	Visitor appeal of Lahaina is reduced.
	Coral reef ecosystems are damaged.
	Green Sea Turtle Habitat is adversely impacted by sediment deposition.

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The U.S. Army Corps of Engineers' Kahoma Stream Flood Control Project addresses the flooding problems in the section of Lahaina town north of Lahainaluna Road. The Kahoma Stream drainage basin include two major valleys, Kahoma and Kanaha, located north of the Lahaina watershed. The Kahoma Stream project installed structural measures including a debris basin and a concrete channel to provide flood protection to the north end of Lahaina Town.

High intensity rainfall in the sugarcane fields above Lahaina Town produces runoff which flows through fields and down canefield roads washing out young cane, eroding fields and roads, and damaging irrigation systems and storm ditches. In-field terraces have been constructed to divert flows to adjacent drainages. Concrete-lined irrigation and storm ditches running along the contour also divert some of the runoff to reservoirs and to Kauaula Stream. However, the terraces and ditches are designed to handle frequently recurring storm events. Runoff generated by storms of 2 to 5-year recurrence overtops the ditches.

Runoff ponds along the eastern shoulder of Honoapiilani Highway and overtops the highway when highway culverts reach capacity or become plugged with debris. The runoff flows through the town, ponding in low spots and flooding roads, residences, businesses, and public properties. Runoff generated by local precipitation also contributes to the flood problem. The following areas in Lahaina are prone to flooding: Maluuluolele Park, Front Street, and Wainee Street.

Approximately 210 acres of land in the watershed are located within the 100-year floodplain. Under present conditions, this includes about 80 acres of agricultural land on both sides of Kauaula Stream and to the northwest of Wainee Village and approximately 130 acres of urban land. (Figure B-1)

The County of Maui requires all new construction within the floodplain to build the first floor above the 100-year flood water level. Floodproofing is usually accomplished by elevating the building site with fill material. Total floodproofing cost for future development has been estimated at $3.3 million.

It is currently estimated that 197 residences, 35 condominium units, 157 businesses, two parks, and two schools are affected by the 100-year flood. Floods damage road surfaces and require mud and debris removal from streets and drainage systems in Lahaina Town. The average annual urban damage from flooding, including floodproofing and public agency costs, is estimated to be $681,200.

In addition to pavement damage and sediment and trash deposition on roadways, floods have inundated Honoapiilani Highway and roads in Lahaina Town resulting in road closures and traffic disruption and congestion. Inundation of roads in Lahaina Town affects the many businesses which rely on tourist flow brought in by cars or buses from outlying resort areas. Keeping Honoapiilani Highway open to traffic is vital to the economy of the Lahaina District because it is the only thoroughfare to the Kaanapali-Napili resort area.

Road closures also hamper access by emergency services. Police, fire, and medical vehicles can be delayed in responding to calls for emergency assistance, resulting in a threat to human life, health and safety.

Except for the very young and the invalid, the depths and velocities of floodwater in Lahaina Town do not pose a threat to human life. Depths to 1.9 feet with a velocity of 0.3 feet per second can be expected on Front Street during the 100-year flood. A threat to human safety can exist in the floodplain adjacent to the Kauaula Stream outlet due to the high volume of discharge from the subwatershed. Depths of 1.5 feet flowing at two feet per second can be expected in the Puamana Subdivision during the 100-year flood.

In the agricultural area, 80 acres of sugarcane land are susceptible to flooding during a 100-year event. Total damage to crops, fields, roads, irrigation systems, and ditches has been estimated to be $50,000 for a 100-year event and $10,700 on an average annual basis.

3.3 Sedimentation

The estimated average gross erosion rate on the sugarcane fields located in the watershed is 9.6 tons per acre per year. Only a fraction of the gross erosion amount is actually transported off of the sugarcane fields as most of the sediment is redeposited in the fields. The quantity of sediment that is transported downstream to the ocean is called sediment yield.

The amount of sediment that is generated and transported by runoff is a function of land management practices and storm intensity and duration. As storm intensity increases, the amount of sediment generation increases exponentially. Therefore, it is during the infrequent, high intensity storms that much of the subject sediment is generated and transported. The average annual sediment discharge is determined by averaging the estimated discharge for all storms anticipated during a 100 year period. During "usual" storm showers the amount of sediment generated may be a very small proportion of the average annual discharge quantity.

The estimated sediment yield from the Kauaula subwatershed is 1,850 tons per year. The Lahaina subwatershed yields about 3,400 tons per year and the drainage area above Puamana Park yields approximately 310 tons annually, for a total of 5,560 tons per year, on the average, for the entire watershed.

An annual average of 400 tons of sediment from the Lahaina subwatershed is trapped by roadside ditches or settles in the low areas in Lahaina Town. An estimated 140 tons of the sediment generated in the drainage area above Puamana Park is deposited, on an annual average basis, above Honoapiilani Highway. Except for sediment in flows that break out of the streambanks, all of the sediment transported by Kauaula Stream is discharged into the ocean. Coarse sediment, in cobble and boulder sizes, is deposited at the mouth of the outlet channel often restricting conveyance capacity.

Except for the coarse sediment fraction that is discharged at Kauaula Stream most of the sediment enters the ocean from the watershed are fine sediments in clay and silt sizes, that is, three thousandths of an inch or

finer in diameter. One analysis of ten samples of surface soils in the Lahaina subwatershed caneland shows that between 58 percent and 91 percent of the soil was in the fine fraction. In the water column, the sediment is perceived as coloration rather than particle grains. The nearshore ocean waters can turn a reddish-brown color for several days following a storm.

Sediment and freshwater discharge can have a harmful effect on reef biota. Turbidity caused by suspended fine sediment particles can block out sunlight to bottom dwelling plants and animals. In calm seawater, fine sediments form larger aggregates called flocs which will settle out of suspension and can smother corals.

In the nearshore marine environment fronting Lahaina, wave action and along shore currents generally provide the agitation needed to keep the fine particles in suspension and to move and mix the sediment laden water body into offshore waters. Bottom surveys conducted during a nine year period indicate stable, well-established coral communities beyond the Lahaina Town fringing reef and in deeper water at the Kauaula Stream mouth. (Grigg, 1983, 1986, 1992) Such reef conditions indicate effective movement of sediment away from the nearshore area into deeper water. Calm ocean conditions or stilled water, such as within the protective fringing reef, present favorable conditions for increased sediment deposition on the ocean bottom.

During floods, runoff from the Lahaina watershed enters the ocean at three general areas: along the Front Street seawall between Lahainaluna Road and Dickenson Street, between Maluuluolele Park and Kamehameha III School, and in the vicinity of the Kauaula Stream mouth. The benthic survey conducted during the course of planning indicates that the nearshore ecosystems of the first two discharge areas within the fringing reef are more developed, diverse, and, therefore, more susceptible to harm by sediment and freshwater inundation. The fringing reef fronting Lahaina Town is characterized by a diversity of reef biota and is generally recognized as a feeding and resting site for a small aggregation of the Hawaiian green sea turtle (Chelonia mydas). The Kauaula Stream mouth and the nearshore area near Puamana Park are not surrounded by fringing reef and have less species diversity than the areas closer to Lahaina Town. The more vigorous wave climate and ocean currents at the stream mouth and fronting Puamana Park dissipate and carry away sediment more effectively than within the fringing reef.

Clean ocean water is an important element of the overall visitor appeal of the Lahaina area. "Red water" reduces visitor appeal which, in turn, negatively affects the tourist industry. There are two ocean-front hotels in Lahaina Town with a total of 192 rooms. The "red water" diminishes the attractiveness of the hotels in the area and visitors are prompted to shorten or cancel their stays. Income losses are estimated at $107,900 on average annual basis.

Ocean activity businesses suffer income losses during periods of "red water." The reef area between Lahaina Harbor and the Kauaula Stream outlet is used by snorkelers and scuba divers on charter tours from Lahaina Harbor. The area is also a good location for surfing. Several instructors use it on a daily basis to teach surfing. Glass bottom boat operators

regularly ply the waters offshore of Lahaina Town. During "red water" episodes, tourists are less likely to pursue these ocean activities.

The nearshore ocean waters offer many noncommercial recreational opportunities for local residents and tourists. In the area fronting Lahaina Town fishing by shorecasting, gill netting, throw netting, and spear fishing is practiced. Seaweed, octopus, lobster, and live shells are also collected on the nearshore reef. Surfing, kayaking, and windsurfing are other recreational activities practiced in the area. "Red water" limits these recreational activities or makes them less enjoyable. The number of recreation days lost due to "red water" is not known.

Some nutrients and agricultural chemicals used in sugar cane cultivation attach, in varying degrees, to fine sediment particles and may be transported downstream in direct runoff. However, application quantities and methods, mostly in dilute aqueous solution through drip irrigation systems, limits the availability of the nutrients and chemicals to erosion and transport.

An analysis of nutrient levels off Kauaula Stream during and after a major storm in December 1982, showed a nutrient pulse during the storm which then diminished to background levels within a week. Sediment dispersion in the ocean environment limits residence time for nutrients in the nearshore area. The lack of dense algal growth fronting the Lahaina Watershed indicates effective dispersal of nutrients along this coastline.

3.4 Opportunities

Natural conditions along with past and present management of human, financial, and biological resources have resulted in a combination of problems which have affected the ecological systems of this watershed. Opportunities exist to develop and to apply a watershed plan that interfaces favorably with the Lahaina Community Development Plan and other resource conservation efforts. This watershed plan has been developed in cooperation with federal, state, and county agencies and community groups and individuals to be economically and ecologically sound.

The implementation of the watershed plan would reduce flood and sediment damage to commercial, residential, agricultural, and public areas of the watershed. The impact of storm generated sediment on the nearshore waters that have economic, recreational, and aesthetic importance could be reduced.

The watershed project could enhance existing programs protecting the area's resources. The on-going soil conservation program implemented in the sugarcane fields are intended to reduce erosion to the minimal level concommitant to cost. The 1985 Food Security Act mandates the application of a conservation plan on Highly Erodible Lands (HEL) that will reduce soil loss to levels that are technically and economically achievable to retain eligibility for Federal farm program benefits. There are 591 acres of cropland that is designated HEL in the Lahaina subwatershed. The land treatment practices used in the Lahaina fields include Cross Slope Farming, Contour Farming, Chiseling and Subsoiling, Terraces, Conservation Cropping System, Volunteer Cover Crop, Crop Residue Use, and Irrigation Water

Management. Sediment modeling indicates that the land treatment practices installed by the program in recent years have reduced sediment production rates by more than a third.

The implementation of a watershed project could provide protection to buildings in the Lahaina Historic District.

The installation of a watershed project in Lahaina would provide flood protection to its citizens and protect the natural resources the watershed is noted for.

4. INVENTORY AND FORECASTING

4.1 Scoping of Concerns

A scoping process was used to identify the concerns that might affect the formulation or selection of alternatives and the resources that may be affected by project actions. Meetings were held involving the SCS, Sponsors, other government agencies, and the general public to identify the concerns. Several of the agencies and individuals were contacted directly for information or comment through written requests.

A broad array of environmental, economic, and social concerns were considered. (Table B - Evaluation of Identified Concerns) Each concern was rated according to its significance to decision making. Concerns rating "high" have a significant effect on decision making. Those rated "medium" may be affected by some alternative plans, while those rated "low" or "none" will not be impacted by any proposed alternatives or will have little significance to decision making.

The first 14 concerns on the list relate to the existing flood and sediment problems which are discussed in Section 3.2 Flood Damage and Section 3.3 Sedimentation. These concerns will be directly addressed by the flood prevention plan.

Concerns 15 through 20 relate to resources or conditions in the watershed that will be affected by project alternatives and must be considered during plan formulation. Those concerns that were rated high and medium will be evaluated and discussed in several sections of this report including Section 4.2 - Existing Condition of Resources, Section 4.3 - Forecasted Conditions of Resources, and Section 7.1 - Effects of Recommended Plan. The effects of the proposed alternatives on the significant concerns are included in Table E - Summary and Comparison of Candidate Plans. Concerns that will not be significantly impacted by the proposed alternatives are discussed immediately below, after which no further consideration will be given.

4.1.1 Land Use Changes - Low

At the present time, land use in the 100-year floodplain consists of 130 acres of urban and 80 acres of agricultural land. According to the Lahaina Community Plan, future land use in the 100-year floodplain will consist of 146 acres of urban and 64 acres of agricultural land. The proposed alternatives will not affect these planned land use changes nor encourage the conversion of agricultural land to urban uses.

TABLE B - EVALUATION OF IDENTIFIED CONCERNS
Lahaina Watershed, Hawaii

Economic, Social, Environmental, and Cultural Concerns	Degree of Significance to Decisionmaking 1/
1. Flood water and sediment damage to urban properties	High
2. Flooding of Lahaina Historic District	High
3. Cost of floodproofing new buildings	High
4. Road and street flood damage and cleanup	High
5. Road closures and traffic disruption and congestion	High
6. Access to emergency services	High
7. Threat to human health and safety	High
8. Reduction in the quality of life	High
9. Floodwater and sediment damage to agriculture	High
10. Sediment discharge into nearshore waters	High
11. Income losses for ocean-front hotels	High
12. Income losses for ocean-based businesses	High
13. Ocean recreation opportunity	High
14. Visitor appeal of Lahaina area	High
15. Threat to coral reef ecosystem	High
16. Prime and important farmlands	High
17. Visual effects	High
18. Geologic hazards	High
19. Threatened and endangered species	High
20. Cultural and historical resources	High
21. Land use changes	Low
22. Stream fish habitat	Low
23. Wildlife habitat	Low
24. Wetlands	None
25. Air quality	Low
26. Mineral resources	None
27. Agricultural water storage development	Low
28. Increase ground water recharge	Low

1/ High - Must be considered in the analysis of alternatives.
Medium - May be affected by some alternatives.
Low - Considered, but not too significant.
None - Need not be considered in analysis.

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4.1.2 Stream Fish Habitat - Low

The proposed alternatives will not affect the lower reaches of Kauaula Stream from Honoapiilani Highway to the ocean. The lower section of stream is a cement rock masonry channel with a concrete channel bottom which is dry throughout the year except during period of heavy rainfall. The cobble/boulder bed of the unimproved upper reach is also usually dry. Except for the tidal backwater in the improved outlet channel, no fish habitat exists in the project-affected reaches of Kauaula Stream.

4.1.3 Wildlife Habitat - Low

The lower reaches of the watershed offer little or no wildlife habitat. Other than a narrow strip of vegetation including haole koa brush (Leucaena glauca) and kiawe trees (Prosopis pallida) on both banks of Kauaula Stream, the lands adjacent to the stream are nearly fully developed as sugarcane fields or residential areas. Therefore, wildlife use of the project area is limited. The sugarcane fields are habitat for mongoose, rats, and mice. Birds, including white-eye, two species of doves, golden plover, cardinal, and black-crowned night heron, inhabit the area. The proposed alternatives will require sugarcane land and undeveloped shrub-covered land for flood prevention purposes. The conversion of the acreage to flood prevention purposes will not significantly affect wildlife populations.

4.1.4 Wetlands - None

No wetlands have been identified within the watershed and no known wetlands would be affected by the proposed alternatives.

4.1.5 Air Quality - Low

There may be an increase in dust during construction of any of the proposed alternatives. The increase in dust will be temporary and localized to the construction area.

4.1.6 Mineral Resources - None

There are no identified mineral resources within the watershed.

4.1.7 Agricultural Water Storage Development - Low

The use of a multi-use floodwater detention reservoir was investigated in the early planning stages. Reservoir capacity in excess of flood prevention needs may have provided an opportunity for agricultural water storage. This measure, however, was dropped from consideration because of the lack of a suitable reservoir construction site in or near the watershed that could be economically feasible to develop.

4.1.8 Increase Groundwater Recharge - Low

The recharge of groundwater resources through the infiltration or injection of flood discharge was suggested. There are no opportunities to increase groundwater recharge via the project.

4.2 Existing Resources

This section describes the present condition of the resources in the Lahaina Watershed. This section also includes discussion of the significant resource concerns identified in Table B - Evaluation of Identified Concerns.

4.2.1 Nearshore Reef Ecosystems

A well developed reef system extends all along the coastline bordering Lahaina Town. The reef extends from Kauaula Stream on the southeast to Mala Wharf on the northwest. This biotope of diverse high coral cover is situated offshore, located in a narrow band adjacent to shore fronting most of the project area. The only break in the reef is the access channel to Lahaina Harbor. The reef is typical of leeward coastal exposures in the Hawaiian Islands.

The dominant reef building coral at depths to about seven meters is Porities lobata. At depths of 10 to 12 meter, Porities compressa is the dominant coral. Beyond 12 meters depth the reef is replaced by a sand or sand-rubble substratum which extends offshore to greater depths. The top of the reef is relatively flat at shallow depths. At the reef edge a drop-off from 6 to 12 meters is found. The coral cover and diversity of coral, other invertebrates, and fish are greatest along the shelf drop-off. Shoreward of the biotope of diverse coral near the Lahaina Boat Harbor is the intertidal region where the surface is dominated by basalt boulders.

It is estimated that an average of 3,400 tons of sediment is annually discharged into this ocean area. Although most of the sediment remains in suspension and is transported away from the area by currents, larger sediment particles and sediment aggregates are deposited on the reef. The healthy condition of the seaward reef communities in this area over a nine year observation indicate the effective dispersal of suspended sediments ocean environment subject to wave and current action.

The clear ocean waters and well-developed reef system along the Lahaina coastline offer many recreational opportunities for watershed residents and tourists. Many tourism-based businesses also rely on the ocean and reef system for their operation.

Fishing by shorecasting and gillnetting is practiced in the nearshore ocean waters near the outlet of Kauaula Stream, or Makila Point. Edible seaweed collecting, octopus fishing, and spearfishing occur on the adjacent reef flat. During periods of wave activity, the area is a good location for surfing and several instructors use it on a daily basis to teach surfing.

An inventory of Maui's coral reefs, published by the Corps of Engineers, documents excellent visibility in deeper waters off Makila Point, with extensive coral cover. This water quality characteristic is important to the commercial diving charter and glass-bottom boats operating out of Lahaina Harbor.

Shorecasters, net-throwers, and skindivers fish in the nearshore ocean waters just southeast of Lahaina Harbor. Clark, in The Beaches of Maui

County, reports that this area of reef fronting Lahaina town "is not attractive to most adults as a swimming area. Snorkelers and divers make good use of the area, however, as do many surfers."

4.2.2 Threatened and Endangered Species

The only plant or animal species listed or proposed by the Federal government as endangered or threatened that occur in or near the Lahaina Watershed are the Hawaiian green sea turtle (Chelonia mydas) and the Humpback whale (Megaptera novaeangliae).

According to local residents, Hawaiian green sea turtles are frequently sighted along the Lahaina coastline. This was confirmed by reconnaissance of the marine macrobiota and water quality conditions by Dr. Brock and Dr. Grigg, in 1989 and 1991, respectively. An important resource in the intertidal habitat fronting the project site are the locally developed stands of alga Pterocladia capillacea which is an important forage food for the threatened turtle. The reduction of sedimentation in the intertidal zone could enhance the quality of the turtle's foraging area.

Endangered Humpback whales are seasonally present in nearshore waters from approximately December through May. Calf rearing and reproductive activities often occur in proximity to the reefs fronting the watershed.

The only endemic bird in the area is the Hawaiian owl, or pueo, (Asio flammeus sandwichensis). The owl is present in the area because of the likelihood of rats and mice in the sugarcane fields.

Critical habitat for any listed, proposed, or candidate species has not been designated or proposed within or near the project area.

4.2.3 Floodplain

Approximately 210 acres in the watershed are located within the 100-year floodplain. Approximately 80 acres of agricultural land along Kauaula Stream and above Honoapiilani Highway between Shaw Street and Prison Street are included. The floodplain includes 130 acres of urban land that is situated mostly below Honoapiilani Highway.

Some representative depths of flooding that can be expected in Lahaina Town during a 100-year flood event under future without project conditions are: 1.9 feet in the Front Street area and 1.3 feet in the Wainee Street area. Maximum velocities are between 0.9 feet per second and 0.5 feet per second. Depths of 1.5 feet with velocities up to two feet per second can be expected in the Puamana Subdivision adjacent to Kauaula Stream.

4.2.4 Urban Development

There are 253 single family residences, four condominium buildings, two hotels, 239 business establishments, two schools, and two parks located within the watershed at the present time. Approximately 197 single family residences, 35 condominium units, 157 business establishments, two schools, and two parks are located in the 100-year floodplain.

The County of Maui currently requires all new construction located within the floodplain to build the first floor above the 100-year flood level. Floodproofing is generally accomplished by elevating or "padding up" the building site with soil or fill material.

4.2.5 Agricultural Resources

Two hundred five acres of land in the watershed is classified as Prime agricultural land and 1,100 additional acres are classified Other Important agricultural land. The determination is made for the Agricultural Lands of Importance to the State of Hawaii classification system established, in 1977, by the State Board of Agriculture. The Prime agricultural land is located in the flat coastal area on Ewa and Pulehu soils. Most of the Prime agricultural land adjacent to Honoapiilani Highway has been converted to nonagricultural uses.

There are 1,262 acres of land in the watershed used for the production of sugarcane. This acreage is part of the Pioneer Mill Company sugar plantation which cultivates 9,000 acres in West Maui. Of the 1,262 acres, 80 acres are located in 100-year floodplain. Pioneer Mill estimates that ten percent of the land is used for roads, ditches, and other "non-cane" uses. All of the sugarcane fields in the watershed are drip irrigated. Yields average 13.5 tons per acre per year. Approximately one-half of the fields are harvested each year.

The SCS Wailuku Field Office has provided technical assistance to the Pioneer Mill Co. for the installation of erosion control practices. All of the sugarcane acreage in the watershed is managed under a Conservation Plan. Conservation practices include 102,900 feet of terraces, 8,000 feet of storm diversions, 49 acres of contour farming, and 982 acres of cross slope farming. All of the fields in the watershed are chiseled and have volunteer cover crop. Without this conservation program, average annual erosion rates on these fields would exceed twenty tons per acre. Current annual soil erosion rates on the sugarcane land average 9.6 tons per acre in the watershed. Approximately three tons of sediment per acre, of the 9.6 tons eroded, is transported to the lower part of the watershed. Without the installed conservation practices, the erosion rate and sediment discharge rate will be considerably higher.

Certified and approved pesticides or crop protection chemicals are used in sugar cane production. All chemicals are registered for use on sugarcane by the U.S. Environmental Protection Agency and Hawaii Department of Agriculture. Approximately 97 percent of the total amount of chemicals used by the industry are for weed control. The primary weed control chemicals are ametryn, atrazine, and diuron. Over two percent of total poundage are growth regulators with glyphosate the primary compound. Insect control and fungus control are usually accomplished with biological agents and genetic resistance. Zinc phosphide use for rodent control is sometimes required. The major weed control chemicals have low toxicological hazard potential.

Nutrients are used in sugarcane cultivation. For the fields in the Lahaina subwatershed, between 300 and 400 dry pounds of fertilizer are applied per acre per year. The fertilizers are applied to the fields in aqueous

solution through the drip irrigation system. This method allows for steady fertilization of the crop with little surplus that can be lost to deep percolation or transport downstream with eroded sediment. Fertilization can be halted during periods of runoff.

4.2.6 Socio-Economic Resources

Lahaina Town is a densely populated urban area. Most jobs are in the growing tourism service sector. Employment in agriculture has declined in recent years.

The resident population for the two census tracts, 314 and 315, in the Lahaina District was 14,574 in 1990. (DBED, 1992) The defacto population, including visitors, during 1990, was over 30,000. Median household income in Maui County was $37,700 in 1990.

The population is composed of many ethnic backgrounds and income levels. Pioneer Mill workers, retirees, and their families, many of whom have lived in or near the watershed since early this century, are predominantly of Japanese or Filipino ethnic backgrounds. Many have middle class homes in the subdivisions along Lahainaluna Road and in the residential areas below Honoapiilani Hwy. Some workers reside in Wainee Village, a vestigial "plantation camp", the likes of which once dotted the West Maui sugarcane fields. The homes and property in Wainee Village are owned by Pioneer Mill and are provided to the workers at nominal cost.

The growth of the Lahaina coast as a resort area has brought an influx of new residents and visitors, primarily from the U.S. mainland and Canada, into the watershed. Condominium and hotel developments such as the Puamana subdivision, Lahaina Shores, and the Maui Islander have been constructed mainly for this market. Mostly Caucasian, this segment of the community is generally older, more affluent, and better educated than the other major sectors of the population.

A community of service sector workers has also developed. This group includes younger, mobile mainlanders, immigrants from Asia and Pacific Islands, and former sugar company workers and their families. Although wages in the tourism-related service industry are generally low, entrepreneurial opportunities are many.

4.2.7 Geologic Hazards

The island of Maui is in Seismic Zone 2 indicating moderate seismic activity. Moderate hazard due to structural failure or tsunami inundation caused by earthquakes exists in the watershed.

4.2.8 Visual Resources

The visual aspects of the "Valley Isle" are the primary attraction to the many visitors who choose Lahaina District as their vacation destination. Sediment-laden runoff generated by intense tropical storms can turn Lahaina Town and the ocean area fronting the watershed into a reddish, muddy mire.

The green, lush mountain vista is also an important aspect of the Lahaina viewscape. So important is the maintenance of the visual resource that AMFAC/JMB, the primary resort developer in West Maui, is willing to operate its subsidiary Pioneer Mill Company at a financial deficit to keep the sugarcane fields in place. (State of Hawaii, HFDC, 1989)

4.2.9 Cultural & Historic Resources

The watershed is rich in cultural and historic resources. During the early eighteenth century, Lahaina was the capitol of the Hawaiian Kingdom. During this period, Lahaina was the favorite wintering site for the American whaling fleet. It was a common sight to see more than a hundred ships laying anchor off Lahaina. Many of the commercial and public buildings are characterized by the architecture of the whaling era. To retain and preserve the cultural and historic resources in Lahaina town, a major section of town is dedicated and registered as a National Historic District. Within the historic district there are eight nationally registered sites.

4.3 Forecasted Conditions

The resources inventoried in the preceding section could change in the future. The evaluation period, or project life, for this project is 50 years. The condition of these resources was projected into the future, assuming no implementation of a flood protection project, to insure that the alternatives would be suited to long term needs and conditions and to serve as a baseline for evaluating the effects of the alternatives over their expected life. Changes caused by project action (environmental impacts) are discussed in Section 7.

4.3.1 Nearshore Reef Ecosystem

This biotope of diverse high coral cover which parallels the watershed seacoast extending from Lahaina Boat Harbor to Kauaula stream outlet will continue to be adversely impacted by sedimentation. The nearshore reef ecosystem will continue to be stressed by sediments deposited by floods through the town of Lahaina and near Kauaula Stream.

4.3.2 Threatened & Endangered Species

The Hawaiian green sea turtle (Chelonia myda) forage area near the Lahaina Small Boat Harbor will continue to be adversely impacted by sediment deposited into the intertidal area. The quality of this foraging will continue to be degraded and the Chelonia may move to other foraging areas.

4.3.3 Urban Development

There is a critical shortage of housing and business/commercial property in the Lahaina area. The Lahaina Community Plan designates 45 acres in the urban areas of Lahaina Town for development to more intensive uses. For example, many current residential areas are zoned for business/commercial use. Sixteen acres presently used for sugarcane production are also designated to be rezoned for urban uses such as single and multifamily residential and commercial. Under future conditions, based on the Lahaina

Community Plan, there would be 311 single family residences, four condominium buildings, six hotels, three shopping plazas with 350 shops, 306 business establishments, four parks, and two schools located within the watershed.

Many of the older historic buildings can only be altered within the guidelines for the Lahaina Historic District. These buildings will be maintained and are expected to remain for the 100-year project evaluation period.

4.3.4 Floodplain

The County of Maui requires all new construction within the floodplain to build the first floor (habitable level) above the 100-year flood water level. All new buildings, therefore, will not be subject to flooding during the 100-year or lesser intensity floods. Under these conditions there will be 168 single family residences, 35 condominium units, 152 business establishments, two schools, and two parks subject to flooding from a 100-year storm.

4.3.5 Agricultural Resources

The Lahaina Community Plan designates 16 acres presently used for sugarcane production for conversion to urban uses. This land is classified as Prime agricultural land. This parcel is located above Honoapiilani Highway and is partially located in the 100-year floodplain. This conversion is expected to occur with or without project installation. The loss of these acres should not effect the productive capability of the Pioneer Mill Company plantation.

Cumulative losses of sugarcane land to proposed development throughout West Maui may reduce the cultivated acreage by Pioneer Mill to less than 5,000 acres and will affect productive capability. (State of Hawaii, HFDC, 1989)

4.3.6 Socio-Economic

The primary economic activities in the Lahaina region are agriculture and tourism. Both play significant and compatible roles for economic growth and maintenance of "quality of life" for Lahaina residents.

The Lahaina Community Plan recommends diversification of the economic base to include agriculture, visitor industry, light industrial, and commercial and professional services. The Community Plan recognizes the importance of agricultural activity to the social character of the area. The viability of agriculture and the preservation of the land resource base for agricultural activities have been designated as "highest" priority issues.

A policy of slow population growth has been recommended by the Lahaina Community Plan. A resident population of 20,000 in the greater Lahaina area is envisioned in the year 2001. This would be a population increase of 25 percent. Although infill in Lahaina Town is expected in the near term, most of the population growth is expected to take place outside of the Lahaina Watershed. The Community Plan also recommends retention of the small-scale, rural character of the region.

4.3.7 Geologic Hazard

Hazards due to effects of earthquakes should not increase in the future.

4.3.8 Visual Resources

New commercial and residential development in the watershed will change the condition of the visual resources in the watershed. Provisions of the Lahaina Community Plan will guide new projects and will maintain many of the important visual resources of the area.

4.3.9 Cultural and Historic Resources

Historic District designation will preserve and maintain the historic properties in Lahaina Town.

5. FORMULATION OF ALTERNATIVES

5.1 General

Alternative plans were formulated to address the problems and concerns described earlier in the Problems and Opportunities and the Inventory and Forecasting sections. The alternatives gave full consideration to current local, state, and federal guidelines and policies and to the concerns expressed by community interests. The basic requirement of all alternatives is that they be economically feasible, socially and environmentally acceptable, and effective in solving the identified problems.

5.2 Formulation Process

The formulation of alternatives was accomplished in three phases. The first phase consisted of developing measures to solve the water resource problems identified through the scoping process described in Chapter 4. Alternatives considered the resource capabilities of the watershed, public concerns, and forecasted changes or conditions in the project area. Land treatment, nonstructural, and structural measures were considered. Each measure was evaluated in terms of its effectiveness in solving the flooding problems in an economically and environmentally acceptable manner.

The second phase of formulation consisted of developing alternative plans. Those measures that remained viable after the evaluation during the first phase were analyzed in detail and were refined into project alternatives. The benefits, costs, and environmental effects of the alternatives were evaluated. The alternatives were tested for completeness, effectiveness, economic feasibility, and acceptability.

Those alternatives that remained after this screening were further refined to maximize beneficial effects through an incremental analysis process. These alternatives were designated as candidate plans. A National Economic Development (NED) plan which maximizes the net economic benefit conferred by the project was developed as a candidate plan. A No Action plan is also included.

The third phase consisted of comparing the candidate plans and establishing a rationale for the selection of the recommended plan.

5.3 Measures

The following structural and nonstructural measures were considered during the formulation process.

5.3.1 Land Treatment Practices

Land treatment practices are vegetative or cultivation practices designed to reduce runoff and erosion potential in the watershed. The Pioneer Mill Company, with SCS technical assistance, has installed land treatment practices to control runoff and limit erosion on its sugarcane lands. All

of the sugarcane fields in the watershed have SCS planned land treatment measures installed.

The conservation practices were applied through resource management systems which are selected combinations of practices applied as needed on a given conservation treatment unit. The following measures were analyzed during the formulation process as a means of individually and collectively reducing soil erosion: Conservation Cover, Chiseling and Subsoiling, Conservation Cropping Sequence, Contour Farming, Terracing, and Irrigation Water Management. More intensive application of the treatments was considered to be unnecessary as most of these practices are currently applied on the sugarcane fields in the watershed by the existing conservation program.

5.3.2 Nonstructural Measures

The nonstructural measures that were considered are intended to lessen the impacts of flooding rather than prevent the flood itself. The nonstructural measures that were considered are discussed below.

Zoning of the floodplain to restrict its further development was examined, but was considered impractical. Zoning regulations would not prevent damage to existing development. There may be public resistance to development restrictions in Lahaina Town, the primary commercial district of West Maui.

Acquisition of vacant parcels and the removal of flood prone buildings by the Sponsors was considered but was found to be too costly.

Relocation of existing floodplain properties to areas outside the floodplain was considered and found to be cost prohibitive.

Floodproofing of flood-prone buildings was investigated. This included elevating structures, building perimeter walls around properties, building protective walls around structures, and applying sea-lanes. The density of development in Lahaina Town and the age of many of the structures makes the installation of floodproofing measures difficult. Historic building guidelines may restrict the application of floodproofing methods on many structures in the Lahaina Historic Preservation District. The lack of an adequate flood warning period also limits the practicality of floodproofing measures that require the placement of flood shields and seals following the sounding of a flood warning.

A system of flood forecasting, warning, and evacuation was considered to be ineffective in the Lahaina area due to the flashy nature of the flooding in the watershed and the difficulty in acquiring timely data.

5.3.3 Structural Measures

Structural measures require group action for installation, provide protection to more than one structure or landowner, and are operated and maintained by the Sponsors. The structural measures considered for flood control included detention reservoirs and flood channels. The structural

measures considered to reduce sedimentation included sediment and debris basins.

A search was made for a detention reservoir site in the Kauaula and Lahaina subwatersheds. No adequate sites were found and the detention reservoir measure was dropped from further consideration.
The flooding in Lahaina Town is a result of runoff conveyed through numerous small drainages spread along the width of the Lahaina subwatershed. For this reason a diversion channel to intercept the runoff from the Lahaina subwatershed and carry it to a safe outlet appeared to be the most practical solution to the flooding problem.

The basic diversion channel that was considered extended across the Lahaina subwatershed from Lahainaluna Road to Kauaula Stream. Differing channel sizes to contain various levels of storm runoff or provide various levels of flood protection were studied.

A low diversion alongside Honoapiilani Highway was considered as an alternative which minimized the amount of agricultural land needed for implementation. The unavailability of efficient channel grade necessitated moving the diversion alignment upslope into the agricultural area.

The main segment of the diversion channel was designed as a vegetated earth channel to minimize installation costs. Concrete channels were required for the upstream reach of the diversion because of the steep slope along Lahainaluna Road and adjacent to Wainee Reservoir to minimize right of way needs. The diversion channel was set below the general slope break at the 50 foot to 80 foot elevation to minimize the volume of excavation and embankment fill.

The highest alignment below the slope break was selected to provide flood protection to the residential development proposed above Honoapiilani Highway. The channel alignment is constrained by Wainee Village and Pioneer Mill Company's Wainee Reservoir. A reach of reinforced concrete channel is used to reduce the right of way width and allow the channel to be constructed nearer the reservoir embankment. No household relocations will be required.

The diversion alignment will require the conversion of Prime and Other Important agricultural land to flood control. However, the diversion alignment overlays 2,000 feet of existing field road and drainage and irrigation ditches. Other portions of the works of improvement will be installed in existing drainageways and peripheral areas that are not cultivated but lie within the agriculturally important zones. Only a portion of the agricultural land that is required to be converted is being cultivated.

Several outlets for the diversion channel were considered. Outlets considered include Kahoma Stream, a culvert under Dickenson Street, a culvert through Maluuluolele Park, and Kauaula Stream. The commencement of construction of the Corps of Engineer's flood control project on Kahoma Stream and the difficulty of crossing Lahainaluna Road and through the existing residential subdivisions precluded its use as an outlet for runoff from the Lahaina subwatershed. The high construction costs of a 1,500 foot

long covered culvert under Dickenson Street made that alternative economically infeasible. An analysis of of outletting storm discharge at the remaining two locations was conducted.

A benthic survey of coastal marine life was conducted to evaluate the potential ecological impact of floodwater runoff on nearshore coral reef ecosystems at the two alternative discharge sites, near Maluuluolele Park and at the Kauaula Stream mouth. (Grigg, 1983) The Kauaula Stream outlet was recommended by the study over the Maluuluolele Park outlet.

A supplemental marine study to evaluate the effects of splitting the flow at Kauaula Stream and diverting a portion of the flow south to a secondary outlet was also conducted. (Grigg, 1986) The study was prompted by concerns over potential increases in sediment discharge and runoff at Kauaula Stream from the Lahaina subwatershed. The supplemental marine study concluded that the optimum location for the secondary outlet from a marine ecology viewpoint would be 3,600 feet south of Kauaula Stream.

Concerns about the effects of sedimentation on the nearshore ocean waters prompted the use of sediment basins along the diversion channel to reduce the fine sediment load entering the ocean. Sediment yields on an average annual and single storm frequency bases were established and the sediment basins were designed to provide sufficient sediment trapping capability and capacity.

There were also concerns regarding the damaging effects of boulders and cobbles in the concrete Kauaula Stream outlet channel. A debris basin on Kauaula Stream was incorporated in the plans to keep boulders and cobbles from entering the improved outlet channel. The debris basin also serves as a stilling basin to allow effective division of flows to two outlets.

Several structural flood protection combinations were developed using the feasible measures identified above. A common feature is a diversion channel that starts at Lahainaluna Road, extends across the watershed, and outlets into Kauaula Stream. A proposal to outlet all of the controlled storm discharge through Kauaula Stream met with community opposition. A second outlet channel was required to meet the criteria of community acceptability.

5.4 Alternative Plans

Alternative plans were developed and evaluated to the extent necessary to determine costs, benefits, and effects on environmental resources. The advantages, disadvantages, risks, and uncertainty of each plan were considered.

The general viability of each alternative was determined by considering four aspects:

Completeness - The extent to which an alternative accounts for all investments and actions necessary to realize planned results.

Effectiveness - The extent to which an alternative alleviates the problems and achieves the opportunities identified.

Efficiency - The extent to which an alternative is most cost effective.

Acceptability - The extent to which an alternative is accepted by the public and compatible with existing laws, regulations, and policies.

5.4.1 ALTERNATIVE 1 - No Action

This alternative foregoes project implementation and is basically a continuation of present conditions. This alternative will not improve the resource condition in the watershed. Although the existing conservation program, including implementation of the Food Security Act of 1985, will continue in the sugarcane fields, flooding and sedimentation problems in the watershed will continue.

5.4.2 ALTERNATIVE 2 - National Economic Development Plan

This structural alternative is based on the combination of measures that were environmentally and socially acceptable and which optimized the National Economic Development Account (NED). By definition, the NED plan maximizes the net benefits attributable to the project measures.

The structural measures that form the basis for the NED alternative include a diversion channel extending from Lahainaluna Road to Kauaula Stream, a debris basin on Kauaula Stream, and two ocean outlet channels.

The diversion channel will be grass-lined with the exception of reinforced concrete channels at a steep reach near Lahainaluna Road and in the vicinity of Wainee Reservoir. No household relocations in Wainee Village is expected. This diversion channel system will also incorporate three sediment basins to control flow velocities and allow sediments to settle out.

A debris basin will be installed on Kauaula Stream to protect the existing concrete channel through Puamana and provide a stilling basin to divide the combined discharge from the Lahaina diversion channel and Kauaula Stream to the two outlet channels. In addition to the existing outlet channel located on Kauaula Stream, a second outlet channel will be constructed two thirds of a mile south of the Kauaula basin. This structural alternative will provide a 100-year level of flood protection.

A preliminary benefits to costs analysis indicated economic feasibility of this alternative plan for the 100-year level of protection. Incremental analysis using other levels of flood protection was used to determine at which level net benefits are maximized by the NED plan.

5.5 Evaluation of Benefits

The evaluation of benefits for the Lahaina Watershed Project measures the beneficial contributions to national economic development associated with

flood hazard and sediment damage reduction . The project improvements contribute to the NED objective by improving the net productivity of flood-prone land resources. This occurs either by an increase in output of goods and services and/or by reducing the cost of using the land resources. Evaluated conditions include potential land use changes, additional development, and similar modifications which will alter the hydrologic response of the watershed and affect potential economic damages. The benefit analysis involves analyzing the relationship between hydrologic, hydraulic, and economic characteristics of the floodplain in accordance with standard SCS procedures. Procedures are in accordance with The Economics and Environmental Principles and Guidelines for Water and Related Land Resources Studies issued by the Water Resources Council on March 10, 1983.

The principal benefits for flood control facilities are inundation reduction benefits. These "benefits" are the loss in income to the nation as a result of flooding, commonly measured as physical damage, business losses, and emergency costs. The inundation reduction benefit is the value of reducing flood losses to activities in the floodplain. It is measured as the reduction in the amount of damages or related costs.

The economic life of the project or project evaluation period will be 100 years. This period is consistent with projects of this scope and type. The actual period over which the project will also include the installation period. The discount rate for Fiscal Year 1992 federal water resources projects is 8-1/2 percent. All benefits and costs are evaluated in constant 1991 dollars.

The benefits of flood hazard reduction were determined by comparing the estimated average annual flood damages with and without the project. Average annual flood damage was derived by adding the projected damage from all of the floods expected during a 100 year period and dividing the total by one hundred. The average annual flood damage analysis includes the damage to agricultural and urban development in the floodplain, public agency and emergency costs, floodproofing costs for new construction, and economic loss due to "red water." Data used in the evaluation of flood damages and benefits were obtained from field investigations of agricultural, residential, commercial, and public properties. For the evaluation, commercial and residential benefits were derived for three areas: Lahaina subwatershed-North, Lahaina subwatershed-South, and Kauaula subwatershed.

The average annual costs and benefits for the 27-year, 50-year, and 100-year levels of protection for Alternative 2 are shown on Table D - Incremental Analysis of NED Plan. The preliminary benefit-to-cost ratios, using average annual costs and benefits, for the 27-year, 50-year, and 100-year plans are 1.06:1.00, 1.21:1.00, and 1.24:1.00, respectively.

TABLE D - INCREMENTAL ANALYSIS OF NED PLAN
Lahaina Watershed, Hawaii
(Dollars)

Description of Increment	Annual Costs 1/ Incremental Cost	Annual Costs 1/ Total Cost	Annual Benefits Incremental Benefit	Annual Benefits Total Benefit	Net Benefits
27-year Protection	535,800	535,800	569,200	569,200	33,400
50-year Protection	20,000	555,800	100,600	669,800	114,000
100-year Protection	27,400	583,200	56,000	725,800	142,600

1/ Includes installation cost amortized at 8 1/2 percent over 100 years plus average annual OM&R cost. August 1992

By virtue of having the highest net benefits, the 100-year level of protection alternative was determined to be the National Economic Development (NED) plan. The 100-year level of protection was the highest level of protection considered.
For the 100-year level of protection, the average annual benefits from reduction of flood damages to residential, commercial, agricultural, and public facilities; reduction in future floodproofing costs; and the reduction in loss of income due to "red water" totals $725,800. Storms with intensities in excess of the 100-year storm will continue to cause economic loss, although at a reduced level. After installation of the project measures, a residual average annual loss of $74,000 due to flooding and sedimentation will continue. The annualized benefits from the proposed project are shown, in detail, in Table 5. A comparative analysis of annualized costs and benefits is included as Table 6.

5.6 Candidate Plans

Candidate plans are those alternatives that could be considered for the recommended plan. Alternative 1, No Action, is a viable choice for the sponsors and is considered a candidate plan. The NED plan, Alternative 2 above, is also a candidate plan. Table E - Summary and Comparison of Candidate Plans provides a comparison of these plans.

Four accounts are used to record the effects and to facilitate the comparison of the candidate plans. The NED account shows effects on the national economy. The environmental quality (EQ) account shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be readily be measured in monetary terms. The regional economic development (RED) account shows the regional impacts of NED effects, income transfers, and employment effects. The other social effects (OSE) account shows urban and community impacts and effects on life, health, and safety. Those concerns with high degree of significance to the decisionmaking process, as shown in Table B - Evaluation of Identified Concerns, are addressed in one of the four accounts.

TABLE E - SUMMARY AND COMPARISON OF CANDIDATE PLANS
Lahaina Watershed, Hawaii

PROJECT FEATURES AND EFFECTS	NO ACTION	ALTERNATIVE 2 100-Year Protection
MEASURES		
Structural Elements	None	Inlet Basin 1,531 feet of Reinforced Concrete Channel 8,900 feet of Earth Diversion Four Sediment Basins Debris Basin with Two Outlets
Landrights Elements	None	31.6 Acres Right-Of-Way Five Cane Road Crossings Relocate Four Pipelines Relocate Nine Utility Poles
Household and Business Relocations	None	None
EFFECTS ON URBAN FLOODING		
Floodwater and Sediment Damage to Structures and Contents	Will continue at average annual loss of $605,500.	Reduced by $566,700 on an average annual basis.
Cost to Floodproof New Construction	Will continue to be required at a cost of $71,500 yearly.	Reduced by $71,500 on an average annual basis.
Damage to Streets and Cost of Sediment Cleanup	Will continue to occur with average annual cost of $4,200.	Reduced by $3,800 on an average annual basis.
EFFECTS ON AGRICULTURAL FLOODING		
Floodwater and Sediment Damage to Crops, Roads, Irrigation Systems, and Ditches	Will continue at an average annual loss of $10,700.	Reduced by $10,700 on an average annual basis.
EFFECTS ON "RED WATER" LOSSES		
Income Losses for Ocean-front Hotels	Will continue to occur with $107,900 average annual loss.	Reduced by $73,100 on an average annual basis.
Loss of Venue for some Ocean-oriented Businesses	Will continue to occur.	Incidence reduced.
PROJECT INVESTMENT		
Installation Cost	$0	$6,389,600
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT		
Beneficial, Annualized		$614,500
Adverse, Annualized		$484,900
Net Benefits, Annualized		$129,600
Benefit:Cost Ratio		1.27 : 1.00
ENVIRONMENTAL QUALITY ACCOUNT		
Sediment Discharge to Nearshore Reef Fronting Lahaina Town from farmland	Will continue at an average annual rate of 3,400 tons.	Reduced by an average of nearly 3,400 tons per year.
Sediment Discharge at Kauaula Stream Mouth	Will continue at an average annual rate of 1,850 tons.	Reduced by an average of 890 tons per year.

TABLE E - SUMMARY AND COMPARISON OF CANDIDATE PLANS
Lahaina Watershed, Hawaii

PROJECT FEATURES AND EFFECTS	NO ACTION	ALTERNATIVE 2 100-Year Protection
ENVIRONMENTAL QUALITY ACCOUNT (continued)		
Sediment Discharge at Second Outlet	Will continue at an average annual rate of 310 tons.	Increased by an average of 2,970 tons per year.
Total Ocean Sediment Discharge	Will continue at an average annual rate of 5,560 tons.	Reduced by an average of 1,320 tons per year.
Disribution of Ocean Sediment Discharge	Most sediment discharged into reef area with high coral density and high species diversity.	Most sediment discharged into area with less developed coral reef and less species diversity.
Flood Protection of Lahaina Historic District	Will continue to flood.	100-year level of flood protection provided.
Prime and Other Important Farmland	No effect	28 acres required for structural measures.
OTHER SOCIAL EFFECTS ACCOUNT		
Transportation	Highway and streets will continue to be flooded.	Reduction in road closures and traffic disruption.
Emergency Services	Access by emergency services will continue to be hampered.	Access by emergency services will be improved.
Human Health, Safety, and Quality of Life	Continued presence of flood hazard	Flood hazard reduced.
Other Social Effects	No effect	No effect.
Ocean Recreation Opportunity	Opportunities denied by "red water" following storms	Incidence of "red water" reduced; recreational opportunities increased.
Visitor Appeal	Reduced appeal due to flooding and "red water"	Increased visitor appeal.
Geologic Hazard	No effect	Slight increase in hazard due to project embankments.
Visual Resources	No effect	Structural improvements will be visible from Honoapiilani Hwy. and benefitted area.
REGIONAL ECONOMIC DEVELOPMENT ACCOUNT		
Positive, Annualized		
Region		$614,500
Rest of Nation		$0
Negative, Annualized		
Region		$150,200
Rest of Nation		$334,700

Notes: Interest Rate - All alternatives evaluated at 8-1/2 percent interest.
Period of Analysis - Alternative 2 evaluated over 103 years.
Price Levels - 1991 price levels used.

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5.7 Project Interaction

Significant interactions between the candidate plans and existing or expected projects include the following:

1. The U.S. Army Corps of Engineers' Kahoma Stream Flood Control Project will alleviate flooding in the watershed to the north of Lahaina Watershed and in the floodplain common to both projects at the lower end of Lahainaluna Road.

2. Realignment of Honoapiilani Hwy. between Kauaula Stream and Honokowai is being planned by the Hawaii State Department of Transportation (DOT). Coordination between the State DOT and SCS is being conducted to assure compatibility of the plans.

3. AMFAC/JMB, Inc. plans residential and public facilities development in the area to the west of the diversion alignments of the candidate plans. The planned flood prevention measures will not be disruptive to AMFAC Properties' development plan.

4. Approximately ten acres of approximately 1,185 acres of land owned by Kamehameha Schools/Bishop Estate in the watershed will be required for project Rights of Way between Lahainaluna Road and Wainee Village. The land is currently under lease to Pioneer Mill Company. Upon expiration of the lease agreement in year 2006, there is a possibility of the conversion of the Bishop Estate property to other uses.

5. The County of Maui intends to install a storm drainage system in the area between Prison and Shaw Streets to accommodate local runoff.

5.8 Risk and Uncertainty

Throughout the planning process efforts were made to obtain the best available data in order to reduce risk and uncertainty. The major areas of risk and uncertainty are discussed below.

1. Storm characteristics such as intensity, duration, and runoff quantities for the various storm frequencies were estimated from limited records for the Lahaina watershed.

2. Sediment yield estimates for the Lahaina subwatershed and Kauaula Stream were made based on known sediment discharges for other Hawaiian drainages and on generalized sediment discharge relationships. Although the correlation between the results of several methods that were used was high for both subwatersheds, sediment yield forecasting is an estimation of an order of magnitude, at best. If the sediment discharge is underestimated, sediment removal from the basins will need to be performed more frequently than anticipated and sediment discharge at the outlet will be higher than expected.

3. Storm runoff and sediment yield quantities for the Lahaina subwatershed were computed with the assumption that the current sugarcane cropping pattern would continue. Should sugarcane cultivation cease or the

manner of cultivation or field layout be changed, the runoff rate and sediment yield could increase or decrease.

4. The channel alignment assumes the continued utilization of the Wainee Reservoir. If the reservoir's use is discontinued other alignments may be available that may decrease the construction cost.

5. Land use in the floodplain under future conditions is based on the Lahaina Community Plan. It is assumed that future land use will not differ with or without project installation.

6. The estimate of damages and benefits for buildings and their contents was based on the following assumptions: 1) all new buildings in the floodplain will be floodproofed and not susceptible to flooding under future without project conditions, 2) under with project conditions floodproofing costs will be eliminated or reduced, 3) current damage estimates will be used for non-floodproofed (existing) buildings and their contents. No attempt was made to increase the value of residential contents in the future.

5.9 Rationale for Plan Selection

Alternative 2, the NED plan, was selected as the Recommended Plan by the Sponsors. Alternative 2 was also chosen by the majority of attendees at the November 19, 1991 public meeting. It will provide a 100-year level of flood protection to the Lahaina Community. It will also virtually eliminate sediment discharge into the ocean ecosystem fronting Lahaina town. It also reduces fine sediment discharge at the Kauaula Stream outlet by twenty-five percent and eliminates coarse sediment discharge. Most of the runoff and sediment discharge from the watershed will outlet into an ocean area with the least developed coral reef resources fronting the watershed.

6. RECOMMENDED PLAN

6.1 Purpose and Summary

Alternative 2, the National Economic Development plan, is the Recommended Plan. The structural measures proposed by the Recommended Plan will reduce floodwater and sediment damages to agricultural and urban properties and reduce sediment discharge into sensitive coral reef areas.

The Recommended Plan was developed to meet the national and Sponsors' objectives of reducing or preventing floodwater damages. The structural measures included in the plan will be installed under authority of Public Law 83-566 with the purpose of flood prevention. Land treatment measures to reduce erosion and sediment delivery in the upper sugarcane fields will continue to be maintained through the ongoing conservation program.

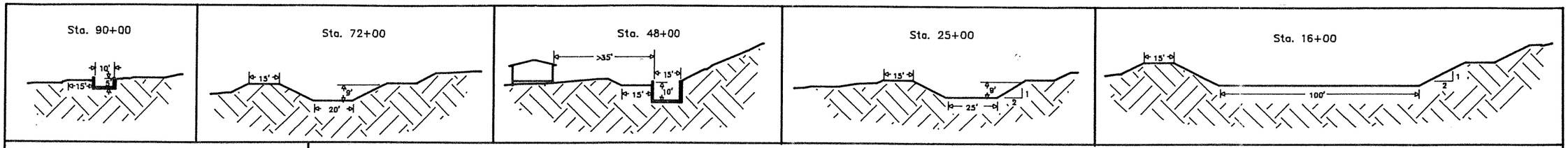
This section of the Plan-EA provides a detailed description of the proposed structural measures to be installed including financing, installation scheduling, and operation and maintenance requirements.

6.2 Plan Elements

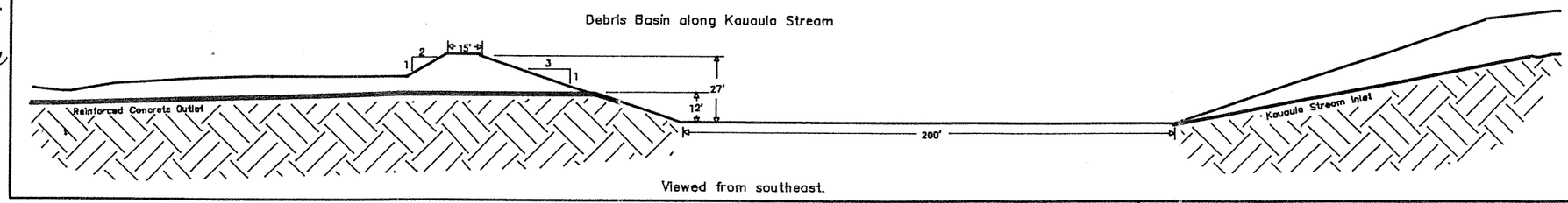
The Recommended Plan proposes the construction of a floodwater diversion channel that starts at Lahainaluna Road, extends across the watershed and outlets into Kauaula Stream. (Figure G - Works of Improvement) The diversion will be grass-lined except for reinforced concrete channel reaches near Lahainaluna Road and adjacent to Wainee Reservoir. The plan also includes the construction of an inlet basin, three sediment basins, a debris basin with two outlet channels at Kauaula Stream and a second diversion channel, with a sediment basin, leading to an ocean outfall two-thirds of a mile to the south. All bare earth areas including all diversion surfaces will be vegetated. Following is a brief description of each plan element starting from the upstream end of the improvements. Refer to Figure G - Works of Improvement.

6.2.1 Lahainaluna Road Inlet Basin

The inlet basin into the reinforced concrete channel section of the proposed diversion will be constructed alongside Lahainaluna Road. The 150-foot by 50-foot basin will be partially excavated and partially embanked with loose rock riprap armoring the entrance. Flows from the drainageway along the south side of Lahainaluna Road and flows from the 18-inch diameter culvert from the subdivision on the north side of the road will be routed into the basin. Boulders and cobbles will be trapped by the basin. Approximately 0.4 acres of right of way will be required for the basin.

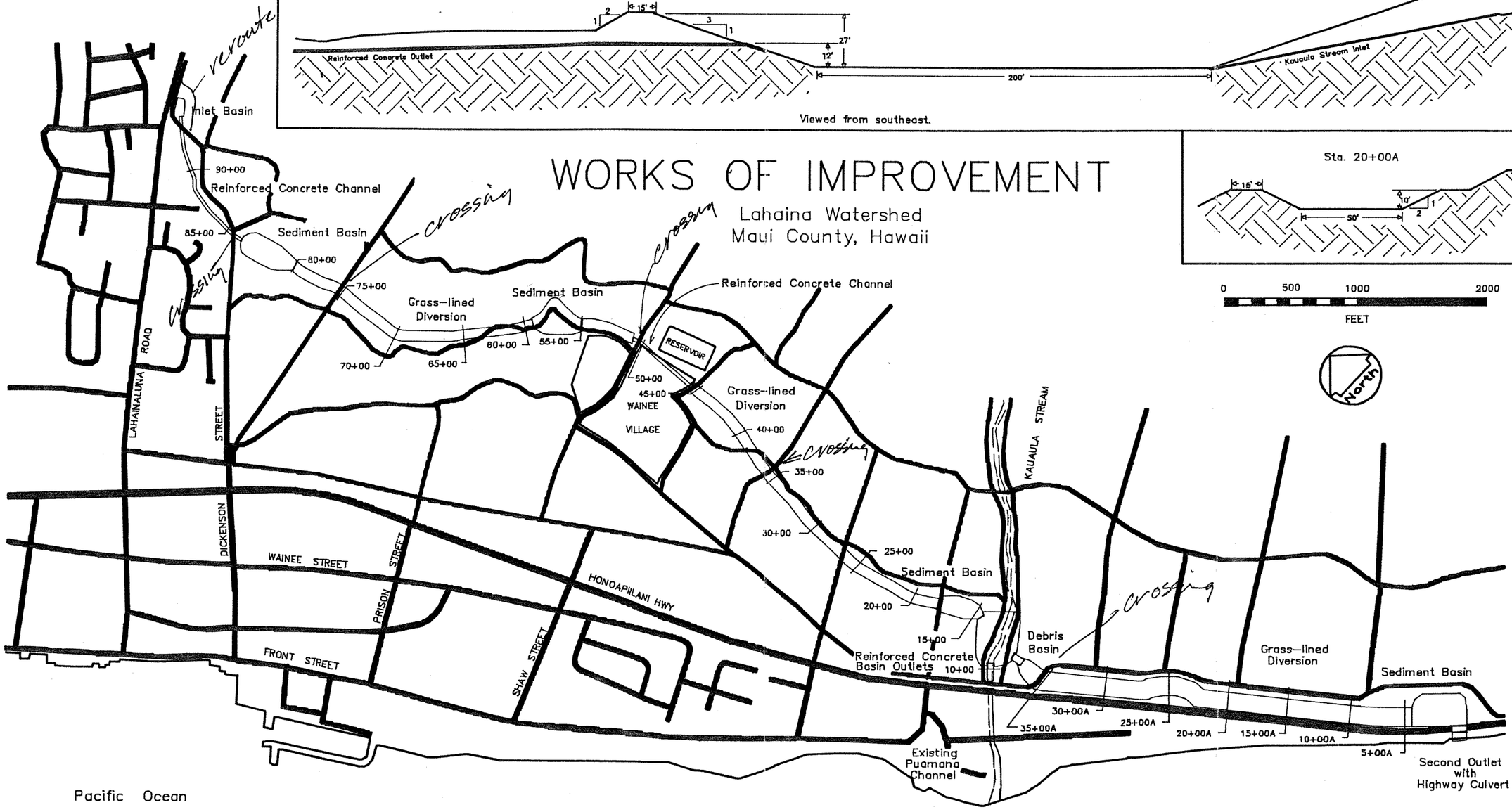


All views looking upstream unless otherwise noted.



WORKS OF IMPROVEMENT

Lahaina Watershed
Maui County, Hawaii



6.2.2 Diversion Channel

The rectangular reinforced concrete channel leading from the Lahainaluna Road inlet basin to the earth diversion channel will be ten feet wide, six to ten feet high, 1,031 feet long, and set at a four percent grade. Flows will enter from the inlet basin over a 31-foot long side inlet weir. An 85-foot long SAF energy dissipating basin will be constructed at the downstream end of the channel. One sugarcane field road will be rerouted and one field bridge will be installed. Approximately 1.0 acres of right of way will be required.

Below the high velocity channel, runoff from the upper sugarcane fields will be intercepted by a 5,800-foot long diversion channel set at 0.20 to 0.35 percent grade. Except for 500 feet of reinforced concrete channel adjacent to Wainee Reservoir, the channel will be earthen with grass lining. Riprap protected inlets will be provided where the diversion intercepts a drainageway. The diversion bottom width will vary from 20 to 25 feet. Side slopes will be shaped at 2:1. Average channel depth will be nine feet.

Three sediment basins will be constructed along the diversion to trap sediment. The basins will have a total capacity of 3,150 cubic yards or approximately 3,150 tons of gravel and finer sediment.

The embankment height on the downslope side of the channel will generally be two to three feet, including freeboard. The maximum embankment height is 10 feet at the sediment basin adjacent to Kauaula Stream.

Five hundred feet of reinforced concrete channel will be installed near the base of Wainee Reservoir embankment to reduce right of way needs and avoid relocation of households in Wainee Village. The rectangular reinforced concrete channel will generally be 15 feet wide and seven to nine feet in depth.

Approximately 17.5 acres of right of way will be required for the diversion across the Lahaina subwatershed. Of the required right of way for this element 16.5 acres are classed Prime or Other Important agricultural land. Relocation of four Pioneer Mill pipelines and three road crossings will be necessary for the installation of the diversion. Due to the presence of the buried pipelines, Pioneer Mill Company has requested no blasting be allowed during construction.

6.2.3 Debris Basin

A debris basin will be installed at the junction of the diversion and Kauaula Stream. The debris basin will trap boulders and cobbles transported by the high gradient Kauaula Stream. The basin will be a flow-through structure with no flood storage or detention capability. Debris storage capacity is 7,100 cubic yards or 9,240 tons.

The debris basin will be partially excavated with a horseshoe shaped earth embankment that rises a maximum of 10 feet from the natural ground. Rock riprap chutes will convey flows from the diversion and from Kauaula Stream into the debris basin.

Two weir outlets from the debris basin will be used. The Kauaula Stream outlet will be set at 28 feet MSL and have a weir length of 40 feet. The outlet will smoothly transition to the improved channel that extends up from the Pioneer Mill bridge just upstream of Honoapiilani Highway. The second outlet to the south will be set at 26 feet MSL and have a weir length of 30 feet. A reinforced concrete chute with a SAF stilling basin will convey flow into the grass-lined outlet channel. Initial flows from the basin will be routed toward the second outlet. At the 100-year peak discharge, the flows will be divided evenly between the two outlets.

In the event of an embankment breach with embankment-full conditions, it is estimated that the breach discharge will be 1,000 cubic feet per second. An emergency action plan and an inundation map showing discharge from a sudden dam breach and from the emergency spillway will be prepared following final design of the debris basin and before commencement of construction. A preliminary dam breach map (Figure B-3) is included in the appendix.

Approximately 3.0 acres of right of way will be required for installation the debris basin. All of the right of way required is classed Prime agricultural land.

6.2.4 Kauaula Stream

The existing channel from the Pioneer Mill bridge seaward will not be improved by the project. Peak discharges directed into the channel will not exceed the 4,500 cfs design discharge of the channel. The debris basin will virtually eliminate the coarse sediment that is presently deposited in the Puamana area of the existing channel.

No right of way will be required for this plan element.

6.2.5 Second Outlet

The channel from the second outlet consists of 3,600 feet of grass-lined waterway, a sediment basin, a culvert under Honoapiilani Highway, and an ocean outfall. The channel cross section will be trapezoidal with a 50-foot bottom width and an average depth of ten feet. The channel will be set a 0.3 percent grade.

Approximately 9.7 acres of right of way will be required for installation of the second outlet. Nearly all of the right of way required is classed Prime agricultural land. Nine telephone poles will require relocation.

6.3 Permits and Compliance

Installation of the proposed measures will be performed in full compliance with all laws and policies of county, state, and federal requirements.

CZM Fed Consistency Determination.
NPDES

County of Maui requirements are as follows:

1. GRADING, GRUBBING, EXCAVATING, AND STOCKPILING PERMIT
   Maui County Central Coordinating Agency
   Department of Public Works
   200 S. High St.
   Wailuku, HI 96793

2. SPECIAL MANAGEMENT AREA PERMIT
   Maui County Planning Department
   250 S. High St.
   Wailuku, HI 96793

State of Hawaii requirements are as follows:

1. HISTORIC PROPERTY REVIEW
   Department of Land and Natural Resources, State Parks
   1151 Punchbowl St.
   Honolulu, HI 96813

2. STREAM CHANNEL ALTERATION PERMIT
   Department of Land and Natural Resources, DWRM
   1151 Punchbowl St.
   Honolulu, HI 96813

3. SPECIAL USE PERMIT
   Department of Business and Economic Development
   Land Use Commission
   335 Merchant St.
   Honolulu, HI 96813

4. SHORE AND SHOREWATERS PERMIT
   Department of Transportation, Harbors Division
   79 S. Nimitz Hwy.
   Honolulu, HI 96813

5. STATE HIGHWAYS PERMIT
   Department of Transportation, Highways Division
   869 Punchbowl St.
   Honolulu, HI 96813.

Federal requirements for permits are as follows:

1. DEPARTMENT OF THE ARMY PERMIT (404)
   U.S. Army Corps of Engineers
   Pacific Ocean Division
   Building 230
   Fort Shafter, HI 96858

NWP #7
Outfall/structure

6.4 Costs

The total installation cost is estimated to be $6,389,600 of which $4,742,300 will be financed with PL-566 funds and $1,647,300 by the local sponsors. (Tables 1 and 2) The installation cost includes the costs of

constructing the proposed structural measures, engineering services, project administration, landrights, and relocation assistance costs. All costs reflect the 1991 price base.

Total construction costs include the costs of constructing an inlet basin, the earth diversion channel, sediment basins, debris basin, and reinforced concrete channels. Construction costs are based on quantity estimates and recent unit prices for similar work done in Hawaii. Total construction costs are estimated at $4,159,000 and are entirely PL-566 costs.

Engineering services costs include the direct costs of engineers and others required for design-level investigations, engineering design, preparation of construction specifications, and construction inspection. Engineering services costs are estimated at 10 percent of total construction cost and equal $416,000. Construction inspection costs are estimated to be $171,000 of the total engineering services cost.

Project administration costs include the costs of preparing invitations to bids, administering contracts, and overhead costs of project installation including legal opinions where needed. Project administration costs are estimated at eight percent of total construction costs and equal $332,800, of which $166,400 are PL-566 funds and $166,400 are other funds.

Land rights costs, which include the costs for the acquisition of 31.6 acres of land, related surveys and legal costs, costs for the construction or reconstruction of road crossings, and costs for the relocation of pipelines and utility lines, are estimated at $1,480,875, all of which are local costs.

Annualized costs are computed by adjusting installation and operation, maintenance, and replacement (OM&R) costs to present value then amortizing the total at 8-1/2 percent for the three year installation period and the 100-year life of the project. Annualized costs are attributable to flood prevention and are considered adverse effects in the NED account.

6.5 Installation and Financing

6.5.1 Installation Schedule

The installation period for the Recommended Plan is three years. During the first year the design of the structural measures, preparation of specifications, and surveying and acquisition of right of ways will be started. Construction of the outlet channel will also take place during the first year. The debris basin will be constructed during the second year. During the third year, construction of the diversion channel will take place. The planned sequence for construction of the structural measures will generally proceed from the downstream improvements and work upstream.

Table G shows the estimated schedule for obligating PL-566 and other funds during the three year installation period.

TABLE G - SCHEDULE OF OBLIGATIONS
Lahaina Watershed, Hawaii
(Dollars) 1/

Year	Items	PL-566 Funds	Other Funds	Total
1	Structural	1,064,500	37,300	1,101,800
	Landrights	0	465,400	465,400
2	Structural	1,228,000	43,100	1,271,100
	Landrights	0	230,200	230,200
3	Structural	2,449,800	86,000	2,535,800
	Landrights	0	785,300	785,300
TOTAL		4,742,300	1,647,300	6,389,600

1/ Price Base 1991 August 1992

6.5.2 Responsibilities

The County of Maui will be responsible for acquiring the necessary permits, licenses, and other entitlements to install the proposed structural measures in the Recommended Plan.

The County of Maui will be responsible for financing all non-federal costs (designated as "Other Funds" in Tables 1 and 2), obtaining rights of way, contracting, and maintaining coordination with federal and state agencies. The County will be responsible for designing and inspecting all road crossings or modifications to road crossings made necessary by the plan. Relocation of pipelines and utility lines will also be the responsibility of the County.

The County will be responsible for providing relocation assistance to any businesses and households affected by project installation.

The SCS will be responsible for financing all PL-566 costs as summarized in Tables 1 and 2, preparing all designs for the flood protection works of improvement, and providing construction inspection services for the flood protection works.

6.5.3 Contracting

Formal contracts for the installation of the Recommended Plan, awarded after receipt of competitive bids, will be used. The County of Maui will be responsible for administration of the contracts and for coordination with SCS during installation.

6.5.4 Landrights and Relocations

Landrights acquisition and household relocation will follow the procedures outlined in the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (PL91-646). No household relocations are expected. If relocation needs arise, relocation advisory services will be provided by the sponsors.

The County of Maui will be responsible for acquiring the 31.6 acres of rights of way required for the installation of the plan. The County will use its power of eminent domain if necessary.

All drainage lots and easements will be subdivided in accordance with Maui County Code, Title 18. Easements required by Pioneer Mill Company and others to cross the the flood protection improvements will be granted.

6.5.5 Financing

The County of Maui will finance its portion of the costs from its general fund.

Federal assistance for installing the Recommended Plan will be provided under the authority of the Watershed Protection and Flood Prevention Act, Public Law 566, 83rd Congress, 68 Stat, 666, as amended (PL-566).

6.5.6 Conditions for Providing Assistance

This Plan-EA does not constitute a document for obligation of PL-566 or other funds. Financial or other assistance furnished by SCS in carrying out the plan is contingent upon appropriation of funds for this purpose.

The Sponsors will ensure full conformance with county, state, and federal laws and regulations.

6.6 Operation, Maintenance and Replacement

The operation, maintenance, and replacement (OM&R) of structural measures will be the responsibility of the County of Maui for the 100-year evaluation period. Prior to signing a project agreement, an Operation and Maintenance Agreement will be entered into by the County and SCS. The agreement will be based on the SCS National Operation and Maintenance Manual 180-V of June 1982 and Amendments and will provide guidelines for operation, maintenance, and replacement of each structural measure. At the time of signing the agreement, the County will assure SCS that it has adequate staffing and equipment to carry out their maintenance responsibilities.

All works of improvement will be inspected annually and after unusually severe events or conditions to determine the maintenance required. The inspection party will consist of representatives of the County of Maui and the West Maui SWCD. SCS representatives will participate in the inspections during the first five years following project completion. The County will prepare a report for each inspection and submit a copy to SCS.

The following describes the essential elements of the OM&R responsibilities of the County.

1. Grass-lined Diversions - Grass lining is to be kept viable through irrigation and fertilization and mowed to prescribed length. Obstructions to channel flow such as debris, large rooted plants, trash, and sediment deposits are to be removed. Scoured areas and scour causes are to be corrected. Sideslopes must be maintained.

2. Concrete channels - Adequate backfill must be maintained along exterior sidewalls. Weepholes are to be kept free of obstructions. Assure surfaces are aligned and show no signs of stress. Monitor concrete channel sidewalls and floor for signs of damage from debris or cavitation scour and repair when necessary.

3. Sediment and debris basin - Maintain adequate storage capacity. Clean out at regularly scheduled intervals and when storage limits are neared. County landfills will accept clean soil material.

The average annual cost for cost for OM&R is estimated to be $40,000.

6.7 Tables

Tables 1, 2, 4, 5, and 6 display the estimated installation cost of the structural measures, annualized costs, annualized benefits, and the benefit:cost ratio of the recommended plan. Tables 3B describes the structural data for the works of improvement.

TABLE 1 - ESTIMATED INSTALLATION COST
Lahaina Watershed, Hawaii
(Dollars) 1/

Installation Cost Item	Unit	Number	Estimated Cost		
			PL-566 Funds SCS 2/ 3/	Other Funds 3/	Total
STRUCTURAL MEASURES					
Channel Work	Miles	1.93	4,742,300	1,647,300	6,389,600
SUBTOTAL STRUCTURAL			4,742,300	1,647,300	6,389,600
TOTAL PROJECT			4,742,300	1,647,300	6,389,600

1/ Price base 1991. August 1992
2/ Federal agency responsible for assisting in installation of works of improvement.
3/ All improvements to be installed on Nonfederal Land.

TABLE 2. ESTIMATED COST DISTRIBUTION
STRUCTURAL AND NONSTRUCTURAL MEASURES
Lahaina Watershed, Hawaii
(Dollars) 1/

Item	INSTALLATION COSTS -- PL-566 FUNDS				INSTALLATION COSTS -- OTHER FUNDS					TOTAL INSTALL. COST
	Construction	Engineering	Project Admin.	Total PL-566	Construction	Engineering	Land Rights	Project Admin.	Total Other	
STRUCTURAL MEASURES										
Startup 2/	121,700	12,200	4,900	138,800	0	0	0	4,900	4,900	143,700
Channel Work										
0+00A to 37+00A	812,000	81,200	32,500	925,700	0	0	528,000 3/	32,500	560,500	1,486,200
14+30 to 96+30	2,149,000	214,900	85,900	2,449,800	0	0	847,900 4/	85,900	933,800	3,383,600
Debris basin										
9+30 to 14+30	1,077,200	107,700	43,100	1,228,000	0	0	105,000	43,100	148,100	1,376,100
SUBTOTAL STRUCTURAL	4,159,900	416,000	166,400	4,742,300	0	0	1,480,900	166,400	1,647,300	6,389,600
TOTAL INSTALLATION	4,159,900	416,000 5/	166,400	4,742,300	0	0	1,480,900	166,400	1,647,300	6,389,600

1/ Price Base 1991

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2/ Includes mobilization, demobilization, field office, pollution control, and clearing and grubbing.

3/ Includes constuction of Honoapiilani Highway culvert, one culvert for Pioneer Mill road, and relocation of nine utility poles.

4/ Includes relocation of 4 Pioneer Mill pipelines and construction of four culverts for Pioneer Mill roads.

5/ May include local cost for construction inspection.

TABLE 3B - STRUCTURAL DATA - CHANNEL WORK
Lahaina Watershed, Hawaii

Channel Reach	Station	Drainage Area Sq. Mi.	100-Year Frequency Design Discharge CFS	Water Surface Elevation Ft. MSL	Hydraulic Gradient Ft./Ft.	CHANNEL DIMENSIONS				"n" value		Velocity Ft./Sec		Excavation Volume Cu. Yd.	Type of Work 3/	Existing Channel Type 4/	Present Flow Condition 5/
						Bottom											
						Gradient Ft./Ft.	Width Ft.	Elevation Ft. MSL	Side Slope	Aged 1/	As Built 2/	Aged 1/	As Built 2/				
Second Outlet	0+00A	3.92	4,450	2.1	0.029	0.029	48.0	-1.0	0	0.014	0.014	30.2	24.3		IL	0	E
	1+00A	3.92	4,450	14.4	0.004	0.004	48.0	8.0	0	0.014	0.014	14.3	9.0	1,222	IL	0	E
	2+00A	3.92	4,450	16.8	0.001	0.001	70.0	6.0	2	0.035	0.030	4.5	4.2	1,259	I	0	E
	4+00A	3.92	4,450	16.2	0.003	0.003	55.0	8.6	2	0.035	0.030	8.3	8.3	8,149	I	0	E
	15+00A	3.75	4,300	19.7	0.003	0.003	50.0	11.9	2	0.035	0.030	8.3	6.3	21,148	I	0	E
	28+00A	3.42	4,050	23.9	0.003	0.003	45.0	15.8	2	0.035	0.030	8.1	6.2	9,128	I	0	E
	35+00A	3.42	4,050	26.2	0.003	0.003	45.0	17.9	2	0.035	0.030	8.0	5.8	8,481	I	0	E
	37+40A 6/	3.42	4,050	30.6	0.006	0.200	40.0	26.0	0	0.014	0.014	22.2	17.2	1,000 8/	IL	0	E
Debris Basin	10+00 7/	3.42	4,050	32.7	0.004	0.028	35.6	25.7	0	0.014	0.014	18.4	14.3	1,000 8/	II	N	I
	11+50	6.85	8,100	38.4	0.000	0.000	40.0	16.0	3	0.035	0.030	3.4	1.6	6,306	II	N	I
	13+00	6.85	8,100	38.4	0.000	0.000	40.0	16.0	3	0.035	0.030	3.4	1.6	32,876	II	N	I
Diversion Channel with Sediment Basins	16+00	2.57	2,100	48.7	0.000	0.000	100.0	38.0	2	0.035	0.030	1.6	1.1	4,289	I	0	E
	20+00	2.57	2,100	48.4	0.003	0.004	25.0	40.7	2	0.035	0.030	6.7	5.8	12,130	I	0	E
	46+00	2.57	2,100	57.1	0.004	0.003	25.0	49.8	2	0.035	0.030	7.3	6.5	47,504	I	0	E
	50+00 9/	2.57	2,100	60.8	0.007	0.005	15.0	53.0	0	0.014	0.014	18.1	16.4	7,934	IL	0	E
	54+00	2.57	2,100	65.9	0.001	0.001	18.0	55.0	2	0.035	0.030	4.9	4.5	5,935	I	0	E
	57+50	2.57	2,100	66.5	0.000	0.000	60.0	55.0	2	0.035	0.030	1.8	1.3	10,387	I	0	E
	70+00	1.98	1,700	71.0	0.003	0.003	20.0	64.1	2	0.035	0.030	6.4	5.6	17,589	I	0	E
	83+00	1.98	1,700	74.2	0.000	0.000	75.0	74.2	2	0.035	0.030	1.6	1.0	26,053	I	0	E
	84+15 10/	1.49	1,200	77.5	0.046	0.333	10.0	74.0	0	0.014	0.014	34.7	27.8	912	I	0	E
	94+00 10/	1.49	1,200	123.6	0.005	0.043	10.0	116.0	0	0.014	0.014	15.8	12.2	2,002	I	0	E
	95+00 11/	1.49	1,200	129.9	0.000	0.000	30.0	120.0	2	0.035	0.030	2.4	1.8	2,696	I	0	E

1/ Velocities associated with design discharge (100-year).
2/ Velocities associated with 10-year frequency discharge.
3/ I - Establishment of new channel, including necessary stabilization measures.
IL - Same as I with impervious lining.
II - Enlargement or realignment of existing channel or stream.
VL - Stabilization of channel using impervious lining. Present capacity adequate.
4/ N - An unmodified, well-defined natural channel or stream.
M( ) - Manmade or previously modified channel with original construction date in parenthesis.
0 - None or practically no defined channel.
5/ I - Intermittant - continuous flow through some seasons of the year but little flow through other seasons.
E - Ephemeral - flows only during periods of surface runoff, otherwise dry.
6/ Debris basin outlet.
7/ Debris basin outlet to Kauaula channel.
8/ Excavation in addition to quantity included in Debris Basin excavation.
9/ Reinforced concrete channel above Wainee Village.
10/ Reinforced concrete high velocity channel.
11/ Inlet basin at Lahainaluna Road.

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TABLE 4 - ANNUALIZED ADVERSE NED BENEFITS
Lahaina Watershed, Hawaii
(Dollars) 1/

Evaluation Unit	PROJECT OUTLAYS		OTHER PROJECT COSTS	
	Amortization of Installation Cost	Operation, Maintenance and Replacement Cost	Other Direct Costs	Total
STRUCTURAL				
Channel Work	452,300	32,600	0	484,900
GRAND TOTAL	452,300	32,600	0	484,900

1/ Price base 1991. Discounted and annualized at 8-1/2 percent discount rate for 103 years.

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TABLE 5 - ESTIMATED ANNUALIZED FLOOD DAMAGE REDUCTION BENEFITS
Lahaina Watershed, Hawaii
(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit	
	Without Project	With Project	Average Annual	Annualized 2/
FLOODWATER				
Agriculture				
Crop	5,000	0 3/	5,000	4,300
Other Agricultural	5,700	0 3/	5,700	4,800
Subtotal	10,700	0 3/	10,700	9,100
Urban				
Residential	215,800	9,800	206,000	174,400
Commercial	389,700	29,000	360,700	305,400
Floodproofing Cost	71,500	0 4/	71,500	60,500
Public Agency	4,200	400	3,800	3,200
Subtotal	681,200	39,200	642,000	543,500
SEDIMENT				
Red Water	107,900	34,800	73,100	61,900
Subtotal	107,900	34,800	73,100	61,900
GRAND TOTAL	779,800	74,000	725,800	614,500

1/ Price base 1991 August 1992
2/ Discount Rate FY 1992: 8 1/2 Percent
3/ Damages will occur from floods of greater magnitude than the 100-year flood but were not evaluated.
4/ Installation of the Lahaina Watershed works of improvement in addition to planned County drainage improvements will eliminate the floodproofing requirement.

TABLE 6 - COMPARISON OF NED BENEFITS AND COSTS
Lahaina Watershed, Hawaii
(Dollars) 1/

Evaluation Unit	Flood Prevention Annualized Benefits 2/				Annualized Costs 3/	Benefit: Cost Ratio
	Floodwater		Sediment			
	Agriculture	Urban	Red Water	Total		
STRUCTURAL						
Channel Work	9,100	543,500	61,900	614,500	484,900	1.27:1.0
TOTAL	9,100	543,500	61,900	614,500	484,900	1.27:1.0

1/ Price base 1991 August 1992
2/ From Table 5.
3/ From Table 4.

7. EFFECTS OF RECOMMENDED PLAN

7.1 General Impacts

This section describes the economic, environmental, and social effects of the Recommended Plan. Many of the impacts that would result from the installation of the plan is summarized on Table I.

7.1.1 Flood Damage Reduction

The Recommended Plan will provide a 100-year level of flood protection to the residential communities of Lahaina Town and Puamana and the commercial core of Lahaina. It will also provide flood protection to the cultural and historic resources in the Lahaina Historic District. In the event of a 100-year flood, the proposed measure will prevent or reduce flood and sediment damage to 197 residences, 35 condominium units, and 157 business firms. Flooding due to low area ponding of runoff generated below the diversion will continue to affect 70 residences, 106 businesses, two schools, roads, and parks, although at a much reduced level. The total average annual damage reduction to residential and commercial buildings is estimated to be $642,000. Residual damage due to runoff originating below the project structures is estimated to be $39,200 on an average annual basis.

The cost of floodproofing new buildings will be reduced by an average of $71,500 per year. Costs for storm cleanup and emergency services will be reduced by $3,200 annually.

Floodwater damage on 59 acres of sugarcane and to agricultural improvements will also prevented. Agricultural damage reduced by an average of $10,700 per year.

Flooding due to runoff generated above the proposed diversion will continue to occur during storm events exceeding the 100-year recurrence interval, although at a reduced level. Residual flooding will also continue to occur during less intense storms as a result of runoff originating from the area below the proposed diversion. The project's effect on the 100-year and 500-year floodplains are shown on Figure B-1 and Figure B-2, respectively.

The incidence of road closures and traffic problems caused by flooding and sediment deposition will be reduced. Access by emergency units, such as ambulances, fire and rescue trucks, police vehicles, and utility service trucks, will be improved. The threat to human safety and health caused by floodwater and sediment deposition on the floodplain will be markedly decreased with installation of the project. The increase in security during floods will improve the quality of life in the benefit area.

7.1.2 Sedimentation and Water Quality

Project installation will reduce the total amount of sediment entering the ocean by nearly one-quarter, from 5,560 tons to 4,240 tons, on an average annual basis. The reduction will be accomplished by sediment trapping in four sediment basins and debris basin. Erosion will be also controlled by

the existing land treatment measures on cultivated fields. The grass lining of the earth diversions will also serve to filter sediment during low flow events.

The earth channel and basins provide opportunity for infiltration of low flows. The sediment basins will be maintained with a two-foot deep sediment pool and the debris basin will have a ten-foot deep sediment pool. The storage and infiltration capability of the structures may prevent or reduce runoff from less intense rain events to the ocean.

Most of the sediment yield from the watershed will be diverted from an area with important ocean ecosystems to an environmentally less sensitive area. Sediment discharge to sensitive reef areas near Lahaina Town with diverse high coral cover and rich species diversity will be reduced. The planned second outlet, two-thirds of a mile south of Kauaula Stream, is characterized by low populations of fauna and flora in the biotope of sand and low scattered coral cover. Sediment discharge will be increased in a area that has been identified by marine studies (Grigg 1986, 1991) as having the poorest coral reef structure in the vicinity of the project area. The proposed outlet area also has less recreational value and visitor interest than other nearshore areas fronting the watershed .

Sediment discharge into the fringing reef area fronting Lahaina Town will be virtually eliminated. Currently, an average of 3,400 tons of sediment are discharged into the area yearly. This discharge would be higher without the maintenance of land treatment measures in the cultivated fields located in the upper watershed area.

The area from the northern boundary of the watershed to Kauaula Stream is valuable to Lahaina's tourism-based commercial operators and for shoreline and nearshore recreational pursuits. Although "red water" episodes will continue to occur as a result of storm runoff along the entire West Maui coastline, peak suspended sediment concentrations and the duration of the episodes will be significantly reduced in the nearshore marine environment fronting Lahaina Town. The diverse coral biotope, including foraging area for the Hawaiian green sea turtle (Chelonia mydas) within the fringing reef formation, will be enhanced by the reduction of sediment.

Income losses to hotels and ocean-based commercial operations in the watershed due to "red-water" will be reduced by $73,100 annually. Recreational opportunities will be increased along the nearshore area fronting Lahaina Town.

The total average annual runoff volume, of both water and sediment, discharged at the Kauaula Stream outlet will be decreased. Discharge of very coarse sediment, less than six inches in diameter, will be virtually eliminated. Channel mouth blockage problems will be reduced. Average annual fine sediment discharge, clay and silt, will be reduced by about one-quarter. Total average annual sediment discharge, both coarse and fine, at Kauaula Stream will be reduced by 900 tons per year and will be about 50 percent of current rates.

Discharge of both water and sediment will increase at the proposed outlet 3,600 feet south of Kauaula Stream. Presently, an annual average of 310

tons of sediment enters the ocean near Puamana Park. With the project installed, the sediment discharge rate will be 3,281 tons on an average annual basis. The ten-fold increase will be of fine sediments that will be readily dispersed in the more active wave and current conditions at the second outlet. The return to background levels of nutrient concentrations within a week in nearshore waters off Kauaula Stream following a 5-year storm, in December 1982, indicates the efficiency of ocean environment in this area to disperse runoff products.

Historically, there have been no water quality problems identified fronting the project area due to nutrients or crop protection chemicals transported from the sugarcane fields by runoff. The installation of the proposed structures will not increase or concentrate the agricultural chemical constituent in storm runoff. The grass-lined diversions, sediment basins, and debris basins will allow infiltration of runoff into the soil and will provide vegetative filtration during during the less intense runoff events when chemical concentrations are known to be higher. The grass lining of the earth diversions and sediment basins will provide additional capability to assimilate nutrients.

7.1.3 Cultural and Historic Resources

The cultural and historic resources located in the floodplain and nationally registered Historic District will be provided flood protection. No known cultural resource of national or state significance will require protection, preservation, or recovery due to the installation of the recommended plan. If cultural resources are uncovered during construction, the SCS will provide appropriate notice to the State Historic Preservation Officer and the U.S. Secretary of the Interior in accordance with the procedures outlined in the SCS General Manual Title 420, Part 401 (SCS, 1983) as amended. SCS will take action to protect or recover any significant cultural resource discovered during construction.

7.1.4 Agricultural Resources

Eighteen acres of Prime farmland and ten acres of Other Important farmland will be converted to flood prevention use. Alternatives to provide flood protection to the floodplain areas while avoiding effects to farmland were considered. The broad drainage pattern across the Lahaina subwatershed was only efficiently controlled by a diversion channel traversing the subwatershed. The channel grade necessitated alignment into the sugarcane lands.

Protection of the downstream urban areas and receiving water from erosion products from the sugarcane fields has been a concern of Pioneer Mill Company and its parent company, AMFAC/JMB, Inc. Both companies endorse the plan and its intended conversion of agricultural lands to other uses. Pioneer Mill Company cultivates approximately 9,000 acres in West Maui. The company has discussed reduction of acreage to between 4,000 and 6,000 acres to streamline their operations and accommodate development plans. Although the subject acreage is more valuable due to its proximity to the company's mill operation, the effects of the loss of 28 acres is not significant when compared to total cultivated acreage.

7.1.5 Visual Resources

The significant reduction of "red water pollution days" of the ocean environment off Lahaina Town will have a positive visual effect in the watershed. The plan proposes the construction of a diversion, a debris basin and channel outlet, and modifications to the Kauaula Stream channel, all of which may have some impact on the area's visual resources.

The proposed diversion will be located across the slope above Lahaina Town at the 50-foot to 80-foot elevation and 400 to 1,500 feet uphill from Honoapiilani Highway. The grassed channel embankment may be visible from the highway and Lahaina Town. Mature sugarcane will provide screening during the majority of the time.

The debris basin will be located on Kauaula Stream 200 feet above Honoapiilani Highway and will be visible from the highway. Vegetative screening and architectural concrete colors and textures will be considered to reduce the visual impact of the basin.

The grassed embankment for the outlet channel will parallel Honoapiilani Highway for two-thirds of a mile. Landscaping along the road side will be considered to minimize the visual effects of the embankment.

Cultivation practices by the sugar company have produced landscape forms that are similar to those proposed by this plan. Terraces, irrigation and storm ditches, and field roads follow the contour of the hillside as will the diversion channel. Large rock piles that dot the Lahaina sugarcane fields are similar in form to the proposed debris basin embankment.

7.1.6 Geologic Hazard

Earth embankments will be constructed for the diversion channel and basins. The embankment for the debris basin on Kauaula Stream will rise a maximum of 10 feet and will be regarded as a "class C hazard" dam. The debris basin has been designed as a "flow-through" structure with no permanent water storage capacity. A preliminary breach inundation map is provided on Figure B-3 for a breach discharge of 1,000 cubic feet per second.

7.1.7 Significant Effects on Identified Concerns

The Recommended Plan addresses or affects eighteen of the concerns listed in Table B as high or medium in significance to decision making during the scoping process. Those effects are summarized in Table I - Summary of the Effects of the Recommended Plan.

7.1.8 Effects on Nationally Recognized Resources

Certain federal policies and laws recognize specific types of resources. These policies and laws impose specific requirements for analysis of the effects of the Recommended Plan as shown in Table J - Effects of the Recommended Plan on Resources of Principal National Recognition.

7.2 Relationship to Land and Water Plans, Policies, and Controls

Appropriate clearinghouse procedures have been followed by the Sponsors in processing the application for assistance under PL-566. The notification of application was issued on November 24, 1980, by the State Clearinghouse, Department of Planning and Economic Development. Since 1988, the State Clearinghouse has been a function of the State Office of Planning. Implementation of the Recommended Plan will complement the objectives of the County of Maui's Lahaina Community Plan.

Table I - SUMMARY OF EFFECTS OF THE RECOMMENDED PLAN
Lahaina Watershed, Hawaii
(Dollars) 1/ Page 1 of 3

NATIONAL ECONOMIC DEVELOPMENT

Beneficial Effects		Adverse Effects	
Components	Measure of Effects (Annualized)2/	Components	Measure of Effects (Annualized)3/
A. Flood Protection		A. Value of resources required for project:	
1. Urban	543,500	1. Project installation	452,300
2. Agriculture	9,100	2. OM&R	32,600
B. Sediment Reduction	61,900		
Total Beneficial Effects	614,500	Total Adverse Effects	484,900

Benefit:Cost Ratio = 1.27:1.0

1/ Price base 1991. Amortized over 103 years @ 8-1/2 percent interest. August 1992
2/ From Table 5.
3/ From Table 4.

Table I - SUMMARY OF EFFECTS OF THE RECOMMENDED PLAN
Lahaina Watershed, Hawaii

Economic, Social, Environmental, and Cultural Concerns	Effects
Floodwater and sediment damage to residential and commercial structures.	Reduced by $566,700. (average annual)
Flooding of Lahaina Historic District	100-year level of flood protection provided. Flooding from localized runoff will continue.
Cost of floodproofing new buildings.	Reduced by $71,500. (average annual)
Damage to street surfaces and sediment and debris cleanup.	Reduced by $3,800. (average annual)
Road closures and traffic disruption and congestion caused by flooding.	Reduced.
Access to emergency services.	Improved.
Threat human to health and safety.	Reduced
Quality of life.	Improved
Floodwater and sediment damage to sugarcane crops, fields, roads, irrigation systems, and ditches.	Reduced by $10,700 (average annual)
Sediment entering ocean from watershed.	Reduced by 1,320 tons or by 37 percent per average year.
Income losses for ocean-front hotels.	Reduced by $73,100. (average annual)
Loss of venue for ocean-based businesses.	Incidence reduced.
Ocean recreational opportunity.	Enhanced
Visitor appeal of Lahaina area.	Improved
Threat to coral reef ecosystems.	Reduced

Table I - SUMMARY OF EFFECTS OF THE RECOMMENDED PLAN
Lahaina Watershed, Hawaii

Economic, Social, Environmental, and Cultural Concerns	Effects
Prime and Other Important farmlands required for project installation.	28 acres required.
Visual resources.	Structural improvements will be visible.
Geologic hazard.	Possibility of basin embankment breach.

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TABLE J - EFFECTS OF THE RECOMMENDED PLAN ON RESOURCES OF PRINCIPAL NATIONAL RECOGNITION
Lahaina Watershed

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air quality	Clean Air Act, as amended (42 U.S.C. 185h-7 et seq.)	No significant effect
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	No effect
Endangered and threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	No significant effect
Fish and wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	No significant effect
Floodplains	Executive Order 11988, Floodplain Management	62 acres eliminated from 100-year floodplain.
Historic and cultural properties	National Historic Preservation Act of 1966, as amended (U.S.C. Sec. 470 et seq.)	100-year flood protection to Lahaina Historic District
Prime and unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act	Eighteen acres Prime farmland lost. Ten acres of other important farmland lost.
Water quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	Reduced total sediment and contaminants entering ocean.
Wetlands	Executive Order 11990, Protection of Wetlands Clean Water Act of 1977 (42 U.S.C. 185h-7 et seq.)	Not present in planning area
Wild and scenic rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271 et seq.)	Not present in planning area
Farmland Protection Policy Act	Public 97-98 - Farmland Policy Act of 1981	No significant effect

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8. CONSULTATION AND PUBLIC PARTICIPATION

8.1 General

Agency consultation and public participation were an integral part of project planning and the environmental evaluation conducted by the Sponsors and SCS. All contacts were noted and the results reported and evaluated in the project documentation file.

Formal agency consultation began with the November 10, 1980 notification by SCS, the County of Maui, and the West Maui Soil and Water Conservation District of the Application for Federal Assistance under PL-566 to the Hawaii State Clearinghouse, Department of Planning and Economic Development, as part of the A-95 review process. All federal agencies with possible interest in the project were also notified of the application for assistance. Informal coordination with the Corps of Engineers and the State of Hawaii was also initiated at that time.

Project planning and environmental evaluation began in October 1981 under the direction of SCS. Various meetings were held with the Sponsors, federal, state, county, and local agencies and the public to identify the concerns listed in Table B - Evaluation of Identified Concerns.

Based on the results of meetings with the Sponsors and the preauthorization studies, SCS requested planning authorization from the SCS Chief in Washington, D.C. This authorization was granted on March 18, 1985, and the agencies and the public were notified.

8.2 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) were consulted, in accordance with Section 7 of the Endangered Species Act, as amended, concerning threatened and endangered species that may be present in the Lahaina Watershed. USFWS and NMFS concurred in a no adverse impact assessment to listed species.

8.3 Cultural Resources

The State Historic Preservation Officer (SHPO) was consulted regarding cultural, historical, and archeological sites within the Lahaina Watershed. SHPO concurred that the proposed project will have no adverse effects on the two sites listed on the National Register and State Register of Historic Places: Lahaina Historic District and Hale Pa'i. SHPO further recommended that an archeological survey be conducted for all areas disturbed by the project.

Following a request by SCS, a Staff Archeologist from the State Historic Sites Section conducted an on-site examination of the diversion alignment to determine if any unrecorded cultural resources would be affected by project installation. The physical inspection resulted in a "negative finding of any evidence of significant cultural resources along the proposed route."

Consultation with SHPO was conducted regarding the historic significance of the five homes in Wainee Village that may have been affected by the project. After a site examination by SHPO and SCS, SHPO determined that, although Wainee Village meets the criteria for listing in the National Register of Historic Places, the five dwellings, due to their peripheral location and alterations have negligible historic value. The Recommended Plan avoids the five homes.

8.4 Public Participation

A major consideration in the development of the Plan-EA was to provide interested and affected groups and individuals an opportunity to participate in the planning process. The Sponsors and SCS developed a public participation plan for the Lahaina Watershed to assure a high level of public participation. Many individual contacts were made with the local residents of the watershed to gather data and to solicit participation in planning and environmental evaluation.

A mailing list was prepared and maintained to ensure timely notification of meetings and distribution of materials. Upcoming meetings and the availability of information were announced in newspaper notices and articles, posters, radio spots, and at meetings of interested groups.

Several public workshops and meetings were held throughout the development of the Plan-EA. A workshop was held in September 1981 to solicit comments from the public regarding the resource problems in the Lahaina Watershed. A meeting was held in December 1985 to further solicit comments from the public regarding the flooding problems in the watershed . Other public meetings were held to discuss alternative plans to alleviate the flooding problems and resolve environmental issues. The watershed plan has been given full public exposure and has been generally accepted by the public and sponsors. The most recent meeting was held in November 1991. In addition, throughout the planning process, many small group meetings were held with sponsors, land operators, landowners and community groups to gather and solicit comments. This process was intensified during 1991, as project alternatives were developed.

8.5 Plan Reviews

The Technical Review Plan-EA was distributed for an informal review by SCS technical reviewers and Sponsors. Discussions and comments on the Technical Review copy were incorporated into the Draft Plan-EA. The notice of availability of the Draft Plan-EA for the Lahaina Watershed was published in the Federal Register and local newspapers. The Draft Plan-EA was distributed for review and comment to interested individuals and to the following agencies and groups:

U.S. Government
Department of Agriculture
- Agricultural Stabilization and Conservation Service
- Farmers Home Administration
- Forest Service
- Office of Equal Opportunity

Department of Defense
    Army Corps of Engineers
Department of Commerce
    National Marine Fisheries
    National Oceanic and Atmospheric Administration
Department of Housing and Urban Development
Department of Health and Human Services
Department of the Interior
    Secretary of the Interior
    Office of Environmental Affairs
    Geological Survey
    Fish and Wildlife Service
    National Park Service
Department of Transportation
    Federal Highway Administration
    United States Coast Guard
Environmental Protection Agency

National Organizations
Advisory Council on Historic Preservation
Natural Resources Defense Council
National Wildlife Federation
Sierra Club
National Audubon Society

State of Hawaii
Department of Agriculture
Department of Health
    Environmental Planning Branch
    Clean Water Branch
Department of Land and Natural Resources
    Historic Preservation Officer
    Forestry and Wildlife Division
    State Parks, Outdoor Recreation, and Historic Sites Division
    Division of Water Resource Management
    Division of Aquatic Resources
    West Maui Soil and Water Conservation District
Department of Business and Economic Development
Department of Transportation
    Highways Division
Office of Environmental Quality Control
Office of the Governor
    Office of Planning

County of Maui
Office of the Mayor
Maui County Council
Department of Economic Development
Department of Planning
Department of Parks and Recreation
Department of Public Works
Maui County Council

Groups
AMFAC Investment Properties Inc.
AMFAC/JMB Inc.
Kamehameha Schools/Bishop Estate
Conservation Council of Hawaii
Hawaii Audubon Society
Hawaii Water Pollution Association
Hawaiian Historical Society
Lahaina Kiwanis Club
Lahaina Yacht Club
Life of the Land
Maui Historical Society
Mayor's West Maui Advisory Committee
National Audubon Society
Nature Conservancy
Outdoor Circle
Pioneer Mill Company, Ltd.
Puamana Community Association
Sierra Club, Hawaii Chapter
West Maui Taxpayer's Association

8.6 Summary of Responses and Comments

Comment letters on the Draft Plan-EA and responses to those comments are included in Appendix A.

LIST OF PREPARERS AND QUALIFICATIONS

The draft watershed plan and environmental assessment was reviewed and concurred in by state staff specialists having responsibility for engineering, soils, agronomy, biology, and geology. A subsequent review of the document and supporting data was conducted by the SCS West National Technical Center.

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GLOSSARY

alluvial - Of, pertaining to, or composed of sediment deposited by flowing water.

alternatives - Possible designs chosen to fulfill the objectives of a project, one of which will be recommended based upon multidisciplinary criteria.

amortization - The process of liquidating a debt by installment payments; to prorate over a defined period, at a specified interest rate.

architectural form liners - Liners placed into concrete forms to create an esthetic design in the finished concrete surface.

benefits, annualized - Projected annual benefit due to project implementation calculated by summing the present value of all benefits accrued during the project life then amortizing the total over the project evaluation period plus the installation period.

benefits, average annual - The long-termed average of the annual benefits expected to occur each year from installation of the project.

benefits, net - The difference between the average annual benefits and the average annual costs; expressed as a negative value when costs exceed benefits.

benefit-cost (B:C) ratio - Average annual benefits divided by the average annual costs or annualized benefits divided by annualized costs.

capacity - The maximum volume that a water conveyance system is capable of transporting, or that a reservoir can hold; the maximum volume that a sediment retaining structure can hold.

chiseling and subsoiling - A land treatment practice which breaks up restrictive soil layers below normal plow depth without inverting or mixing the surface soil layer to improve infiltration and root development.

conservation - Natural resource management practices that assume a "wise useage" policy; i.e., renewable resources are managed on a sustained yield basis, while nonrenewable types are used with minimum wastage.

conservation plan - A technical assistance provided by SCS to farmers and ranchers; outlines resource management practices which insures their perpetual availability; see also land treatment.

costs, annualized - Annual project cost calculated by adjusting all installation and OM&R costs to present value after which the total is amortized over the project period.

costs, average annual - The average cost incurred each year to pay for a project; usually involves the amortized construction cost plus the annual cost of operation, maintenance, and replacement.

costs, engineering services - Those expenses associated with surveys, investigations, designs, and preparation of plans and specifications.

costs, landrights - The cost of securing easements, right-of-way, and real property; for PL-566 purposes, also includes construction costs of bridges, culverts, and utility modifications.

costs, local - Those expenses borne by the local project sponsors as outlined under PL-566.

costs, other - Expenses borne by nonfederal funding; usually funded by local sponsors.

costs, relocation - All expenses associated with moving of households and businesses from condemned properties.

cross section - A view of an object formed by cutting though it, usually at right angles to its axis.

cubic feet per second (cfs) - A hydraulic term denoting flow rate; equal to 448.8 gpm.

culvert - Any water conveyance structure passing underneath a road or embankment, usually a pipe or reinforced concrete box.

cut - A slope or embankment from which earth is excavated (removed); antonym -- fill.

damage factors - Anticipated damages to crops and/or urban structures expressed as a percentage of the total value of the undamaged crop and/or structure; i.e., a decimal amount which, multiplied by the value of the undamaged crop and/or structure, yields and estimate of damages in dollars.

discharge (Q) - The flow rate of water through any pipe, ditch, culvert, etc.; usually expressed in cfs.

diversion channel - Any channel that redirects the natural flow of flood waters.

diversity, species - The variety of kinds of plants or animals in an area; in general, high species diversity indicates high biological productivity.

ecology - The science of the relationships between organisms and their environment.

ecosystem - The area of influence by all living and nonliving factors in the environment; because of the principal of environmental interrelationship ecosystems always interact with each other.

embankment - A mound of earth and/or stone built to hold back water or support a roadway.

erosion - The detachment, transportation, and deposition of soil.

erosion, rill - The erosional action of water that forms small (less than 1 foot deep), steep-sided channels called rills; left unchecked, rills become gullies.

erosion, sheet - The uniform movement of soil on a slope by sheets of running water, as distinct from streams.

evaluation period - Life of the project. At the end of the evaluation period, all installation costs are paid and all project structures are fully depreciated.

excavation - The act of digging out and removing earth from a given area.

fill - Earth material, including rock, placed on a site to form dams or embankments; also used to raise the level of the ground or "fill in" depressions.

filter - A rock or mesh material used where subsurface water drains into a pipe or channel to prevent detachment and movement of soil particles.

fines - The fine fraction of soils and sediment, consisting of clay and silt particles smaller than 0.074 mm. in diameter (by USDA nomenclature).

flood plain - An area subject to flooding; includes lands bordering streams, rivers, ponds, lakes, and undrained lowlands.

flood prone - Areas that are likely to experience inundation by floodwater.

flood proofing - Protecting an individual structure against flood damage by installing such devices as flood walls, flood shields, or ring dikes; also includes elevating the structure above the flood level.

flood shield - A device installed when flood proofing a building which seals an entrance when in place.

flood wall - Impermeable wall placed around and adjacent to a building for flood proofing.

flood warning system - A system or device, usually electronic, that sounds an audible sound when flooding danger is imminent in a local area; e.g., overtopping of dams.

floodwater retarding structure - A dam or reservoir that impounds floodwaters and releases them over an extended period; also called flood water detention structures.

freeboard - The distance between the design water surface and the top of a dam or channel.

habitat - The area where an organism or biological population normally lives or occurs; includes the total area where all physical and biological life requirements of a species are found.

impacts, environmental - Any change in environmental conditions, positive or negative, that occur as a result, direct or indirect, of installing a project or other modification.

incremental benefit-cost analysis - The process by which each individual segment, measure, or structure is separately evaluated in terms of comparing benefits to costs before adding the next segment, measure, or structure.

indigenous - Occurring or living naturally in an area; not introduced; native.

induced flooding - New flooding, and/or increased depth and duration of flooding, caused by the project.

landrights - The ownership of real property and/or its use, temporary or permanent; see also easements and right-of-way.

landscape architecture - The process of designing a view or vista, usually, to enhance the visual resource.

land treatment - Soil and water conservation practices on rural lands that preserve and perpetuate the soil resource base; see also conservation plan.

land use - The service or activity to which a parcel of land is employed; e.g., urban residential, commercial, industrial, conservation, recreation, etc.

natural resources - Those components of the environment which are at least potentially useful to man, both economically and metaphysically; includes minerals, trees, fossil fuels, fish, wildlife, scenery, etc.

National Economic Development Plan (NED) - A plan, or element of a plan, that maximizes net national economic development benefits.

National Environmental Policy Act (NEPA) - A 1970 law that requires each federal agency to prepare an Environmental Impact Statement to assess and avoid adverse environmental impacts in advance of each major action, recommendation, or project, that would significantly affect the quality of the human environment. If the effects on the quality of the human environment are not considered significant, then the less intensive Environmental Assessment is prepared.

nonstructural - Water and sediment management practices that avoid structural modifications and construction; includes flood proofing, flood warning systems, relocation, flood insurance, land use regulation, etc.; see also structural measures.

"n" value - A coefficient of channel roughness used in hydraulic computations; determined by such factors as bed material, bank material,

surface irregularity, vegetation, uniformity of cross section, obstructions, and meandering.

operation, maintenance and replacement costs (OM&R) - Costs associated with the general use and repair of channels, reservoirs, structures, and their related rights-of-way.

percent event - Denotes the magnitude of a flood; i.e., a flood that has a certain percent chance of occurring in any one year.

Public Law 83-566 (PL-566) - See Watershed Protection and Flood Prevention Act.

prime agricultural land - Prime farmland that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, or other land, but not urban built-up land or water). It has the soil quality, growing season, and irrigation supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

probable maximum flood - The amount of surface water produced from a theoretical storm in which all meteorological parameters are maximized at the same time.

reach - A segment of the project area associated with a stream or channel; boundaries are arbitrarily defined and are generally established early in the study.

recurrence interval - The time period (in years) between storms of a specified intensity; inverse of percent event (e.g., 1 percent event = 100-year storm).

reservoir - Any water storage facility.

residual flooding - All surface water flooding recognized to remain in the after project measures have been implemented.

right-of-way - The right to pass over property owned by another party or the property requirement for the installation of structural measures.

riprap - A loose or grouted assemblage of stones placed along the inside slope of a channel or embankment to reduce erosion and provide fortification.

scoping - The process of determining the significant issues to be addressed in the development of a project.

sediment - Solid material, both mineral and organic, that is suspended in or being transported by moving water or has been deposited.

sedimentation - The act or process of eroding, transporting, and depositing sediment.

sediment delivery ratio - The ratio of soil actually transported out of the watershed as sediment to the total amount eroded; usually expressed as percentage.

sediment yield - The amount of soil removed from a drainage basin; only represents a fraction of the total erosion as some material remains in the watershed.

soil - The layer of the earth's surface composed of both organic and mineral elements and capable of supporting plant life.

Soil and Water Conservation District - A local unit of state government that is responsible for soil and water conservation within its boundaries.

soil structure - The arrangement of primary soil particles into larger aggregates termed granular, platy, prismatic, columnar, and blocky.

soil texture - The relative proportions of soil particle sizes found within a given soil sample or type; sizes include silt, clay, sand, and gravel.

species - A fundamental category of classifying living things, ranking after genus, and consisting of organisms capable of interbreeding.

spillway, emergency - An ungated outlet from a reservoir which prevents over topping by floodwater during large storms.

spillway, principal - A structure associated with a dam to allow for controlled releases of water.

spoil - Refuse material removed by digging or dredging.

stage - The elevation of the water surface at any channel or reservoir cross section.

structural measures - Water and sediment management practices that involve the construction of channels, reservoirs, sewers, and other devices; see also nonstructural measures.

value, content - The cash worth of personal property contained within a building subject to flood damage.

volunteer cover crop - Land treatment practice which allows preexisting vegetation to reestablish on opened farm fields to provide erosion protection.

watershed - The topographic area drained by a single river or creek system.

Watershed Protection and Flood Prevention Act (PL 83-566) - Administered by the Soil Conservation Service, this law provides technical assistance and cost sharing to local sponsors for developing and implementing plans in watersheds no larger than 250,000 acres; may be multipurpose.

weir - An overflow structure to raise the water level and regulate the flow; often used to divert water into another channel.

APPENDIX A

COMMENTS RECEIVED ON

DRAFT WATERSHED PLAN - ENVIRONMENTAL ASSESSMENT

AND RESPONSES TO COMMENTS

Appendix A

LINDA CROCKETT LINGLE
Mayor
TELEPHONE 243-7855

OFFICE OF THE MAYOR
COUNTY OF MAUI
WAILUKU, MAUI, HAWAII 96793

March 18, 1992

Mr. Warren M. Lee
State Conservationist
Soil Conservation Service
P.O. Box 50004
Honolulu, HI 96850

SUBJECT: LAHAINA WATERSHED PROJECT
DRAFT WATERSHED PLAN - ENVIRONMENTAL ASSESSMENT

Dear Mr. ~~Lee~~: Warren,

Thank you for this opportunity to review the draft report of the Watershed Plan and Environmental Assessment.

My office does not have any comments on your draft report at this time. However, several of my County departments are currently reviewing the report and they will send you their comments, if any, under separate cover.

If you need any assistant in this matter, please feel free to call Nolan Perreira, my Executive Assistant, at 243-7855.

Very truly yours,

LINDA CROCKETT LINGLE
Mayor, County of Maui

RMN:ch(ED92-146)
H2Oshed.lcl

xc: Engineering Division

LINDA CROCKETT LINGLE
Mayor
TELEPHONE 243-7855

OFFICE OF THE MAYOR
COUNTY OF MAUI
WAILUKU, MAUI, HAWAII 96793

April 10, 1992

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

Dear Mr. Lee:

Enclosed for your information are comments relating to the Lahaina Watershed project. The West Maui Advisory Committee has been and continues to be a strong supporter of this project. Your personal response to Mrs. Soares on their concerns would be very much appreciated.

Sincerely,

LINDA CROCKETT LINGLE
Mayor, County of Maui

NP:jso
Enclosure
c:\letter\38

1

Appendix A

April 7, 1992

Mayor Linda Crockett-Lingle
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Subject: Lahaina Watershed Project

Dear Mayor Crockett-Lingle:

A copy of the draft Watershed Plan - Environmental Assessment - for the Lahaina Watershed Project, has been reviewed by this Committee, and we offer the following:

1. The addition of a second debri basin higher up in the Kauaula Stream area is recommended.

2. The appearance of the basin, color of cement, plantings, etc. should be visually pleasing in both directions. Should homes or a by-pass be built, the mauka view will be as important as the makai appearance.

3. By changing the path from Wainee Village to a higher point, up towards the reservior, how much more water volume will be created below the water shed to the aquatic center?

Please be advised that although the above concerns are being expressed, the West Maui Advisory Committee strongly supports the Lahaina Watershed Project, and feels that it will benefit the Community as a whole in terms of flood control. We do not feel that an Environmental Impact Statement is necessary, nor do we feel that it would provide the Community with any more information.

Time is of the essence, therefore, we ask that the Administration continue to support the project and our efforts in this regard.

Sincerely,

WEST MAUI ADVISORY COMMITTEE

(Mrs.) Donna S. Soares
Chairperson

DSS:cr

cc: Howard Kihune, Chairperson
County Council

LINDA CROCKETT LINGLE
Mayor

BRIAN W. MISKAE
Director

ROBERT K. KEKUNA, JR.
Deputy Director

JOHN E. MIN
Long Range Division

COLLEEN M. SUYAMA
Current Planning Division

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

April 13, 1992

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

Dear Mr. Warren:

Re: **DRAFT WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT LAHAINA WATERSHED, MAUI COUNTY, HAWAII**

2

Thank you for your letter and enclosure of February 26, 1992 requesting comments on the captioned noted document.

From a strictly planning perspective we support generally, improvements which relate to life/safety issues. Installation of works designed to prevent flooding and thus limit loss of life and destruction of property are encouraged. The design of such improvements must consider the potential negative impacts of introducing concentrated volumes of fresh water into the near-shore ocean environment. My level of expertise is somewhat limited in the area of drainage work design and I therefore cannot comment on the specifics of your project.

The Lahaina Community Plan addresses the issue of drainage by supporting the implementation of flood control projects to address present problem areas. The Plan also recommends the development and adoption of a drainage master plan emphasizing land management techniques such as natural landscaping, periodic maintenance of streams and drainageways and avoidance of development in flood prone areas. It points out that wherever feasible, such management techniques should be used instead of structural solutions such as building artificial stream channels. It has been asserted that these stream channels which are capable of introducing high volumes of fresh water into the ocean may be causing an imbalance in the near shore biotic environment.

Appendix A

Warren Lee
April 13, 1992
Page 2

Thank you for this opportunity to comment at this time. When further information is available on the project, we would be pleased to review it.

Yours truly,

Brian Miskae, Director
Department of Planning

cc: Linda Crockett Lingle, Mayor
C. Suyama
Long Range Division

SCSdrain.bm

DEPARTMENT OF
PARKS AND RECREATION
COUNTY OF MAUI

LINDA CROCKETT LINGLE
Mayor
CHARMAINE TAVARES
Director
ARMAND PADUA
Deputy Director

1580 KAAHUMANU AVENUE, WAILUKU, HAWAII 96793 (808) 243-7230

April 16, 1992

Mr. Warren M. Lee
State Conservationist
United States Department
of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

RE: DRAFT WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT
LAHAINA WATERSHED, MAUI COUNTY, HAWAII

I have no comments to offer on the above project but would like to thank you for giving me the opportunity to review the plan. 3

Sincerely,

CHARMAINE TAVARES
Director of Parks & Recreation

Appendix A

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

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

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

April 22, 1992

Mr. Warren M. Lee
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

SUBJECT: DRAFT WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT
LAHAINA WATERSHED, MAUI COUNTY, HAWAII

We have reviewed the Watershed Plan and the Environmental Assessment and offer the following comments:

Solid Waste Division:

1. Alternate means of disposal of grubbed material and rock shall be utilized other than disposal at the County landfills. Only clean soil material will be accepted at the County landfills.

2. We anticipate that the Olowalu Sanitary Landfill will be closed to all users by June 1992. An solid waste generated by this project will need to be disposed of at the Central Maui Landfill.

Land Use and Codes Administration:

1. All drainage lots and easements must be subdivided in accordance with Maui County Code Title 18.

2. In accordance with the Maui County Code Section 18.20.130, Subsection B, a ten (10) foot wide "minimum" maintenance road is needed for the length of the channel. Please ensure this provision is addressed in the design of this project so that the County would have access.

Highways Division:

1. Presently, this division does not have adequate equipment or personnel to properly maintain this future channel. It is suggested that a provision be made in this document that the this point is made. In addition, a recommendation should be made by your agency requesting the proper manpower and equipment be provided by the County.

Wastewater Reclamation Division:

1. It is recommended that two (2) sedimentation basins with two outlets be selected for this area.

Engineering Division:

1. Abstract: The abstract should include a statement that the Lahaina Watershed project is in conformance and/or compliance with EPA's Clean Water Act and other Federal/State regulations concerning non-point source water pollution.

2. Page "iv", line 12: The chief legal officer of the "County" not the "state'.

3. Page 27, line 18: The amount of sediment generated is also dependent upon land management practices.

4. Page 44, line 25: The phrase "evaluation period of 50 years" needs to further defined. Since the project is designed for a 100 year storm, the reader might be confused. This reference is also used on page 58, line 16.

We thank you for this opportunity to comment and apologize for the late response.

Very truly yours,

George N. Kaya

George N. Kaya
Director of Public Works

LL:(Lahwtsh.scs)

cc: All Divisions

Appendix A

RETURN VIA MESSENGER

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

February 26, 1992

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

'92 MAR -4 A

OEQC
QUALITY

Subject: Draft Watershed Plan-Environmental Assessment -
Lahaina Watershed, Maui County, Hawaii

We are transmitting, for your review and comment, the draft Watershed Plan-Environmental Assessment (Plan-EA) for the Lahaina Watershed, Hawaii. The present plan supercedes the draft Plan-EA that was circulated for review in December 1990, but was not finalized.

The Plan-EA was prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and is in accordance with Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

We are requesting that comments be received by this office on or before April 17, 1992. If your comments are not received by the due date, we will assume you do not wish to comment.

Sincerely,

Warren M. Lee

RETURN TO: WARREN M. LEE
State Conservationist

Thanks.
Congratulations on your MOA with Hawaiian Homelands.

Enclosure

cc:(w/o encl.)
John W. Peterson, Director, WPD, SCS, Washington D.C.
Dennie Burns, Assistant Chief-West, SCS, Washington, D.C.
Tommy George, Director, WNTC, SCS, Portland, OR
Neal Fujiwara, DC, Wailuku FO, SCS, Wailuku, HI

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

March 4, 1992

Mr. Warren M. Lee
State Conservationist
Soil Conservation Service
P.O. Box 50004
Honolulu, HI 96850

Subject: Draft Watershed Plan - Environmental Assessment -
Lahaina Watershed, Maui County, Hawaii

Thank you for the opportunity to review the draft watershed plan/EA for the Lahaina Watershed project. After reviewing the document, we have no objections to the intent of the project. No threatened and endangered plants would be found in the area due to it being on residential (urban) and agriculture-designated lands. You did mention several animal T&E species (the Pueo and the Green Sea Turtle) but the project should not be detrimental to their survival in the area. 5

Should you have any questions, please feel free to call Mr. Carl T. Masaki of my staff at 587-0166.

Sincerely,

Michael G. Buck
Administrator

cc: Maui DOFAW

Appendix A

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

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

IN REPLY REFER TO:

HWY-PS
2.1036

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

Mr. Warren M. Lee
State Conservationist
United States Department of
Agriculture
Soil Conservation Center
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Draft Watershed Plan - Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your letter of February 26, 1992, requesting our comments on the subject project. We have the following comments:

1. The project's second drain outlet appears to be in the vicinity of the planned Honoapiilani Highway Bypass. Please coordinate with our Highways Division to prevent any conflicts.

2. All plans for construction work within our State highway right-of-way must be submitted for our review and approval.

Sincerely,

for Rex D. Johnson
Director of Transportation

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

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

REF: HP-JEN

APR 9 1992

LOG NO: 4872
DOC NO: 2200A

Mr. Warren M. Lee, State Conservationist
United States Department of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

SUBJECT: National Historic Preservation Act Compliance -- Draft Watershed Plan - Environmental Assessment
Lahaina, Maui

Thank you for the opportunity to comment on this document.

This document has adequately identified significant historic sites within the project area (page 44), and has also incorporated our previous comments on the draft plan and EA (page 98). Copies of our previous comments should be included in Appendix A. 6

Your agency has fully complied with Section 106, National Historic Preservation Act. We have concurred with your determination that the proposed undertaking will have "no effect" on significant historic sites in Lahaina.

Should you have any questions about these comments, please call Ms. Annie Griffin of our State Historic Preservation Division at 587-0013.

Very truly yours,

WILLIAM W. PATY, Chairperson and
State Historic Preservation Officer

AG:jen

Appendix A

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:KCK

APR 22 1992

File No: 92-590
Doc. ID: 548

Mr. Warren M. Lee
State Conservationist
United Stated Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Subject: Draft Watershed Plan and Environmental Assessment Lahaina Watershed

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

Brief Description:

The purpose of the 'Lahaina Watershed Plan and Environmental Assessment' is to appraise the economic feasibility and environmental acceptability of providing flood protection to urban and agricultural properties in the Lahaina watershed.

The Lahaina watershed covers 4,920 acres and consists of two subwatersheds; the 2,140-acre Lahaina subwatershed and the 2,780-acre Kauaula subwatershed. Approximately 3,400 acres of this total are in forest and brushland,1,080 acres are used for the production of sugarcane and 440 acres are in urban uses, such as residential and commercial. Seventy-nine percent of this acreage is privately owned and 21 percent is owned by the State of Hawaii.

The plan proposes the construction of several structures to reduce the adverse effects of flooding and sedimentation. The primary element is a 6,831-foot floodwater diversion channel that starts at Lahainaluna Road, extends across the Lahaina subwatershed, and discharges at two ocean outlets. Approximately 1,530 feet of the channel would be reinforced concrete and 5,300 feet would be earth with grass lining. Associated structures include an inlet basin, a debris basin, an energy dissipating basin, three sediment basins and a second outlet channel and ocean outfall.

According to the applicant, the proposed project will reduce total sediment discharge to the ocean and improve the quality of the nearshore marine environment. Sediment discharge to the fringing reef fronting Lahaina Town will be nearly eliminated. It is also anticipated that coarse sediment discharge at Kauaula Stream will be nearly eliminated and that fine sediment discharge will be reduced 25 percent.

Conversely, sediment discharge at the second outlet site, 0.7 miles south at Kauaula Stream, will increase ten times. According to the applicant, the marine environment at this location has the least developed coral reef and the lowest species diversity for sites along the project area coastline. This proposed discharge site is also believed to have the most favorable current conditions to disperse fine sediments.

Division of Aquatic Resources Comments:

Although the proposed project is expected to nearly eliminate sediment discharge on the reef fronting Lahaina Town and reduce the total sediment discharge to the sea, much of the sediment discharge will be simply redirected to a second outlet site south of Kauaula Stream. The applicant has determined this site to have the least developed coral reef, the lowest species diversity and the most favorable current patterns for sediment dispersal among sites along the project area coastline.

To evaluate the merits of this project and the implications of redirecting sediment flow, we would like to review the data upon which these determinations were based.

7

Historic Preservation Program Concerns:

This document has adequately identified significant historic sites within the project area (page 44), and has also incorporated our previous comments on the draft plan and EA (page 98).

The USDA - Soil Conservation Service has fully complied with Section 106, National Historic Preservation Act. We have concurred with its determination that the proposed project will have "no effect" on significant historic sites in Lahaina.

Division of Land Management:

We suggest that this outlet be considered at Launiupoko Stream rather than Kauaula Stream where sediment discharge will increase 10 times. There are two shoreline parks downcurrent of this outlet. As such, local people could be impacted negatively.

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

Very truly yours,

John P. Keppeler, II
for WILLIAM W. PATY

cc: Maui County Planning Dept

Appendix A

JOHN WAIHEE
GOVERNOR OF HAWAII

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

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

In reply, please refer to:
92-085/epo

April 28, 1992

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

Dear Mr. Lee:

Subject: Draft Watershed Plan-Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

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

This assessment provides an evaluation of environmental effects expected from construction of a flood water diversion channel within the Lahaina watershed. A 100-year return time was chosen as the design level for flood protection. Construction of four sediment basins and one debris basin (for Kauaula Stream) in association with this channel is expected to reduce the present mass loading of sediments into coastal waters by 1,690 tons per year (37 percent per average year).

The major environmental improvement predicted is reduction of storm-related episodes of "red water" on coral reefs located off the Lahaina waterfront. However, much of the existing sediment load will simply be transported and released through an ocean shoreline outfall to be constructed south of Puamana, in an area with less reef development and less associated recreational use. Although any reduction of sediment loading into nearshore waters will be beneficial to both the health of the coral reef ecosystem and to recreational ocean users, the problem of eutrophication of coastal waters, as evidenced by recent macroalgal blooms along the West Maui coastline, has not been addressed in this watershed plan.

Both residents and visitors to the west Maui coastline are affected by the series of increasingly dense seasonal macroalgal blooms occurring in shallow coastal waters. These blooms are causing degradation of coral reef ecosystem and interfering with recreational use of coastal waters. Because algal blooms are a

partial function of nutrient type and rate of input, it is evident that the composition of the nutrient load presently entering west Maui waters on an annual basis is suitable for rapid uptake and conversion to algal biomass.

Although the West Maui algal blooms have been concentrated along the coastline north of the Lahaina watershed, there is no reason to assume that the coastline from Mala Wharf south will remain unimpacted by these blooms. A prudent approach is to suggest that watershed plans, especially those for watersheds along the west Maui coastline, include nutrient management plans as well as sediment reduction plans. Slight eutrophication of shallow coastal waters is becoming evident in many areas of the State; consequently, we recommend that methods for controlling total loads of surface-applied nutrients entering both surface waters and groundwater be explicitly set forth in watershed management plans. These management plans must begin to address more than flood control measures in order to adequately protect the quality of the State's coastal waters.

If you should have any questions regarding this matter, please contact Dr. June Harrigan of the Environmental Planning Office at 586-4337.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

c: Environmental Planning Office (J. Harrigan)

Appendix A

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

March 12, 1992

Warren M. Lee
te Conservationist
l Conservation Service
. Box 50004
Honolulu, Hawaii 96850

Subject: Review--Draft Watershed Plan-Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

I have reviewed the subject draft report and offer two comments for your consideration.

1. There are a few minor errors in the watershed boundaries delineated on figure A page 11. The most significant errors are located in the vicinity of Lahainaluna High School and near Hauaula Stream between altitudes 400 and 600 feet. It is unlikely that these minor errors would have any significant effect on area determinations.

2. On page C-18 it was stated that "The validity of the hydrology model was justified by utilizing it on nearby watersheds that are gaged".
A crest-stage gage has been operated on Kauaula Stream 0.7 miles upstream from Hanoapiilani Highway (bypass) with a drainage area of 4.12 square miles since the early 60's. This gage is in the study area. Why wasn't it used?
On page C-20 assumption number 5 mentions some use of the gage on Kauaula Stream (station number 16643300). Now I'm confused, was data from the gage used or not?
Results for peak flood discharges shown on page C-21 indicate that the 1960 peak discharge of 2,660 cfs at station 16643300 would have a recurrence interval of about 15-years, is this reasonable? The 1960 flood is said to be the greatest of record in this area (p23 of your report).

As noted above comment number one is relatively minor and may even border on being too picky. Comment number two leaves me with more serious concerns. Computed flood peaks are the basis for your analysis and study results can be no better than these estimates. Available data for station 16643300 imply that your estimated peak flood discharges may be too high.

If there are any questions concerning my comments please feel free to call me at FTS 551-2653 or at non-FTS 808-541-2653.

Sincerely,

Richard Fontaine
Hydrologist

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

March 25, 1992

REPLY TO
ATTENTION OF:

Planning Division

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

Dear Mr. Lee:

Thank you for the opportunity to review the latest (February 1992) Draft Watershed Plan and Environmental Assessment for the Lahaina Watershed, Maui. Our previous comments (letter dated February 15, 1991) have been incorporated into the present draft document. We have no additional comments.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

Appendix A

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Honolulu Office
Seven Waterfront Plaza, Suite 500
500 Ala Moana Boulevard
Honolulu, HI 96813-4918

MAR 27 1992

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

Dear Mr. Lee:

SUBJECT: Draft Watershed Plan
Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

We have reviewed the draft Watershed Plan-Environmental Assessment Plan (Plan-EA) for the Lahaina Watershed, Maui County, Hawaii. This supersedes the draft Plan-EA circulated for review in December 1990, but not finalized.

We have no substantive comments to offer, but we do appreciate the opportunity to participate in the review. We will not be needing a copy of the Final Assessment.

If you have any questions, you may call Frank Johnson at (808) 541-1327.

Very sincerely yours,

Patty A. Nicholas
Director
Community Planning and
Development Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

MAR 30 1992

Warren M. Lee
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee;

The SCS "Draft Watershed Plan - Environmental Assessment - Lahaina Watershed, Maui County" was forwarded to our office for review. Unfortunately, we do not have sufficient staff to perform a comprehensive technical review of the flood and erosion control measures proposed. We presume that your public participation process has already made this document available to the very active public interest groups in Maui. The primary responsibility for Hawaii's Nonpoint Source (NPS) Program (and the review of such watershed plans) resides with the Hawaii Department of Health. If you have not already made this document available to HIDOH, we ask that you do so to assure consistency with the Hawaii NPS State Management Plan.

Also, we ask that you consider the viability of using such projects for increasing the habitat areas for native species by "naturalized" rather than cement structures. Since the lower reaches of the watershed offer little or no wildlife habitat, perhaps this project is an opportunity to change that picture. Your progress in addressing the extensive nonpoint source pollution runoff in Maui is of great interest to EPA and we appreciate SCS's role in implementation of NPS Best Management Practices throughout Hawaii. 10

If you have any questions in this matter please call me or if your staff have any questions in this matter, please ask them to call Linda Powell at 415/744-2017.

Sincerely,

for Harry Seraydarian
Director
Water Management Division

cc: Dr. Bruce Anderson, Hawaii Department of Health

Printed on Recycled Paper

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 W. Ocean Blvd., Suite 4200
Long Beach, CA 90802-4213

April 14, 1992 F/SW023:JJN

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

Dear Mr. Lee:

The National Marine Fisheries Service (NMFS) has reviewed the Draft Watershed Plan and Environmental Assessment (EA) for Lahaina Watershed, County of Maui, Hawaii. The EA was prepared by the County of Maui and the U.S. Soil Conservation Service (SCS) and is dated February 1992. We offer the following comments for your consideration pursuant to the National Environmental Policy Act.

The document describes a plan for flood protection in the Lahaina watershed. Alternatives considered during planning include no action, nonstructural, and structural measures. The Recommended Plan proposes the installation and maintenance of structural measures to reduce the adverse effects of flooding and sedimentation. The primary element is a floodwater diversion channel that starts at Lahainaluna Road, extends across the Lahaina subwatershed, and discharges at two ocean outlets. Accompanying measures include four sediment basins and one debris basin. The structures will provide a 100-year level of flood protection to a benefitted area which includes 197 homes, 157 businesses, two schools, two parks, and 80 acres of irrigated sugarcane.

NMFS is pleased to note that the proposed project will reduce the sedimentation of nearshore ocean waters. It is estimated that 5,560 tons of sediment enters coastal waters annually from the Lahaina watershed. The project would reduce this input by 1,320 tons per year. In addition, the majority of sediment would be diverted to the second outlet, an area with a relatively depauperate marine community in comparison to the rest of the project coastline.

Despite the projected reduction in sediment yield, NMFS continues to have concerns regarding the project. We are particularly concerned with the increase in sediment load from the second outlet, from 310 tons annually to a projected average of 2,970 tons per year. We suggest that an additional detention reservoir or sediment basin be constructed to remove as much of this sediment yield as possible, in order to further protect coastal waters and fishery habitat from turbidity and siltation.

We also wish to point out that the Lahaina watershed project is in close proximity to the Honokowai area north of Lahaina where two massive algae blooms occurred during 1989 and 1991. Effluent from recently constructed outlet structures in this area have been mentioned as possible sources of the algae blooms. A study is presently ongoing to determine the actual cause of the blooms. Although runoff through drainage culverts has not been confirmed as contributing to the blooms, we suggest that additional information be obtained to assure that the Lahaina watershed project will not generate similar blooms in nearshore waters off the proposed project discharge points.

NMFS appreciates the opportunity to comment on the Lahaina Watershed EA. Should you have any questions concerning these comments please contact Mr. John Naughton, Pacific Islands Environmental Coordinator, at our Pacific Area Office in Honolulu.

Sincerely,

E C Fullerton

E.C. Fullerton
Regional Director

cc: NOAA Ecology and Conservation Office
Corps, Honolulu District
F/SWO23, Naughton

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

April 8, 1992

Mr. Warren M. Lee
State Conservationist
Soil Conservation Service
P.O. Box 50004
Honolulu, HI 96850

Dear Mr. Lee:

The U.S. Environmental Protection Agency (EPA) has reviewed the **Draft Watershed Plan and Environmental Assessment (DEA) for the Lahaina Watershed, Maui County, Hawaii**, pursuant to the National Environmental Policy Act (NEPA) and §309 of the Clean Air Act.

The DEA analyzes alternative measures to reduce the adverse effects of flooding and sedimentation in the Lahaina watershed. The proposed action is construction of a floodwater diversion channel that discharges floodwater to two ocean outlets. The alternative includes four sediment basins and one debris basin, which would serve to reduce overall sediment load discharged to the ocean.

We support the goal of reducing overall sediment discharge to the nearshore zone. However, we have concerns regarding the potential adverse impacts that could result from diversion of the sediment load. We recommend that additional information be provided in the Final Environmental Assessment (FEA) regarding impacts to the nearshore zone in the project vicinity. Our specific comments follow.

1. According to Grigg (1991), "[p]lacement of the second outlet at Site D' is equivalent to diverting the heaviest sediment load to the worst area in terms of ecological and recreational values" (DEA, p. C-36). Grigg concludes that Site B is probably more degraded than Site A due to the presence of Kauaula Stream and sediment discharge at Site B. It is unclear, however, why Site D' is less productive than Site A. The FEA should address this issue. Furthermore, we have concerns regarding the potential long-term effects of a 10-fold sediment increase on nearshore habitat off of Kauaula Stream or Site D'. The FEA should identify and quantify the potential adverse effects of the proposed action at sites B and D' for various storm frequencies.

2. According to the DEA, nutrient concentrations in the nearshore waters off Kauaula Stream would take up to a week to return to background levels following a 5-year storm (p. 88). However, the DEA does not include projected recovery times following 25-, 50-, or 100-year storms. The FEA should include this information.

3. The FEA should clarify whether any fresh water would continue to be discharged in the nearshore zone adjacent to Lahaina Town during floods and non-flood events. The FEA should discuss any potential negative effects of reduced or eliminated freshwater flow to the nearshore zone in this area.

We appreciate the opportunity to comment on the proposed project. Please send us a copy of the FEA when it is officially filed with our Washington, D.C., office. If you have any questions, please contact me at (415) 744-1584, or have your staff contact Jeanne Geselbracht at (415) 744-1576.

Sincerely,

Jacqueline Wyland, Chief
Office of Federal Activities

Lahaina.dea
001576
92-065

Appendix A

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
Office of Environmental Affairs
600 Harrison Street, Suite 515
San Francisco, California 94107-1376

May 6, 1992

ER 92/230

Warren M. Lee, State Conservationist
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee

The Department of the Interior (Department) has reviewed the Draft Watershed Plan/Environmental Assessment for the Lahaina Watershed, Maui County, Hawaii. The Department does not have any comments.

We appreciate the opportunity to review the draft documents.

Sincerely,

Patricia Sanderson Port
Regional Environmental Officer

cc: Director, OEA (w/orig. incoming
Regional Director, FWS

AMFAC/JMB HAWAII, INC
700 Bishop Street
P.O. Box 3230
Honolulu, Hawaii 96801
(808) 945-8111
Fax (808) 945-8153

April 15, 1992

Amfac

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

Subject: Draft Watershed Plan-Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Dear Mr. Lee:

We have reviewed the Lahaina Watershed Plan and would like to offer the following comments:

1) Pioneer Mill Company, Limited and Amfac/JMB Hawaii, Inc. are highly supportive of this project. With the benefits resulting from this project and the reduction in flooding, we would like to see this project implemented and construction to begin as soon as possible.

2) On page 69, there is an inconsistency which states that "17.5 acres of Right of Way will be required." Shouldn't this be 31.6 acres?

3) The plan should include fencing of the concrete lined sections and any portion of the project which may pose hazards to people.

4) Page 78 states that "fine sediments (from the debris basins) can be spread on the sugar cane fields." We have not agreed to this concept.

5) We feel that the land acquisition figures contained on page 80 should be reviewed. Pioneer Mill Company will require compensation for all land acquired and all costs required to restore the utility of all Pioneer Mill Company facilities which are impacted. We are currently looking into the details of the impacts on our operations. The proposed plan appears to displace a major cane haul road between station 0+00 and station 35+00. The construction of new cane haul roads are very costly.

Appendix A

6) The project traverses property containing underground water development tunnels. The construction notes should specify no blasting allowed during construction.

7) Pioneer Mill will require easements for any Pioneer Mill facilities which cross the right of way and any crossing which may be constructed in the future.

Thank you for the opportunity to comment on this project. We hope that it will proceed smoothly.

Very truly yours,

Michael B. Burke
Manager
Land Administration

MBB/kk

xc: D. DeCastro
B. Hatton
D. Morrell

KAWAIAHAO PLAZA
567 South King Street
Suite 200
P.O. Box 3466
Honolulu, Hawaii 96801
Telephone (808) 523-6200
Fax (808) 537-4214

KAMEHAMEHA SCHOOLS / BERNICE PAUAHI BISHOP ESTATE

April 16, 1992

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

Dear Mr. Lee:

Comments on Draft Watershed Plan-Environmental Assessment for Lahaina Watershed, Maui County, Hawaii

On behalf of Kamehameha Schools/Bishop Estate ("KS/BE"), we would like to submit the following comments in regard to the above-referenced Environmental Assessment ("EA"):

1. Based on the information disclosed in the EA, it appears the Lahaina Watershed Flood Control Project (Project) could have potential impact on lands owned by KS/BE and currently under lease to Pioneer Mill. The project proposed may involve the acquisition of approximately 31.6 acres of private land for rights-of-way, primarily for the installation of flood control works. See, EA at pp. 3-4 and 76. Based on the drawings provided on pages 13 and 68 of the EA, it appears that some structural improvements and other flood control works may be located on KS/BE's land. The EA should disclose whether KS/BE's land may be acquired for Project rights-of-way, and if so, where such rights-of-way are proposed to be located. Although the property is currently under lease, the agreement will expire January 1, 2006 and will revert to KS/BE control.

2. In addition, the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4321 et seq., as implemented by the NEPA regulations, requires the responsible federal agency to describe the economic effects of the proposed action. 40 C.F.R. §§ 1502.16 and 1508.8. Although your agency has analyzed the effect of the Project on the development plans of AMFAC/JMB, Inc., EA at p. 63, a similar analysis is not provided in respect to the other private landowners. As you

are aware, KS/BE is the second largest private landowner in the Lahaina Watershed. See EA at p. 10. Although currently in cane operation, there is a possibility of conversion to another use upon lease expiration and as a result of the construction of the Lahaina By-pass mauka of the project.

Please incorporate our comments into the Environmental Assessment. We have also retained the services of a water consultant and wish to reserve the right to incorporate his recommendations in our comments by supplemental letter within the next two weeks. If you have any questions, please feel free to call me at 523-6239.

Very truly yours,

Kapu C. Smith

Kapu C. Smith
Land Manager, Region II

kcs

WEST MAUI TAXPAYERS ASSOCIATION

April 10, 1992

Mr. Warren M. Lee, State Conservationist
USDA, Soil Conservation Service
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Warren:

Subject: Lahaina Watershed Project

On behalf of the 3,000+ members of the West Maui Taxpayers Association, we of the Board of Directors, give our support to this project.

We have studied the draft Watershed Plan - Environmental Assessment and feel this information is sufficient to address the concerns we have had with this project. We would also agree with the suggestions that have been submitted by the West Maui Advisory Committee, and would like a response to the question of water volume near the new aquatic center with the path change from Wainee Village to a higher point.

We feel that this project should be moved forward at it's quickest possible time frame. We appreciate the need for flood control improvements in our community and feel that this project, as presented, will bring great health and safety improvements.

Yours truly,

Charlie Nalepa
Executive Director

POST OFFICE BOX 10338 / LAHAINA / MAUI / HAWAII / 96761 / TELEPHONE (808) 661-3042

Appendix A

Natural Resources
Defense Council, Inc.

212 Merchant Street
Suite 203
Honolulu, Hawai'i 96813
808-533-1075

LETTER OF TRANSMITTAL

To: Warren Lee
State Conservationist
U.S.Dept. of Agriculture
Soil Conservation Service

Date: 4/27/92

Re: Draft Watershed Plan - EA
Lahaina Watershed,
Maui County, HI

THE FOLLOWING DOCUMENTS: draft Watershed Plan - EA for the Lahaina Watershed, HI

* * *

ARE TRANSMITTED:

( ) For your information	( ) For approval/signature
( ) For your files	( ) For necessary action
( ) For review & comment	( ) For distribution
( ) Pursuant to our conversation	( ) Please return
( ) As requested/required	(X) Other: See remarks below

* * *

REMARKS: Thank you for the opportunity to view and comment on the Draft Watershed Plan for the Lahaina Watershed. In the future, we would greatly appreciate it if documents of this nature be sent directly to us at our address above, rather than to our Washington, D. C. office. Mahalo.

* * *

COPY TO:

Washington Office:
1350 New York Ave., N.W.
Washington, DC 20005
202 783-7800

Western Office:
90 New Montgomery
San Francisco, CA 94105
415 777-0220

New York Office:
122 E. 42nd St.
New York, NY 10168
212 949-0049

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

May 21, 1992

The Honorable Linda Crockett Lingle, Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mayor Lingle:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

Enclosed is our response to the comments by the West Maui Advisory Committee.

We appreciate your support and interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

Enclosure

DKubo/mm

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

May 21, 1992

Donna S. Soares, Chairperson
West Maui Advisory Committee
Office of the Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mrs. Soares:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 7, 1992.

COMMENT: The addition of a second debris basin higher up in the Kauaula Stream area is recommended.

RESPONSE: Although some additional debris trapping can be accomplished by creating a debris basin at the 200 foot elevation where a grassed depression now exists, the added expense to construct and maintain such a basin limits its feasibility. The lower basin is required at its location to effectively divert the storm water to two outlets.

COMMENT: The appearance of the basin should be visually pleasing in both directions.

RESPONSE: We agree that the visual impact of the project structures should be minimized as much as possible. Community input during the design stage through the project sponsors, the County of Maui and the West Maui Soil and Water Conservation District, is the best way to assure that measures to retain the area's scenic resources are included in the designs.

COMMENT: How much more water will be discharged toward the aquatic center if the diversion is moved higher toward Wainee Reservoir?

RESPONSE: A shift in the channel alignment in the vicinity of Wainee Reservoir will not significantly affect the volume or peak discharge of runoff to the aquatic center area. We estimate an upslope shift of the diversion channel by 200 feet will increase runoff by 10 percent. Changes in land use in the area can potentially increase runoff more significantly.

Thank you for your support and interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

Mill Akl ACTING
WARREN M. LEE
State Conservationist

cc: Mayor Linda Crockett-Lingle, County of Maui, 200 S. High St., Wailuku, HI 96793
Charlie Nalepa, Executive Director, West Maui Taxpayers Association, P. O. Box 10338, Lahaina, HI 96761

DKubo/mm

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

May 21, 1992

Brian Miskae, Director
Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Miskae:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your support and interest in the Lahaina Wat- hed project.

Sincerely,

Mill Ake ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Charmaine Tavares, Director
Department of Parks and Recreation
County of Maui
1580 Kaahumanu Avenue
Wailuku, Hawaii 96793

Dear Ms. Tavares:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

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

Dear Mr. Kaya:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 22, 1992.

COMMENT: Alternate means of disposal of grubbed material and rock shall be utilized other than dispoal at the County landfills. Olowalu landfill will be closing to all users by June 1992.

RESPONSE: The Plan/EA will state that alternate disposal means for all spoil material will be sought.

COMMENT: All drainage lots and easements must be subdivided in accordance with Maui County Code Title 18.

RESPONSE: The subdivision requirement will be noted in the Plan/EA.

COMMENT: A 10 foot wide maintenance road is required along the length of the channel.

RESPONSE: Fifteen foot wide maintenance roads have been planned along both sides of grass-lined channels and along one side of the reinforced concrete channels.

COMMENT: Statement suggested that the County Highways Division has no resources to maintain the project. A recommendation should be made for the sponsors to obtain the needed manpower and equipment.

RESPONSE: The County will assure SCS that it has the necessary workforce and equipment to carry out the maintenance responsibility when the Operation and Maintenance Agreement is signed.

COMMENT: It is recommended that two sedimentation basins with two outlets be utilized.

RESPONSE: A enlarged sedimentation basin on the second outlet was evaluated in order to increase trapping efficiency. An improvement from six percent to 20 percent trap efficiency can be obtained by widening the bottom of the basin from 70 feet to 200 feet at an additional cost of approximately $200,000.

With the expanded basin, the average annual quantity of sediment trapped will increase from 30 tons to 90 tons. The trap efficiency can only be applied to sediment generated above the second outlet channel as sediment from other areas have been earlier routed through other project basins. The net result is that the average annual sediment discharge at the second outlet will be reduced from 3,281 tons to 3,221 tons.

It is difficult to attain high trap efficiencies due to the fine nature of the sediment. The surface soils are mostly kaolinitic clays. Roughly one-half of the sediment generated in the sugarcane fields is clay sized. We expect thet clay and silt sediments will remain fully suspended through the flood protection system and in the nearshore marine environment due to the turbulence.

COMMENT: Suggest a statement in the Abstract to the effect that the project complies with the Clean Water Act and other nonpoint source pollution regulations.

RESPONSE: Compliance with the National Environmental Policy Act will necessarily result in compliance/conformance with CWA and NPS regulations.

COMMENT: Correction to page iv, line 12: The chief legal officer of the County not the State.

RESPONSE: The statement is believed to be correct as written.

COMMENT: The amount of sediment generated is also dependent on land management practices.

RESPONSE: Such a statement has been added.

COMMENT: Define 50-year "evaluation period" to avoid confusion with 100-year level of protection.

RESPONSE: The phrase has been further defined and has been included in the glossary.

Thank you for your support and interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING

WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

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

Dear Mr. Choy:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Michael G. Buck, Administrator
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Buck:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

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

Dear Mr. Johnson:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

William M. Paty, Chairperson and State Historic Preservation Officer
State Historic Preservation Division
33 South King Street
Honolulu, Hawaii 96813

Dear Mr. Paty:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your assistance and interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

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

Dear Mr. Paty:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 22, 1992.

COMMENT: The Division of Aquatic Resources would like to review data regarding redirection of floodwater and sediment flow to the second outlet.

RESPONSE: We are glad to make available our documentation files to the Division of Aquatic Resources. Three reports by Dr. Richard Grigg, in 1982, 1986, and 1991, concerning the reef resources fronting the project area were sent, on May 15, 1992, to Mike Yamamoto of the Division of Aquatic Resources. These reports form the basis for our ocean outlet configuration.

COMMENT: "We suggest that the this outlet be considered at Launiupoko Stream rather than at Kauaula Stream where sediment discharge will increase 10 times."

RESPONSE: The two outlet system will discharge at Kauaula Stream and at a location 3,600 feet south of Kauaula Stream. Sediment discharge at Kauaula Stream will be reduced. Sediment discharge at the second outlet site will be increased from the existing condition. An expanded analyses of runoff and sediment discharge is included in the final Plan/EA.

The cost of conveying the floodwater from Kauaula Stream to the Launiupoko Stream outlet at Launiupoko Point, over 12,000 feet to the south, and controlling the additional runoff from the increased drainage area is prohibitive.

Thank you for your support and interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

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

Dear Mr. Paty:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 28, 1992.

COMMENT: The problem of eutrophication of coastal waters, as evidenced by recent macroalgal blooms along the West Maui coastline, has not been addressed in this watershed plan.

RESPONSE: Project planners have discussed the problem of algae blooms with a number of specialists who are currently evaluating the problem. Although the specific causes for the algae bloom in the Honokowai area are not yet confirmed, the basic requirements for the situation to occur are known. Nutrients, especially phosphorus, needs to be continually or nearly continually present in the localized environment.

It appears that runoff from the project will be infrequent, occuring only during periods of intense rainfall. Most runoff from minor rain showers will be infiltrated or retained in the waterway/basin system and will not discharge into the ocean. The active current and wave climate fronting the second outlet will effectively disperse nutrient pulses due to storm runoff and will prevent "stewing" of the nutrient rich water in the nearshore area.

Dr. Grigg noted a slight increase of algae, particularly Hypnea cervicornis and Sargassum echinocarpum, between his 1986 and 1991 surveys. This may be indicative of a regionwide trend of increased algae production.

COMMENT: We recommend that methods for controlling total loads of surface-applied nutrients entering both surface waters and groundwater be explicitly set forth in watershed management plans.

RESPONSE: The purpose of the Lahaina Watershed plan is to provide flood protection to the Lahaina community and surrounding agricultural area. Sediment reduction, through the utilization of basins, was added as a feature related to discharge of floodwater. The development of a nutrient management for all landusers in the watershed is beyond the scope of this planning effort.

Thank you for your support and interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

William Meyer, District Chief
Water Resources Division
U.S. Geological Survey
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813-5412

Dear Mr. Meyer:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

Our responses to the comments by the USGS hydrologist were sent directly to the reviewer on March 18, 1992.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

March 18, 1992

Mr. Richard Fontaine, Hydrologist
United States Geological Survey
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Fontaine:

Thank you very much for your comments of March 12, 1992, regarding the draft Lahaina Watershed Plan-Environmental Assessment. The following responses are offered to satisfy your concerns:

The data from the crest gage #16643300 (Kauaula Stream) was used as the basis of verifying the hydrologic analysis for the Lahaina and Kauaula subwatersheds. As discussed on page C-19, runoff/rainfall relationships were adjusted to closely match the gage data at Kauaula Stream. Results were also compared to the adjacent Kahoma Stream Watershed. To clarify this, the discussion on page C-18 will be reworded to indicate the analysis used for both Kahoma and Kauaula Stream gage data.

Although the 1960 storm was the greatest storm of record in the area, the majority of the damages occurred in the Lahaina Subwatershed. As is typical of many watersheds in Hawaii, the storm patterns can be very localized. Rainfall intensities may vary significantly from one watershed to the next, even if they are adjacent to each other. This appears to have been the case in this storm.

An analysis of rain gage data indicated the storm was most intense in the upper Kahoma Watershed and Lahaina Subwatershed. Rain gage #374 within the Kahoma Watershed (Kahoma Intake - elevation 2000) had 24.0 inches of rain on May 14, 1960, which exceeded the 100-year event. However, rain gage #375 (Kauaula Intake - elevation 1590) within the Kauaula Watershed had only 3.30 inches of rain or a 2-year event. This explains why the damages in Lahaina Subwatershed were so extensive, while the stream gage within Kauaula Stream indicated only a 15-year event.

Based on this rainfall analysis and the fact that the hydrologic analysis has been calibrated to the stream gage data for Kauaula Stream, it is felt that the discharges estimated in this project were not excessive.

Thank you again for your concern.

Sincerely,

/s/ Warren M. Lee

WARREN M. LEE
State Conservationist

GAHUNA/kf

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

May 21, 1992

Kisuk Cheung, P.E., Director of Engineering
U.S. Army Engineering District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Patty A. Nicholas, Director
Community Planning and Development Division
U.S. Department of Housing and Urban Development
500 Ala Moana Blvd., Suite 500
Honolulu, Hawaii 96813-4918

Dear Ms. Nicholas:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

Appendix A

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

May 21, 1992

Harry Seyardarian, Director
Water Management Division
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Seyardarian:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

E. C. Fullerton, Regional Director
National Marine Fisheries Service
Southwest Region
501 W. Ocean Blvd., Suite 4200
Long Beach, CA 90802-4213

Dear Mr. Fullerton:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 14, 1992.

COMMENT: We suggest that an additional detention reservoir or sediment basin be constructed to remove as much of the sediment to the second outlet as possible.

RESPONSE: Although we are not able to site a detention basin in the project area, a larger sediment basin near the second outlet to improve trapping efficiency was evaluated. An improvement from six percent trap efficiency to 20 percent can be obtained by widening the bottom of the basin from 70 to 200 feet at an additional cost of approximately $200,000.

With the expanded basin average annual trapping will increase from 30 tons to 90 tons. The trap efficiency can only be applied to the sediment generated above the channel to the second outlet as sediment from other areas have been earlier routed through other project basins. The net result is that the average annual sediment discharge at the second outlet will be reduced from 3,281 tons to 3,221 tons.

It is difficult to attain high trap efficiencies due to the fine nature of the sediment. Roughly one-half of the sediment generated in the sugar cane fields is clay sized. We expect that clay and silt sediments will remain fully suspended through the project improvements and in the nearshore environment with the prevailing wave and current action at the second outlet site.

COMMENT: We suggest that additional informantion be obtained to assure that the Lahaina Watershed project will not generate algae bloom problems.

RESPONSE: Project planners have discussed the problem of algae blooms with a number of specialists who are currently evaluating the problem. Although the specific causes for the algae bloom in the Honokowai area are not yet confirmed, the basic requirements for the situation to occur are known. Nutrients, especially phosphorus, needs to be continually or nearly continually present in the localized environment.

It appears that runoff from the project will be infrequent, occuring only during periods of intense rainfall. Most runoff from minor rain showers will be infiltrated or retained in the waterway/basin system and will not discharge into the ocean. The current and wave climate fronting the second outlet will effectively disperse nutrient pulses due to storm runoff and will prevent "stewing" of the nutrient rich water in the nearshore area.

Dr. Grigg noted a slight increase of algae, particularly Hypnea cervicornis and Sargassum echinocarpum, between his 1986 and 1991 surveys. This may be indicative of a regionwide trend of increased algae production.

Thank you for your interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Jacqueline Wyland, Chief
Office of Federal Activities
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Wyland:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All comments received during the review period have been addressed and appropriate changes to the final Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 6, 1992.

COMMENT: It is unclear why Site D' is less productive than Site A.

RESPONSE: The following statements have been included in the final Plan/EA.

The bottom at Site D' is characterized as "sandy with low outcrops of barren limestone rock supporting small clumps of living coral." (Grigg, 1991) The lack of broad reef structure fronting Site D' results in a stronger wave climate near the shoreline and supports the littoral transport of sand to cobble sized sediments along the coastline which, in turn, may inhibit development of a fixed coral community.

Site D' supports a lesser diversity of fish and coral species and has less coral cover than at Site A or B as evidenced by the inventories by Dr. Grigg in 1986 and 1991. The approximate mean percentage of coral cover, during the two surveys, at Site A is 50 percent, at Site B it is 30 percent, and at Site D' it is six percent.

COMMENT: The FEA should identify and quantify the potential adverse effects of the proposed action at sites B and D' for various storm frequencies.

RESPONSE: The most significant effects are the changes to runoff and sediment discharge rates with project installation. The following two tables which show the storm water and sediment discharges at Kauaula Stream (Site B) and at the second outlet location (Site D') before and after project installation, for varying storm recurrence intervals, will be included in the final Plan/EA.

The following are the before and after project peak storm water discharges, in cubic feet per second, at the two sites.

	Site B		Site D'	
	Before	After	Before	After
2-Year	460	100	5	260
5-Year	1,300	480	20	730
10-Year	2,160	920	60	1,260
25-Year	4,100	1,950	170	2,280
50-Year	5,910	2,900	320	3,240
100-Year	8,100	4,050	560	4,450

The following are the total sediment discharge, in tons, at Sites B and D':

	Site B		Site D'	
	Before	After	Before	After
2-Year	1,260	50	0	400
5-Year	3,200	300	410	3,500
10-Year	5,500	1,010	980	6,160
25-Year	9,000	3,980	2,310	8,680
50-Year	13,000	5,830	3,710	12,270
100-Year	18,000	8,200	5,810	17,400

By examination of the sediment discharge amounts, the discharges at Site D' are comparable in quantity to the present condition at Site B. A primary difference is that the present discharge at Site B is approximately one-third coarse sediment while the projected sediment at Site D' will be nearly all fines. Coarse sediment will deposit in the vicinity of the stream mouth. Fine sediments generally remain suspended in the water column and are moved offshore by currents except in calm environments such as embayments and harbors.

A comparison of sediment discharge during the 2-year, and more frequent, storms indicates the discharge at Site D' will be considerably less than that at Site B during such storms of lesser intensity that occur several times a year. This situation is due primarily to the efficiency of the sediment basins. During intense storms temporary degradation, due to sediment and fresh water outflow, can be expected at any outlet.

An indication of the potential impacts at Site D' caused by the increased sediment load can be found in the the present condition of the Kauaula outlet. Even with a sediment discharge regime equal or exceeding that proposed for Site D', the reef community is not extensively degraded.

COMMENT: Include recovery times for nutrient concentrations to return to background levels for 25-, 50-, and 100-year storms.

RESPONSE: The recovery of nearshore nutrient concentrations to background levels following an intense storm will vary as a function of many factors. Once stream runoff has ended, the most important factors will be related to generalized movement of the receiving seawater. If strong seaward currents and active wave climate exist, a rapid recovery to background levels of all suspended and dissolved contaminants will occur regardless of the storm intensity. We expect this to be the case at Site D' where dye plume trajectories move directly off shore into deeper water where it engages the off shore current.

COMMENT: Clarify if any fresh water will continue to be discharged at A. Discuss any negative impact from reduction or elimination of freshwater discharge.

RESPONSE: Storm runoff will still be discharged at Site A from the drainage area below the proposed project diversion. The drainage area is predominantly urban. The County of Maui is preparing plans to improve the local drainage system.

There is no identified negative impact from installation of the project on Site A as a result of diminished surface water flow. There is probably a significant volume of fresh groundwater issuing along the coastline which will not be affected by the project. The Lahaina area has been characterized by the USGS as a low-head coastal area where little or no coastal sediment impedes the flow of freshwater to the ocean.

We appreciate your interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Patricia Sanderson Port, Regional Environmental Officer
U.S. Department of the Interior
Office of the Secretary
Office of Environmental Affairs
600 Harrison Street, Suite 515
San Francisco, California 94107-1376

Dear Ms. Port:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Michael B. Burke, Manager
Land Administration
Amfac/JMB Hawaii, Inc.
700 Bishop Street
P. O. Box 3230
Honolulu, HI 96801

Dear Mr. Burke:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 15, 1992.

COMMENT: On page 69, it is stated that "17.5 acres of Right of Way will be required. Shouldn't it be 31.6 acres?

RESPONSE: The 17.5 acres refers to the Right of Way need for just the Lahaina subwatershed diversion that leads to Kauaula Stream.

COMMENT: The project should provide fencing of the concrete channels and other sections of the project thet may pose a hazard.

RESPONSE: Safety fencing will be provided along concrete channels and hazardous areas such as the debris basin.

COMMENT: There is no agreement that fine sediments in the basin can be spread on the cane fields.

RESPONSE: The project sponsors will consult with the landowners and operators to determine the best use or disposal method for sediment in the basins.

COMMENT: Land acquisition figures should be reviewed.

RESPONSE: The installation costs shown on page 80 are estimates based on data gathered during the past five years of planning. We recognize that there will be variability in cost.

During the design phase, SCS designers and project sponsors will work closely with Pioneer Mill and other land owners and operators to minimize disruption to their activities. Modifications to the planned structures can be made at that time.

COMMENT: Because of water tunnels in the area, construction notes should specify no blasting.

RESPONSE: Such a specification will be made. Geologic investigations during planning, indicate that all earthwork can be accomplished using equipment.

COMMENT: Pioneer Mill will require easements across the flood protection Rights of Ways.

RESPONSE: Required Pioneer Mill easements will be noted during the Right of Way subdivision process.

Thank you for your support and interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Kapu C. Smith
Land Manager, Region II
Kamehameha Schools/Bernice Pauahi Bishop Estate
567 S. King St. Suite 200
P. O. Box 3466
Honolulu, HI 96801

Dear Ms. Smith:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments received during the review period have been addressed and appropriate changes to the Plan/EA have been made.

We wish to respond to specific comments in your letter, dated April 16, 1992.

COMMENT: The Plan/EA should disclose whether KS/BE owned land will be acquired for Rights of Way and where such land is located.

RESPONSE: Approximately ten acres of land owned by KS/BE will be required for project Rights of Way between Lahainaluna Road and Wainee Village. The exact location and areal amounts will be determined following a design level survey.

COMMENT: Describe the economic effects of the proposed action on the KS/BE holdings in the Lahaina Watershed.

RESPONSE: We will include a statement in the Project Interaction section that the affected KS/BE lands are currently under lease to Pioneer Mill. Upon expiration of the lease agreement in year 2006, there is a possibility of conversion of the property to other uses.

Thank you for your interest in the Lahaina Watershed project. Please contact me if we can be of further assistance.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

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

May 21, 1992

Charlie Nalepa, Executive Director
West Maui Taxpayers Association
P.O. Box 10338
Lahaina, Hawaii 96761

Dear Mr. Nalepa:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

Our reply to the comments by the West Maui Advisory Committee is enclosed.

We appreciate your support and interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

Enclosure

DKubo / mm

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

May 21, 1992

Natural Resources Defense Council, Inc.
212 Merchant Street, Suite 203
Honolulu, Hawaii 96813

Madam/Sir:

Subject: Draft Watershed Plan and Environmental Assessment
Lahaina Watershed, Maui County, Hawaii

Thank you for your review of the draft Watershed Plan and Environmental Assessment (Plan/EA) for Lahaina Watershed, Hawaii. All review comments have been addressed and appropriate changes to the final Plan/EA have been made.

We appreciate your interest in the Lahaina Watershed project.

Sincerely,

ACTING
WARREN M. LEE
State Conservationist

DKubo/mm

APPENDIX B

SUPPORT MAPS

100 YEAR URBAN FLOODPLAIN

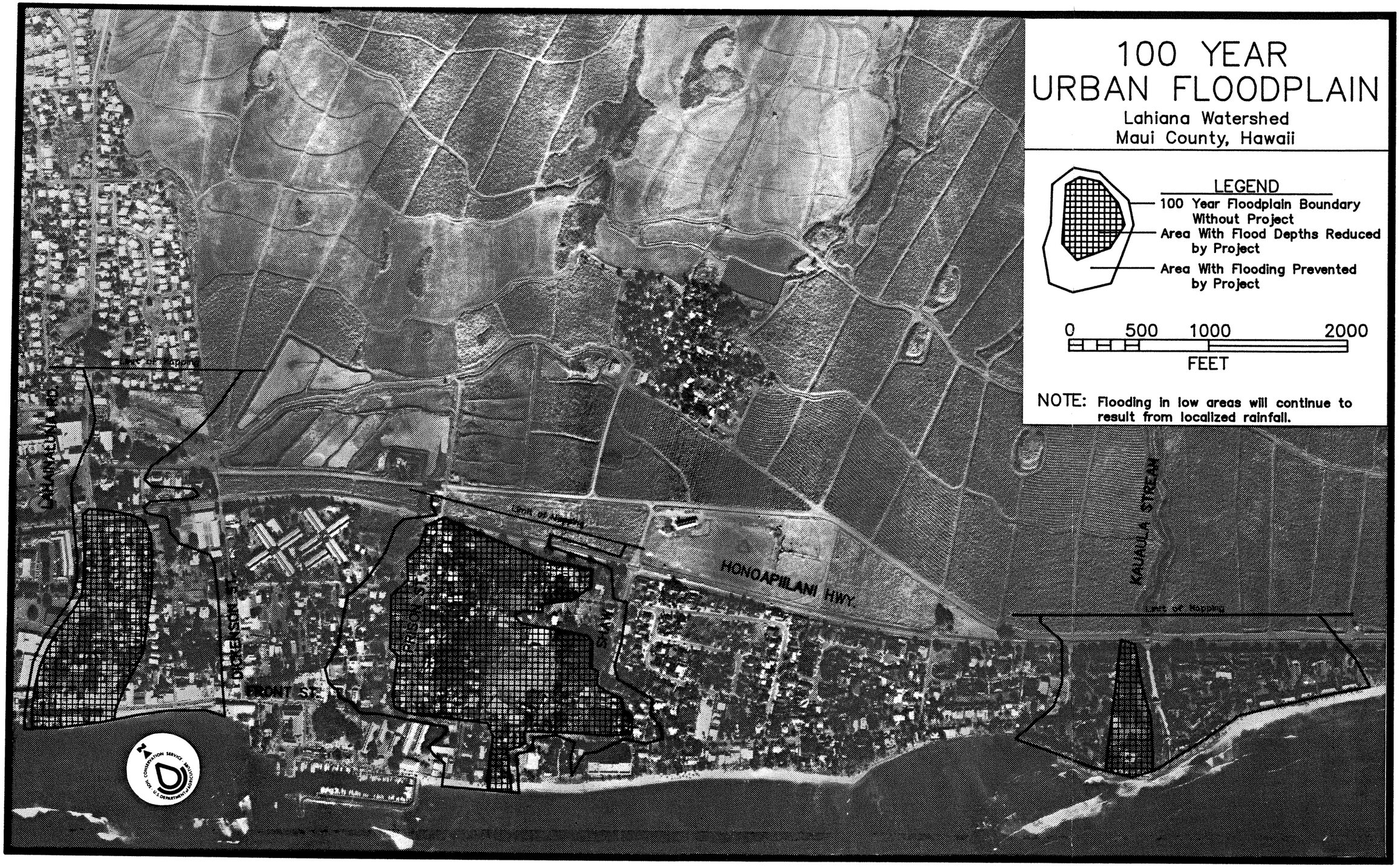
Lahiana Watershed
Maui County, Hawaii

LEGEND

- 100 Year Floodplain Boundary Without Project
- Area With Flood Depths Reduced by Project
- Area With Flooding Prevented by Project

0 500 1000 2000
FEET

NOTE: Flooding in low areas will continue to result from localized rainfall.



500 YEAR URBAN FLOODPLAIN

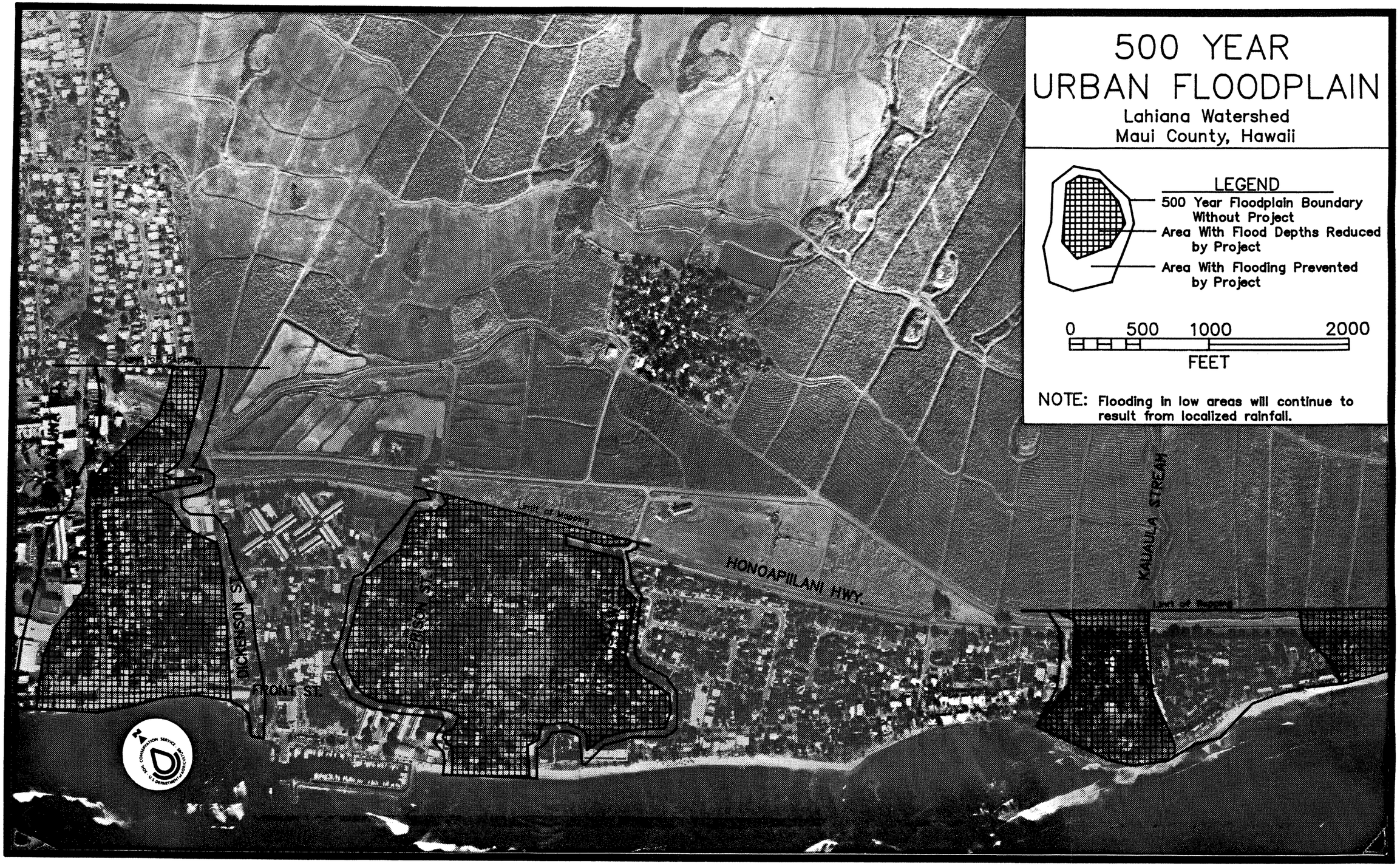
Lahiana Watershed
Maui County, Hawaii

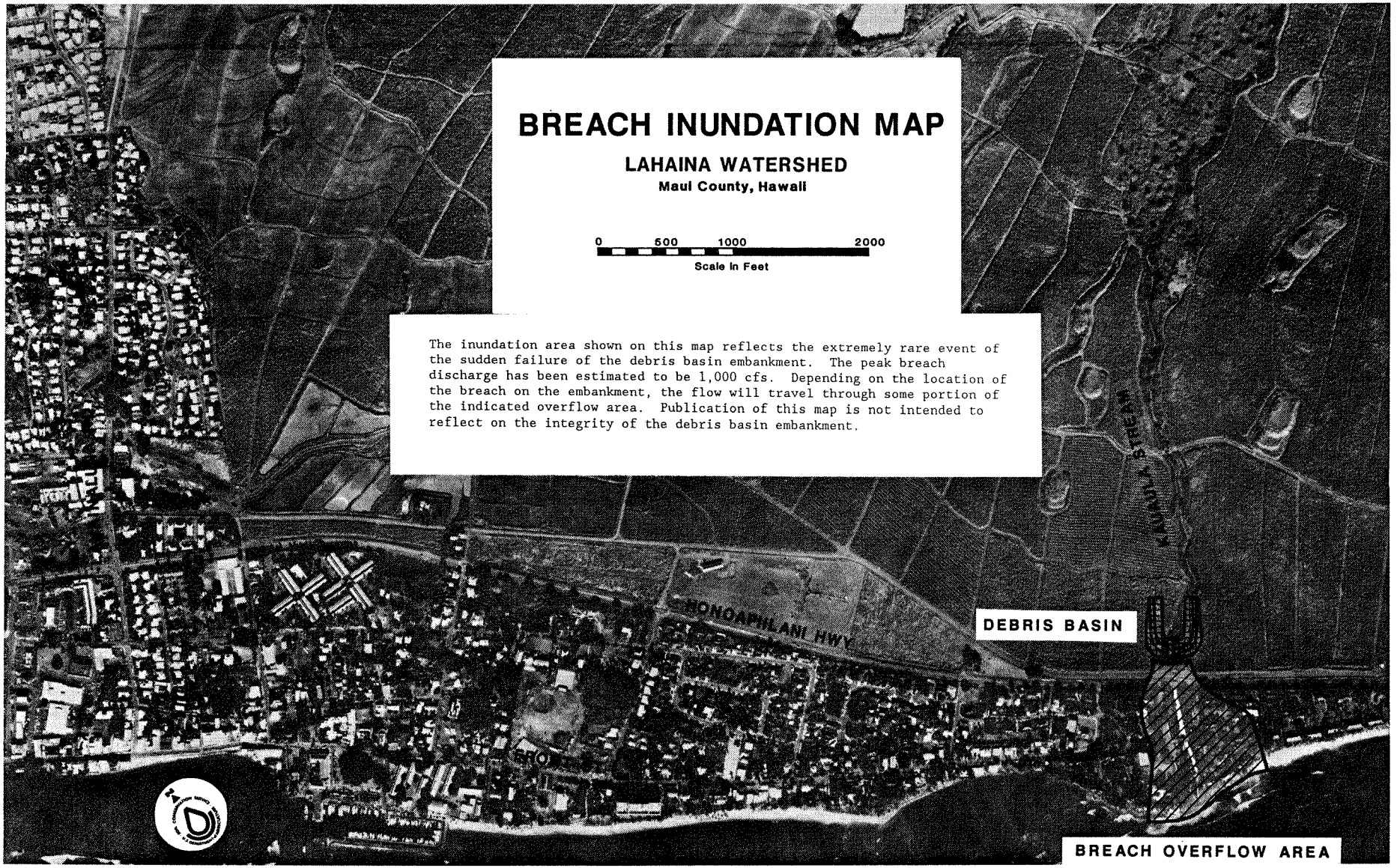
LEGEND

- 500 Year Floodplain Boundary Without Project
- Area With Flood Depths Reduced by Project
- Area With Flooding Prevented by Project

0 500 1000 2000
FEET

NOTE: Flooding in low areas will continue to result from localized rainfall.





BREACH INUNDATION MAP

LAHAINA WATERSHED

Maui County, Hawaii

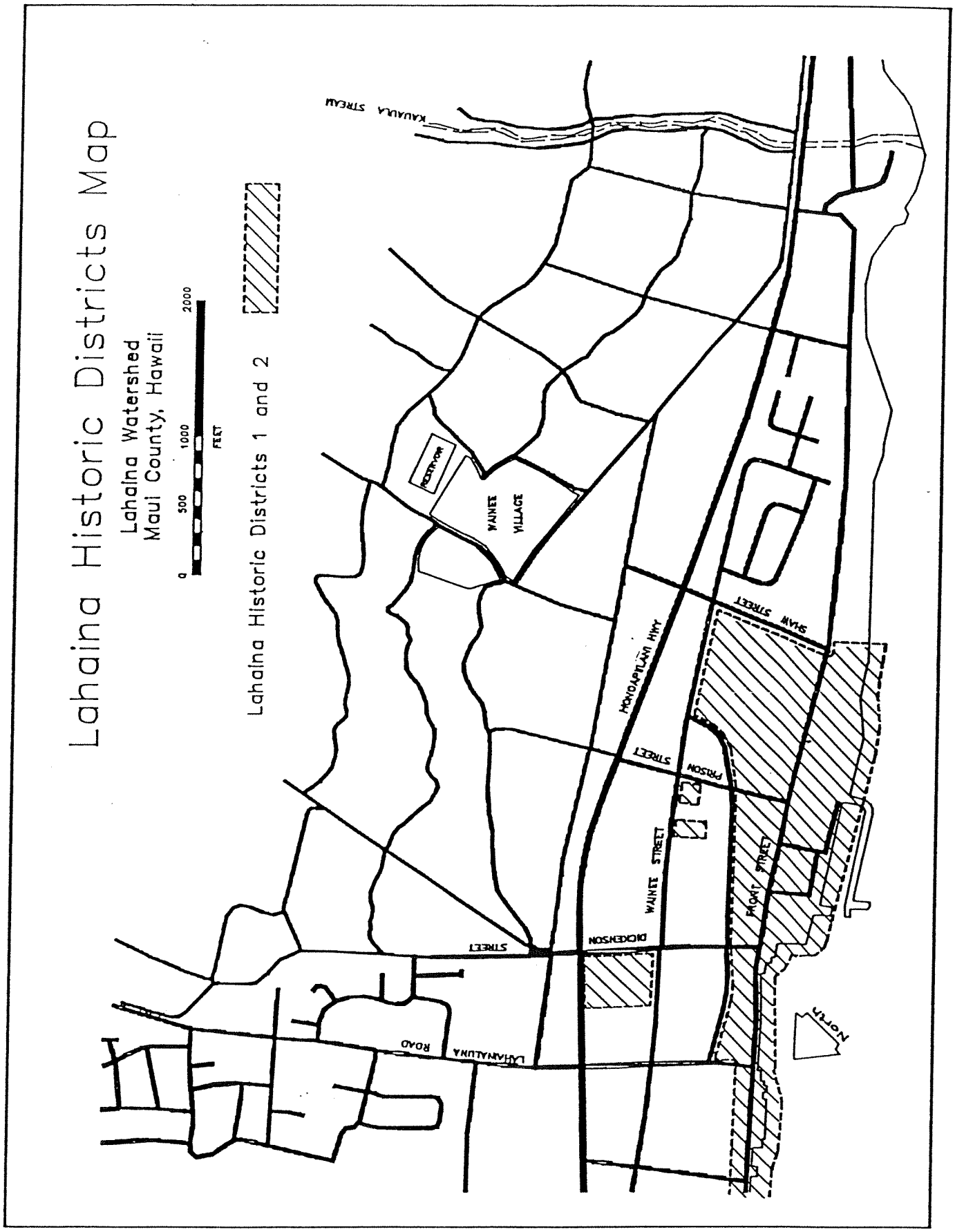
0 500 1000 2000

Scale in Feet

The inundation area shown on this map reflects the extremely rare event of the sudden failure of the debris basin embankment. The peak breach discharge has been estimated to be 1,000 cfs. Depending on the location of the breach on the embankment, the flow will travel through some portion of the indicated overflow area. Publication of this map is not intended to reflect on the integrity of the debris basin embankment.

APPENDIX C

INVESTIGATION AND ANALYSES REPORT


Lahaina Historic Districts Map
Lahaina Watershed
Maui County, Hawaii
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500
1000
2000
FEET
Lahaina Historic Districts 1 and 2
KAUAULA STREAM
WAINEE VILLAGE
HONOAPIILANI HWY
SHAW STREET
PRISON STREET
FRONT STREET
WAINEE STREET
DICKENSON STREET
LAHAINALUNA ROAD
NORTH

INVESTIGATION AND ANALYSES

PROJECT FORMULATION

Flooding is a major concern in the town of Lahaina on the island of Maui. Over 25 damaging floods have occurred in the Lahaina area since 1879. These floods have caused damage to residential properties and commercial operations. Lahaina is listed as a historic district in the National Register of Historic Places.

The local sponsors of the project are the West Maui Soil and Water Conservation District and the County of Maui. Before the sponsors submitted a formal application for planning assistance, preliminary studies were conducted by SCS to determine if the watershed would qualify for PL-566 assistance. The studies identified the watershed problems, environmental concerns, and six alternative plans to alleviate the problems. The study findings are contained in the Lahaina Watershed Preapplication Assistance Report.

The formal application for federal assistance was submitted to and approved by the Department of Land and Natural Resources, the State Clearinghouse for water resource projects, in September 1981.

Additional information was gathered by SCS as part of the post-application phase of planning. Because of the concern of outletting storm waters into the coastal waters, Dr. Richard W. Grigg, Associate Marine Biologist, University of Hawaii, was contracted to conduct a benthic survey of the nearshore environment. A report entitled "Assessment of Potential Marine Ecological Impacts of the Lahaina Watershed Project", was prepared. The report recommended the Kauaula Stream mouth as the outlet area that would least be impacted by storm runoff.

The watershed's land and water resource problems were studied in greater detail, and recent changes in land use plans for Lahaina were considered. New information gathered in this post-application phase was used to determine whether acceptable alternative plans could be developed and PL-566 assistance provided. The six alternatives were reevaluated and five of the plans were found to be unacceptable because of economic feasibility, environmental concerns, or other findings. One alternative was found to be acceptable. A preauthorization report for the Lahaina Watershed was prepared and a request for planning authorization was submitted to National Headquarters. Planning was authorized on March 18, 1985.

Federal, State, and County agencies were informed of the planning start and asked to provide any information or concerns they may have on the watershed area. Information was provided by the following: State Historic Preservation Officer, State Division of State Parks, State Department of Land & Natural Resources, U.S. Fish & Wildlife Service, State Division of Forestry and Wildlife.

During project planning two basic configurations were formulated. One configuration used Kauaula Stream as the sole outlet. The other used

Kauaula Stream in conjunction with a secondary outlet to the south of Puamana Park.

Formulation of an alternative that would divert a portion of the storm water in Kauaula Stream south to second outlet necessitated a supplemental reconnaissance marine assessment of the Puamana outlet and second outlet areas. Dr. Grigg was contracted to do the supplemental work. A site two-thirds mile south of Puamana Park was identified as the best outlet because it is the poorest reef area. The Kauaula Stream outlet was the second choice. After analyzing the alternatives, the singular outlet at Kauaula Stream was initially selected because it was thought that environmental impacts were not significantly increased by using the singular outlet and because it afforded considerable cost savings.

In 1991, heightened concerns about increased floodwater and sediment discharge at Puamana made the single outlet alternative unacceptable to the affected community. The two outlet alternative was further refined with the avoidance of the Wainee Village homes and reduction of the debris basin embankment.

The evaluation of sediment discharge from the Lahaina Subwatershed and the Kauaula Subwatershed was a major item of work during planning. The reduction of fine sediment entering the nearshore waters fronting Lahaina Town and the coarse sediment yield from the Kauaula Subwatershed were quantified using varied data and sediment transport relationships. The SCS Sedimentation Geologist from the West National Technical Center assisted the Hawaii staff with quantification of the sediment yield values.

During evaluation of these alternatives, meetings were held with the State Department of Transportation to coordinate the Lahaina By-Pass road alignment with the project. The Planning Staff also met with AMFAC Properties to discuss the development plans AMFAC, Inc. had for the area. The State Historic Preservation Office (SHPO) was asked to assist in conducting a reconnaissance archaeological survey of the proposed alignment of the floodwater diversion, debris basin and the outlet channel alignment to the second outlet.

The National Economic Development (NED) Plan was determined using incremental analysis of costs and benefits. A flood protection plan providing 100 year level of protection was selected as the NED Plan.

Four public meetings were held in Lahaina during post-authorization planning of the project. The first meeting, in 1985, was for the purpose of gathering data and concerns from the public. The second meeting, in 1986, discussed the formulated alternatives and resulted in the selection of a community preferred alternative. The third meeting presented the recommended alternative formulated in 1990 which proposed the single outlet through Puamana. In response to community concerns, a redesigned plan was presented at a public meeting in November 1991.

INVESTIGATION AND ANALYSES

ECONOMICS

Introduction

The evaluation of benefits for the Lahaina Watershed Project measures the beneficial contributions to national economic development (NED) associated with flood hazard reduction. The project improvements contribute to the NED objective by improving the net productivity of flood prone land resources. This occurs either by an increase in output of goods and services and/or by reducing the cost of using the land resources. Evaluated conditions include potential land use changes, additional development, and similar modifications which will alter the hydrologic response of the watershed and affect potential economic damages. The benefit analysis involves analyzing interrelationship between hydrologic, hydraulic and economic characteristics of the floodplain with standard SCS procedures. Procedures are in accordance with The Economics and Environmental Principles and Guidelines for Water and Related Land Resources Studies issued by the Water Resources Council on March 10, 1983.

The principal benefits for flood control facilities are inundation reduction benefits. These "benefits" are the loss in income to the nation as a result of flooding, commonly measured as the physical damages, business losses, and emergency costs. The inundation reduction benefit is the value of reducing flood losses to activities which would use the floodplain without any plan. It is measured as the reduction in the amount of damages or related costs. The economic life of the project evaluated is 100 years. This period is consistent with projects of this scope and type. The discount rate for current FY 1992 Federal water resources projects is 8 1/2 percent. All benefits and costs are evaluated in constant 1991 dollars and extrapolated to the base year.

Project Costs

The total installation costs include the first construction cost, contingency, indirect costs, relocation costs, and rights-of-way costs. To obtain the annualized installation costs the sum total is adjusted to present value then amortized over a 100 year economic life plus the project installation period at the specified discount rate. Added to the annualized first cost is the annualized operation, maintenance, and replacement (OM&R) costs. The sum is the annualized project cost, which is compared to corresponding benefit values.

Project Benefits

The benefits of flood hazard reduction were determined by computing the difference in average annual flood damages with and without the project. The average annual flood damage analysis includes the evaluation of damages to agricultural and existing commercial and residential development in the floodplain, upgrading of the contents of residential, and emergency costs. Data used in the evaluation of flood damages and benefits were obtained from field investigations of agricultural, residential, commercial, and

public properties. For the evaluation, benefits were derived for each subwatershed area: Lahaina Subwatershed-North, Lahaina Subwatershed-South, and Kauaula Subwatershed.

Unit Damages

Buildings in the floodplain are primarily wood frame structures, constructed on post or concrete slab. However, some concrete block structures are found in the lower reaches of the floodplain. In computing the estimated damages to residential development, water surface elevations in the floodplain area were first determined for various flood magnitudes using data from past floods as a reference. The depth of flooding and the estimated damages were then determined by correlating the floor elevations and the depth-damage curves for type of structures, commercial contents (inventory), and residential contents that were developed for the area. The depth-damage curve was adjusted to reflect conditions in the floodplain. The value of each structure in the floodplain was obtained from the State of Hawaii Department of Taxation.

Computations were made using the SCS derived URB I computer program revised 11/09/86. Currently there are 279 homes, 3 condominiums, and 2 hotels in the floodplain. The 239 commercial or public establishments occupy 69 building structures in the Lahaina Watershed Floodplain within the Lahaina community. Of the above totals, 184 residences and 134 commercial businesses receive flooding. To maintain the character of the Lahaina Historic District all new buildings and remodeling work are wooden structures on concrete slab. Every establishment was identified under the Standard Industrial Classification nomenclature (SIC) system with categories listed on Table 1. One existing major industrial establishment is affected by flooding. Value of contents for each establishment was estimated from field interviews including cost of probable damage at varying stages of flooding, and depreciated accordingly. When available historical damages experienced were included. Structural values for all commercial and residential buildings were available from public records.

In computing the estimated damages to commercial developments, water surface elevations and floodplain area were first determined for various flood magnitudes. The depth of flooding and estimated content damages for each commercial establishment were furnished by each establishment. Estimated damages to structures were determined by correlating the floor elevation and the depth percent damage curves for each type of structure. These curves were developed by the Hawaii District of the Corps of Engineers for the Kahoma Flood Control Project using damage data from flood insurance reports and adjusted using records of past floods from field interviews in Lahaina community to reflect conditions of the floodplain. The Kahoma Watershed is located west and adjacent to the Lahaina Watershed. Much of the new commercial development in the greater Lahaina community is currently occurring in the Kahoma Watershed.

Value of contents for each establishment was estimated from field interviews including estimated cost of probable damage at varying stages of flooding. When available, historical damages experienced were included. Market values for all buildings affected by flooding were obtained from

public records. These commercial buildings currently have a total structural value of about $ 14 million.

Most of the commercial firms in the Lahaina floodplain are located in the Lahaina North Subwatershed, while the residential areas are concentrated in the Lahaina South Subwatershed and Kauaula Subwatershed.

Approximately 80 acres of sugarcane land is susceptible to overland flooding. However, only 64 acres will be protected. Normally, sugarcane is a two (2) year crop in that section of the watershed. During the first seven to nine months of growth the fields are prone to erosion, sedimentation, and damage to irrigation systems. Some minor damages to plantation roads is also sustained. However, the plantation has minimized flood damages by scheduling harvesting of fields susceptible to flooding during the early summer months which are characterized by low rainfall. Damages are further minimized by the maintenance of existing land treatment measures as soon as the sugarcane crop is harvested. Therefore, agricultural damages are generally low because of excellent field crop management. A damage frequency analysis was used to determine average annual damages.

Public agency damages or emergency costs are based on analysis of operation during the past floods. They include expenditures for County emergency crew, Red Cross relief work, County, State, and Federal investigation teams, police, and rescue crews. Also included are living away from home expenses for the flood victims and loss of income for the duration of the cleaning and restoration operation. The damage frequency analysis was used to determine average annual damages. Emergency costs spent by County crews represented the bulk of expenses expended by all public and relief agencies. These costs consisted of clean-up and pumping water out of residences located in low lying areas.

Discharge-Damage Computation

Water surface elevations were determined for various magnitudes of floods by reach in analyzing probable damages. Length of reach was limited by maximum grade change of one foot. A discharge damage relationship was determined by correlating the various flood stages and number of businesses and residences affected by their first floor elevation. Tangible damages were totalled and plotted against the corresponding discharge.

Damage Frequency Computation

The damage frequency information was derived by use of the URB-1 Computer Program. Total average annual equivalent damages are estimated to be $195,620 (Residential), $389,700 (Commercial), $10,700 (Agriculture), and $4,180 (Public Property). Floodproofing costs are estimated at $71,530. Red Water Pollution damages to the Resort Industry is estimated at $107,910. With the proposed improvements, the residual annual damages are estimated to be $19,190 (Residential) and $30,700 (Commercial). Average annual agricultural and public agency damages were calculated by using the historical method which analyzed three major storms of record. Based on the Lahaina Community Development Plan, sugar cane land acreage in the floodplain will maintained as a green belt.

Appendix C

TABLE 1

SIC CODES USED IN THE LAHAINA COMMERCIAL SECTOR

SIC CODE	INDUSTRY - BUSINESS
	Manufacturing
391	Jewelry, silver, plated ware
	Wholesale Trade
504	Sporting Goods, toys, hobby
514	Groceries & related products
518	Beer, wine, distilled beverages
	Services
739	Miscellaneous business services
	Retail Trade
541	Grocery stores
553	Auto & home supply stores
554	Gasoline service stations
561	Men, boys, clothing, furnishing
562	Women ready-to-wear stores
563	Women accessory & speciality store
564	Children, infant wear store
565	Family clothing store
566	Shoe store
569	Miscellaneous apparel & accessories
573	Radio, TV stores
580	Eating and drinking places
591	Drug store & propriety store
594	Miscellaneous shopping good store
597	Jewelry retail
599	Miscellaneous retail stores, other

Flood Reduction

According to Maui County Ordinance 1145, floodproofing is a requirement for all construction within the Lahaina Watershed floodplain up to and including the 100-year flood limit as delineated by the "final flood insurance rate map 1 June 1981". Lahaina has not experienced any appreciable decline in tourist activity and property values have continued their spiral particularly with the influx of foreign Japanese investment capital. Housing continues to be a critical issue despite major strides by the tourist industry to provide housing and development capital to develop the necessary infrastructure.

Despite the threat of rising interest rates, construction costs have continued to follow the upward spiral of property values. While all business-commercial and business-residential (apartment-hotel) properties are expected to be floodproofed, there is expected to be considerable resistance to develop vacant single family residential lots in the flood plain. Periodic monitoring has affirmed this.

Total available land area in the flood plain zoned for business-commercial and business-residential (apartment-hotel) that is subject to the flood plain ordinance is approximately 31 acres. Of this total land area thirty (30) percent or approximately 10 acres will dedicated to parking and landscaped areas.

Intangible benefits which would accrue from the recommended project are the reduction of health hazards associated with floods, and the improved morale of residents of the floodplain as result of the reduction in flood damages and, in the case of the Kauaula Subwatershed, threat to life and limb.

Future Development

Since the mid-1930's, there has been a steady upward trend in per capita personal income and personal consumption expenditures. This constant increase measures the growing affluence of people and is reflected in the continuous upgrading of consumption items including living quarters and personal possessions. In computing flood damages to existing development, the future increase in damageable property must be considered to reflect reasonable treatment of what damages would occur. The following rationale and data were used in developing future flood damage reduction benefits:

a. In consideration of the Maui County Flood Plain and Tsunami Inundation Area Ordinance and the Flood Disaster Protection Act of 1973, no new development is anticipated in the flood plain without adequate flood proofing. The existing number of residential homes and commercial structures can be expected to increase slowly until the watershed project is installed. All new construction until then is required to be flood proofed.

b. The per capita income, as published in the 1988 Department of Business and Economic Development (DBED) State of Hawaii, Population and Economic Projections for Maui County: 1985 to 2010 was used to project future residential damages and is shown on Table 5.

c. The average value of residential structures and contents are $32,220 and $12,491 respectively.

d. The existing average annual content damage is $52,325.

Per capita income is projected to increase from $11,938 in 1989 to $22,987 in 2060 (In 1982 Dollars) (Table 2). Assuming that the value of contents would increase to a maximum of 75 percent of the value of a structure or $24,165, based on present average value of residential structures in the floodplain, the maximum value would be reached by the year 2060. Using procedures outlined in section 2.4.11 of the Economic and Environmental Principles and Guidelines, the average annual damage resulting from application of the affluence factor methodology to existing residential development is $18,610. Per Capita Income Factor was calculated at 1.11.

Business and Financial Losses

Benefits from prevention of business and financial losses are not expected to accrue from the project. Increased business activity outside the flood plain limits would offset any losses that may occur to flooded commercial enterprises.

Sediment Pollution "Redwater" Damage Analysis

The Sediment Pollution "Redwater" Damage Analysis for the Lahaina Watershed was based on the "Redwater" Damage Analysis completed for the Honolua Watershed Project which is also located in West Maui. Honolua Watershed Project is currently in its final stages of installation. The basic assumption supporting the damage analysis is that sediment pollution of the nearshore marine environment is a function of rainfall and erosion. This relationship was developed by analyzing each storm in terms of its computed frequency and resultant days of impaired water quality or locally called "red water days".

Average annual "red water days" were determined "red water" frequency curves for each subwatershed area by gathering data for thirteen (13) storms that occurred from 1955 through 1968 in the Honolua Watershed. Surveys of hotels in the watershed established the decrease of occupancy related to the number of "red water days" generated by each storm. A reasonable estimate of damages attributable to each storm by determining the income loss caused by premature guest check-outs caused by the polluted nearshore marine environment. Average weighted room rates were developed to account for the differences in room rates for each hotel in each subwatershed.

Three average annual "red water days" curves were developed to reflect the basic variations of the reef formation. Well developed reef formations affronting a watershed functioned like sediment holding basins causing long periods of "red water days". The protective reef formations limited wave action and dissipation of sediment into the open ocean. In contrast, the lack of a reef formation affronting a watershed or drainage area accelerates the mixing action caused by waves and ocean currents. This causing the sediment to dissipate rapidly after a storm, resulting in a

short period of "red water days". Therefore, to continue the developed rationale in the "red water damage analysis" for the Lahaina Watershed economic investigation, the type of reef formation affronting the resort development was determined.

In the case for the Lahaina Watershed, a well developed reef formation is present. A similar situation exists for the Honokowai subwatershed in the Honolua Watershed. Therefore, the Honokowai "Red Water Frequency Curve" was used to represent the Lahaina Watershed "Red Water Frequency Curve". This determination was verified during the interviews of public agency personnel, hotel managers, local fishermen, and other members of the public.

Summary of Benefits

The 100-year level of protection was selected as the NED project. The average annual benefits from prevention of flood damages to residential, commercial, agriculture, and public facilities is estimated at $215,560 (residential), $389,700 (commercial), $71,500 (reduction of floodproofing), $10,700 (agriculture), and $3,800 (public property). With the proposed improvements, residual damages $29,000 (commercial), and $34,790 (red water) is expected to occur annually. Three (3) levels of protection twenty seven (27) year, fifty (50) year, and one hundred (100) year were analyzed to determine the most efficient level of protection. Due to economic efficiency, it was determined that the 100-year level of protection would the National Economic Development (NED) project.

TABLE 2

PROJECTED PER CAPITA INCOME

Year	Projected DBED Per Capita Income	Percent Increase Base Year 1989 to 2060	Projected Content Value
1976	$ 6,239		
1977	6,842		
1978	7,589		
1979	8,329		
1980	9,141		
1981	9,778		
1982	10,562		
1983	10,968		
1985	11,100		
1989	11,938		12,491
1990	12,400		13,497
1995	13,400		14,455
2000	14,300		15,065
2005	14,900		15,671
2010	15,500		16,300
2015	16,123		16,956
2020	16,771		17,638
2025	17,445		18,346
2030	18,147		19,084
2035	18,576		19,851
2040	19,635		20,649
2045	20,424		21,479
2050	21,245		22,343
2055	22,099		23,241
2060	22,987	93.5	24,175

Appendix C

INVESTIGATION AND ANALYSES

GEOLOGY

Introduction

An investigation of the foundation conditions along the alignment of the proposed Lahaina Watershed diversion was conducted during the period of March 17-19, 1986. A supplemental investigation was performed in September 1991, along the diversion alignment and in the drainage areas leading to the diversion.

The results were used determine channel stability and estimate sediment and debris basin capacities. Sediment discharge from the Lahaina and Kauaula subwatersheds was examined and sediment yield estimates were made for with project and without project conditions.

Location

The Lahaina Watershed is 4,920 acres in size and is located on the northwest side of the Island of Maui. (See location map). The watershed has a very steep rainfall gradient. Average annual rainfall ranges from 15 inches along the coastline to 300 inches in the mountains, located 4 miles inland. Average annual temperature is 75 degrees F.

Of the 4,920 acres, 440 acres are in urban uses such as residential and commercial; 1,080 acres are used for agricultural purposes, primarily sugarcane production; and 3,400 acres are forest and brushland. The major urban area is located along the coastline and is a part of Lahaina town. Sugarcane dominates the landscape from elevation 40 to 1,400 feet. The upper watershed area is forest and brushland.

Geological Setting

Maui is the second largest island in the Hawaiian chain. It was formed by two volcanic mountains, East and West Maui mountains.

East Maui, or Haleakala volcano, is 10,025 feet high and 33 miles across. West Maui is 5,788 feet high and 18 miles across.

The Lahaina watershed is located in West Maui. The West Maui mountains are incised by deep amphitheater-headed valleys. Kauaula Stream, a major drainageway in the watershed, occupies one of these valleys. The volcano is the "central type" in contrast to the "fissure type", because dikes radiate in all directions from the ancient caldera and almost all the lava beds are steep and many were poured from the central vent. Typically, the lava flows are thin-bedded a'a and pahoehoe.

The volcanic rocks of West Maui are divided into three series. The oldest is the Wailuku volcanic series - basaltic flows that built the volcano. The Honolua volcanics, consisting of thin andesitic and trachytic flows, covers the Wailuku volcanics. After a period of quiescence, eruptions produced the Lahaina volcanic series.

The major geologic units in the watershed consists of the Wailuku and Honolua volcanic series, sediments of consolidated earthy deposits, and sediments of unconsolidated deposits.

Foundation Investigation

Structural Data

The proposed structural measures consists of diversion channels, sediment basins, a debris basin, and an outlet channel. The grass-lined earth diversion will have a trapezoidal cross-section of 2:1 side slopes and bottom width that varies from 20 to 25 feet. Three sediment basins will be constructed along the diversion by widening the channel width to 75 feet to 125 feet and lowering the channel bottom by two feet. Two reaches of reinforced concrete channel totalling 1,531 feet will also be installed.

The diverted runoff from the Lahaina subwatershed will be combined with discharge from the Kauaula subwatershed at an excavated debris basin located on Kauaula Stream, 200 to 600 feet upstream from Honoapiilani Highway. Coarse sediment transported by Kauaula Stream will be trapped in this basin. The basin will also divide the flow between two outlets, the existing improved channel through Puamana and a proposed outlet leading to the south. The maximum height of the basin embankment will be ten feet.

The second outlet will be grass-lined, trapezoidal in cross section, and have a bottom with between 45 and 55 feet.

Exploration

The purpose of the 1986 investigation was to determine the subsurface conditions along the alignment of the proposed diversion. A backhoe was used to excavate 17 test pits, that ranged in depth from 1.5 to 10 feet. Soil samples were obtained for testing.

The surface material generally consists of clay, CL. Below the clay are deposits of boulders or "older alluvium". The older alluvium consists of mottled brown to red-brown deeply weathered, poorly sorted, nearly impermeable friable conglomerates.

The subsurface conditions can be separated into three types: lava flows, older alluvium, and river run boulders and cobbles.

The 1991 investigation determined grain sizes of the soils through which the channel would be constructed. A boring was made at the debris basin site to estimate difficulty of excavation to the basin invert.

Conclusion

The subsurface conditions along the floodwater diversion alignment can be separated into three types: lava flows, older alluvium, and river run boulders and cobbles. All of the subsurface material along the alignment can be excavated using standard excavation equipment.

Appendix C

There is an abundance of coarse material in the subsurface in the alluvium and river run soils making the channel stable under design flow conditions. The initial flows will carry the fines and in time a bed armor will form in the sections of river run material.

Since there will be a substantial amount of cobbles and small boulders excavated, the embankments should make use of this available material.

The subsurface conditions at the Kauaula Stream debris basin site consists mainly of large boulders and cobbles. The foundation is strong enough to support the proposed embankment. There may be a problem in storing or disposing of the large boulders.

Sediment Yield Investigation

Quantification of sediment yield from the two subwatersheds was necessary for design of the sediment basins along the diversion and of the debris basin on Kauaula Stream. Sediment yield analysis was also needed to establish the reduction of sediment to the Lahaina Town nearshore area.

The Modified Uniform Soil Loss Equation was used to evaluate sediment yield by storm event for the Lahaina Subwatershed. The form of the equation used is: S = 95*((Q*qp)**0.56)*K*L*S*C*P. The subwatershed was divided into seven subareas along the slope separated by existing ditches or field roads. The average annual sediment yield varied from 20 tons/acre in the steepest sub area to less than 2 tons/acre in the flattest subarea. A 30 percent delivery ratio was used resulting in an average annual sediment yield of 3,800 tons per year. During the peak discharge of the 100 year storm the sediment basins are expected to retain soil particles larger than 3 mm in diameter. Initial soils tests indicated that roughly 25% of the sediment, by weight, will be larger than 3 mm in diameter. The 1991 examination showed the surface soils above the diversion to be finer.

A average trap efficiency of 25 percent is estimated for the sediment basins due to high sediment trapping rates of the grass-lined channel and basins during low intensity storm events.

Additional studies correlating Lahaina subwatershed sediment discharge to that from sugarcane fields in Waialua, Oahu and Kamooalii Watershed, Oahu resulted in yield by storm event.

Storm Recurrence Interval	Tons per Event
100 years	10,000
50 years	7,500
25 years	5,500
10 years	3,500
5 years	1,700
2 years	1,000

Coarse sediment yield from Kauaula Stream was estimated to size the debris basin. It was assumed that an inexhaustible sediment supply existed in the upper watershed and that yield was limited only by transport capability of the channel. A yield vs. storm frequency relationship was developed using

tractive force-boulder size analysis and using other empirical relationships. Estimated sediment discharge rates were compared to known discharge rates of Moanalua Stream and Kamooalii Stream.

The bedload discharge rates by storm recurrence are as follows for Kauaula Stream.

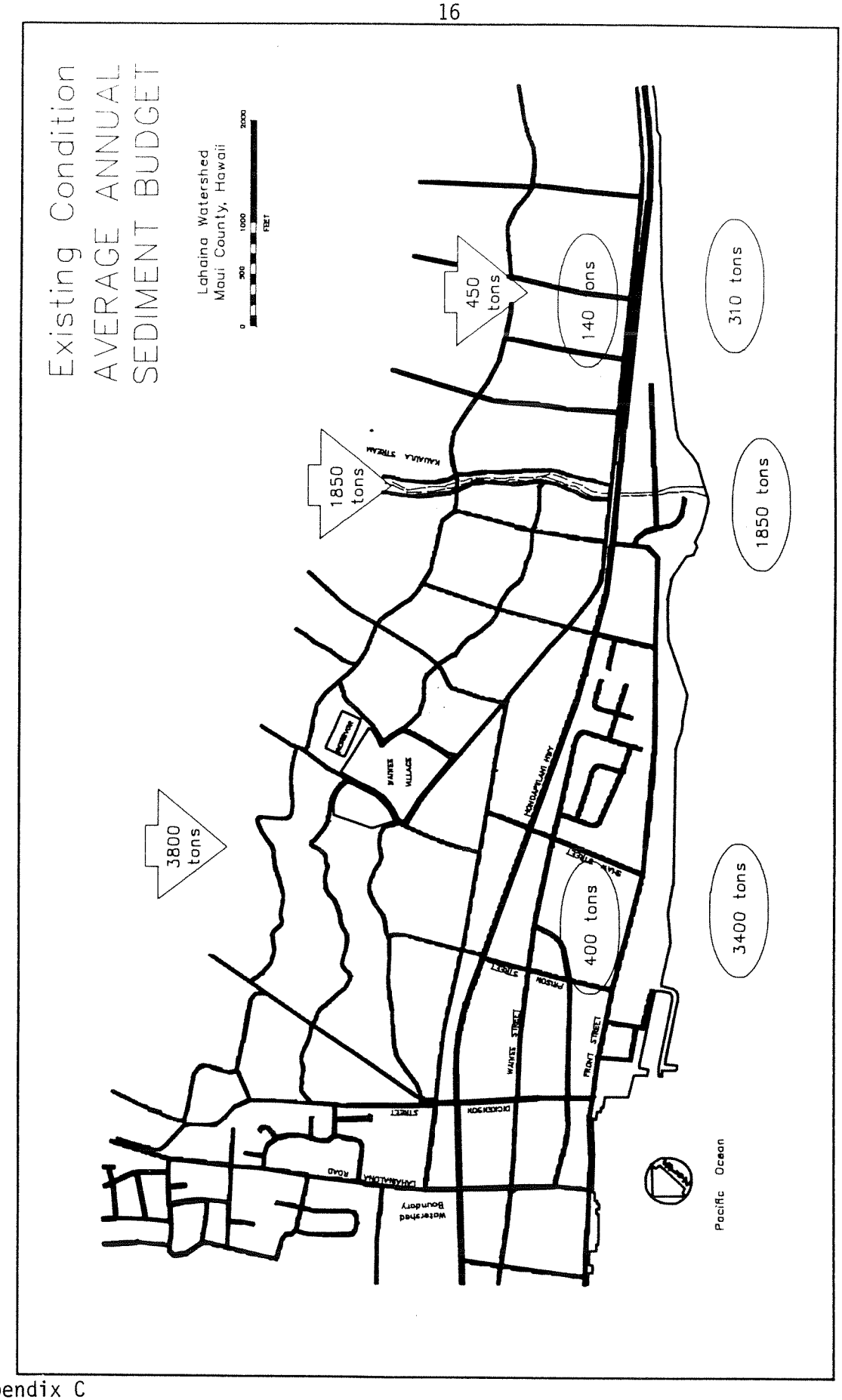
Storm Recurrence Interval	Tons per Event
100 years	7,000
50 years	5,000
25 years	3,200
10 years	2,000

Sediment budgets for the Average Annual, with and without project implementation, are shown in Table 3.

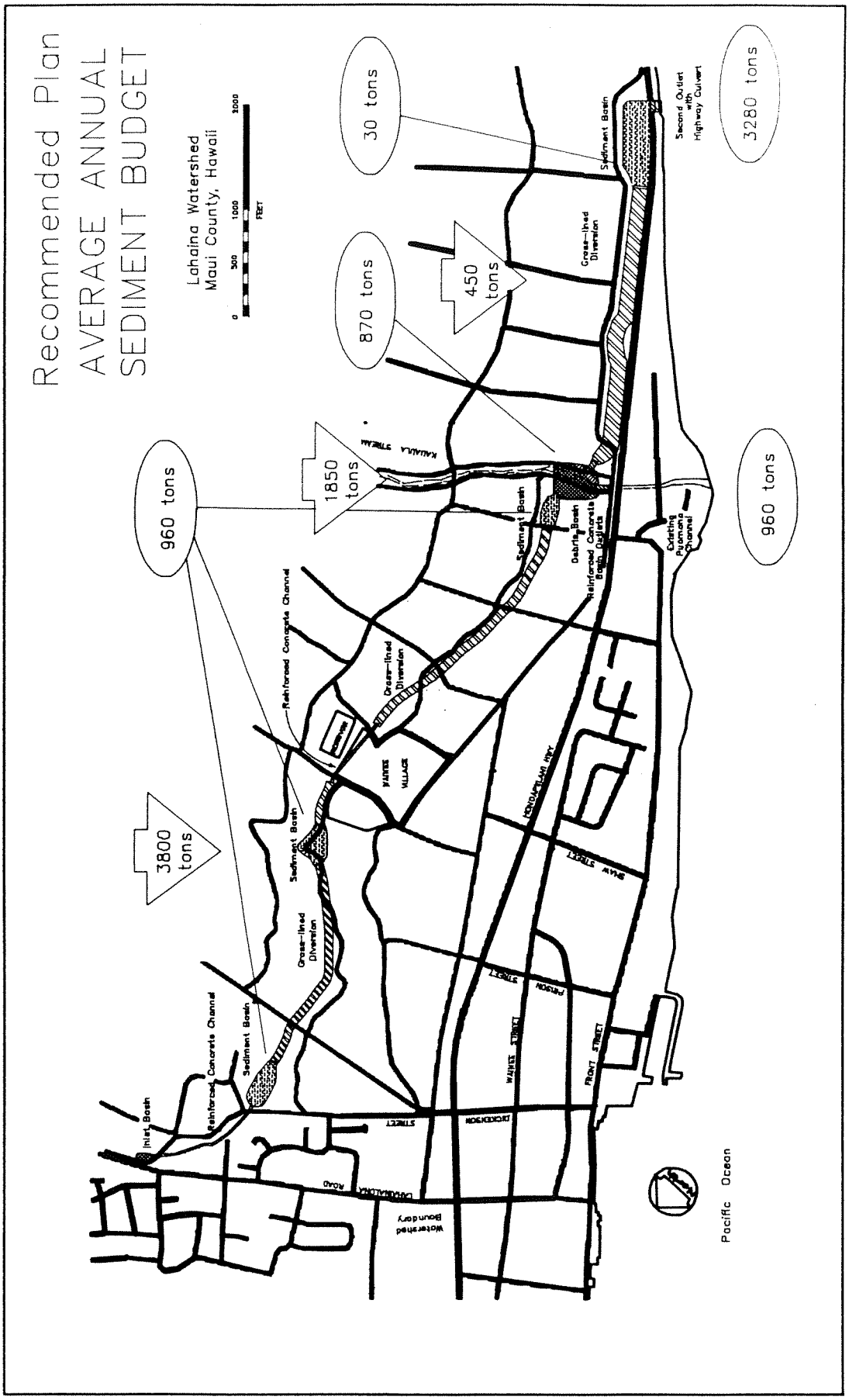
AVERAGE ANNUAL SEDIMENT BUDGET /1
Lahaina Watershed, Hawaii
(Tons)

	Conditions without Project			Conditions with Project		
	Fine Sediment	Coarse Sediment	Total Sediment	Fine Sediment	Coarse Sediment	Total Sediment
LAHAINA SUBWATERSHED						
Sediment Yield	3,800	0	3,800	3,800	0	3,800
Floodplain Deposition	400	0	400	0	0	0
Sediment Basin Deposition	---	---	---	960	0	960
Ocean Discharge	3,400	0	3,400	0	0	0
Lahaina to Kauaula	0	0	0	2,840	0	2,840
KAUAULA SUBWATERSHED						
Sediment Yield	1,300	550	1,850	1,300	550	1,850
Debris Basin Deposition	---	---	---	325	545	870
Ocean Discharge	1,300	550	1,850	954	5	959
Kauaula to 2nd Outlet	0	0	0	2,861	0	2,861
SUBWATERSHED ABOVE 2ND OUTLET						
Sediment Yield	450	0	450	450	0	450
Floodplain Deposition	140	0	140	0	0	0
Sediment Basin Deposition	---	---	---	30	0	30
Ocean Discharge	310	0	310	3,281	0	3,281
TOTAL OCEAN DISCHARGE	5,010	550	5,560	4,235	5	4,240

/1 Average tons/year over 100 year evaluation period. It is not intended to reflect conditions during any given year.


Existing Condition
AVERAGE ANNUAL
SEDIMENT BUDGET
Lahaina Watershed
Maui County, Hawaii
0
300
1000
2000
FEET
3800 tons
1850 tons
450 tons
140 tons
310 tons
1850 tons
400 tons
3400 tons
Watershed Boundary
Pacific Ocean
KAUAULA STREET
DICKENSON STREET
FRONT STREET
PRISON STREET
WAINEE STREET
HONOAPIILANI HWY
DUKE KAHANAMOKU ROAD

Appendix C


Recommended Plan
AVERAGE ANNUAL
SEDIMENT BUDGET
Lahaina Watershed
Maui County, Hawaii
0
500
1000
2000
FEET
3800 tons
960 tons
1850 tons
870 tons
450 tons
30 tons
3280 tons
960 tons
Inlet Basin
Reinforced Concrete Channel
Sediment Basin
Grass-lined Diversion
Reinforced Concrete Channel
Grass-lined Diversion
Sediment Basin
Sediment Basin
Debris Basin
Reinforced Concrete Basin Outlets
Grass-lined Diversion
Sediment Basin
Second Outlet with Highway Culvert
Dunbar Pumping Channel
Watershed Boundary
Pacific Ocean

Appendix C

INVESTIGATION AND ANALYSES

HYDROLOGY

Introduction

The hydrologic investigation for the Lahaina Watershed involved determination of peak runoff discharges and water surface profiles that were used to design structural measures and evaluate flood benefits. Peak discharges and water surface profiles were determined using conventional SCS hydrology and hydraulic computer models. The validity of the hydrology model was justified by utilizing it on nearby watersheds that are gaged. The water surface model was correlated to known highwater marks within Lahaina.

The Lahaina Watershed, typical of most small watersheds in the islands, has steep upland slopes that run into the flat coastal plains. Land use in the watershed range from agricultural (sugarcane) and conservation in the uplands and urban in the plains.

This watershed was subdivided into two subwatersheds, the Lahaina and Kauaula subwatersheds. Based on interviews with local residents in Lahaina, both of the subwatersheds was further divided into the north and south portions. The north portion of the Lahaina Subwatershed extends from just southerly of the Papalaua Street to Dickensen Street, while the south portion extends from Dickensen Street to Shaw Street. The north portion of the Kauaula Subwatershed extends northerly of the improved channel and the south portion extends southerly from the channel into the Puamana Subdivision.

The runoff from each of subwatersheds drains into the ocean. The Kauaula Subwatershed outlets to the ocean via an improved concrete lined trapezoidal channel and the Lahaina Subwatershed, with no defined outlet, drains through various areas in the commercial and residential areas of Lahaina town.

Methodology

Peak Discharge

The hydrology computer model used was the TR-20 program, which is based on SCS's NEH-4, Hydrology. This program required the following input parameters: curve number (CN), time of concentration, rainfall distribution, rainfall depth, and antecedent moisture condition.

The major landuse in the Lahaina Subwatershed is sugarcane, and a composite CN was developed based on the stages of growth since sugarcane is a two year crop and is constantly being harvested and planted throughout the subwatershed. This composite CN was used in the both subwatersheds, along with CN values for residential, open space, pasture, industrial, brush land, and Ohia-Koa forest type found in NEH-4 and the Hawaii Forest Type Legend. The Soil Survey for the Islands of Kauai, Oahu, Maui, Molokai, and

Lanai, State of Hawaii was used to determine soil series and their respective hydrologic properties.

Standard Type-I rainfall distribution with an antecedent moisture condition II was used to determine peak discharges. Actual rainfall data was also used to try to develop synthetic hydrographs in the Kahoma Watershed in order to check the validity of the TR-20 program. However, the results were inconclusive. The 24-hour rainfall depths for various frequency storms were extrapolated from rainfall maps in Technical Paper No. 43. Time of concentration for each stream within the subwatersheds was computed from the velocities read from charts of figure 15.2 fo NEH-4.

The validity of the SCS TR-20 model was tested on the two streams that are presently being gaged. Input parameters for watersheds of these two streams were used in the model to predict peak discharges for various storm frequencies. A discharge-frequency curve for each stream was plotted and compared with Water Resources Council (WRC) discharge-frequency curve estimated from gaged data and it was found that the results were divergent. However, adjustments to the CN, the frequency curves generated by the model was made parallel to the WRC frequency curves. These adjustments were then applied to the models for the Lahaina and Kauaula subwatershed. Further, discharge per square mile for these subwatersheds was also compared to the the values for the gaged data of Kahoma Stream and were found to be comparable.

Water Surface Profile

The WSP-2 computer program was the hydraulic model used to generate water surface profiles for the economic evaluation of alternatives. Water surface profiles were developed for both the north and south portions of Lahaina and Kauaula subwatersheds. The input parameters to this program were cross-sectional data for the drainages, surface roughness, and stream lengths.

Cross-sections were developed from a aerial photo topographic map that had a scale of 1" = 200' and a contour intervals of 1 and 2-feet. Surface roughness (Manning's "n') was adjusted such that the water surfaces matched high water marks of known storms. In the urban areas the "n" was equal to about .20. The storm of January 1982 was used as the storm of record. The stream reach lengths were read off the topographic maps.

URB1 (Economics Data)

In order to determine flood benefits the stage/discharge data and peak discharges from the WSP-2 and TR-20 model along with data from the economist were used in the URB1 program to develop the annual average flood damages for the various alternatives.

To account for the existing storm drain systems within Lahaina Subwatershed, it was assumed that these systems would be able to handle up to a 5-year frequency storm in the Front Street area. All other areas were assumed to have negligible benefit from existing drainage systems due to the flat slopes and possible plugging of drains.

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Hydrologic and Hydraulic Assumptions

The following were the assumptions that were the basis of the hydrologic and hydraulic analysis:

1. The Lahaina Watershed was split into two subwatersheds: Lahaina and Kauaula. Each of these subwatersheds were further split into their respective north and south portions. This was based on interviews with local people, Pioneer Mill people and topographic maps. The crux of these interviews indicated that Dickenson Street was the dividing line for the north and south portion of the Lahaina Subwatershed and Kauaula Stream was used as the dividing line for the Kauaula Subwatershed.

2. Kauaula Stream, within the Kauaula Subwatershed has only limited capacity (< 10 year frequency). A WSP2 run was used to determine the most critical section where the stream would overtop. Due to the difficulty in determining where the overtopping water would go, it was assumed that 50% of the water that overtops would go to the north and 50% would go to the south. These flows were then routed through the Puamana Subdivision. Side boards were assumed based on aerial top survey.

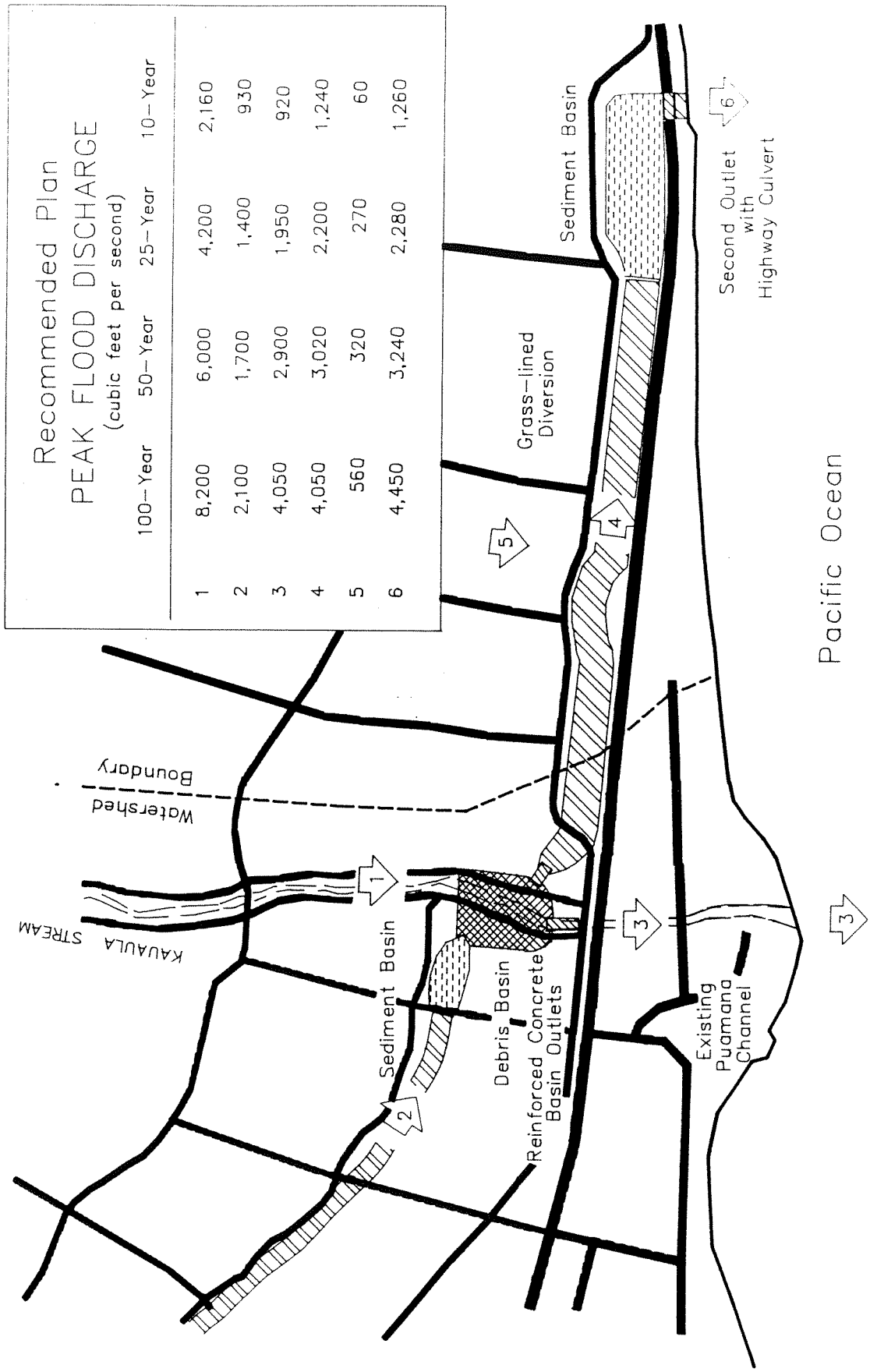
3. "n" values used in the urban areas were adjusted in the WSP-2 runs to fit known high water marks for the January 21, 1982 storm.

4. Existing storm drain systems within the commercial area of Lahaina town were assumed to have capacity of handling up to a 5 year storm. All other systems were not considered as having any capacity.

5. Within the Kauaula Subwatershed, the discharge-frequency relationships were adjusted by reducing CN values to fit the WRC Bulletin 17B assuming station skew (with adjustment for historical data) for the gage on Kauaula Stream (#16643300). CN values for the Lahaina Subwatershed weren't reduced because the sugarcane fields are irrigated most of the time and the soils are probably saturated to some extent.

6. Estimates for CN values of sugarcane (furrow and drip) were weighted according to the length of crop stage. CN for brushland and forest were developed using the forest service maps that detailed the different forest types in Hawaii. CN for residential and commercial were based on values in NEH-4.

7. "R" values to determine velocity for Tc determination were estimated from cross-sections taken off the quad sheets. Velocities were either read from Fig 15.2 of NEH-4 or estimated from WSP-2 runs.


Recommended Plan
PEAK FLOOD DISCHARGE
(cubic feet per second)
100-Year 50-Year 25-Year 10-Year
1 8,200 6,000 4,200 2,160
2 2,100 1,700 1,400 930
3 4,050 2,900 1,950 920
4 4,050 3,020 2,200 1,240
5 560 320 270 60
6 4,450 3,240 2,280 1,260
Pacific Ocean
Sediment Basin
Grass-lined Diversion
Second Outlet with Highway Culvert
Watershed Boundary
KAUAULA STREAM
Sediment Basin
Debris Basin
Reinforced Concrete Basin Outlets
Existing Puamana Channel

Appendix C

INVESTIGATION AND ANALYSES

ENGINEERING

General

The engineering analysis for the Lahaina Watershed consisted of evaluating alternatives for providing flood protection to the commercial, residential, and agricultural areas in the watershed that are damaged by frequent flooding. The alternative plans were based on a diversion of the problem runoff to one of more ocean outlets. The major components of the investigation are as follows.

1. A hydrologic analysis was conducted to obtain storm frequency vs. runoff relationships for the Lahaina and Kauaula subwatersheds.

2. Nonstructural and structural measures were evaluated for effectiveness in solving the identified problems.

3. A diversion channel was designed to intercept the runoff from the Lahaina subwatershed upstream of present and most proposed development. Allowable flow velocities for the grass-lined earth channel were established. Sediment discharge rates were estimated for sediment basin design. The diversion channel was located with the objective of minimizing installation costs while maximizing the benefitted area.

4. Ocean outlet alternatives were evaluated with respect to installation cost, environmental effects, and effects to cultural resources. The Kauaula Stream outlet was determined to be one of the most appropriate ocean outlet. A second outlet was also evaluated in order to keep Kauaula outlet flows within the design discharge for the existing channel and to reduce sediment impacts on the reef resources fronting Puamana.

   A debris basin on Kauaula Stream to prevent damaging coarse sediment from entering the existing improved outlet was designed following a sediment yield analysis of Kauaula Stream. The basin is also needed to still the combined flows in order to effectively divide the flows with the two outlet weirs.

5. A National Economic Development alternative was developed by combining the acceptable measures into an integrated plan. The costs for various levels of protection with the NED alternative were compared against their benefits to determine the level of protection providing the maximum net benefits. The 100-year level of protection was determined to be the NED plan.

Solutions to the Flooding Problem

Land Treatment

Intensified land treatment measures on the sugar cane fields were considered in order to decrease runoff and reduce soil erosion. The

ongoing conservation program by Pioneer Mill with assistance from the SCS and the West Maui SWCD was thought to provide the necessary land treatment. Additional land treatment efforts would not appreciably reduce runoff or sediment discharge volumes.

A computer based model was used to compare soil erosion and sediment yield with and without the conservation practices installed. The comparative model, AGNPS, developed by the USDA Agricultural Research Service and the University of Minnesota, showed an average 40% decrease in sediment yield with the conservation practices applied.

The conservation practices applied on the Lahaina fields are described below.

Conservation Cover is used to reduce soil erosion and sedimentation, improve water quality, and create or enhance wildlife habitat by establishing and maintaining perennial vegetative cover to protect soil and water resources on land retired from agricultural production.

Chiseling and Subsoiling is used to improve water and root penetration and aeration by loosening the soil, without inverting and with a minimum of mixing of the surface soil, to shatter restrictive layers below normal plow depth that inhibit water movement or root development.

Conservation Cropping Sequence is used to improve or maintain good physical, chemical, and biological conditions of the soil; help reduce erosion; improve water use efficiency and water quality; improve wildlife habitat; or break reproduction cycles of plant pests by adapting a sequence of crops designed to provide adequate organic residue for maintenance or improvement of soil tilth.

Contour Farming is used to reduce erosion and control water by farming sloping land in such a way that preparing land, planting and cultivating are done on the contour. (This includes following established grades of terraces and diversions.)

Drip Irrigation System is used to efficiently apply irrigation water directly to the plant root zone to maintain soil moisture within the range for good plant growth without excessive water loss, erosion, reduction in water quality or salt accumulation. This is a planned irrigation system in which water applicators (orifices, emitters, porous tubing, perforated pipe) operate efficiently under low pressure. The applicators can be placed on or below the surface of the ground.

Irrigation Water Management is used to effectively use available irrigation water supply in managing and controlling the moisture environment of crops to promote the desired crop response; to minimize soil erosion and loss of plant nutrients; to control undesirable water loss; and to protect water quality. This is accomplished by determining and controlling the rate, amount and timing of irrigation water in a planned and efficient manner.

Appendix C

Terraces are constructed to (1) reduce slope length, (2) reduce erosion, (3) reduce sediment content in runoff water, (4) intercept and conduct surface runoff at nonerosive velocity to a stable outlet, (5) retain runoff for moisture conservation, (6) prevent gully development , (7) reform the land surface, (8) improve farmability, (9) reduce flooding, or (10) improve water quality. Terraces consist of an earth embankment, a channel or a combination ridge and channel constructed across the slope.

Nonstructural Measures

Nonstructural measures to decrease flood and flood related damage were considered. Nonstructural measures are intended to modify the impacts of flooding rather than modifying the flood itself. The nonstructural measures considered are described below.

Zoning of the floodplain to restrict its further development was examined. The fact that zoning regulations would not prevent damage to existing development and public resistance to development restriction in the primary commercial district dropped this measure from further consideration.

The acquisition of vacant parcels and the removal of flood prone homes were considered but was found to be cost prohibitive. Residential properties in the floodplain area have sold recently for as much as $430 per square foot.

Floodproofing of public and commercial buildings was investigated. This included elevating structures, building perimeter walls around properties, building protective walls around structures, and applying sealants. The density of development in Lahaina Town and the age of many of the structures makes the installation of floodproofing measures difficult. The lack of an adequate flood warning period also limits the practicality of many floodproofing measures.

A system of flood forecasting, warning, and evacuation was considered ineffective in the Lahaina situation due to the flashy nature of flooding in Hawaii.

Structural Measures

A cursory search for a floodwater detention reservoir site was made for the Lahaina subwatershed. For the Lahaina subwatershed, a detention volume on the order of 50 million gallons was needed. A properly located site with adequate storage volume does not exist and the detention reservoir measure was dropped from further consideration.

The flooding in Lahaina is a result of runoff conveyed through numerous small drainages spread along the width of the Lahaina subwatershed. For this reason, a diversion channel to intercept the runoff from the Lahaina subwatershed and carry it to a safe outlet appeared to be the most practicable solution to the flooding problem. Frequency vs. discharge relationships were developed for the Lahaina and Kauaula subwatersheds by the Hawaii hydrologist using the SCS TR-20 computer program.

Appendix C

A diversion channel extending across the Lahaina subwatershed from Lahainaluna Road to Kauaula Stream was planned. Most of the diversion channel will be vegetated earth channel. Channel stability was determined using the procedure discussed in USDA-ARS, Stability Design of Grass-Lined Open Channels (1987).

Several outlet locations were considered for the diversion channel. The the completion of design and the commencement of construction of a flood control project on Kahoma Stream, to the north, precluded its use to outlet the additional runoff from the Lahaina subwatershed. Ocean outlets at the end of Dickenson Street and at Maluuluolele park between Prison Street and Shaw Street with covered concrete channels were proposed. High construction costs and environmental concerns regarding sediment discharge into the fringing reef area fronting Lahaina town diminished their practicability.

Kauaula Stream, to the south, presented many advantages as an outlet for the diversion channel. The Kauaula subwatershed peak discharge is nearly four times greater than the discharge from the Lahaina subwatershed for the same frequency storm. Kauaula Stream capacity and its ocean outlet have been naturally developed to accommodate high runoff and high sediment concentrations. In addition, the Kauaula subwatershed is considerably greater in length than the Lahaina subwatershed resulting in a lag between the peak discharges from the two subwatersheds. For the same storm, the peak discharge from the Lahaina subwatershed will pass well before the peak discharge from the Kauaula subwatershed. The discharge from the diversion channel is not expected to increase the the peak discharge in Kauaula Stream more than 2%.

The inability of the existing outlet structures to accommodate the 100-year discharge without modification and community concerns about the increase in discharge in the existing outlet channel and impacts to the fronting reef environment by the increased sediment discharge prompted consideration of a second outlet. A outlet location two-thirds of a mile to the south of Kauaula Stream was identified in a supplementary marine examination. (Grigg, 1986)

The primary earth diversion channel was set below the general slope break at the 80 foot to 100 foot MSL elevation to minimize the volume of excavation and embankment fill. The highest alignment, 50 feet to 80 feet MSL, below the slope break was selected to provide flood protection to the development proposed by AMFAC, in 1982, above Honoapiilani Highway. The slope of the diversion channel has been set to minimize the right of way needs while maintaining earth channel stability.

The diversion will be lined with bermudagrass. Stability analysis was conducted in accordance with USDA-ARS, Stability Design of Grass-Lined Open Channels.

A noncohesive soil was assumed to account for the large fraction of coarse material along the lower reaches of the diversion channel. The iterative analysis indicates channel stability given a D75 soil particle size greater than 1 inch diameter with an average stand of bermudagrass 6 inches in length. Soils tests show D75 greater than or equal to 1 inch at Stations

18+40 and 36+70. The geologist's test pit notes indicates considerable cobbles and boulders at the locations that were not included in the sieve tests. Cohesive soil analysis was conducted for the CL soil at Station 40+00, Plasticity Index of 14.

The grass-lined channel analysis was conducted on the upper part of the diversion, above Station 55+00, assuming cohesive soil conditions due to a smaller coarse fraction in the soil profile. At Station 75+00, the ML soil at the 6.5 foot depth had a plasticity index of 17.

Channel stability was confirmed at the tested locations for good bermudagrass lining mowed to six inch length.

At the upstream end of the earth diversion a reinforced concrete U-frame channel is used because of the steep gradient (4%). An earth inlet basin along side Lahainaluna road will collect the roadside runoff and the discharge from the 2 foot diameter culvert from the subdivision to the north of the road. The inlet basin will also trap debris. A side inlet weir from the inlet basin will be used at the upstream end of the concrete channel. Side inlets to allow surface runoff to enter the channel along the uphill side of the channel will be provided.

A St. Anthony Falls stilling basin will be installed at the downstream end of the reinforced concrete channel. Tailwater will be provided by a sediment basin.

The channel alignment is constrained by Pioneer Mill's Wainee Reservoir. The channel has been kept below the toe of the reservoir embankment while minimizing its effect on the households in Wainee Village. A reach of reinforced concrete channel has been incorporated adjacent to Wainee Reservoir in order to narrow right of way width and avoid relocation of households in Wainee Village. The nearest home to the channel right of way is estimated to be 35 feet away.

Three sediment basins will be installed along the earth channel. The basins will be widened sections of channel with inverts set two feet below normal channel grade to provide sediment storage.

Average velocities through the basins will be limited to two feet per second at full sediment capacity. Sediment particles and aggregates larger than 3 mm will be trapped by the sediment basins. Preliminary soils analysis showed that roughly one-quarter of the surface soil particles are larger than 3 mm. Subsequent, more detailed surface soils analysis indicate finer soils often with less than 10 percent of the soil particles larger than 3 mm. Although a trap efficiency of about 10 percent can be expected during the 100 year storm, a trap efficiency of 25 percent is assumed over the entire range of flows. The average annual sediment discharge of the Lahaina subwatershed is estimated to be 3,800 tons. Storage capacity of 3,150 cubic yards exists in the three basins. One cubic yard of fine sediment is assumed to weigh one ton.

The uppermost sediment basin will be 200 feet in length and 75 feet wide at the bottom. This basin is situated at the upstream end of the earth diversion and provides a stilling pool for the SAF basin. The middle basin

is placed at the natural draw north of Wainee Village and will be a triangular 100 feet by 100 feet shape. The basin will be able to trap the larger cobbles and boulders that will be transported by high concentrated flows. The lower basin is situated just upstream of the debris basin. The basin is roughly 200 feet long by 80 feet wide at its bottom.

Where the projected diversion enters the Kauaula Stream channel a debris basin will be built to prevent damaging boulders and large cobbles from entering the concrete outlet works. The channel reach immediately upstream of the debris basin has an average slope of over 6%. Boulders, several feet in diameter, are transported during high flows.

Transport of boulders by the high gradient stream occurs during periods of heavy streamflow. The upper watershed supply of the coarse sediment is considered unlimited by the Sedimentation Geologist. Cultivation of the sugarcane fields unearths large stones that are pushed up against the stream channel and often roll into the channel. Bedload transport functions were examined to develop a storm frequency vs. bedload discharge relationship for Kauaula Stream that could be used to determine the storage requirement of the basin. Relationships developed from sediment discharge records for Moanalua Stream on Oahu were also used.

The basin was designed to capture all stones larger than 6" in diameter. Storage for coarse sediment discharge from a 100-year, 24-hour storm plus five years of annual sediment discharge was desired. It was determined that velocities of five feet per second or less would allow settlement of stones larger than 6" diameter. It was determined from the transport analysis that 7,000 tons of coarse sediment would be discharged during a 100-year storm. The average annual bedload yield was estimated to be 550 tons with a density of 1.3 tons per cubic yard. Approximately 3,450 tons of fine sediment discharge annually to the debris basin was also estimated.

A partially excavated, partially embanked basin, 400 feet long and 250 feet wide, is proposed for Kauaula Stream. Because the basin is set on slope, it will require an embankment 10 feet high at its downstream end and excavation 30 feet deep at its upstream end. The embankment will have a 15-foot top width, 2:1 outside side slope, and 3:1 interior side slope. Its total storage capacity will be approximately 9240 tons. The basin will be of "flow-through" design with no water storage capacity.

With a full sediment pool and at design discharge the average velocity through the basin will be approximately 2 fps.

Due to the limited capacity of Kauaula Stream in the reach down the alluvial slope, inflow into the debris exceeding the design discharge is not expected. Although flow exceeding 12,000 cfs is expected from the West Maui mountains in the event of a 500-year storm, once released from the valley, floodwater will flow down the alluvial slope through a natural channel that has a capacity that varies between 4,000 and 10,000 cfs. Discharge exceeding channel capacity will flow overland as out of bank flow. Although some return flow to the channel will occur, instream discharge will, effectively, be equal to the capacity of the reach of channel with least conveyance above the basin.

Appendix C

A severe constriction of Kauaula Stream exists at the Lahaina Pump Ditch #2 bridge located approximately 1,000 feet upstream of the proposed debris basin. Present bridge capacity is about 2,000 cfs. The bridge is in need of repair due to erosion around the pier footing. We expect that the bridge will be rebuilt by the Pioneer Mill Company, at which time flow capacity can be increased. Much of the out of bank flow can be returned to the stream channel by grading the cane fields and roads.

Construction of the realigned Honoapiilani Highway will likely require the installation of a bridge over Kauaula Stream uphill of the debris basin. The bridge will funnel all out of bank flow once again into the channel. On the other hand, the bridge capacity will also limit the peak flow. Continued coordination with the State Department of Transportation can assure that design discharge to the basin can be maintained.

Although the basin is designed as a flow-through structure with no retention or storage pool, its location above the state highway and the Puamana subdivision makes it a class "C" structure. Dam breach discharge was estimated by the method in NEM 210-V, Circular No. 1 - Dam Breach Discharge Criteria. The breach discharge was estimated at 1,000 cfs. Although an attenuated flood routing was not conducted, the wave front inundating the Puamana Subdivision from a catastrophic breach would be about six inches high, assuming a 200-foot wave front travelling at 10 feet per second.

Incremental analysis of costs and benefits indicates Alternative 2 that provides 100-year protection maximizes net benefits and is the National Economic Development plan. The NED plan is shown as Alternative 2 in the Plan/EA and was selected as the recommended plan.

Project Costs

Project cost estimates were made based on work item quantities and unit costs from contracts and bid proposals for SCS funded construction in the state during the past 10 years. The August 1985 bids from Napili 2-3 sediment control structure of Honolua Watershed Project 12 miles to the north of the Lahaina area were heavily relied upon. The unit costs were updated to 1991 costs using the ENR Construction Cost Index. The unit costs were reviewed by the Hawaii SCE.

Quantities for each work item were calculated for the five project reaches through the preparation of low and medium intensity engineering designs. A computerized spreadsheet was used to calculate and sum the resultant costs.

Flood protection construction costs were allocated to PL-566 funds. Some construction costs, including relocation of utilities and pipelines and construction of road crossings for the sugar company roads, were assumed to be land rights costs and were allocated to sponsor funding.

An additional 12% was added to the construction costs for contingencies. Engineering services costs were estimated at 10% of total installation and administrative services costs at 8% and were apportioned to the two funding sources. Although an analysis of the fraction of engineering and administrative costs for past SCS contracts was not conducted, the rates

that are used are similar to those used for other SCS projects of like nature and magnitude.

The cost of acquisition of rights of way were estimated by examining present land use and proposed land use in the project area. Right of way costs were allocated without contingency to sponsor costs. Relocation assistance costs were apportioned by the ratio of the costs borne by the two funds.

Unit costs were first developed in 1986. Costs were updated to 1991 levels by using the Engineering News Record construction cost index. Most construction cost items were increased by 11 percent at that time.

A 100-year project evaluation period was used. Three years for installation is assumed. Construction costs were discounted to present value for year zero and a 8-1/2% discount rate with 100 year amortization was used to to compute the annualized installation cost.

Operation, Maintenance and Replacement (OM&R) costs were estimated by summing manpower and equipment costs for items of work such as administration, inspection, vegetation control, and trash clearing. Percentages of installation cost were used for periodic maintenance of structures and replacement of structural work.

Total annualized cost include the annualized installation cost and annualized OM&R cost.

The summary of installation costs for the selected plan is shown as Table 4 below. The variation between the total cost shown below and that used in the Plan-EA is due to rounding.

Appendix C

COSTSHEET
LAHAINA WATERSHED PROJECT - 100 YR ALTERNATIVE, 2 OUTLETS
TOTAL COSTS

CONSTRUCTION ITEMS	UNITS	NO. UNITS	UNIT COST	TOTAL COST
CLEAR AND GRUB	L.S.	1	11400	11400
MOBILIZATION	L.S.	1	45800	45800
POLLUTION CONTROL	L.S.	1	34300	34300
STRUCTURE REMOVAL	EA.	0	5700	0
EXCAVATION, UNCLASSIFIED	CU.YD.	231708	5.7	1320736
EARTHFILL, COMPACTED	CU.YD.	54200	11.5	623300
CONCRETE, CLASS 4000	CU.YD.	3095	310	959450
STEEL REINFORCING	LB.	414394	0.8	331515
EPOXY COATED REINF. STEEL	LB.	0	1.60	0
RIPRAP, LOOSE	CU.YD.	1613	57	91941
RIPRAP, GROUTED	CU.YD.	493	172	84796
DRAINFILL AND BEDDING	CU.YD.	2422	85	205870
DRAINLINE	LN.FT.	4640	11.5	53360
CHAINLINK FENCING	LN.FT.	4870	12.5	60875
VEGETATIVE COVER	AC.	16.51	5000	82550
ASPHALT BASE REM./REPLAC.	SQ.YD.	167	40	6680
PIPELINE RELOCATION 1/	L.S.	1.00	68600	68600
FIELD OFFICE	L.S.	1	17200	17200

1/ includes relocation of 9 utility poles.

SUBTOTAL				3998373
CONTINGENCY (12%)				479805
CONSTRUCTION COST				4478178
ENGINEERING COST (10%)				447818
ADMINISTRATIVE COST (8%)				358254
RIGHT OF WAY COST (AG.)	AC.	31.58	35000	1105300
RIGHT OF WAY COST (RES.)	AC.	0	500000	0
HOUSEHOLD RELOCATION	EA.	0	50000	0
TOTAL PROJECT COST				6389549

COST SHARE ITEM	PERCENT PL-566	PL-566 COST	LOCAL COST	TOTAL COST
CONSTRUCTION	92	4159893	375575	4535469
ENGINEERING	100	415989	0	415989
ADMINISTRATION	50	166396	166396	332791
RIGHT OF WAY	0	0	1105300	1105300
HOUSEHOLD RELOCATION	0	0	0	0
TOTAL COSTS		4742278	1647271	6389549

INVESTIGATION AND ANALYSES

PUBLIC PARTICIPATION

Public participation in the planning process assures that concerns of the citizens, groups, and agencies affected by project implementation receive careful consideration and are incorporated into the plan where possible. The request for federal assistance to relieve flood problems in Lahaina was received from the West Maui Soil and Water Conservation District and the County of Maui in November, 1980. A series of scoping meetings with the sponsors, agencies, and the public was begun in late 1981.

An informal workshop was conducted on September 12, 1981, at the Lahaina Civic Center, where individualized interchange between SCS staffers and the public was made possible. Several meetings with groups, such as the major land users, landowners, and the Puamana Subdivision residents, were held in 1982 and 1983. It was through such meetings that the basic plan to provide flood protection was developed. A history of flooding and the resulting losses was established to describe the existing conditions for the Preauthorization Report (SCS, 1985). Input from Pioneer Mill Co. and AMFAC Properties helped determine the future condition scenario incorporating Pioneer Mill's cultivation plans and needs and AMFAC Properties' development plans

Planning Authorization was granted by SCS National Headquarters on March 18, 1985. During that year a concerted effort was made to contact the major groups and agencies that would be affected by the project or had jurisdiction over any aspect of the project. Consultation with the following agencies and individuals was begun 1985:

Hawaii Division of Water and Land Development
Hawaii Office of Historic Preservation
Hawaii Division of Aquatic Resources
Hawaii Division of Forestry and Wildlife
Hawaii Department of Planning and Economic Development
(now the Hawaii Office of Planning)
Hawaii Department of Transportation
Senator Daniel K. Inouye
Senator Spark M. Matsunaga
Representative Daniel K. Akaka
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Forest Service.
Puamana Community Association

A Public Meeting was held at Kamehameha III School on the evening of December 3, 1985. At the widely publicized meeting a preliminary plan to provide flood control was described and the attendees were asked to voice their comments and concerns. It appeared that sediment discharge was a major concern of the attendees. They supported measures, e.g. sediment basins, to decrease sediment discharge to the reef area. A letter responding to their voiced concerns was prepared and mailed to the attendees.

Appendix C

Following the development of alternative plans for flood protection a Public Meeting was held at Kamehameha III School on July 2, 1986. Four plans were described that offered varying levels of protection. Three alternatives utilized Kauaula Stream as the project outlet. One alternative used two outlets. The engineering works, constraints and costs were described. The economic analysis for the project was described. Benefit-cost ratios were provided for each alternative. The attendees were polled on the alternatives. The group recommended the 50-year level of protection alternative with a single outlet, which also offered the highest B:C ratio, to the sponsors.

On July 20, 1989, after plan selection and near the completion of the draft Plan/EA, a public meeting was held in Lahaina to describe the forthcoming report. Comments and questions from the audience indicated support for the project. After a delay to clarify project benefits, the draft Plan/Environmental Assessment was distributed for review in December 1990.

During the review and at the public meeting held on February 25, 1991, objections to portions of the plan arose. Strong community opposition to the use of Kauaula Stream as the sole project outlet was generated by some owners and residents of the Puamana units. Concerns about the adequacy of the 50-year level of protection, relocations in Wainee Village, and the potential hazard of the debris basin embankment also arose.

The negative community response led to the revision of the plan in mid-1991 to satisfy the community concerns. Through a process of correspondence, phone conversations, and meetings, a modified alternative utilizing two outlets, with a reduced embankment hazard, requiring no household relocations, and providing a 100-year level of protection was prepared.

A public meeting was held on November 19, 1991, at the Lahaina Civic Center to present the alternative, receive comments, and respond to questions. Approximately 100 persons were in attendance. A number of individuals and organization representatives expressed support for the proposed project. There were also others present who voiced concerns about the environmental effects of watershed runoff and impacts in the nearshore area. A summary of the meeting was compiled and sent to all persons on the attendance list.

The draft Plan/EA was sent to all agencies and individuals listed in the Consultation and Public Participation section of the Plan/EA for review. In addition, copies of the draft Plan/EA was made available through the Public Libraries in Lahaina and Wailuku and at the Wailuku and Honolulu SCS offices. Availability of the document was publicized through mailed announcements and newspaper notices. Approximately 100 copies of the draft Plan/EA were distributed. The review period extended from March 1, 1992 to April 17, 1992. Twenty-two letters with review comments were received.

Evaluation of Concerns

The identification and evaluation of concerns was an ongoing process through the development of the watershed plan. Community concerns were elicited through public meetings, meetings with local organizations, and through personal contact by West Maui SWCD members. The planning staff, in

consultation with the SWCD, County of Maui, and the SCS Wailuku Field Office, developed a list of concerns voiced by the local community. Also incorporated into the list were the environmental and cultural concerns that are normally taken into account during environmental assessment.

Most of the concerns that warranted attention related to the flood problem or the flood-borne sediment. Loss of property or income due to flooding and sediment damage was, perhaps, the most significant concern. The stoppage of business and services in Lahaina Town due to flooding was another major concern. The threat to human safety was also expressed. Many people in the tourism industry expressed concerns about the adverse effects of floods and sediments to the ocean environment and the resulting loss of revenue.

All of the concerns expressed by the community that were affected by the installation of the watershed plan were accorded a "high" degree of significance to decisionmaking. Those concerns that remain unaffected by any of the alternative watershed plans or were not existent in the watershed were determined to have a "low" or "none" ranking.

Appendix C

INVESTIGATION AND ANALYSES

ENVIRONMENTAL ANALYSIS

General

The environmental analysis was a continuing process throughout the planning process. The process consisted of the following steps:

1. Scoping of Concerns -- Environmental and cultural resources are identified and existing data collected.

2. Preliminary Assessment -- Those concerns that may be significantly impacted by the project are identified.

3. Detailed Investigation/Inventory -- Field investigation or inventory of those concerns identified in the Preliminary Assessment is conducted to develop an adequate information base.

4. Detailed Assessment -- Determination of the impacts of the project is made.

The analysis began by contacting the various State and Federal agencies responsible for natural and cultural resources management and requesting assistance in determining any impact on the environment due to the installation of alternatives to alleviate the flooding, erosion and sedimentation problems in the area. The "scoping of concerns" utilizing government agencies has proven to be a satisfactory arrangement in previous SCS planning projects as working relationships with mutual understanding of agency priorities have been established.

Where concerns were raised, specialists were called upon to develop field data and to make an assessment of the impacts of the project on the resource.

Public meetings and meetings with the sponsors were held to identify concerns and to discuss the environmental impacts of the alternatives.

Environmental Concerns

Marine Resources

From the outset, project planners were aware that a major concern was the effect on the coastal environment near the area where the diverted flood waters would enter the ocean. SCS contracted for a study of the effects of flood waters on the coastal environment and the conclusions were used to consider outlet locations that would have the least effect.

An assessment of potential marine ecological impacts of the Lahaina Watershed project was conducted in 1982 and 1983, by Dr. Richard W. Grigg, Marine Biologist, University of Hawaii. The contract involved assessing the potential ecological impacts within the fringing reef fronting Lahaina Town and at the stream mouth of Kauaula Stream. Dr. Grigg concluded that

the potential environmental impact to the marine environment at the Kauaula Stream mouth would be considerably less than than to the nearshore reef area fronting Lahaina Town.

Another purpose for conducting the marine study was to establish a baseline against which changes to the marine environment caused by installation of the project could be assessed.

A second marine ecology assessment was conducted by Dr. Grigg in 1986, regarding nearshore sites to the south of Kauaula Stream in an effort to identify a second outlet site. One of the preliminary alternatives that was considered employed a second outlet to raise the flood prevention level of protection while retaining the existing bridges and outlet channel for Kauaula Stream. The supplemental assessment concluded that a second outlet approximately 3,600 feet to the south would cause the least adverse impact to the reef resource. The preliminary alternative with two outlets was judged to be too costly and was not selected as the Recommended Plan in 1990.

During review of the draft Plan/EA, issued in December 1990, concerns were raised by members of the Puamana community about the effects of the combined runoff from the Lahaina and Kauaula subwatersheds on the reef resources fronting the stream mouth. A two outlet plan was again evaluated to reduce floodwater and sediment discharge at Kauaula Stream. Dr. Grigg was asked, in September 1991, to resurvey the previously examined sites for the following purposes:

1. Ascertain any changes to the reef environment that had taken place between the 1983 and 1986 surveys and the present time. The resurvey provided validation of the reef resource data collected earlier. The resurvey also provided a means to assess the effects of present runoff and sediment conditions on the reef.

2. Reevaluate Site D', the proposed second outlet, for its suitability as an outlet to receive approximately three-quarters of the total runoff and sediment from the Lahaina watershed.

3. Determine if changes in algae abundance had taken place since the previous surveys. This item was prompted by a algae outbreak six miles north of Lahaina that had received much public attention.

By swimming transect lines identical to the earlier surveys and comparing photographs of quadrats taken at the same depths, Dr. Grigg concluded the following (Grigg, 1991):

"1. No differences in percent coral cover and species composition of coral and algae at Sites A and B were detected between surveys taken in 1982-1983 and 1991. This result is evidence that current discharge practices are ecologically sound and that over the long-term the reef ecosystems at Sites A and B are stable. Neither site should be negatively impacted by the placement of a new outlet at Site D'.

"2. Site B, directly off Kauaula Stream is more degraded than Site A; coral cover is about 20% less overall. This condition is probably related to the presence of Kauaula Stream and sediment discharge at this site.

"3. Site D', the locale selected for the new second ocean outlet for the Lahaina watershed project, is the most degraded area between it and Lahaina Harbor. No significant changes in species composition or abundance of coral or algae have occured at Site D' between 1986 and 1991. Placement of the second outlet at Site D' is equivalent to diverting the heaviest sediment load to the worst area in terms of ecological and recreational values.

"4. Neither the present or proposed new project pose any significant negative impacts to endangered or threatened species in the area including the Hawaiian green sea turtle (Chelonia mydas)."

The bottom at Site D' is characterized as "sandy with low outcrops of barren limestone rock supporting small clumps of living coral." (Grigg, 1991) The lack of broad reef structure fronting Site D' results in a stronger wave climate near the shoreline and supports the littoral transport of sand to cobble sized sediments along the coastline which, in turn, may inhibit development of a fixed coral community.

Site D' supports a lesser diversity of fish and coral species and has less coral cover than at Site A or B as evidenced by the inventories by Dr. Grigg in 1986 and 1991. The approximate mean percentage of coral cover, during the two surveys, at Site A is 50 percent, at Site B it is 30 percent, and at Site D' it is six percent.

The most significant effects of project installation are the changes to runoff and sediment discharge rates. The following two tables show the storm water and sediment discharges at Kauaula Stream (Site B) and at the second outlet location (Site D') before and after project installation, for varying storm recurrence intervals.

The following are the before and after project peak storm water discharges, in cubic feet per second, at the two sites.

	Site B		Site D'	
	Before	After	Before	After
2-Year	460	100	5	260
5-Year	1,300	480	20	730
10-Year	2,160	920	60	1,260
25-Year	4,100	1,950	170	2,280
50-Year	5,910	2,900	320	3,240
100-Year	8,100	4,050	560	4,450

Appendix C

The following are the total sediment discharge, in tons, at Sites B and D':

	Site B		Site D'	
	Before	After	Before	After
2-Year	1,260	50	0	400
5-Year	3,200	300	410	3,500
10-Year	5,500	1,010	980	6,160
25-Year	9,000	3,980	2,310	8,680
50-Year	13,000	5,830	3,710	12,270
100-Year	18,000	8,200	5,810	17,400

By examination of the sediment discharge amounts, the discharges at Site D' are comparable in quantity to the present condition at Site B. A primary difference is that the present discharge at Site B is approximately one-third coarse sediment while the projected sediment at Site D' will be nearly all fines. Coarse sediment will deposit in the vicinity of the stream mouth. Fine sediments generally remain suspended in the water column and are moved offshore by currents except in calm environments such as embayments and harbors.

A comparison of sediment discharge during the 2-year, and more frequent, storms indicates the discharge at Site D' will be considerably less than that at Site B during such storms of lesser intensity that occur several times a year. This situation is due primarily to the efficiency of the sediment basins. During intense storms temporary degradation, due to sediment and fresh water outflow, can be expected at any outlet.

An indication of the potential impacts at Site D' caused by the increased sediment load can be found in the the present condition of the Kauaula outlet. Even with a sediment discharge regime equal or exceeding that proposed for Site D', the reef community is not extensively degraded.

The recovery of nearshore nutrient concentrations to background levels following an intense storm will vary as a function of many factors. Once stream runoff has ended, the most important factors will be related to generalized movement of the receiving seawater. If strong seaward currents and active wave climate exist, a rapid recovery to background levels of all suspended and dissolved contaminants will occur regardless of the storm intensity. We expect this to be the case at Site D' where dye plume trajectories move directly off shore into deeper water where it engages the off shore current.

Storm runoff will still be discharged at Site A from the drainage area below the proposed project diversion. The drainage area is predominantly urban. The County of Maui is preparing plans to improve the local drainage system.

There is no identified negative impact from installation of the project on Site A as a result of diminished surface water flow. There is probably a significant volume of fresh groundwater issuing along the coastline which will not be affected by the project. The Lahaina area has been characterized by the USGS as a low-head coastal area where little or no coastal sediment impedes the flow of freshwater to the ocean.

Appendix C

Biological Resources

Following project authorization, assessment of biological resources in the project area was conducted at a reconnaissance level through inquiries to responsible Federal and State agencies. In October 1985, letters were sent to the U.S. Fish and Wildlife Service, State Division of Aquatic Resources, and the State Division of Forestry and Wildlife requesting assistance to identify impacts to biological resources in the Lahaina watershed. Dr. Grigg's marine assessment was also made available to the agencies.

The U.S. Fish and Wildlife Service concurred with Dr. Grigg's 1983 findings and recommendations. In addition, Fish and Wildlife Service recommended that sediment control measures be utilized to minimize sediment discharge to the ocean.

The State Division of Aquatic Resources responded that although use of the Kauaula outlet would "probably harm marine life less" than discharge near the boat harbor, sediment and nutrient loading of the deeper water off Makila Point may impact coral and glass bottom tour boat operation.

The State Division of Forestry and Wildlife responded that the "project area lies well outside the forested and wildlife areas of the watershed." The Division of Forestry and Wildlife foresaw no impact to forestry or wildlife due to the project.

There are no undisturbed natural areas in the lower part of the Lahaina Watershed that will be affected by project installation. The diversion channel alignment is now used for sugarcane cultivation and associated roads, ditches, and vacant land. The benefitted area below the diversion is in agricultural and urban uses. Vegetation in the lower watershed consists predominantly of introduced species. Of the native plant species, including the endemic wiliwili (Erythrina sandwicensis) and 'anunu, none are considered rare, threatened, or endangered by either federal or state governments.

The only animal species listed as threatened or endangered occurring near the project area are the Hawaiian green sea turtle (Chelonia mydas) and the Humpback whale (Megaptera novaeangliae). Consultation with specialists from National Marine Fisheries indicates no significant adverse impact to the green sea turtle will be caused by the project implementation.

Fish habitat in the Kauaula Stream is limited to the lower reaches where there is tidal backwater in the existing concrete outlet channel.

The wildlife habitat is limited to the sugarcane fields and the vegetated area along the Kauaula Stream. These areas are habitat for rats and mice. The Hawaiian owl, or pueo (Asio flammeus sandwichensis) may frequent the area because of the likelihood of rats and mice inhabiting the sugarcane fields.

The proposed alternative will require approximately 28 acres of agricultural land for the installation of the floodwater diversion channel.

The vegetated earth diversion channel will restore approximately 20 acres of similar habitat.

Cultural Resources

Consultation with the State Office of Historic Preservation was begun in 1985 with a request for assistance to determine possible impacts to historic or cultural sites due to installation of the project.

A review of the Division of State Parks and Historic Sites indicates that the Lahaina Watershed project installation does not occur on historic properties that are listed on the Hawaii Register or the National Register of Historic Places, or that have been determined eligible for inclusion on the National Register of Historic Places. Project improvements will be as close as one-half mile from the Lahaina Historic District (site #3001) and Hale Pa'i (site #1596), sites listed on the National Register of Historic Places.

A field inspection of the proposed floodwater diversion, sediment basins, debris basin, and outlet channel sites were made by a staff archaeologist of the State Historic Sites Section, in March 1986. The field inspection resulted in the determination that the project will have no adverse effect on the Lahaina Historic District.

A physical inspection of the proposed floodwater diversion alignment, also conducted in March 1986, resulted in a negative finding of any evidence of significant cultural resources along the proposed route which has been extensively disturbed and modified by sugarcane production since the 1860's. In the event that any previously unidentified sites or remains are uncovered, work will be stopped in the immediate area and the State Office of Historic Preservation will be notified. The State Historic Preservation Officer will assess the impact and will make recommendations for mitigation activity, if warranted.

In the earlier plan, the installation of the diversion channel may have required the removal of up to five homes in Wainee Village. The houses were characterized as "plantation camp" houses. Thousands of such homes were constructed by the plantations throughout Hawaii to house workers during the pre-World War II period.

Through consultation with the SHPO, it was determined, in September 1989, that 1) Wainee Village meets the criteria for historic sites and 2) the homes affected by the project have little historic value due their peripheral location and extensive alterations. Any demolition of these houses will be accompanied by recording and documentation of the structure as may be required by the State Historic Preservation Office. No such relocations are needed for the Recommended Plan.

Forestry

Letters were sent to both the U.S. Forest Service and the State Division of Forestry and Wildlife requesting assistance to identify possible impacts to forest resources due to installation of the project. Their response

indicates there will be no impact resulting from this project on forest resources in the area.

Important Agricultural Land

There are 205 acres of prime agricultural land and 1100 acres of other important agricultural land in the watershed area. Twenty-eight acres of prime and other important agricultural land will be converted to flood prevention purposes as a result of the project.

Consultation with The Pioneer Mill Company, operator of the affected farmland, has been ongoing. The impact of the conversion of agricultural land to flood prevention purposes is offset by the reduction in agricultural flooding damage and reduction in downstream sediment impacts.

Visual Resources

The scenic beauty of the Lahaina area is an economic asset that should be maintained. Although the proposed works of improvement will be visible from many locations in the Lahaina area, significant adverse impact should not exist. The earth diversion and its embankment will be visible from the town area. The grassed embankment will blend into the agricultural landscape when it is not screened by mature sugarcane.

The most visible component will be the debris basin on Kauaula Stream approximately 200 feet above Honoapiilani Hwy. In form, the basin embankment will resemble the many rockpiles in the area that have been created by sugarcane cultivation operations. Vegetative screening and use of architectural textures and colors for concrete works will minimized its visual impact.

Viewscape modelling of the project improvements using a U.S. Forest Service computer program called "New Perspectives" was attempted in 1986, in Portland, OR. Coarse line drawings of existing and after installation views of the diversion and debris basin were produced on a pen plotter. Although the technology appeared promising, the effort was not followed through due to time and cost constraints.

Conclusion

Throughout the planning, environmental impacts of the proposed alternatives were considered. Meetings with the sponsors, the public, private industry, and state and county agencies were held to ascertain and evaluate environmental effects that may result from project implementation.

Identified concerns such as effects of sediment and agricultural chemicals on marine ecosystems have been considered and analyzed using best available knowledge and data. Project measures have been planned to minimize adverse impacts. Comments received during review of the draft Plan/ Environmental Assessment were answered with no unresolved issues.

A Finding of No Significant Impact was issued on June 19, 1992 and was published in the Federal Register, Volume 57, No. 130, on July 7, 1992.

Appendix C

The administrative waiting period during which no project action was taken closed on August 7, 1992.

Appendix C

APPENDIX D

PROJECT MAP

PROJECT MAP

Lahaina Watershed
Maui County, Hawaii

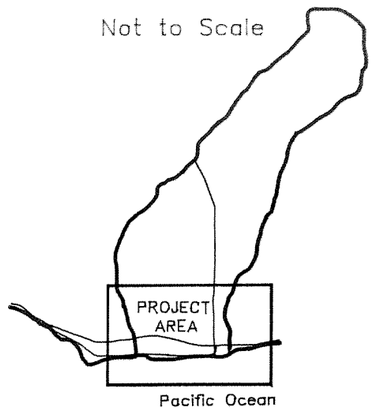
0 500 1000 2000
FEET

North

Inlet Basin
Reinforced Concrete Channel
Sediment Basin
Grass-lined Diversion
Sediment Basin
Reinforced Concrete Channel
RESERVOIR
WAINEE VILLAGE
Grass-lined Diversion
KAUAULA STREAM
Watershed Boundary
LAHAINALUNA ROAD
Watershed Boundary
LAHAINALUNA STREET
DICKENSON
WAINEE STREET
PRISON STREET
HONOAPIILANI HWY
Sediment Basin
Debris Basin
Reinforced Concrete Basin Outlets
Grass-lined Diversion
Sediment Basin
FRONT STREET
MALULUOLELE PARK
SHAW STREET
Existing Puamana Channel
Second Outlet with Highway Culvert
LAHAINA TOWN
Pacific Ocean
PUAMANA

LAHAINA WATERSHED

Not to Scale



LEGEND

CHANNEL WORK

BENEFITTED AREAS

Urban

Agriculture

Common Floodplain

Nearshore Marine