EXECUTIVE CHAMBERS

HONOLULU

BENJAMIN J. CAYETANO
GOVERNOR

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OFFICE OF ENVIRONMENTAL QUALITY CONTROL

November 12, 1999

TO: The Honorable Kazu Hayashida, Director
Department of Transportation

SUBJECT: Acceptance of Final Environmental Impact Statement for Saddle Road Improvements

With this memorandum, I accept the Final Environmental Impact Statement for Saddle Road Improvements, Mamalahoa Highway to Milepost 6, the island of Hawaii, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. The economic, social and environmental impacts, which will likely occur should this project be implemented, are adequately described in the statement. The analysis, together with the comments made by reviewers, provides useful information to policy makers and the public.

My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws but does not constitute an endorsement of the proposed action.

I find that the mitigation measures discussed in the environmental impact statement will minimize the negative impacts of the project. Therefore, if this project is implemented, the Department of Transportation and/or its agents should perform these or alternative and at least equally effective mitigation measures at the discretion of the permitting agencies. The mitigation measures identified in the environmental impact statement are listed in the attached document.

Benjamin J. Cayetano

BENJAMIN J. CAYETANO

Attachment

c: Honorable Bruce S. Anderson, Ph.D., M.P.H.
Office of Environmental Quality Control

1999 FEIS HAWAII
SADDLE ROAD IMPROVEMENT 1 OF 2

SEP 8 1999
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FHWA-FPHI-EIS-97-1-F

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FINAL
ENVIRONMENTAL IMPACT STATEMENT
PART I

Saddle Road (State Route 200)
Mamalahoa Highway (State Route 190) to Milepost 6

County of Hawai'i, State of Hawai'i
FHWA Project No. A-AD-6(1)

U.S. Department of Transportation
Federal Highway Administration
Central Federal Lands Highway Division

State of Hawai'i
Hawai'i Department of Transportation
Highways Division

FHWA-FPHI-EIS-97-1-F

SADDLE ROAD (STATE ROUTE 200)
Mamalahoa Highway (State Route 190) to Milepost 6
County of Hawai'i, State of Hawai'i
FHWA Project No. A-AD-6(1)

FINAL ENVIRONMENTAL IMPACT STATEMENT
PART I
Submitted Pursuant to Section 42 U.S.C. 4332(2)(c)
and Chapter 343, Hawai'i Revised Statutes by the

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration (FHWA)
Central Federal Lands Highway Division
and
STATE OF HAWAI'I
Hawai'i Department of Transportation (HDOT)
Highways Division

Cooperating Agencies
U.S. Army Garrison, Hawai'i
Hawai'i Department of Hawaiian Homelands
Hawai'i Department of Health

For additional information, the following persons may be contacted for additional information concerning this document:

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FHWA-FPHI-EIS-97-1-F

SADDLE ROAD (STATE ROUTE 200)
Mamalahoa Highway (State Route 190) to Milepost 6
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Mr. Kazu Hayashida, Director
Hawai'i Department of Transportation

August 9, 1999
Date

ABSTRACT

This Final Environmental Impact Statement (FEIS) presents the Recommended Alternative and the evaluation of impacts associated with the proposed improvement of Saddle Road between the Mamalahoa Highway (SR 190) and Milepost 6 near Hilo. Twelve action alternatives were under consideration that incorporate use of the existing alignment and potential new alignments. The Recommended Alternative reconstructs the existing substandard two-lane roadway to a two-lane roadway with shoulders for a design speed of 80 to 100 kilometers per hour. Existing Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, and poor pavement, with no shoulders. The existing road passes through key training areas of the U.S. Department of the Army's Pohakuloa Training Area (PTA), creating conflict between motorists and military training units. The Recommended Alternative will improve pavement condition, increase safety and capacity, improve quality of traffic flow, decrease cross-island travel times, and stimulate economic growth and development. The Recommended Alternative will realign the road within the PTA to minimize conflicts between military and public uses. Substantive issues have been resolved and included protected species of flora and fauna, Critical Habitat for the Endangered Palila, wetlands and biological habitats of importance, archaeological resources, fire hazard, residential displacement, and noise.

The FEIS consists of three separate documents: Part I, Part II, and Part III. Part I is the FEIS core document, the revised version of the DEIS. It presents the project purpose and need, alternatives considered, affected environment, environmental consequences, mitigation commitments, and an Executive Summary. Part II is the documentation of the public/agency involvement process. It includes the project development history, the project mailing list, correspondence and notices associated with the EIS process, hearing transcripts and associated documentation, and agency and public comments and responses regarding the DEIS. Part III comprises the technical addendum. It includes copies of supplemental studies related to social impacts, 404(b)(1) wetland issues, and Traditional Cultural Properties (TCP). It includes the final archaeological inventory survey report, the Memorandum of Understanding (MOA) related to cultural resources, the Endangered Species Act (ESA) Section 7 Biological Opinion (BO), the Palila Mitigation Memorandum of Understanding (MOU), and supporting correspondence and documentation. Primary revisions made and new text added to Part I of this FEIS, since the publishing of the DEIS, have been bracketed in the left margin.

Comments on this FEIS are due on or before the close of business October 5, 1999.

All measurements in this document are metric.

Conversion Factors

1 meter = 3.281 feet
1 kilometer = 0.621 miles
1 hectare = 2.471 acres
1 foot = 0.305 meters
1 mile = 1.609 kilometers
1 acre = 0.405 hectares

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LIST OF ABBREVIATIONS

AASHTO ..... American Association of State Highway and Transportation Officials
ACC/MVM ..... accidents per million vehicle miles
ADT ..... average daily traffic
ALF ..... A'a Lava Flows
ALISH ..... Agricultural Lands of Importance to the State of Hawai'i
ASTM ..... American Society of Testing and Materials
BA ..... Biological Assessment
BCE ..... before the Common Era
BMP ..... best management practice
BO ..... Biological Opinion
BRD ..... Biological Resources Division
C ..... Celsius
CAA ..... Federal Clean Air Act
CAAA ..... 1990 Clean Air Act Amendments
CDP ..... Hilo Community Development Plan
CDUA ..... Conservation District Use Application
CE ..... Common Era
CFR ..... Code of Federal Regulations
cm ..... centimeters
CWA ..... Clean Water Act
CZM ..... Hawai'i Coastal Zone Management
DAR ..... Defense Access Road
dB ..... decibels
dBA ..... A-weighted decibel scale
DEIS ..... Draft Environmental Impact Statement
DHHL ..... State of Hawai'i Department of Hawaiian Home Lands
DLNR ..... State of Hawai'i Department of Land and Natural Resources
DHHS ..... State of Hawai'i Department of Health and Human Services
DOA ..... U.S. Department of the Army
DOD ..... U.S. Department of Defense
DOFAW ..... State of Hawai'i Division of Forestry and Wildlife
DOH ..... State of Hawai'i Department of Health
EIS ..... Environmental Impact Statement
EMP ..... Ecosystem Management Plan
EO-PTA ..... Environmental Office of the PTA
EPA ..... Environmental Protection Agency
ESA ..... Endangered Species Act
F ..... Facultative (Vegetation)
FU ..... Facultative Upland (Vegetation)
FW ..... Facultative Wetland (Vegetation)

FEIS ..... Final Environmental Impact Statement
FEMA ..... Federal Emergency Management Agency
FHWA ..... Federal Highway Administration
GVP ..... Gross Value Product
ha ..... hectares
HAR ..... Hawai'i Administrative Rules
HCM ..... Highway Capacity Manual
HDLIR ..... State of Hawai'i Department of Labor and Industrial Relations
HDOT ..... State of Hawai'i Department of Transportation
HELCO ..... Hawaiian Electric Light Company, Inc.
HFBS ..... Hawai'i Forest Bird Survey
HHCA ..... Hawaiian Homes Commission Act
HHL ..... Hawaiian Home Land
HHLP ..... Hawaiian Home Land Program
HRS ..... Hawai'i Revised Statutes
IFA ..... Institute for Astronomy (University of Hawai'i at Hilo)
km ..... kilometers
kV ..... kilovolt
L ..... liters
LEDPA ..... Least Environmentally Damaging Practicable Alternative
L_{eq} ..... average noise level over a 1-hour period
LOS ..... Level of Service
LUPAG ..... Land Use Pattern Allocation Guide
m ..... meters
m^3 ..... cubic meters
mm ..... millimeters
MOA ..... Memorandum of Agreement (Section 106)
MOU ..... Memorandum of Understanding (Palila MOU)
MP ..... milepost
MPO ..... Metropolitan Planning Organizations
MTMC ..... Military Traffic Management Command
NAAQS ..... National Ambient Air Quality Standards
NAC ..... Noise Abatement Criteria
NEPA ..... National Environmental Policy Act
NHPA ..... National Historic Preservation Act
NOAA ..... National Oceanic and Atmospheric Administration
NPDES ..... National Pollutant Discharge Elimination System
NPL ..... National Priority List
NPS ..... National Park Service
NRC ..... National Research Council
NRCS ..... U.S. Natural Resource Conservation Service
NRHP ..... National Register of Historic Places
NWI ..... National Wetlands Inventory

OBL ..... Obligate Wetland (Vegetation)
OHA ..... Office of Hawaiian Affairs
PCB ..... Polychlorinated Biphenyl
PLF ..... Pahoehoe Lava Flows
PM_{10} ..... particulate matter smaller than ten microns in diameter
PTA ..... Pohakula Training Area
R ..... receptors
RCRA ..... Resource Conservation Recovery Act
RCRIS ..... Resource Conservation and Recovery Information System
ref ..... cross reference
ROD ..... Record of Decision
ROW ..... right-of-way
SEE Team ..... Social, Economic, and Environmental Study Team
SHPD ..... State Historic Preservation Division
SHPO ..... State Historic Preservation Officer
SIPs ..... State Implementation Plans
SLU ..... State Land Use
SMA ..... Special Management Area
SR 200 ..... State Route 200 (Saddle Road)
SR 190 ..... State Route 190 (Mamalahoa Highway)
SR 19 ..... State Route 19
SR 11 ..... State Route 11
SRTF ..... Saddle Road Community Task Force
SWPPP ..... Stormwater Pollution Prevention Plan
TRB ..... Transportation Research Board
UPL ..... Obligate Upland Plants
URARPAPA ..... Uniform Relocation Assistance and Real Property Acquisition Policies Act
U.S. DOT ..... U.S. Department of Transportation
USACE ..... U.S. Army Corps of Engineers
USAG-HI ..... U.S. Army Garrison, Hawai'i
USARPAC ..... U.S. Army Pacific Command
USFWS ..... U.S. Fish and Wildlife Service
USGS ..... U.S. Geological Survey
UST ..... underground storage tanks
VA ..... Volcanic Ash Deposits
vpd ..... vehicles per day

EXECUTIVE SUMMARY

S.1 INTRODUCTION

The Federal Highway Administration, Central Federal Lands Highway Division (FHWA), in cooperation with the State of Hawai'i Department of Transportation (HDOT) is proposing to improve Saddle Road, State Route 200 (SR 200). The U.S. Department of the Army (DOA), Military Traffic Management Command (MTMC), serves with the FHWA as co-administrator of the Defense Access Road (DAR) Program. FHWA is the lead agency for environmental compliance. This Environmental Impact Statement (EIS) has been prepared to evaluate the proposed action in accordance with the National Environmental Policy Act of 1969 as amended (NEPA) and Chapter 343 of Hawai'i Revised Statutes (HRS) related to Environmental Impact Statements.

The proposal would upgrade and modernize Saddle Road as a two-lane highway that would meet AASHTO design standards for rural arterials and provide adequate capacity to handle anticipated traffic volumes through 2014 and beyond. The portion of Saddle Road to be improved by this project is approximately 78 kilometers (km) in length and extends from the Mamalahoa Highway (SR 190) to Milepost (MP) 6, near Hilo, Hawai'i (Figure 2.2.1, *Overview of Segments Under Consideration*). The Saddle Road project is included in the Island of Hawai'i Long Range Land Transportation Plan as a Tier 1 Project and will be placed in the federally-required State Transportation Improvement Program (STIP).

The MTMC has determined that the design and construction of the Saddle Road improvements within the approximate limits of the Pohakuloa Training Area (PTA) would be eligible for DAR funds. Funds for constructing the DAR section of highway must be authorized and appropriated by Congress. HDOT will improve the remaining portion of the road, as funds become available.

Existing Saddle Road is approximately 85 km in length extending west from Hilo to its junction with the Mamalahoa Highway (SR 190), approximately 10 km south of Waimea, on the Island of Hawai'i. It was constructed in 1942 by DOA. Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, poor pavement, and substandard drainage. It does not meet contemporary design standards.

Saddle Road is the only paved road serving the astronomical observatory complex on Mauna Kea, Waiki'i Ranch, upper Kaumana, Mauna Kea State Recreation Area, Kilohana Girl Scout Camp, and major hunting areas. Saddle Road is also an important cross-island link for business travel, the transport of goods and services, tourism, recreation, shopping, and commuting.

Saddle Road is the only paved arterial serving the PTA. PTA provides unique training opportunities to the 25th Infantry Division (Light) and units of other services supported by U.S. Army, Hawai'i. These unique opportunities include live-fire maneuver training by larger size infantry units than can be accommodated on Oahu, the ability to fire certain weapons systems at

their maximum range, and the ability to train and certify aviation units. PTA plays an important role in complementing other Army live-fire training ranges on the Island of Oahu.

Transportation of ammunition, water, training equipment, and troops from harbors on both sides of the island creates long, slow-moving convoys on Saddle Road. Saddle Road is also used by PTA personnel to commute to work.

S.2 PURPOSE AND NEED

The purpose of this project is to provide a safe and efficient route for access along Saddle Road and for cross-island traffic between East and West Hawai'i. The proposed improvements to Saddle Road would address five general types of needs: roadway deficiencies, conflicts with and hazards of military operations, capacity, safety, and social demand and economic development.

S.2.1 Roadway Deficiencies

Although Saddle Road is presently two-directional, in practicality, deterioration of the pavement has reduced much of the road to one asphalt travel lane, roughly 4 meters (m) in width, with shoulders less than 1 m in width. Shoulder pavement is more patchy than continuous and shoulder areas do not have adequate "clear zone" or recovery areas. The narrow width and poor pavement conditions encourage motorists to drive in the center of the road, increasing the potential for accidents, including head-on collisions. One stretch of Saddle Road contains six one-lane bridges.

Saddle Road is characterized by steep grades and sharp curves with horizontal and vertical alignment deficiencies, which in many places prevent motorists from being able to see ahead a safe distance to pass or stop. Under these conditions, passing slow-moving vehicles is very hazardous. In addition, pavement markings and roadway signage over much of the road are currently inadequate. Drainage structures are undersized and Saddle Road is often closed during major storm events because of flooding and hazardous road conditions.

S.2.2 Conflicts/Hazards with Military Operations

Saddle Road crosses through the northern portion of the PTA. Extensive training along and across the road has created conflicts between the traveling public and military training exercises, and has reduced the quality of many training maneuvers. Some military operations require artillery to fire over Saddle Road. Training operations by infantry require troops to break from "tactical" formations to "administrative" formations to move across the road. With little warning, motorists may encounter soldiers or military equipment crossing the road.

S.2.3 Capacity

The 1994 average daily traffic (ADT) on Saddle Road was 900 vehicles. Without the project, Saddle Road ADT is projected to be 4,400 by 2014. This level of need far exceeds the road's existing traffic capacity. With the proposed improvements, Saddle Road ADT is expected to increase to 14,000 by 2014, nearly a four-fold increase over that of the No Action Alternative. The projected increase is because of a variety of demands: increased usage associated with commuter traffic; residential development at both ends of the road; tourism and recreation; agriculture; military operations; the Mauna Kea telescope complex; and increasing congestion along alternative cross-island routes.

Level of Service (LOS) expresses quality of traffic flow. It relates to the density of traffic in comparison to the roadway's capacity and expresses conditions of speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. The quality of traffic flow is described in six categories of service, A through F, with LOS A representing traffic in a free flow or uncongested condition, and LOS F representing serious congestion and considerable delays (Table S.1, *Current and Future Traffic Volumes and LOS*). On a two-lane road, such as Saddle Road, LOS is primarily determined by the ability to pass.

Using operational analysis procedures presented in the Highway Capacity Manual, Third Edition, 1994, the LOS under current conditions was calculated. Based on these procedures, Saddle Road is operating at LOS B in some segments, and LOS D in most areas (Table S.1). Given the poor condition of the pavement, its narrow width, alignment deficiencies, and poor sight distances, LOS B overstates the road's current level of service. The FHWA has concluded that the overall LOS for Saddle Road is D. In this instance, LOS D reflects that passing demand is high while passing capacity is very low.

With projected traffic growth and no road improvements, Saddle Road is expected to deteriorate to LOS E by 2014. With LOS E, passing in most locations would be unsafe and *platooning* (slow-moving vehicle causes the backup of vehicles unable to pass) would occur.

With the proposed improvements, the road's current LOS D would be improved to LOS B along W-3, PTA-1, and most of EX-3 by the design year 2014. Roughly the lower 8.1 km of EX-3 and the E-3 alignment would operate at LOS C much of the time, with short segments at LOS D during peak hours in the design year (ref: Figure 2.2.1, Segments Under Consideration). This lower LOS on part of recommended alignments is primarily a result of a more curvilinear alignment with reduced passing opportunities on steeper grades. The curvilinear alignment and reduced passing opportunities are the result of efforts to minimize impacts on sensitive environmental resources in this area. LOS C is acceptable for a design standard when there are overriding factors such as cost and impacts.

TABLE S.1
Current and Future Traffic Volumes and LOS

Year	Alternative	ADT	LOS
1994 Estimated Traffic	Baseline Conditions	900	D
2014 Projected Traffic	No Action Alternative	4,400	E
2014 Projected Traffic	All Action Alternatives	14,000	B

S.2.4 Safety

Roadway deficiencies, conflicts with military operations, and capacity limitations contribute to safety concerns on Saddle Road. Saddle Road's accident rate of 5.43 accidents per million vehicle miles (ACC/MVM) is notably higher than the average rate for rural two-lane highways throughout the State of Hawai'i (3.0 ACC/MVM). Roadway deficiencies also hinder the response of emergency vehicles responding to fires, accidents, and other incidents along Saddle Road.

S.2.5 Social Demand and Economic Development

East and West Hawai'i are distinct in economic opportunities and development. Without an efficient, safe, cross-island route, business opportunities across the island are more limited, and the economies of East and West Hawai'i would be expected to continue to diverge. Government functions are located on the east side of the island in Hilo, where housing costs are generally lower, while much of the tourism-related economic growth and employment is occurring in West Hawai'i. In addition, these conditions create a need for some people to commute cross-island. Decreased cross-island travel times would increase labor force mobility.

SR 19 along the Hamakua Coast is considered the most feasible alternative to Saddle Road for cross-island transportation. SR 19 is longer than Saddle Road between Hilo and Kailua-Kona, and Hilo and Waikoloa. Between Hilo and Waimea, SR 19 is the shorter route. Because of the deficiencies of Saddle Road, the lack of services and few roadside amenities, SR 19 currently carries a larger percentage of the cross-island traffic, resulting in congestion on SR 19 during peak travel hours and increased travel time.

S.3 ALTERNATIVES

Over a three-year period, 1994 to 1997, alternatives for improvement of Saddle Road were developed and refined with the input and involvement of a Social, Economic, and Environmental

Team (SEE Team), the Saddle Road Community Task Force (SRTF, a volunteer citizen's group), government agencies, local residents, landowners, and citizens-at-large through agency and public scoping meetings, the distribution of a DEIS, and public hearings. The SEE Team is an interagency project coordination and guidance team established by FHWA at the outset of all projects and, in this instance, consisted of HDOT, Hawai'i County, U.S. Army Corps of Engineers (USACE), U.S. Army [U.S. Army Pacific Command (USARPAC), U.S. Army Garrison, Hawai'i (USAG-HI), and MTMC], USFWS, Environmental Protection Agency (EPA), and FHWA. This process allowed for early consideration of engineering and environmental issues and numerous refinements of the alternatives under consideration. Of the alternatives considered, some were determined to warrant further analysis, while some were initially considered but eliminated. A No Action Alternative was also considered and evaluated. A Preferred Alternative was not presented in the DEIS.

Documenting the final results of this process, an FHWA *Recommended Alternative* was ultimately selected. The selection of this Recommended Alternative was made with full consideration of the potential impacts of the project and the review of public and agency comments. A legally binding Record of Decision (ROD) will be prepared for this Recommended Alternative.

S.3.1 Design Parameters Common to All Action Alternatives

Saddle Road is to be developed to rural arterial design standards, incorporating design controls presented in the following table. Uphill passing lanes, truck escape ramps, scenic pullouts, and military vehicle crossings will be incorporated into project designs as needed to enhance safety and improve the projected level of service. Table S.2, *Design Criteria*, provides a summary of the design features of the proposed project.

TABLE S.2
Design Criteria

Design Speed	80 km per hour*
Minimum Curve Radius	230 m
Maximum Superelevation	8 percent
Curves	Simple curves with 67 percent of runoff on tangent
Maximum Grade	8 percent

*Design speed may be increased up to 100 km per hour in areas where feasible

The proposed improvements to Saddle Road would incorporate two 3.6-m travel lanes with two 2.4-m paved shoulders. Passing lanes or pullouts will be added in selected locations. In

environmentally vulnerable portions of the study corridor within the PTA, additional features would be constructed to minimize fire hazards, including paved fire breaks, fencing, and asphalt curbs.

S.3.2 Action Alternatives Identified and Considered

The project area has been divided into four sections. Section I begins on the west end at the junction with Mamalahoa Highway (SR 190) and extends east to Saddle Road MP 42. Section II extends from MP 42 to MP 28. Section III extends from MP 28 to MP 9, and Section IV extends from MP 9 to the eastern project terminus, MP 6 (ref: Figure 2.2.1).

A total of 20 segments within the aforementioned sections were initially considered (ref: Figure 2.3.1). Of these, 12 segments were eliminated from further consideration at various points of the study process by consensus of the SEE Team. These alternatives were eliminated because they failed to meet the criteria developed in the purpose and need (e.g., road deficiencies, capacity) or because it was evident without further detailed analysis that the anticipated impacts of their construction were clearly greater than other alternatives. The remaining eight segments were considered feasible, warranting further analysis: W-2 and W-3 in Section I; PTA-1, PTA-3, and EX-2 in Section II; EX-3 in Section III; and EX-4A and E-3 in Section IV. In addition, the No Action Alternative is also considered.

Section I. Segments W-2 and W-3 represent alternative routes to the existing Saddle Road alignment within Section I. Located south of the existing alignment, W-2 would connect Saddle Road to Mamalahoa Highway (SR 190) at Waikoloa Road, Segment W-3 would connect with Mamalahoa Highway (SR 190), 4.8 km south of Waikoloa Rd.

Section II. Segment EX-2 consists of the complete reconstruction of Saddle Road to bring it up to American Association of State Highway and Transportation Officials (AASHTO) standards. This segment would be reconstructed along the existing Saddle Road corridor. It would not accomplish the desired separation of motorists from military maneuvers. Segments PTA-1 and PTA-3 represent alternative routes to the existing Saddle Road alignment within Section II. Located north of the existing roadway, PTA-1 and PTA-3 would succeed in separating Saddle Road motorists from military maneuvers.

Section III. Segment EX-3 consists of the complete reconstruction of Saddle Road to meet AASHTO standards. This segment would be reconstructed along the existing Saddle Road corridor. No feasible or practicable alternatives to the existing corridor were identified within Section III.

Section IV. Segment EX-4A consists of the complete reconstruction of Saddle Road to meet AASHTO standards. This segment would be reconstructed along the existing Saddle Road corridor on the west and east ends of Section IV, but would split from the existing roadway for a 2-km portion in the middle to follow an existing transmission line corridor. Segment E-3

represents an alternate alignment to EX-4A through Section IV and relocates the road south of the existing Saddle Road and farther away from the residential areas in upper Kaumana.

Table S.3, *Comparison of Segments*, provides a summary of the key engineering characteristics and costs of each segment.

TABLE S.3
Comparison of Segments

Segments and Corresponding Station Numbers	Length (km)	ROW (ha)	Max. Grade (%)	Estimated Construction Cost (million $)[1]	Estimated Mitigation Cost (million $)[1]	Total Cost (million $)[1]
Section I - MP 53.6 (Mamalahoa Highway) to MP 42						
W-2:	17.0	73	8.0	39.0	0.5	39.5
W-3:*	15.5	70	8.0	39.0	0.5	39.5
Section II - MP 42 to MP 28						
EX-2:	21.6	47	5.2	38.0	5.0	43.0
PTA-1:*	20.5	83	7.8	38.5	15.0	53.5
PTA-3:	22.1	85	7.8	40.5	15.0	55.5
Section III - MP 28 to MP 9						
EX-3:*	30.9	60	8.0	60.0	1.0	61.0
Section IV - MP 9 to MP 6						
EX-4A:	4.0	12	10.9[2]	15.0	5.0	20.0
E-3:*	5.5	29	8.0	17.0	1.0	18.0
Recommended Alternative				154.5	17.5	172.0

[1] 1999 dollars
[2] Exception to standard in one location less than 500 m in length.
* Designates Recommended Alternative Segments.

S.3.3 No Action Alternative

The No Action Alternative would maintain Saddle Road as it is today. It would include existing maintenance efforts with some possible surface rehabilitation activities. It would not enhance safety, eliminate roadway deficiencies, improve level of service, improve operational function, accommodate future traffic levels, nor reduce or eliminate conflicts between motorists and PTA military operations.

S.3.4 Selection of FHWA-Recommended Alternative

Following the issuance of the Saddle Road Draft EIS (DEIS), the public hearing, and the close of the public comment period, and in consideration of the scientific and technical information developed for the project, as well as public input received, the SEE Team identified Segment W-3 (Section I), PTA-1 (Section II), EX-3 (Section III), and E-3 (Section IV) as their recommendation to the FHWA for improving Saddle Road. The FHWA has adopted these four segments as their *Recommended Alternative* (ref: Figure 2.2.1). The following text summarizes the primary reasons for the selection of these four segments. The No Action Alternative was not selected because it would not satisfy the project's purpose and need.

Section I

One of the most notable considerations in the selection of W-3 as the Recommended Alternative was its efficiency for serving cross-island traffic because the largest percentage of motorists using Saddle Road are coming from or going to Kona. In terms of overall time and fuel savings, W-3 would result in greater benefits to Saddle Road motorists and the community as a whole.

Based on the information available on terrain and geology, and the shorter length of W-3 over W-2, the FHWA determined that W-3 would prove less costly to build than W-2, if detailed design cost estimates were conducted. In addition, traffic operations would be more efficient on W-3 because of less steep grades.

The FHWA also considered public opinion. With the proximity of W-2 to Waiki'i Ranch, community members expressed concern that the siting of Saddle Road on the W-2 alignment would result in noise pollution and would impact the commercial viability of their properties. In consideration of community benefits, construction cost savings, and other reasons noted, W-3 was selected as the recommended alternative for Section I.

The abandoned existing Saddle Road serving Waiki'i and other local access needs would become the responsibility of Hawai'i County to maintain. A modern intersection connecting the existing road to W-3 would be provided at MP 42.

Section II

The most notable consideration in the selection of PTA-1 is that EX-2 would not completely satisfy the project purpose and need because no improvement in the quality and safety of military training would be anticipated and existing conflicts between the military and the public would be only partially removed. In contrast, either PTA-1 or PTA-3 would completely satisfy the project purpose and need. Both of these alignments would also result in substantial impacts by direct modification of Palila Critical Habitat. However, as stated by the U.S. Fish and Wildlife Service (USFWS) in the Final BO, the mitigation measures built into the project design will offset the

modifications being made to Palila Critical Habitat and enhance the likelihood of survival and recovery of the Palila. Palila is the lone surviving Finch-billed Honeycreeper found on Hawai'i.

The most notable differences between PTA-1 and PTA-3 is that PTA-1 is shorter, provides a more direct alignment, would be less costly, and would impact less Palila Critical Habitat. In consideration of the mitigation measures developed for the Palila and the other reasons stated, PTA-1 was selected as the recommended alternative for Section II.

Ownership of the existing Saddle Road in this Section would be transferred to the military as required.

Section III

As a result of much discussion and investigation of potential alternative routes through Section III, it was concluded that all routes other than EX-3 would provide notably greater impacts to adjacent resources. Segment EX-3 was selected as the recommended alternative for Section III.

Section IV

While E-3 would result in the fill of more wetland resources, much of this wetland area is in degraded habitat. In consideration of the native habitat disturbed, the impacts to biological resources were determined to be roughly equivalent for E-3 and EX-4A. EX-4A would cut through the community of Kaumana and would require the acquisition of residential property and the relocation of 11 to 28 households. It would approach or exceed the national noise abatement criteria at 29 residences, and would cause a substantial increase in noise at 18 additional ones. In addition, when considering initial construction and long-term motorist operating costs, EX4A would be the more costly segment over the life of the project. The FHWA also considered public opinion. Letters from Kaumana residents and the Kaumana City Association expressed support for the selection of E-3 and opposition to EX-4A. For these reasons, E-3 was selected as the recommended alternative for Section IV.

S.3.5 Least Environmentally Damaging Practicable Alternative, Sections III and IV

In Sections III and IV, the fill of jurisdictional wetlands will be required for the construction of proposed Saddle Road improvements. To determine the *Least Environmentally Damaging Practicable Alternative* (LEDPA), to address concerns and requirements of the EPA, the USFWS, and the USACE, and to provide a wetland mitigation proposal, a 404(b)(1) Analysis Report was prepared for this project. The 404(b)(1) Analysis Report was prepared in accordance with the "Guidance Papers to Facilitate the Implementation of the Memorandum of Understanding for the NEPA and Section 404 Integration Process for Surface Transportation Projects in Hawai'i" (June, 1994) and the 40 CFR Part 230 Section 404(b)(1) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material. The results of this analysis

identified Segment EX-3 as the LEDPA within Section III and E-3 as the LEDPA within Section IV.

S.4 PROJECT DEVELOPMENT AND PUBLIC INVOLVEMENT

The following paragraphs briefly summarize the key components of the project's development, emphasizing those actions related to the agency and public involvement process. The input received during this process was voluminous and extremely varied in content regarding issues and concerns. For this reason, the reader is referred to Part II of the FEIS for additional, more detailed information.

To incorporate input from participating agencies throughout the project development process, a Social, Economic, and Environmental Team (SEE Team) was established in 1990. The SEE Team is comprised of representatives from each participating agency (ref: FEIS - Part II, 1.2.2). A series of SEE Team meetings were held from January 1990 to March 1998 (ref: FEIS - Part II, 1.1).

In May 1993, various citizens of the County of Hawai'i were invited by Senator Inouye to form a task force for the project. The Saddle Road Community Task Force (SRTF) was formed to solicit and disseminate information about the project within the community (ref: FEIS - Part II, 1.2.1). A series of SRTF meetings were held from June 1993 to July 1999.

From January 1994 to the present, numerous one-on-one meetings were held upon request with interested individuals, agency representatives, and public and private organizations to provide project briefings and/or receive input on project issues and concerns. These included groups such as community councils, community associations, chambers of commerce, and clubs.

A Letter of Intent was sent to all interested parties, agencies, and organizations, and a Notice of Intent was published in the Federal Register, March 1994 (ref: FEIS - Part II, 1.4.1). Notifications of public scoping meetings were mailed in April 1994 (ref: FEIS, Part II, 1.4.1) and Public Scoping Meetings were held in Hilo (May 10), Kona (May 11), and Waimea (May 12). An Interagency Scoping Meeting was held in Hilo (May 10).

In July 1994, project information centers were maintained in Hilo and Kona for several months to make project information available to interested persons and to receive comments. Notices of these centers were published in Hilo and Kona newspapers.

Newsletters were prepared and distributed to a mailing list of over 1,500 people. The first was published in November 1994. To report on the progress of the project, four additional newsletters were subsequently published and distributed, from November 1996 through August 1999 (ref: FEIS - Part II, 1.5).

In October 1995, pursuant to State law, an Environmental Assessment and Notice of Preparation of an EIS was submitted to the State of Hawai'i Office of Environmental Quality Control (ref: FEIS, Part II, 1.4.2). This notice was published in their environmental bulletin which is monitored regularly by interested agencies, organizations, and the public.

In May 1996, sixteen invitations were extended for Cooperating Agency status on the project. Only three agencies acknowledged receipt of the invitation.

A Preliminary DEIS was distributed to all participating, cooperating, and coordinating agencies for review and comment. Two widely-attended interagency meetings were held to discuss issues, impacts, and mitigation as presented in the Preliminary DEIS; one in October of 1996 (prior to the distribution of the Preliminary DEIS to disseminate findings), and another in April 1997 for review and comment on the document prior to publication.

A formal public comment period began with the issuance of the DEIS in October 1997 and the publishing of the Notice of Availability in the Federal Register and Hawai'i Office of Environmental Quality Control Bulletin (ref: FEIS - Part II, 2.1). Two public hearings were held (Waikoloa - Thursday, December 11, 1997 and Hilo - Saturday, December 13, 1997) during this comment period to provide information and solicit formal comments on the project. The hearing transcripts are included in the FEIS (ref: Part II, 2.2). Approximately 100 members of the public provided written comments on the DEIS; roughly 20 individuals presented oral comments at the Waikoloa hearing and approximately 30 individuals presented oral comments at the Hilo hearing. All public and agency comments are included in their entirety in this FEIS (ref: Part II, 2.2, 3.2, and 4.2). A summary of agency comments and associated responses has been prepared and included in the FEIS (ref: Part II, 3.1). Public comments were also summarized, resulting in nearly 320 representative comments (ref: FEIS - Part II, 4.1). The public and agency comments were too varied and numerous to further summarize within this Executive Summary. In response to agency and public comments received on the DEIS, the FHWA project team undertook additional studies and analyses as warranted, prepared responses, and incorporated additional information into the FEIS.

In the summer and fall of 1998, numerous meetings and exchange of correspondence occurred between FHWA and the USFWS, the EPA, and numerous other agencies to resolve issues related to section 7 consultation, wetlands mitigation and the LEDPA, and Palila mitigation. The results of this consultation and coordination are contained in the USFWS Final Biological Opinion (BO), 404 (b)(1) Analysis Report, and the Palila MOU, respectively (ref: FEIS - Part III).

If approved, the ROD would be issued in the summer of 1999. Assuming that the Recommended Alternative is confirmed in the ROD, roadway design could begin immediately following the issuance of the ROD. Surveying, mapping, and Unexploded Ordnance clearance could begin in early fiscal year 2000 as soon as funds are available and phased construction could begin as early as late 2000, if funds become available. An estimated implementation schedule for the complete project is provided in Chapter 1 (ref: Table 1.8.1, *Estimated Implementation Schedule*).

S.5 AFFECTED ENVIRONMENT

S.5.1 Human Environment

Saddle Road provides access to land uses along its corridor, including PTA, the astronomical observatory complex on Mauna Kea, Waiki'i Ranch, Kaumana, the Mauna Kea State Recreation Area, and major hunting areas. The road is also an important cross-island link for business travel, the transport of goods and services, tourism, recreation, shopping, and commuting. Saddle Road is not used regularly by bicyclists or pedestrians because of the substantial change in elevation along its length, foggy and rainy weather, and the lack of adequate shoulders.

Hunting is a long-standing tradition in Hawai'i. Introduced pigs, sheep, goats and a variety of gamebirds are hunted in public hunting units accessed by Saddle Road on the PTA, and nearby state hunting areas. Many areas have limited access because of rugged terrain, sparse road networks, or military limitations.

Much of the Saddle Road corridor is rural in nature. Figure 3.1.1, *Existing Land Use*, depicts general land uses within the study corridor. The primary land use in Section I is ranching. The local population is clustered in Waiki'i Ranch, a residential development with agricultural lots located along the existing Saddle Road alignment. Recreational resources include the Kilohana Girl Scout Camp, and limited hunting lands.

Land uses within Section II are primarily characterized by military use of the PTA. Barracks and other base housing facilities support the military personnel training and working at the PTA. Mauna Kea State Park, the only public park within the study area, offers opportunities for camping, picnicking, hiking, and birding. Public areas for hunting are also available. Section II includes lands set aside for the Hawaiian Home Lands Program (HHLP), which created a land reserve available to qualifying Native Hawaiians for residential, agricultural/farming, and pastoral/ranching homesteads.

The primary land use within Section III is State Conservation District open space; ranching activities are also present. No notable population is present. As in Section II, lands are set aside in this area for the HHLP. Designated hunting areas are located within this section.

The primary land use within Section IV is farming; single-family residential development characterizes a portion of the existing Saddle Road corridor. Population within Section IV is clustered in upper Kaumana, an older suburb of Hilo. Public recreational resources include hunting lands.

Three categories of valuable agricultural land were assessed for the State of Hawai'i: *Prime Agricultural Lands*, *Unique Agricultural Lands*, and *Other Important Agricultural Lands*. Prime

Agricultural Lands are present within Section IV of the study corridor, Other Important Agricultural Lands are present within Sections I and II.

Section 4(f) properties are afforded protection under 49 U.S.C. Section 303. Such properties include any publicly owned land of a public park, recreation, or wildlife and waterfowl refuge of national, State, or local significance, or land of an historic site of national, State, or local significance. Properties in the vicinity of the proposed project include Mauna Kea State Park, Kipuka 'Ainahou Nene Sanctuary, and 19 National Register of Historic Places (NRHP)-eligible archaeological sites. No use of these Section 4(f) properties occur within any of the action or no-action alternatives.

Ambient noise levels along Saddle Road within the project corridor are generally low, reflecting the light traffic volumes on Saddle Road and the undeveloped and unpopulated nature of much of the landscape. Noise levels in the vicinity of PTA can be periodically high in association with military training activities and low-flying aircraft.

The Island of Hawai'i supports two distinct regional economies. The regional economy in East Hawai'i is centered in Hilo, the seat of island government and home to the University of Hawai'i at Hilo and Hawai'i Community College. Historically, the economy on the east side was based on agriculture, with sugar as the main crop. A steady decline in the sugar industry over the past 20 years resulted in the closure of the last commercial operations in 1996.

The regional economy on the west side of the island is primarily based on tourism. Overall, economic activities related to tourism have been rapidly expanding since 1980 and are expected to continue to expand into the next century. A declining economy in East Hawai'i has resulted in an increasing number of individuals seeking employment in tourism-related activities in West Hawai'i.

There are three routes between Hilo and Waimea/Kailua-Kona. The northern route is SR 19, north from Hilo through Waimea and continuing on to Kailua-Kona. The southern route follows SR 11 southwest from Hilo through Volcanoes National Park. The third route is Saddle Road. Table S.4, *Estimated Travel Distance*, compares the distance between major destinations for each route.

TABLE S.4
Estimated Travel Distance

	Estimated Distance (km)	
Route	**Hilo -Kailua-Kona**	**Hilo - Waimea**
SR 19	152	87
SR 11	200	265
Existing Saddle Road	140	97

Saddle Road is the shortest route between East and West Hawai'i, especially between Hilo and the Kona Coast. Although Saddle Road is currently narrow, with steep grades and sharp curves, travel time is still as low or lower than for the other two routes.

Total employment on the island has been expanding since 1980. The average annual employment growth rate for 1980 to 1994 was 5.1 percent on the west side compared to 1.8 percent on the east. Growth rates in job creation have been declining in East Hawai'i, while increasing in West Hawai'i. Income trends parallel those of job creation growth rates. More workers in East Hawai'i are seeking job opportunities in West Hawai'i.

Roughly 1.1 million tourists visited the Island of Hawai'i in 1995, with approximately 33 percent visiting the east side of the island and 67 percent visiting the west. Because of the condition of Saddle Road, automobile rental agencies restrict or prohibit use of their vehicles on the road, discouraging some tourists from including cross-island trips in their itineraries.

People first arrived in the Hawaiian archipelago probably sometime between A.D. 300 and 600. The earliest inhabitants, probably departing from the Marquesas Islands, brought pigs, dogs, fowl, and many of the cultivated plants important to their subsistence economy including coconut, breadfruit, and taro. The early society is presumed to have been structured around the Polynesian concept of hereditary chieftainship, where the difference between the commoner and chief was not nearly as great as it would become in later Hawai'i culture.

Native Hawaiians relied on the environment for survival. They recognized and practiced respect for a hierarchy of life based on regeneration and protection of food sources. They prioritized the non-disturbance of seed producing forest areas to promote new growth. To the Native Hawaiians the older trees are primary; those who use these trees as residence or food source are secondary. For this reason, mamane forest and kipuka are regarded as having special value to native Hawaiians. The mountains or land, water, and sky were a necessary part of the life cycle. The most prominent, celebrated place of religious importance within the project corridor is Mauna Kea, a natural land feature.

S.5.2 Physical Environment

Hawai'i, the largest island of the Hawaiian Archipelago, covers an area of approximately 16,360 km^2. The island was formed by the activity of five volcanoes. The proposed project is located along the southern flank of Mauna Kea Volcano. The Saddle, located between Mauna Kea and Mauna Loa volcanoes, was formed by lava flows from both volcanoes which coalesced and formed a broad upland apron. Mauna Kea has not erupted in historical time, and is considered dormant. Mauna Loa remains active and is responsible for recent lava flows visible from the road.

Ground elevations along the study corridor range from 390 m above mean sea level, occurring in Section IV, to 2055 m, occurring in Section II. The elevational differences and the open vegetation through the Saddle provide panoramic views of distant vistas and interesting geologic features. Rolling hills, cone shaped pu'u (cinder cones), broad valleys, and mountains are examples of the diverse landforms found within the corridor.

In Section I, the landscape consists of a predominantly pastoral setting with few built features. The section is characterized by a broad, open grassland used for grazing. The existing visual quality is moderately low to moderate. Section II traverses a relatively flat valley. Much of the landscape is dotted with pu'u. Other elements include the built features of the PTA, grasslands, and shrublands. The eastern end of this section enters lava flows with sparse emergent vegetation. The existing visual quality ranges from moderately low to moderately high. Section III enters a landscape in which the lava flows are older and vegetation is more pronounced. The roadway weaves through forests with an understory of ferns and shrubs and pasture lands. The existing visual quality is predominantly moderately high. In Section IV, single family residences are located along the existing alignment of Saddle Road, creating a more urban setting for Segment EX-4A. Segment E-3 departs from the existing alignment and traverses mature forest with a dense understory of ferns and shrubs as well as agricultural pastureland. The existing visual quality of Segment EX-4A ranges from moderately low to moderately high. The existing visual quality of E-3 is moderately high.

The proposed roadway alignments are generally underlain by four types of geologic materials, including volcanic ash deposits, cinder sand deposits, 'a'a lava flows, and pahoehoe lava flows. Speleological resources, such as caves and lava tubes, occur within the project vicinity.

Geologic hazards within the study corridor include low-lying areas with potential flooding hazard, steep slopes with the potential for instability and landslides, soft soils or wetlands, ground subsidence, and known faults that may traverse the proposed roadway segments. In addition, the entire island is considered a lava hazard zone. The eastern portion of the study corridor is at greater risk from lava inundation than the western portion.

Average annual rainfall within the project corridor ranges from less than 500 millimeters (mm) in Sections I and II, to 5,000 mm or more per year in Sections III and IV. Fog is not uncommon in the morning and afternoon hours. Trade winds blow from the northeast.

Water resources and drainage characteristics occurring along the length of the project are diverse because of variations in the amount of rainfall. Infiltration of surface waters into the substrate is high and serves to recharge the island's groundwater aquifers. There are no areas within the project vicinity designated as principal or sole source aquifers.

Sheet flow of rainfall runoff is prevalent. The topography is pseudokarstic and no perennial rivers or streams occur in the project corridor, nor within the watersheds tributary to the Saddle Road culverts and bridges. The project area crosses several major intermittent drainages, many of which were formed by glacial activity and contain no waters of the U.S.

No Wild and Scenic Rivers are located within the project corridor or its vicinity. The proposed project is located within an area regulated by the Hawai'i Coastal Zone Management (CZM) Program. The CZM program has established specific objectives and polices to protect and preserve recreational resources, historic resources, scenic and open space resources, coastal ecosystems, and economic uses, to minimize coastal hazards, and to manage development. The project area is not within a defined Special Management Area of the CZM program.

While there are no State air quality monitoring sites on the Island of Hawai'i, data available from other sources indicate that ambient pollutant levels are well below the State and Federal standards. There are no designated *non-attainment areas* (places that do not meet the National Ambient Air Quality Standards) within the State of Hawai'i.

S.5.3 Biological Resources

Vegetation types dominated by both native and nonnative plants occur within the project area. Plant communities dominated by introduced or alien species are also referred to as *nonnative vegetation types* in this document. Plant communities dominated by plants which occur naturally in the Hawaiian Islands are referred to as *native vegetation types*. Examples of nonnative vegetation types include fountain grass/mixed shrubland, pasture land, and lowland wet grassland. Examples of native vegetation types include 'a'ali'i shrubland, mamane/naio forest, pioneer vegetation on recent lava flows, and montane wet forest.

The majority of Section I is pasture land dominated by kikuyu grass and other nonnative range grasses. It has been used for grazing for some time. Lower elevations of Section I support fountain grass/mixed shrubland. Areas covered by native plant communities are rare. The few remnant pockets of native mixed shrubland occur on cinder cones and larger stony ridges and outcrops, areas inaccessible to cattle and other grazing animals.

The vegetation within Section II is primarily native. Because the PTA has not been grazed and military development is restricted to certain areas, the majority of the PTA remains in native natural plant communities with a large proportion of the installation containing rare plants. Hard-stemmed lovegrass grassland, 'aweoweo shrubland, and 'a'ali'i shrubland are found on alluvial flats and the lower slopes of Mauna Kea on the western portion of this section. Mamane/naio forest occupies areas higher in elevation just north of the project area through the entire section and along the project corridor from the PTA cantonment area eastward past Mauna Kea State Park. At the eastern end of this section, nonnative pasture land vegetation is found on grazed lands.

Section III is dominated by native vegetation types. It traverses a variety of micro-climatic zones and a number of vegetation types because past volcanic activity has created a mosaic of soils of different ages and character. Recent lava flows exhibit sparse pioneering vegetation. *Kipuka*, isolated pockets of late successional forest located on old lava flows, are interspersed through this section. Kipuka exhibit unique biological character, supporting the complex structure of the native Hawaiian rainforest, usually with an overstory canopy dominated by koa, a middle canopy layer dominated by 'ohi'a, and a lower canopy dominated by tree ferns. This habitat supports numerous species which are *endemic* (unique to the Hawaiian Archipelago) and is highly susceptible to invasion by alien species when disturbed.

Section IV passes through highly modified habitat which is dominated by alien species.

Fire poses a grave threat to some Hawaiian ecosystems by converting native habitats into grasslands dominated by nonnative species. Because few native Hawaiian animals or plants are adapted to wildfires, mortality during fires is high. Native shrubs and trees may recover from fire to some degree, but native plant communities are usually overwhelmed by more aggressive alien species. Many nonnative species, such as fountain grass, have a tendency to carry fire, are fire adapted, and thrive in the aftermath of fire. The establishment of this grass increases the threat of fire.

Sections I and II traverse extremely dry habitat and are highly susceptible to fire. Because most of Section I has been highly modified and is now characterized by alien-dominated vegetation types, the impact of wildfires on native plants in this section is minimal. Within Section II, native-dominated vegetation types are prevalent. These vegetation types are extremely vulnerable to destruction by wildfire. Fire threatens the survival of rare-native animal species which rely on native habitats like the mamane/naio forest. Sections III and IV are not highly susceptible to fire because they are characterized by heavy rainfall.

Wetland occurrence within the project corridor is limited to the area east of MP 14, within Sections III and IV. Within this area, three major native vegetation types occur: 'ohi'a forest, 'ohi'a scrub, and koa-'ohi'a forest. Because of local conditions, the presence of hydrophytic vegetation was considered the determining factor in locating regulatory wetlands. Under this

method, wetlands were present on all of the 'ohi'a forest, approximately 15 percent of the 'ohi'a scrub, and less than 2 percent of the koa-'ohi'a forest.

The list of native birds likely to occur within the project area includes 18 species, 9 of which are endemic and 3 of which are migratory. There are also 28 nonnative resident species. While the bird fauna throughout the project area is dominated by introduced species, Sections II and III support a relatively high diversity of native birds within mamane/naio forest and kipuka habitats.

Hawai'i has only one native terrestrial mammal, the Hawaiian hoary bat, which is distributed throughout the project area. All other terrestrial mammals in Hawai'i were introduced by man and are considered alien species.

The project area harbors a diverse native and nonnative invertebrate fauna, including 13 snail and hundreds of insect and arthropod species. The invertebrate populations found within Sections I, III, and IV are dominated by introduced species. Section II supports a variety of endemic insects, as well as the most diverse assemblage of snails found in the project area. Within Section III, a variety of endemic insects are associated with kipuka and cave habitats.

Listed species refer to those species afforded legal protection as *endangered, threatened, proposed endangered,* and *proposed threatened* by the USFWS. Table S.5, *Listed Species in the Vicinity of the Project Area,* identifies listed species known or expected to occur within the project area. All listed species identified are endangered, with the exception of the Newell's Shearwater, which is threatened. Proposed endangered or threatened species are also addressed in this EIS.

Critical Habitat has been established for the endangered Palila within Section II and occupies nearly all mamane/naio forest habitat identified for the project. Palila are highly dependent on mamane trees as a food source and for nesting. Fire has been identified as the single greatest threat to the continued survival of the Palila and other sensitive species which rely on the mamane/naio forest habitat. The northern boundary of the 'Ainahou Nene Sanctuary is adjacent to the existing Saddle Road for a length of 7.6 km in Section III.

TABLE S.5
Listed Species in the Vicinity of the Project Area

Section I	Section II	Section III	Section IV
Plants			
Portulaca sclerocarpa: found in the vicinity of the existing alignment.	*Silene hawaiiensis*: found in the vicinity of all segments.	*Plantago hawaiiensis, Cyanea platyphylla, Clermontia peleana*: found outside of the EX-3 area of disturbance.	None identified.

TABLE S.5
Listed Species in the Vicinity of the Project Area

Section I	Section II	Section III	Section IV
Birds			
Dark-rumped Petrel: known to travel over W-2 and W-3. Nene: incidental use probable along W-2 and W-3.	Dark-rumped Petrel: known to travel over all segments. Nene: incidental use probable along all segments. Palila: habitat adjacent to PTA-1 and PTA-3. 'Akiapol 'au: habitat adjacent to all segments.	Dark-rumped Petrel, Newell's Shearwater: known to travel over EX-3. Nene: incidental use probable along EX-3. 'Akiapola 'au, Hawai'i Creeper, Hawai'i 'Akepa, 'O 'u, Hawaiian Hawk: habitat adjacent to EX-3.	Dark-rumped Petrel, Newell's Shearwater: known to travel over EX-4A and E-3. Hawaiian Hawk: habitat adjacent to EX-4A and E-3.
Mammals			
Hawaiian hoary bat: detected in low numbers along W-2 and W-3.	Hawaiian hoary bat: detected in moderate numbers along all segments.	Hawaiian hoary bat: detected in moderate numbers along EX-3.	Hawaiian hoary bat: detected in low numbers along EX-4A and E-3.
Invertebrates			
None identified.	None identified.	None identified.	None identified.

S.5.4 Cultural Resources

Prehistoric use of the project area includes cross-island travel, access to interior resources, birdcatching, agriculture, basalt gathering, and harvest of koa logs. Historic use of the project area includes ranching, hunting, cross-island travel, lumber milling, growing sugar cane, tourism, military strategy during World War II, and military training.

Nineteen archaeological sites within the survey corridor are recommended for listing on the NRHP. These include Old Waimea-Kona Belt Road and a habitation/animal enclosure (Section I); Ka'ohe Wall, Humu'ula Sheep Station Perimeter Walls, Old Waimea-Humu'ula Wagon Road, and a post and wire fence (Section II); Pu'u 'O'o-Volcano Trail, Humu'ula Sheep Station Perimeter Walls, Hilo-Pu'u 'O'o Trail, Saddle Road, two linear lava wall sites, and a lava paving site (Section III); a surveyor's cairn, 'Ola'a Flume, Hilo Country Club, and Senator Kimi's House (Section IV).

S.6 ENVIRONMENTAL CONSEQUENCES

Table S.6, *Summary of Impacts*, summarizes the environmental consequences of the proposed actions assessed in the Saddle Road FEIS. The table outlines differences between each of the build and no action alternatives for major resource categories.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Land Use and Hunting			
W-2, W-3: Direct loss of approximately 60 ha of ranchland. No direct loss of hunting lands. Improved access to hunting areas and ranch land. *No Action:* No direct loss of existing land uses. No direct impacts to hunting lands. No improvement of access to hunting areas.	*EX-2:* No loss of ranching or hunting lands. *PTA-1:* Direct loss of 13 ha of ranchland. Direct loss of 78 ha of hunting lands. *PTA-3:* Direct loss of 91 ha of hunting lands. *PTA-1, PTA-3:* Incursion of new road alignment into quality hunting area in Humu'ula. Change in management of bird hunting lands on Ka'ohe Lease Lands. Gain of 1,990 ha of bird hunting land at Pu'u Mali. *No Action:* No direct loss of existing land uses. No impacts to hunting lands. No improvement of access to hunting areas. No gain in bird hunting lands.	*EX-3:* Direct loss of 45 ha State land. No direct loss of hunting lands. Improved access to State land and hunting areas. *No Action:* No direct loss of existing land uses. No direct loss of hunting lands. No improvement of access to hunting areas.	*EX-4A, E-3:* Direct loss of State land and privately-owned residential lands. Direct, marginal loss of hunting land due to placement of road alignment. Improved access to hunting areas. *No Action:* No direct loss of existing land uses. No direct loss of hunting lands. No improvement of access to hunting areas.
Pedestrian / Bicycle Facilities			
W-2, W-3: No established bicycle or pedestrian trails. Improved safety for bicyclists and pedestrians with construction of adequate shoulders to function as bike route. Less traffic within Waiki'i. *No Action:* No established bicycle or pedestrian trails nor improved conditions for bicyclists and pedestrians.	*EX-2, PTA-1, PTA-3:* No established bicycle or pedestrian trails. Improved safety for bicyclists and pedestrians with construction of adjacent paved 2.4-m fire-break that would function as a bike route. *No Action:* No established bicycle or pedestrian trails nor improved conditions for bicyclists and pedestrians.	*EX-3:* No established bicycle or pedestrian trails. Improved for bicyclists and pedestrians with construction of adequate shoulders to function safely as bike route. *No Action:* No established bicycle or pedestrian trails nor improved conditions for bicyclists and pedestrians.	*EX-4A, E-3:* No established bicycle or pedestrian trails. Improved safety for bicyclists and pedestrians with construction of adequate shoulders to function as bike route. *E-3:* Less traffic within Kaumana. *No Action:* No established bicycle or pedestrian trails nor improved conditions for bicyclists and pedestrians.
Right-of-Way (ROW) / Relocation			
W-2, W-3: Direct take of roughly 70 ha of land for ROW. *No Action:* No take for ROW.	*EX-2:* Direct take of 47 ha of land for ROW. *PTA-1, PTA-3:* Direct take of 83 ha (PTA-1) and 85 ha (PTA-3) of land for ROW. Relocation needed for 13 buildings on PTA. *No Action:* No take for ROW.	*EX-3:* Direct take of 60 ha of land for ROW. *No Action:* No take for ROW.	*EX-4A:* Direct take of 12 ha of land for ROW. Relocation needed for 11-28 homes. *E-3:* Direct take of 29 ha of land for ROW. *No Action:* No take for ROW.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Farmlands			
W-2: Direct conversion of 55.0 ha of *other important agricultural lands.* *W-3:* Direct conversion of 18.6 ha of *other important agricultural lands.* *No Action:* No direct loss of farmland.	*EX-2:* Direct conversion of 18.9 ha *other important agricultural lands.* *PTA-1, PTA-3:* Direct conversion of 6.7 ha of *other important agricultural lands.* *No Action:* No direct loss of farmland.	*EX-3:* No direct loss of *prime* farmland or *other important agricultural lands.* *No Action:* No direct loss of farmland.	*EX-4A:* No direct loss of *prime* farmland or *other important agricultural lands.* *E-3:* Direct loss of 8.79 hectares (ha) of *prime* farmland. *No Action:* No direct loss of farmland.
Social			
W-2, W-3: Improvement in traffic flow and access to area. Reduction in traffic volumes within Waiki'i. No disproportionate impact to disadvantaged groups. No impacts to native Hawaiian cultural resources. *W-2:* Increase in traffic volumes on Waikoloa Rd. *No Action:* No improvement in accessibility of recreational resources. No disproportionate impact to disadvantaged groups. Increasing congestion on alternative route (SR 19).	*EX-2, PTA-1, PTA-3:* Improvement in traffic flow and access to area. No disproportionate impact to disadvantaged groups. *EX-2:* Increase in conflicts with PTA. Loss of about 10 ha of mamane forest (special value to native Hawaiians). *PTA-2, PTA-3:* Separation of PTA operations and motorists. Loss of about 30 ha of mamane forest. *No Action:* No improvement in access to area. Gradual increase in conflicts with PTA. No disproportionate impact to disadvantaged groups. Increasing congestion on SR 19. No additional impacts to native Hawaiian cultural resources.	*EX-3:* Improvement in traffic flow and access to area. No disproportionate impact to disadvantaged groups. Potential impact on kipuka (special value to native Hawaiians). *No Action:* No improvement in access to area. No disproportionate impact to disadvantaged groups. Increasing congestion on SR 19.	*EX-4A, E-3:* Improvement in traffic flow and access to area. No disproportionate impact to disadvantaged groups. *EX-4A:* Construction-related impacts to Kaumana. Increase in traffic volumes in Kaumana. *E-3:* Reduction in traffic volumes within Kaumana. *No Action:* No improvement in accessibility of recreational resources. No disproportionate impact to disadvantaged groups. Increasing congestion on SR 19.
Economic			
W-2, W-3: Generation of direct and indirect employment from construction activities. Decrease in cross-island travel time and associated increase in monetary savings. Improvements to safety and associated savings on accident costs. *No Action:* No generation of direct or indirect employment from construction. No decrease in cross-island travel time nor increase in monetary savings. No improvements to safety and traffic flow.	*EX-2, PTA-1, PTA-3:* Generation of direct and indirect employment from construction activities. Decrease in cross-island travel time and associated increase in monetary savings. Improvements to safety and associated savings on accident costs. *No Action:* No generation of direct or indirect employment from construction. No decrease in cross-island travel time nor increase in monetary savings. No improvements to safety and traffic flow.	*EX-3:* Generation of direct and indirect employment from construction activities. Decrease in cross-island travel time and associated increase in monetary savings. Improvements to safety and associated savings on accident costs. *No Action:* No generation of direct or indirect employment from construction activities. No decrease in cross-island travel time nor increase in monetary savings. No improvements to safety and traffic flow.	*EX-4A, E-3:* Generation of direct and indirect employment from construction activities. Decrease in cross-island travel time and associated increase in monetary savings. Improvements to safety and associated savings on accident costs. *No Action:* No generation of direct or indirect employment from construction activities. No decrease in cross-island travel time nor increase in monetary savings. No improvements to safety and traffic flow.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Noise			
W-2: Substantial increase in noise levels at future development sites; no exceedence or approach of NAC. *W-3:* No substantial increase, no exceedence or approach of NAC. *W-2, W-3:* Reduction in traffic noise in Waiki'i. *No Action:* No exceedence or approach of NAC nor substantial increase. Increase in traffic noise levels in Waiki'i as traffic levels grow.	*EX-2:* No exceedence or approach of NAC. Substantial increase in noise at two groups of PTA barracks. *PTA-1, PTA-3:* Exceedence or approach of NAC at 3 receptors (PTA). Substantial increase in noise at PTA receptors and group of 8 cabins at Mauna Kea State Park. *No Action:* No exceedence or approach of NAC nor substantial increase at any sensitive receptors.	*EX-3, No Action:* No noise sensitive land uses are located within section.	*EX-4A:* Exceedence or approach of NAC at 29 residences; substantial increase in noise at 18 additional ones. *E-3:* No exceedence or approach of NAC. Substantial increase in noise at 14 residences. *No Action:* Exceedence or approach of NAC at 3 residences. No substantial increase in noise at any sensitive receptors.
Hazardous Materials			
W-2, W-3, No Action: No impacts to hazardous waste sites identified. *No Action:* No impacts to hazardous waste sites.	*EX-2:* Possible impact to accumulated spills near PTA Fuel Storage Area or minor localized soil contamination. *PTA-1, PTA-3:* Possible impact to minor localized soil contaminations. Unexploded ordnance may be encountered. *No Action:* No impacts to hazardous waste sites.	*EX-3, No Action:* No impacts to hazardous waste sites identified.	*EX-4A, E-3, No Action:* No impacts to hazardous waste sites identified.
Energy			
W-2, W-3: Conservation of fuel. Expenditure of resources to build road. *No Action:* No immediate change in energy use patterns. Gradual increase in fuel expenditure as traffic increases.	*EX-2, PTA-1, PTA-3:* Conservation of fuel. Expenditure of resources to build the road. *No Action:* No immediate change in energy use patterns. Gradual increase in fuel expenditure as traffic increases.	*EX-3:* Conservation of fuel. Expenditure of resources to build the road. *No Action:* No immediate change in energy use patterns. Gradual increase in fuel expenditure as traffic increases.	*EX-4A, E-3:* Conservation of fuel. Expenditure of resources to build the road. *No Action:* No immediate change in energy use patterns. Gradual increase in fuel expenditure as traffic increases.
Visual			
W-2, W-3: Decrease in visual quality; substantial change in visual character. *No Action:* No changes to visual quality or visual character.	*EX-2:* Decrease in visual quality; notable to severe change in visual character. *PTA-1, PTA-3:* Decrease in visual quality; substantial to severe change in visual character. *No Action:* No changes to visual quality or visual character.	*EX-3:* Decrease in visual quality; severe change in visual character. *No Action:* No changes to visual quality or visual character.	*EX-4A, E-3:* Decrease in visual quality; substantial change in visual character. *No Action:* No changes to visual quality or visual character.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Soils / Geologic Hazards			
W-2, W-3: Construction-related increase in soil erosion. Potential breaks into caves, associated hazard to construction workers, and resultant changes in cave ecosystem. Volcanic hazard to improved road. *No Action:* No construction-related impacts to soils. No potential to break into caves. Volcanic hazard to existing road.	*EX-2, PTA-1, PTA-3:* Construction-related increase in soil erosion. Potential breaks into caves, associated hazard to construction workers, and resultant changes in cave ecosystem. Volcanic hazard to improved road. *No Action:* No construction-related impacts to soils. No potential to break into caves. Volcanic hazard to existing road.	*EX-3:* Construction-related increase in soil erosion. Potential breaks into caves, associated hazard to construction workers, and resultant changes in cave ecosystem. Volcanic hazard to improved road. *No Action:* No construction-related impacts to soils. No potential to break into caves. Volcanic hazard to existing road.	*EX-4A, E-3:* Construction-related increase in soil erosion. Potential breaks into caves, associated hazard to construction workers, and resultant changes in cave ecosystem. Volcanic hazard to improved road. *No Action:* No construction-related impacts to soils. No potential to break into caves. Volcanic hazard to existing road.
Floodplains / Water Resources			
W-2, W-3: Decreased likelihood of damage to road base and surface from flood. Decreased likelihood of flood waters inundating the roadway. No change in floodplain elevations. Increased likelihood of contaminated stormwater degrading surface or groundwater quality. *No Action:* No impacts to floodplains. Continued likelihood of damage to road base and surface from flooding.	*EX-2, PTA-1, PTA-3:* Decreased likelihood of damage to road base and surface from flood. Decreased likelihood of flood waters inundating roadway. No change in floodplain elevations. Increased likelihood of contaminated stormwater degrading surface or groundwater quality. *No Action:* No impacts to floodplains.	*EX-3:* No crossings of waterways anticipated. No change in floodplain elevations. Increased likelihood of contaminated stormwater degrading surface or groundwater quality. *No Action:* No impacts to floodplains.	*EX-4A, E-3:* Decreased likelihood of damage to road base and surface from flood. Decreased likelihood of flood waters inundating roadway. No change in floodplain elevations. Increased likelihood of contaminated stormwater degrading surface of groundwater quality. *E-3:* Crosses 100-year floodplain. *No Action:* No impacts to floodplains.
Wild & Scenic Rivers			
W-2, W-3, No Action: No impacts to Wild and Scenic Rivers.	*EX-2, PTA-1, PTA-3, No Action:* No impacts to Wild and Scenic Rivers.	*EX-3, No Action:* No impacts to Wild and Scenic Rivers.	*EX-4A, E-3, No Action:* No impacts to Wild and Scenic Rivers.
Coastal Zone Mgmt. (CZM) Program			
W-2, W-3, No Action: No inconsistencies with objectives of CZM Program.	*EX-2, PTA-1, PTA-3, No Action:* No inconsistencies with objectives of CZM Program.	*EX-3, No Action:* No inconsistencies with objectives of CZM Program.	*EX-4A, E-3, No Action:* No inconsistencies with objectives of CZM Program.
Air Quality			
W-2, W-3: Temporary, localized impacts to air quality during construction. No exceedence of air quality standards. *No Action:* No construction-related impacts to air quality. No exceedence of air quality standards.	*EX-2, PTA-1, PTA-3:* Temporary, localized impacts to air quality during construction. No exceedence of air quality standards. *No Action:* No construction-related impacts to air quality. No exceedence of air quality standards.	*EX-3:* Temporary, localized impacts to air quality during construction. No exceedence of air quality standards. *No Action:* No construction-related impacts to air quality. No exceedence of air quality standards.	*EX-4A, E-3:* Temporary, localized impacts to air quality during construction. No exceedence of air quality standards. *No Action:* No construction-related impacts to air quality. No exceedence of air quality standards.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Vegetation			
W-2: Disturbance of 58 ha of nonnative vegetation types and 10 ha of native vegetation types. *W-3:* Disturbance of 60 ha of nonnative vegetation types and 10 ha of native vegetation types. *No Action:* No direct impacts to native vegetation or habitat types. Gradual increase in risk of fire and possible dispersal and possible introduction of alien species.	*EX-2, PTA-1, PTA-3:* Increased risk of fire and introduction of alien species to native habitats. *EX-2:* Disturbance of 1 ha of nonnative and 68 ha of native vegetation types. *PTA-1:* Disturbance 12 ha of nonnative and 73 ha of native vegetation types. *PTA-3:* Disturbance of 3 ha of nonnative and 85 ha of native vegetation types. *No Action:* No direct impacts to native vegetation or habitat. Gradual increase in risk of fire and possible dispersal and possible introduction of alien species.	*EX-3:* Disturbance of 97 ha of native vegetation types. Increased risk of introduction of alien species to native habitats. Potential impacts to kipuka. *No Action:* No direct impacts to native vegetation or habitat types. Gradual increase in risk of dispersal and possible introduction of alien species.	*EX-4A:* Disturbance of 10.7 ha of predominantly native vegetation types, of which 9 ha have been highly invaded by alien species. *E-3:* Disturbance of 11 ha of nonnative vegetation types and 11 ha predominantly native vegetation types, of which 9 ha have been highly invaded by alien species. *No Action:* No direct impacts to native vegetation or habitat types. Gradual increase in risk of dispersal and possible introduction of alien species.
Fire Hazard			
W-2, W-3: Reduction in risk from fire to Critical Habitat; increased risk to ranchland. *No Action:* Increased fire hazard from existing condition with increased traffic volumes.	*EX-2, PTA-1, PTA-3:* Reduced fire risk with mitigation. *EX-2:* Greater suppression buffer than PTA alts. *PTA-1, PTA-3:* Less suppression buffer than EX-2. *No Action:* Increased fire hazard from existing condition with increased traffic volumes.	*EX-3:* Minor increase in fire ignition risk from that of existing condition. *No Action:* Increase in fire ignition risk with increased traffic.	*EX-4A, E-3,* Decrease from existing condition due to paved shoulders. *No Action:* Effectively the same as existing condition.
Waters of the U.S./Wetlands			
W-2, W-3, No Action: No waters of the U.S. No wetlands.	*EX-2, PTA-1, PTA-3, No Action:* No waters of the U.S. No wetlands.	*EX-3:* Impact to approximately 2.4 ha of wetlands in native habitat. *No Action:* No impact to wetlands.	*EX-4A:* Impact to approximately 0.4 ha of wetlands in native habitat. *E-3:* Impact to approximately 0.5 ha of wetlands in native habitat, and 2.7 ha of wetlands in agriculturally-disturbed habitat. *No Action:* No impact to wetlands.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Birds			
W-2, W-3, No Action: No negative impacts to native birds anticipated.	*EX-2:* Loss of habitat for native birds. Increased risk of fire and introduction of alien species to native habitats. Fire risk minimized with fire shoulders. *PTA-1:* Loss of habitat for native birds. Increased risk of fire and introduction of alien species to native habitats. Fire risk minimized with fire shoulders. *PTA-3:* Loss of habitat for native birds. Increased risk of fire and introduction of alien species to native habitats. Fire risk minimized with fire shoulders. *No Action:* Indirect impacts on native birds. Increased traffic, risk of fire, and introduction of alien species. Fire breaks will not be constructed.	*EX-3:* Temporary displacement of individual endemic birds during construction. Increased risk of loss of kipuka habitat with introduction of alien species. *No Action:* Minor, indirect impacts to native birds with increasing risk of introduction of alien species.	*EX-4A, E-3, No Action:* No negative impacts to native birds anticipated.
Mammals			
W-2, W-3, No Action: No negative impacts to Hawaiian hoary bat anticipated.	*EX-2, PTA-1, PTA-3, No Action:* No negative impacts to Hawaiian hoary bat anticipated.	*EX-3, No Action:* No negative impacts to Hawaiian hoary bat anticipated.	*EX-4A, E-3, No Action:* No negative impacts to Hawaiian hoary bat anticipated.
Invertebrates			
W-2, W-3: Loss of native snail populations in the eastern portion of the segment. Increased potential for further dispersal and possible introduction of alien species. *No Action:* No increase in direct impacts to invertebrates. Gradual increase in risk of fire and dispersal and possible introduction of alien species.	*EX-2, PTA-1, PTA-3:* Impacts to endemic species as a result of loss of native habitat. Increased potential for further dispersal and possible introduction of alien species. *No Action:* No increase in direct impacts to invertebrates. Gradual increase in risk of fire and dispersal and possible introduction of alien species.	*EX-3:* Disturbance of 96.5 ha of habitat, all of which is native vegetation types. Increased risk of dispersal and possible introduction of alien species in native habitats. Impacts to kipuka. *No Action:* No increase in direct impacts to native vegetation or habitat types. Gradual increase in risk of dispersal and possible introduction of alien species.	*EX-4A, E-3:* Increased potential for impacting cave ecosystems. Increased potential for further dispersal and possible introduction of alien species. *No Action:* No increase in direct impacts to invertebrates.

TABLE S.6
Summary of Impacts

Section I	Section II	Section III	Section IV
Threatened & Endangered Species			
W-2, W-3, No Action: No increase in direct impacts to threatened or endangered species.	*EX-2:* No direct impacts to Palila Critical Habitat. Increased risk of wildfire and dispersal and possible introduction of alien species. *PTA-1:* Direct modification of 41.5 ha of Palila Critical Habitat. Increased risk of wildfire and dispersal and possible introduction of alien species. *PTA-3:* Direct modification of 46.1 ha of Palila Critical Habitat. Increased risk of wildfire and dispersal and possible introduction of alien species. *No Action:* Minor, indirect impacts to threatened and endangered species with increasing risk of fire and introduction of alien species.	*EX-3:* No increase in direct impacts to threatened or endangered species. Increased risk of dispersal and possible introduction of alien species. *No Action:* Minor, indirect impacts to threatened and endangered species with increasing risk of dispersal and possible introduction of alien species.	*EX-4A, E-3, No Action:* No increase in direct impacts to threatened or endangered species.
Archaeological Resources			
W-2, W-3: A relatively small segment of one eligible historic linear feature, Old Waimea-Kona Belt Road will be impacted. Adverse effect, but can be mitigated. *W-3:* Impacts to one historic habitation/animal enclosure, significant for data recovery only. No adverse effect. *No Action:* No impacts to archaeological resources.	*EX-2*: A relatively small segment of one historic linear feature, Ka 'ohe Wall, will be impacted. Adverse effect, but can be mitigated. *EX-2, PTA-3*: A relatively small segment of one historic linear feature, Humu'ula Sheep Station Perimeter Wall, will be impacted. Adverse effect, but can be mitigated. *PTA-1*: A relatively small segment of one historic linear feature, Old Waimea-Humu'ula Wagon Road, will be impacted. Adverse effect, but can be mitigated. Impacts to one historic fence, significant for data recovery only. No adverse effect. *No Action:* No impacts to archaeological resources.	*EX-3*: Relatively small segments of four historic linear features, Pu 'u 'O 'o-Volcano Trail, Humu'ula Sheep Station Perimeter Wall, Hilo-Pu 'u 'O 'o Trail, and Old Saddle Road, will be impacted. Adverse effect, but can be mitigated. Impacts to two historic linear walls and one historic paving; data collected, no adverse effect. *No Action:* No impacts to archaeological resources.	*EX-4A*: Impacts to one historic cairn. Site significant for data recovery only. No adverse effect. *E-3*: A relatively small segment of one historic linear feature, 'Ola 'a Flume, will be impacted. Adverse effect, but can be mitigated. Impacts to Hilo Country Club and Senator Kimi's House; sites significant for data recovery only. No adverse effect. *No Action:* No impacts to archaeological resources.
Traditional Cultural Properties			
W-2, W-3, No Action: No impacts to Traditional Cultural Properties (TCP).	*EX-2, PTA-1, PTA-3, No Action:* No impacts to Traditional Cultural Properties.	*EX-3, No Action:* Indirect effect to Mauna Kea TCP. No mitigation required.	*EX-4A, E-3, No Action:* No impacts to Traditional Cultural Properties.
Section 4(f)			
W-2, W-3, No Action: No use of Section 4(f) Properties.	*EX-2, PTA-1, PTA-3, No Action:* No use of Section 4(f) Properties.	*EX-3, No Action:* No use of Section 4(f) Properties.	*EX-4A, E-3, No Action:* No use of Section 4(f) Properties.

S.7 CUMULATIVE IMPACTS

Cumulative impacts are the result of incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions. Development within the Saddle Road area and on the island as a whole has resulted in the loss and degradation of resources unique to the island. The development within the Saddle Road corridor includes ranching operations, recreational facilities, public use areas, utility corridors, mining operations, military facilities, hunting units, scientific research, and residences. Current plans and potential projects under consideration in the project vicinity include the expansion of Mauna Kea Science Reserve, the extension of the runway at Bradshaw Army Airfield, the construction of an additional electric transmission line, the installation of a fiber optics transmission line, the extension of Puainako Street, and the development of an improved connection between Mamalahoa and Queen Ka'ahumanu Highways.

An improved roadway would increase the pressures of growth and development in areas served by Saddle Road. This would contribute to traffic along Saddle Road and use of the area by residents and tourists. Increased traffic and increased use of the area regardless of road improvements are expected to result in further introduction and spread of alien species, heightened risk of fire, and associated impacts on native ecosystems and species. Development and land use conversion across the island have created a trend toward the destruction of cultural resources, reduction in visual quality, soil erosion, water quality degradation, the destruction of caves, and the alteration of topographical features. All build alternatives, and to a lesser extent the No Action Alternative, would contribute to this trend.

S.8 PROPOSED MITIGATION COMMITMENTS

Mitigation measures have been developed in order to minimize both short-term and long-term impacts of the proposed project. Mitigation commitments for impacts to the human environment are to maintain free-flowing access to existing land uses, provide scenic pullouts and parking, facilitate emergency access, minimize traffic conflicts, and keep the public informed of anticipated delays. FHWA will develop relocation assistance and benefits for any residents displaced by the project. Hazardous materials and unexploded ordnance will be handled to ensure proper treatment of these materials. Native Hawaiians will be employed to observe cultural ritual protocol at the construction site.

Mitigation commitments for construction impacts to the physical environment are to implement dust and equipment emission control measures. Prior to construction, FHWA will coordinate with speleological experts to reduce the risk of impacting caves or lava tubes. Construction techniques that create natural-appearing roadside surfaces and roadway appurtenances will be utilized to minimize the visual impact of the project at the location of cut and fill slopes. Remnant landforms will be removed at select locations.

General mitigation commitments for impacts to biological resources are to limit surface disturbance to within the ROW, ensure proper environmental awareness of construction workers, revegetate appropriate locations, prohibit night-time construction lighting, and adopt construction practices that minimize dispersion of alien species. An alien plant species monitoring and control program will be implemented. During final design, the alignment will be shifted to avoid kipuka. Sensitive habitats like kipuka will be fenced during construction along the right-of-way (ROW). A fire ecologist will be contracted to create a fire model(s) and develop a comprehensive fire management plan. Paved fire breaks will be constructed in areas of critical fire concern, and emergency call boxes will be provided along the route in fire prone areas. To offset unavoidable impacts of the project to wetland and aquatic areas disturbed by the roadway footprint, mitigation commitments will incorporate restoration efforts to restore and preserve habitat within all portions of the ROW not essential to the operation and maintenance of the roadway. Restoration efforts may also include the acquisition or preservation of lands beyond those needed for ROW. A search for Hawaiian Hawk nests will be conducted within Sections III and IV prior to construction.

Commitments have been made to undertake significant mitigative steps to offset potential impacts on federally-designated Critical Habitat for the endangered Palila. A Palila Mitigation Plan has been prepared and an associated Memorandum of Understanding (MOU) has been developed and signed by participatory agencies. Mitigation includes the acquisition and management of areas for habitat restoration and Palila translocation (FEIS - Part I, 3.18.3).

Mitigation commitments for impacts to 19 archaeological sites eligible for the NRHP include avoidance through the shifting of the alignment, data recovery efforts, the installation of interpretive signs and pullouts to enhance public awareness, and periodic monitoring during construction. These commitments have been agreed upon by the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Office (SHPO), HDOT, FHWA, and Office of Hawaiian Affairs (OHA) and documented in an executed Memorandum of Agreement (MOA).

S.9 PROJECT DEVELOPMENT HISTORY OF THE SADDLE ROAD PROJECT

The following list summarizes the history of the Saddle Road EIS project and provides notable milestones to the coordination and public involvement process. Initially, improvements for Saddle Road had been considered only along the existing alignment within the boundaries of the PTA. The summary provided begins with the decision to expand the project planning to include the roadway sections outside of the PTA boundary.

2/91 Interagency scoping meeting held in Honolulu to discuss various agency needs and concerns for improvements along existing alignment within PTA. PTA realignment recommendation presented by U.S. Army representatives. Full EIS anticipated for

realignment. Consensus achieved between most agency representatives, with some reservations, that realignment would improve public safety.

4/91 Request made by MTMC that development efforts along the existing alignment be stopped and efforts be redirected to develop the realignment proposal.

5/91 New estimate and schedule submitted by FHWA for realignment construction between MP 30 and 43. Cost estimated at $11.3 million. New surveys, mapping, location studies, and environmental compliance expected to delay initial construction project. Because HDOT did not agree with realignment proposal, work stopped by FHWA until agreement between participating agencies could be reached.

6/91 Support for realignment proposal forwarded by Senator Daniel Inouye and HDOT.

11/91 SEE Team reconvened to advance project development considering realignment proposal. Need determined for full EIS for entire Saddle Road from MP 5 to MP 53 to comply with logical termini requirement.

2/92 Estimate prepared by FHWA to complete project development, including environmental compliance from MP 5 to MP 53. Cost estimated at $2.3 million. Interagency meeting held in Honolulu and public scoping meetings held in Hilo, Waimea, and Captain Cook. FHWA work suspended pending MTMC consideration of additional project development requirements.

4/92 HDOT participation in additional project development funding requested by MTMC.

2/93 $2.34 million in DAR funds for project development authorized by MTMC.

3/93 Project development activities resumed. Aerial survey and mapping process for realignment studies initiated.

5/93 Citizens of the County of Hawai'i invited to form a task force by Senator Inouye to solicit and disseminate information about the project within the community and work with the project development team.

6/93 SEE Team reconvened for meeting in Honolulu. First citizens task force meeting held (SRTF).

8/93 Mission Statement adopted and goals identified by SRTF.

1/94 RUST Environment and Infrastructure selected by FHWA, under an umbrella contract to perform environmental compliance and preliminary route location design studies. Okahara & Associates (O & A) selected by RUST for all local project coordination

efforts in Hawai'i. Meeting held between FHWA, RUST, O & A, SRTF, and various agencies to establish communications and develop schedule for project development and scoping process.

3/94 Letter of Intent sent to all interested parties, agencies, and organizations and Notice of Intent published in Federal Register.

4/94 Notification of Public Scoping Meetings mailed to all interested parties, agencies, and organizations.

5/94 Public Scoping Meetings held in Hilo, Kona, and Waimea. Interagency Scoping Meeting held in Hilo. SRTF scoping meeting held in Waimea and SEE Team scoping meeting held in Hilo. Traffic Study completed by RUST. Traffic volumes on Saddle Road determined to be 900 ADT in 1994 and forecasted to be 14,000 ADT in 2014 with proposed improvements.

6/94 Several SRTF Meetings held to generate input on project purpose and need.

7/94 Saddle Road Project Information Centers opened in Hilo and Kona to make project information available to interested persons and to receive comments. Notices of information centers published in Hilo and Kona newspapers.

8/94 SRTF Meeting held to brief members on project development progress and review proposed alignments developed through scoping process. Field trip to view alternative alignments conducted. Recommended alternatives developed by SRTF to present to SEE Team for further consideration.

10/94 SEE Team meeting held in Hilo to brief team on scoping results, review project objectives and purpose, and select alternative alignments for further engineering and environmental study (102 miles of alternatives selected).

11/94 SRTF meeting held to review project alternatives advanced for further consideration and project issues and concerns identified. First *Saddle Road Newsletter* published and sent to mailing list (approximately 800 distributed).

2/95 Second project development contract initiated with RUST for surveying, mapping, preliminary route location design, and environmental field studies and reports on alternatives developed through scoping process. RUST project team selected, consisting of 12 subconsultants; 10 locally based in Hawai'i.

3/95 SRTF Meeting held to brief members on status of project development tasks recently initiated and receive input on progress, issues, and concerns. Meetings held with State of Hawai'i Department of Land and Natural Resources (DLNR) to coordinate rights-of-

entry for surveying and environmental inventories; review procedures of environmental studies for consistency with Conservation District regulations. Through October of 1995, field work conducted by subconsultants, including biological, botanical, avian, and archaeological surveys and interviews of tourists, road users, truckers, and other citizens conducted.

4/95 Interagency meeting held to brief agencies on project status and schedule for environmental field inventories and engineering studies. New construction cost estimates prepared: PTA section $35 million, remainder of Saddle Road $68 million.

8/95 Coordination meeting held with DOA at PTA to discuss issues and concerns relative to alternative alignment studies to date.

10/95 Field review of potential alternative alignments and available mapping for west side held with RUST and O & A. Critical Interagency meetings held with DOA and USFWS, DLNR, and NBS to discuss findings of preliminary route location alternatives and potential environmental effects and to receive comments on resulting issues and concerns. Funds made available to begin work on environmental studies portion of RUST contract.

Environmental Assessment and Notice of Preparation of EIS submitted to Office of Environmental Quality Control.

11/95 SRTF, SEE Team and Interagency meetings held to review preliminary alternatives route location and design and receive input. Line and grade field review of first half of staked preliminary alignments held with HDOT, RUST, FHWA, and other interested agencies. Comments incorporated in revisions.

12/95 SRTF meeting held to review project progress and future project development procedures and schedule.

2/96 Line and grade field review of second half of staked preliminary alignments held with RUST and O & A. Team planning concept initiated for project development. Environmental Project Manager and Local Coordination Manager appointed.

3/96 Discussions with U.S. Army Corps of Engineers (USACE) held to perform remaining archaeological inventories and studies within the PTA.

4/96 SRTF and SEE Team meetings held. SRTF briefing on project status held at PTA with Senator Inouye and DOA representatives. SEE Team meeting held to review progress status and issues and concerns on various project alternatives. Decision made by SEE Team to eliminate alternatives W-4 and E-1 from further detailed consideration; concurrence obtained from SRTF. Several meetings held between FHWA staff and

National Biological Service (NBS), USFWS, and USACE to discuss Palila critical habitat (field trip and mitigation discussions), invertebrate inventories, archaeological studies in PTA, and wetlands considerations. Informal consultation initiated with USFWS on critical habitat impact mitigation for Section 7 Consultation.

5/96 Preliminary route location design plans completed and exhibits submitted to environmental subconsultants for study reports. Preliminary Design Study Report completed. Sixteen invitations for Cooperating Agency status sent; three acceptances received.

Meetings held between FHWA staff and U.S. Army Garrison-Hawai'i (USAG-HI), USFWS, Division of Forestry and Wildlife (Hawai'i), HDOT, and National Biological Service (NBS) to discuss coordination of DOA's Ecosystem Management Plan (EMP) with Palila mitigation effort and general elements of a Palila Mitigation Plan as proposed by NBS. First draft of a specific mitigation proposal with cost estimates presented by NBS.

6/96 Workshop given by FHWA, Hawai'i Division, to subconsultant team on EIS Preparation. New construction cost estimates submitted based on preliminary design received from consultants: PTA, $34 million to $40 million; remainder of Saddle Road, $92 million to $106 million. Cost dependent on alternative selected.

7/96 Modification made to RUST contract to provide for biological survey and report on invertebrate species as required by USFWS, research to assess social effects of alternatives relative to Native Hawaiian culture, and extend the authority of existing subconsultant to provide archaeological and historical properties investigations within PTA in lieu of USACE. State participation in funding of Saddle Road project development effort committed by HDOT.

8/96 Meetings held between FHWA staff and USAG-HI regarding coordination of their EMP efforts with Saddle Road mitigation proposals. Discussions held with new subconsultant to develop Public Information Program (newsletters followed). Additional cultural properties field inventories initiated within PTA.

9/96 Meeting held with subconsultant to initiate compilation of Biological Assessment (BA) as required for Section 7 consultation of Endangered Species Act.

10/96 SRTF, Interagency, and SEE Team project development meetings held in Hilo to review project alternatives and associated affected environments, impacts, and proposed mitigation, and solicit input relative to issues, and concerns. Proposed project schedule and interagency coordination discussed. Selection of possible preferred alternatives discussed by SEE Team. Alternatives EX-4 and EX-1 eliminated.

11/96 Interagency meeting held in Honolulu, hosted by Senator Inouye, to discuss specific project mitigation elements, processes, and coordination required including critical habitat replacement land transfers, management strategies, funding, and necessary agreements. Elements and procedure for BA to be required by USFWS for this project confirmed. Fire prevention roadway cross-section confirmed. Discussions held on coordination of DOA's EMP with Palila Mitigation Plan. Discussions held with HDOT on project development issues impacting scope of possible initial construction project. Field trip conducted with FHWA, USFWS, and USACE to review wetland findings and discuss procedures for jurisdictional delineation and permitting requirements. Issue #2 of *Saddle Road Newsletter* distributed to approximately 1,170 groups and individuals.

12/96 SRTF meeting held to present results of discussions and interagency coordination to date and receive community-related input from members on all project issues and concerns as well as public information program progress and plans. FHWA solicitation opened for new contract for Hawai'i-based firm; first task order to include continued work on environmental studies and preliminary design.

1/97 Issue #3 of *Saddle Road Newsletter* mailed to approximately 1,170 groups and individuals.

3/97 Preliminary Draft EIS (PDEIS) distributed to all participating, cooperating, and coordinating agencies for review and comment. PDEIS distributed to internal staff for review. BA submitted with request for early coordination under Section 7 to USFWS. Need determined for additional funding to complete further environmental compliance studies. Technical report on archaeological and historical properties received at FHWA.

4/97 Two Interagency meetings held to discuss issues, impacts, and mitigation proposed as presented in the PDEIS. Most agency written comments received by end of month as requested. Confirmation from USFWS received that all details of multi-agency management of Palila mitigation lands would need to be resolved before submittal of BA. Letter sent transmitting cultural properties report to SHPO and requesting concurrence with eligibility determinations. O & A selected for work in Hawai'i under Indefinite Delivery/Indefinite Quantity Contract. O & A's first task order provides for continuance of environmental and design work on project.

5/97 Procedures and methodology for DOA 404 permitting and jurisdictional determinations requested from USACE. Verification of Nene Sanctuary status requested from DLNR.

6/97 Draft summary of Palila mitigation lands multi-agency management strategies tentatively agreed upon by coordinating agencies in a series of meetings in May and June sent to agencies for comment. Meeting of various individuals and hunting organizations held to identify issues related to potential impacts on hunting resources and activities.

7/97 | Task order executed with O & A to proceed with additional environmental compliance work and location and design refinements for environmental mitigation under ID/IQ contract. Response from USACE on 404 permitting and delineation requirements received. Meetings held with various hunting organizations and individuals to identify issues related to potential impacts on hunting resources and activities.

8/97 | Meeting of FHWA, O & A, and subconsultants held to determine new schedule and required coordination for remaining work through publication of DEIS, public hearings, and close of public comment period. Response letter received from SHPO regarding eligibility concurrence. Jurisdictional determination requested and received from USACE

10/97 | DEIS published and distributed to mailing list. BA submitted to USFWS with request for initiation of Section 7 Formal Consultation.

11/97 | Notice of Availability of DEIS published in Federal Register and Hawai'i Office of Environmental Quality Control Bulletin. Public Hearing notices published and letter advising of availability of DEIS and Public Hearing locations and dates sent to project mailing list. Notice received from SHPO stating that further ethnographic studies would be required to determine eligibility of mamane forest and Mauna Kea as Traditional Cultural Properties.

12/97 | Two Public Hearings held: one held on weekday on west side of Island of Hawai'i and one held on Saturday on east side of Island of Hawai'i. Public comment period ended. USFWS letter received stating that BA was adequate and a Final BO would be delivered by March 27, 1998.

1/98 | DEIS comments received through this month. EPA comment letter received and discussions with EPA, USACE, State of Hawai'i DLNR and SHPD began to resolve outstanding issues.

2/98 | To allow more time to resolve endangered plant issues, FHWA and USFWS mutually agree to extend the date for the Final BO to April 17 and that it would be submitted in draft form until Palila mitigation implementation details could be confirmed. DEIS comments received from DOI; began resolution of outstanding issues with USFWS.

3/98 | SEE Team reviews all information and agency coordination received to date and comparative analysis of alternatives and recommends selection of W-3, PTA-l, EX-3, and E-3 as Recommended Alternative. Work begins on 404(b)(1) analysis to address issues raised by the EPA and USACE with regard to alternative alignments in wetland area and proposed mitigation.

4/98	USFWS issues Final BO in which it is concluded that "the mitigation measures built into the project...will offset the modifications being made to palila critical habitat and enhance the likelihood of survival and recovery of the palila." Revised archaeological inventory and historic assessment report submitted to SHPO requesting concurrence with eligibility determinations, effects, and proposed mitigation.
5/98	404(b)(1) Analysis Report submitted to the HDOT, USACE, EPA, USFWS with request for concurrence on the selected alternative and mitigation measures proposed.
6/98	Letters of concurrence from USFWS, HDOT, and USACE on 404(b)(1) Report received. EPA indicates verbally that they do not agree with suppositions, analyses, alternative selection, and mitigation as proposed in 404(b)(1) Report and that a memorandum outlining the basis for disagreement will follow.
8/98	Letter from EPA received in disagreement with selection of Least Environmentally Damaging Practicable Alternative (LEDPA) in Section IV as well as mitigation proposed.
9/98	Reply to EPA August letter sent, meeting with EPA to resolve issues of disagreement, additional costs of non-selected alternative and mitigation requirements agreed upon.
10/98	Letter sent to EPA outlining modifications to LEDPA costs and mitigation and identifying the basis for agreement. Agreement reached with SHPD on eligible sites, effects, and mitigation proposed; MOA finalized with SHPD and consultation begins with OHA on MOA.
11/98	Preliminary FEIS distributed to all agencies for final review and comment.
12/98	Letter received from EPA documenting agreed upon LEDPA alternatives, wetlands mitigation, and 404 Permit process to be followed for programmed projects. Revised Draft MOA transmitted to OHA and signatory parties.
1/99	Meetings held with agencies to discuss preliminary FEIS, resolve any remaining concerns. Initiate consultation with DHHL on Section 106 MOA. All signatory parties to MOA reach agreement; concurring party OHA indicates disagreement on wording in MOA with respect to their role and sites.
2/99	Meeting held with DLNR to brief new director and reinforce coordination efforts required in Palila mitigation and MOA finalization. Problems develop with BRD budgeting of partial Palila mitigation.
3/99	Clarification of significance criteria for archaeological sites received from SHPO. Staff meeting with OHA to discuss further concerns on MOA.

4/99 | Meeting with OHA Land Committee to request recommendations of approval of MOA to Trustees; OHA Trustees approve MOA. All issues resolved and FEIS revised for publication. "Reasonable assurance" of Palila mitigation funding secured from DOD.

7/99 | Meetings with DLNR and ranchers to review Uniform Relocation Assistance and Real Property Acquisition Policy Act and initiate transferral of Palila mitigation lands. Final SRTF meeting held.

8/99 | FEIS published and Conservation District Use Application (CDUA) submitted. Final project newsletter distributed to mailing list.

Numerous meetings were held between January, 1994, and the present with interested individuals, agency representatives, and public and private organizations to provide project briefings and receive input on project issues and concerns. A list of organizations for which one or more formal project briefings were presented at various stages of the project is presented in Table S.7, *Community Organizations*.

TABLE S.7
Community Organizations

Kaumana Community Association	Hawai'i Island Chamber of Commerce
Upper Kaumana Community Council	Big Island Business Council
Kaumana City Association	Kona Senior Citizens
Waiki'i Ranch Community Association	Waimea Community Association
Waimea Rotary Club	AARP-Hilo Chapter
South Hilo Rotary Club	Waimea Exchange Club
Waimea Lions Club	Hilo Woman's Club
Big Island Retired Military Association	Sierra Club
Hawai'i County Council	Various hunting groups

Open community meetings were held in Hilo, Kona, and Waimea from April through October, 1995, to present project briefings and distribute social impact survey questionnaires.

S.10 CONSISTENCY OF ALTERNATIVES WITH EXISTING PLANS AND POLICIES

The proposed Saddle Road project complies with appropriate State and County land use policies, plans, goals, objectives and controls. It would facilitate implementation of the State Plan, the

Transportation Function Plan, the Island of Hawai'i Long Range Highway Plan, the County of Hawai'i General Plan, and the land use controls and regulations as established pursuant to the State Land Use Law and the Hawai'i County Zoning Code. Table S8, *Conformance with Land Use Plans and Policies*, summarizes the project's conformance with previously described land use plans and policies.

TABLE S.8
Conformance with Land Use Plans and Policies

Agency	Name of Plan	Year Adopted/ Revised	Purpose or Description of Plan	Conformance with Plan or Policy
State of Hawai'i	Hawai'i State Plan	1991	Establishes broad goals, objectives and policies to guide the overall development of the State.	Consistent with State goals on economy/transportation
State of Hawai'i	Hawai'i State Function Plan	1991	Establishes guidelines for implementation of the State Plan with respect to Transportation.	Consistent with Plan on regional mobility, land use, economic development.
State of Hawai'i	Coastal Zone Mgt. (CZM) Program	1977	Establishes objectives and policies to protect coastal resources and areas.	Project conforms with objectives, policies in all seven CZM resource areas.
State of Hawai'i	Hawai'i Long Range Land Trans. Plan	1991	Identifies and prioritizes major highway system improvements necessary to accommodate future traffic demands.	Consistent with recommendation for realignment or reconstruction of the Saddle Road.
County of Hawai'i	County of Hawai'i General Plan	1989	Long-Range Comprehensive Plan guiding the overall development of the County.	Consistent with Transportation Goals of the General Plan
County of Hawai'i	General Plan LUPAG and Facilities Map	1989	Maps show general location of land uses and roadway networks in relationship to each other.	Project is consistent with Maps which call for improvement of Saddle Road.
County of Hawai'i	Hilo Com. Dev. Plan	1975	Short to medium term guide to implement the General Plan within the Hilo area.	Saddle Road within the Hilo planning area is recommended for improvement.
County of Hawai'i	NE Hawai'i Com. Dev. Plan	1979	Provides short to medium term development guide for the Hamakua region of the County	Plan call for improvement of existing Saddle Road as a primary roadway.

Mgt. = Management, Trans. = Transportation, Com. = Community, D.V.. = Development

S.11 REQUIRED PERMITS AND APPROVALS

A number of permits or other approvals may be necessary prior to implementation of the Recommended Alternative. The following list (Table S9, *Permits and Approvals*) represents those permits or approvals identified to date. Additional permits might be identified subsequently if project modifications, mitigation measures, or refinements in final design warrant.

TABLE S.9
Permits and Approvals

Permit / Approval Status	Applicable Activities	Applicable Areas	Regulatory Agency
Clean Water Act (CWA), Section 404 Permit(s) / to be submitted as each Section is advanced. None required in Sections I and II.	Discharge of dredged or fill material into waters of the U.S.	Navigable waters of the U.S., which include areas seaward of the mean high water level; rivers, streams, and wetlands; inland waters subject to tidal influences or which are drained by rivers or streams running to the ocean.	Corps of Engineers (USACE)
CWA, Section 401 Water Quality Certification / to be submitted during final design of each Section.	Discharge to waters of the State.	Waters of the State.	State of Hawai'i Department of Health (DOH), Clean Water Branch
Historic Sites Review / to be submitted during final design of each Section.	Any construction in the vicinity of a designated historic place or archaeological site.	Sites listed on national or State registers of significant historic resources.	DLNR
State Highways Permit / to be submitted during final design of each Section.	Any work.	Within State highway ROW.	State of Hawai'i Department of Transportation (HDOT)
Conservation District Use Application (CDUA) / submitted 1-99.	Any use of conservation lands.	Lands designated conservation by the State, including submerged lands.	DLNR

TABLE S.9
Permits and Approvals

Permit / Approval Status	Applicable Activities	Applicable Areas	Regulatory Agency
State Land Use (SLU) Approval / to be submitted during final design of each Section.	Any activity.	State-owned lands throughout the State, including submerged lands.	DLNR
Stream Channel Alteration Permit / to be submitted during final design of each Section.	Alter stream channels, or the flow of water therein, by changing the shape of the channel, placing materials in or removing materials from a stream channel.	Streams and rivers of the State where specified by law.	DLNR
Permit to Construct an Air Pollution Source / submitted by contractor prior to construction.	Constructing or installing a new air pollution source or modifying an existing source.	Statewide	DOH
National Pollutant Discharge Elimination System (NPDES)/ to be submitted during final design of each Section.	Discharge any pollutant, altering the quality of any discharge, increasing the quantity of any discharge.	Surface streams and coastal waters of the State.	DOH
Subdivision Approval / to be submitted during final design of each Section.	Dividing or consolidating parcels of land.	Statewide	County
Flood Hazard Controls / to be submitted during final design of each Section.	Any development.	Flood hazard zones on Flood Insurance Rate Maps prepared by the National Flood Insurance Program.	County
Grading, Grubbing, Excavating and Stockpiling Permits / to be submitted during final design of each Section.	Any excavation or fill, the removal of vegetation from the surface of the ground, or the purposeful accumulation and set-aside of loose soil.	Statewide	County

TABLE S.9
Permits and Approvals

Permit / Approval Status	Applicable Activities	Applicable Areas	Regulatory Agency
Coastal Zone Management Federal Consistency / Submitted 10-98, Approved 12-98.	Project involving Federal funds or lands.	Statewide	State of Hawai'i Office of Planning

S.12 RESOLVED ISSUES

Several issues emerged during circulation of the DEIS that required further coordination with regulatory agencies; however, all have been resolved to the satisfaction of the agencies involved. There were no unresolved issues at the time of publication of this Final EIS. These formally-unresolved issues and their resolution are as follows.

1) The selection of the LEDPA and mitigation for proposed wetlands in Sections III and IV of the project area pursuant to Section 404 of the Clean Water Act:

   The EPA, the USACE, and the USFWS agreed that EX-3 and E-3 are the LEDPAs in Sections III and IV, restoration and preservation measures are acceptable mitigation for wetland impacts, and 404 Permit applications can be submitted concurrent with a review of Section 404(b)(1) issues by HDOT in Sections III and IV when these Sections are programmed for project development (ref: FEIS-Part II, Section 1.4 and Part III, 404(b)(1) Report and Associated Correspondence).

2) Assurances for implementation of mitigation for impacts to the federally designated Palila Critical Habitat in Section II in order to successfully conclude Formal Consultation under Section 7 of the Endangered Species Act (ESA):

   Formal Consultation with the USFWS under Section 7 of the ESA was successfully concluded with the issuance of a Final BO which contains reference to a Palila MOU as the mechanism for ensuring implementation of the Palila Mitigation Plan (ref: FEIS-Part I, 3.18.3 and Part III, BO and MOU).

3) The status of Mauna Kea as a TCP and possible impacts to this TCP should it be eligible for listing on the NRHP:

   An MOA pursuant to Section 106 of the National Historic Preservation Act (NHPA) has been successfully executed by the FHWA, the SHPO, and the ACHP with concurrences by

OHA and HDOT. This MOA recognizes that Mauna Kea is eligible for listing as a TCP; however, because of the minimal indirect impacts to this potential TCP from the proposed project, the Area of Potential Effect is more directly associated with activities managed by the Institute for Astronomy of the University of Hawai'i - Hilo and, therefore, should be investigated further as part of an ongoing study through that organization (ref: FEIS-Part I, 3.19.3.1.3 and Part III, MOA).

CHAPTER 1
PURPOSE AND NEED FOR ACTION

CHAPTER 1 - PURPOSE AND NEED FOR ACTION

The Federal Highway Administration, Central Federal Lands Highway Division (FHWA) in cooperation with the State of Hawai'i Department of Transportation (HDOT) are proposing to improve Saddle Road. The U.S. Department of the Army (DOA), Military Traffic Management Command (MTMC), serves with the FHWA as co-administrator of the Defense Access Road (DAR) Program. FHWA will serve as the lead agency for compliance with the National Environmental Policy Act of 1969 as amended (NEPA). Compliance with Chapter 343 of Hawai'i Revised Statutes (HRS) relating to environmental impact statements is also required because State lands and resources are involved in the project. This Environmental Impact Statement (EIS) has been prepared to evaluate the proposed action in accordance with NEPA and HRS 343.

The Final EIS (FEIS) consists of three separate documents: Part I, Part II, and Part III. Part I is the FEIS core document, the revised version of the DEIS. It presents the project purpose and need, alternatives considered, affected environment, environmental consequences, mitigation commitments, and an Executive Summary. Part II is the documentation of the public/agency involvement process. It includes the project development history, the project mailing list, correspondence and notices associated with the EIS process, hearing transcripts and associated documentation, and agency and public comments and responses regarding the DEIS. Part III comprises the Technical Addendum. It includes copies of supplemental studies related to social impacts, 404(b)(1) wetland issues, and Traditional Cultural Properties (TCP). It includes the final archaeological inventory survey report, the Memorandum of Understanding (MOA) related to cultural resources, the Biological Opinion (BO), the Palila Mitigation Memorandum of Understanding (MOU), and supporting correspondence and documentation.

1.1 INTRODUCTION

The proposed improvements to Saddle Road would upgrade and modernize this transportation facility as a two-lane highway that would meet contemporary design standards for rural arterials and provide adequate capacity to handle anticipated traffic volumes through 2014 and beyond. The portion of Saddle Road to be improved by this project is approximately 78 kilometers (km) in length and extends from the Mamalahoa Highway (SR 190) to Milepost (MP) 6, near Hilo, Hawai'i (Figure 2.2.1, *Overview of Segments Under Consideration*).

The MTMC has authorized DAR funds to prepare an EIS for the entire Saddle Road, including such preliminary design work as may be necessary for completing the EIS. The MTMC has determined that the design and construction of that portion of the Saddle Road improvements within the approximate limits of the U.S. Army Pohakuloa Training Area (PTA) are eligible for DAR funds because of the impact of the military operations at the PTA on Saddle Road. Funds for constructing the DAR section of Saddle Road must be authorized and appropriated by Congress.

The remaining portions of the Saddle Road improvement project will be funded by monies appropriated through future legislative actions. It is anticipated that HDOT will design and construct segments outside of PTA. It has been agreed that improved segments of Saddle Road constructed with DAR funds will be owned and maintained by HDOT.

1.2 DESCRIPTION OF EXISTING ROADWAY

Saddle Road, State Route 200 (SR 200), is a two-lane road approximately 85 km in length extending westerly from Hilo to a junction with State Route 190 (SR 190), the Mamalahoa Highway (SR 190), approximately 10 km south of Waimea, on the Island of Hawai'i.

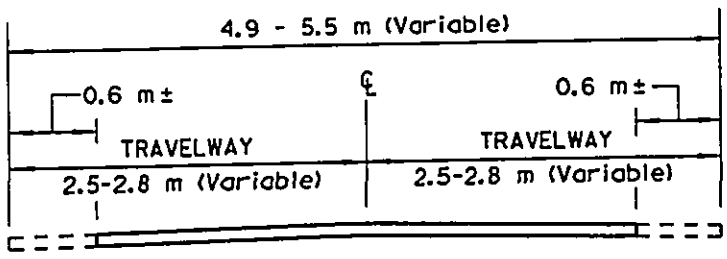
Saddle Road is a shorter route between East and West Hawai'i than Highway 19 (SR 19) and Highway 11 (SR 11), the other two alternative east - west routes (Figure 2.2.1). In its current poor condition, Saddle Road does not provide a viable cross-island link. Cross-island traffic uses SR19 predominantly. Saddle Road serves as an alternate route when flooding, landslides, or other emergencies or disasters cause road closures on SR 19 or SR 11. Information on the traffic conditions, traffic patterns, level of service, and accident history of Saddle Road is provided in 1.6, Purpose and Need.

For this project, the logical termini were determined to be the Mamalahoa Highway (SR 190) and MP 6 near Hilo. The Mamalahoa Highway (SR 190) was determined to be the western project terminus because it represents a separate, established transportation route with connections to all destinations on the west side of the Island. MP 6 was determined to be the eastern project terminus because it represents the extent of previous road improvements to Saddle Road, and is the site of a future connection with the proposed Puainako Street Extension.

1.3 SADDLE ROAD USE PATTERNS

Saddle Road is the only paved road serving the Mauna Kea Science Reserve International Astronomical Observatory Complex (University of Hawai'i Observatory), residential areas of Waiki'i Ranch and Kaumana, Mauna Kea State Park, and the Kilohana Girl Scout Camp. It serves as access to the state's major hunting areas on Mauna Kea, Ka'ohe, PTA, Mauna Loa, Kipuka 'Ainahou, Hilo Forest Reserve, and Upper Waiakea Forest Reserve. Saddle Road is also important for providing a cross-island transportation route to connect East and West Hawai'i for business travel, the transport of goods and services, tourism/recreation, shopping, and to some extent, commuting.

Saddle Road is the only paved arterial serving the PTA. No permanent training units are stationed at the PTA. The facility serves as the only light infantry, live-fire training facility in the Pacific for the U.S. Army Pacific Command (USARPAC) and other Pacific Command Units. The transportation of ammunition, training equipment, and troops from harbors on both the west



Patched Pavement

Patched Pavement

Note:
Continuous patch of shoulder pavement extends travelway width.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

TYPICAL SECTION
EXISTING ROADWAY

FIGURE 1.6.1

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and east side of the island creates long, slow-moving convoys on Saddle Road. Saddle Road is also used by PTA personnel to commute to and from work.

Traffic distribution on Saddle Road is estimated at 50 percent in each direction. Trucks constitute approximately 10 percent of the total traffic on Saddle Road.

1.4 OTHER RELEVANT TRANSPORTATION PROJECTS

Two other relevant transportation projects have been initiated by HDOT that would further enhance the role of Saddle Road as a vital transportation route within the region. These include a proposed connection between the Mamalahoa Highway (SR 190) and Queen Ka'ahumanu Highway in the vicinity of Waikoloa Road on the west side of the Island and the Puainako Street Extension in Hilo. The scoping process has begun for the proposed connection between the Mamalahoa Highway (SR 190) and Queen Ka'ahumanu Highway. The Federal EIS for the Puainako Street Extension is now underway and a DEIS has been released for public review. The proposed project addressed in this EIS has logical termini regardless of whether these two related projects are built (ref: FEIS - Part I, 2.1).

1.5 BACKGROUND

Saddle Road was constructed in 1942 by the DOA. In 1945, the road was released by the Federal Government and turned over to the Territory of Hawai'i. The Territory of Hawai'i maintained the road until 1957 when the lack of territorial funds necessitated transfer of road maintenance to the County of Hawai'i. In 1965, the State of Hawai'i authorized the establishment of a State highway system. Saddle Road was included in this State system and an agreement was made in 1968 between the County and the State to exchange the road jurisdiction. This agreement was never implemented, however, because of a lack of State funding; the County has continued to maintain Saddle Road up to the present.

Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, poor pavement, and substandard drainage (Rust 1996a). Between 1988 and 1998, the County of Hawai'i widened and repaved approximately 35 km of the road (MP 28 to 6); however, geometric deficiencies still exist. Beyond the 1988 to 1998 improvements, Saddle Road has received only minimal upgrades since it was originally built. Today, the alignment, grade, sight distances, drainage, and other features remain substandard for arterial highways. Photographs which document the pavement condition and other deficiencies of the road are located in the Visual Resource Assessment prepared for this project (Logan Simpson & Dye 1996, Tech. App. Vol. VII).

1.6 PURPOSE AND NEED

The purpose of this project is to provide a safe and efficient route for access to land uses along Saddle Road and for cross-island traffic between East and West Hawai'i. The proposed improvements to Saddle Road would address five general types of needs: roadway deficiencies, conflicts and hazards with military operations, capacity, safety, and social demand and economic development.

This project is included in the Hawai'i Long Range Land Transportation Plan as a Tier 1 project. Projects will be added in the federally required State Transportation Improvement Program (STIP) in segments as projects are programmed prior to construction. The FEIS - Part II, 1.1, provides a chronological description of how the purpose and need were derived and alternatives were established.

1.6.1 Roadway Deficiencies

Although Saddle Road is presently two-directional, in practicality, deterioration of the pavement has reduced much of the road to one asphalt travel lane, 3.6 to 4.3 meters (m) in width, with shoulders 0.6 m in width (Figure 1.6.1, *Typical Section, Existing Roadway*). Pavement deterioration has compromised the integrity of the shoulders, where pavement is more patchy than continuous. The narrow width and poor pavement condition encourage motorists to drive in the center of the road, increasing the potential for accidents, including head-on collisions. One stretch of Saddle Road, between the PTA and the Mamalahoa Highway (SR 190), contains six one-lane bridges.

With horizontal and vertical alignment deficiencies, Saddle Road is characterized by steep grades and sharp curves, which in many places prevent motorists from seeing ahead an adequate distance. The narrow travel lane, inadequate shoulders, steep grades, sharp curves, and associated substandard sight distances, make the passing of slow-moving vehicles very hazardous. In addition, pavement markings and roadway signage are currently inadequate along Saddle Road. Drainage structures are undersized, resulting in periodic flooding of portions of the roadway. Saddle Road is often closed during major storm events due to flooding and hazardous road conditions. Additional detail on roadway conditions and deficiencies is provided in the Preliminary Design Report (Rust 1996a).

1.6.2 Conflicts/Hazards with Military Operations

Saddle Road crosses through the northern area of the PTA. The road separates the PTA cantonment area and the Bradshaw Army Airfield from the majority of its training areas, firing points, and impact zones. Extensive training along and across Saddle Road has created conflict between the traveling public and military training exercises and has reduced the quality of many of the training exercises undertaken. Some military operations require troops to fire over Saddle Road, while some require troops to break from a "tactical mode" to an "administrative mode" to

move across the road to reach firing ranges on the opposite side. With little or no warning, motorists on the road may encounter soldiers or military equipment crossing the road. This creates a potentially life-threatening situation for both the traveling public and military personnel, particularly in places where sight distance is low.

1.6.3 Capacity

Future growth in traffic volumes is projected for Saddle Road for both the No Action and build alternatives. The 1994 average daily traffic (ADT) on Saddle Road was 900 vehicles. With the No Action Alternative, the Saddle Road ADT is projected to be 4,400 by 2014 (Rust 1994). Completion of proposed improvements to Saddle Road would be expected to further increase traffic volumes to 14,000 ADT by 2014, a sixteen-fold increase over existing levels and a three-fold increase over that of the No Action Alternative for 2014. This level of need far exceeds the road's existing traffic capacity. The projected increase is due to a variety of demands including increased usage associated with commuter traffic; residential development in the Kohala, Waikoloa, and Waiki'i Ranch areas; tourist related traffic; recreational travel; agricultural transportation; military operations; the Mauna Kea telescope complex related traffic; and increasing congestion along alternative cross-island routes.

The transportation of ammunition, training equipment, water trucks, and troops to and from the PTA creates long, slow-moving convoys on Saddle Road. With Saddle Road's severe limitations to passing, platoons of traffic are created as motorists are trapped behind slow-moving vehicles or convoys.

Level of Service (LOS) is a qualitative measure of operational conditions within a traffic stream and motorists' perception of those conditions. It relates to the density of traffic relative to roadway capacity. It expresses conditions of speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. The quality of traffic flow is described in six categories of service, A through F, with LOS A representing traffic in a free flow condition, and LOS F representing serious congestion and considerable delays (Table 1.6.1, *Current and Future Traffic Volumes and LOS*). On a two-lane road LOS is primarily determined by the ability to pass, which is largely dependent on the percentage of steep grades, traffic volumes, and sight distance (Rust 1994). LOS A through F are described as follows.

- LOS A represents uncongested, free-flow conditions. On a two-lane road, passing demand is well below passing capacity. Drivers are delayed no more than 30 percent of the time by slow moving vehicles. For multi-lane highways, the ability to maneuver within the traffic stream is high. Minor traffic flow disruptions at this level are easily absorbed without causing significant delays or queuing.

- LOS B is indicative of a stable flow where the presence of other vehicles begins to be noticeable. As passing demand approaches capacity on two-lane roadways, platooning is

common. At this level, minor traffic disruptions are still easily absorbed, but local deterioration in LOS will be more obvious.

- LOS C represents conditions at which noticeable delays occur and the freedom to maneuver between lanes becomes restricted. Slowing of traffic is particularly noticeable when vehicles turn left and passing capacity is reduced.

- LOS D represents congestion and the limits of stable traffic flow. Traffic congestion severely restricts speeds and the ability to maneuver. Only the most minor of traffic disruptions can occur without extensive queues forming. On two-lane roads, passing demand is high while passing capacity approaches zero.

- LOS E represents unstable traffic flow operations at or near capacity. Any disruption, no matter how minor, causes queues and deterioration of LOS. Passing becomes virtually impossible on two-lane roadways.

- LOS F represents heavily congested flow with the traffic demand exceeding capacity. Operations within queues are very unstable, with traffic experiencing short spurts of movement followed by stoppages.

Using operational analysis procedures presented in the Highway Capacity Manual (HCM), Third Edition, 1994, the LOS under current conditions was calculated. According to this theoretical approach, Saddle Road is operating at LOS B in some segments, and in LOS D in most areas. LOS B overstates the road's current level of service given the poor condition of the pavement, its narrow width, alignment deficiencies, and poor sight distances. The FHWA has concluded that the overall LOS for Saddle Road is D, due to these numerous deficiencies and steep grades.

With projected traffic growth and no proposed improvements, Saddle Road is expected to deteriorate to LOS E by the year 2014. With LOS E, passing in most locations is unsafe and platooning occurs when slower vehicles or other interruptions are encountered. With the proposed improvements, Saddle Road LOS D would be improved to LOS B along W-3, PTA-1, and most of EX-3 by the design year 2014. LOS B describes only slight, occasional congestion. It is considered a more-than-adequate condition. Approximately the lower 8.1 km of EX-3 and the E-3 alignment would operate at LOS C much of the time, with short segments at LOS D during peak hours in the design year. This lower LOS on part of recommended alignments EX-3 and E-3 is primarily a result of a more curvilinear alignment with reduced passing opportunities on steeper grades. The curvilinear alignment and reduced passing opportunities are the result of efforts to minimize impacts on sensitive environmental resources in this area. LOS C is acceptable for a design standard when there are overriding factors such as cost and impacts. Table 1.6.1, *Current and Future Traffic Volumes and LOS*, summarizes the results of traffic modeling conducted for the EIS.

TABLE 1.6.1
Current and Future Traffic Volumes and LOS

Year	Alternative	ADT	LOS
1994 Estimated Traffic	Baseline Conditions	900	D
2014 Projected Traffic	No Action Alternative	4,400	E
2014 Projected Traffic	All Action Alternatives	14,000	B

1.6.4 Safety

Roadway deficiencies, conflicts/hazards with military operations, and capacity limitations contribute to safety concerns of Saddle Road. Historical accident data for 1986 through 1994 for Saddle Road from HDOT indicate a total of 626 accidents. Five included fatalities, 315 resulted in injuries (excluding fatal accidents), and 306 involved property damage only. The average rate for rural two-lane highways throughout the State of Hawai'i is about 3.0 accidents per million vehicle miles (ACC/MVM). The average 5.43 ACC/MVM for Saddle Road is notably higher (81 percent) than the State average (ref: FEIS - Part I, 3.4.4) (Rust 1994).

Emergency vehicles responding to fires, accidents, and other incidents along Saddle Road are also affected by the narrow, winding alignment of Saddle Road, its inadequate sight distances, deteriorating pavement, inadequate shoulders, and poor passing conditions, which hinder the quick response of fire trucks, ambulances, police cars, and other emergency vehicles.

1.6.5 Social Demand and Economic Development

Saddle Road is needed for access to the PTA, Mauna Kea, Mauna Loa, Mauna Kea State Park, outdoor recreation areas along the road including areas used for hunting and gathering, ranch lands, and the communities of Waiki'i Ranch and Kaumana. It is also important for providing a cross-island transportation route to connect East and West Hawai'i for business travel, the transport of goods and services, tourism/recreation, shopping, and to some extent for commuting.

East and West Hawai'i differ in economic and development patterns and opportunities. Government functions and the University of Hawai'i at Hilo are located on the east end of the island in Hilo, where housing costs are generally lower, while much of the current economic growth and tourism-related growth and employment is occurring in West Hawai'i. Without a feasible, safe, cross-island route, business opportunities across the island are more limited, and the economies of East and West Hawai'i would be expected to continue to diverge (ref: FEIS - Part I, 3.3) (Terry 1996, Tech. App. Vol. V). In addition, these conditions create a need for some

people to commute cross-island. Decreased cross-island travel times would increase the mobility of the labor force.

In addition to Saddle Road, two other routes can be used for travel to cross-island destinations: SR 19 and SR 11. SR 11, however, is from 50 to 150 km longer than the other two routes, and is generally not used by frequent travelers. For this reason, SR 19 along the Hamakua Coast is considered the only feasible alternative to Saddle Road for cross-island traffic. SR 19 is approximately 12 to 17 km longer than Saddle Road between Hilo and Kailua-Kona, and Hilo and Waikoloa. Between Hilo and Waimea, SR 19 is the shorter route. Because of the roadway deficiencies of Saddle Road, its pavement condition, and a lack of services and roadside amenities, SR 19 currently carries a larger percentage of the cross-island traffic, resulting in congestion on SR 19 during peak travel hours, increasing the time needed to complete the trip.

Tourists currently do not have easy access to the interior of the island. Due to the condition of Saddle Road, automobile rental agencies restrict or prohibit use of their vehicles on the road, preventing many tourists from experiencing the attractions within the Saddle Road area.

1.7 CRITERIA FOR SELECTION OF ALTERNATIVES

This EIS process identified and evaluated alternatives for improving Saddle Road to provide a safe and efficient link between East and West Hawai'i. To fulfill the project's purpose and need, the following criteria were used in the selection of alternatives.

- Eliminate substandard roadway design elements and geometric deficiencies. Each alternative would upgrade and modernize Saddle Road in accordance with *A Policy on Geometric Design of Highways and Streets, 1994* by the American Association of State Highway and Transportation Officials (AASHTO), allowing its addition to the State highway system (ref: FEIS - Part I, 2.1). The new roadway would be wider, would have gentler curves and grades, would have adequate shoulders, and would allow motorists adequate sight distance.

- Minimize conflict between the traveling public and PTA military training operations. Two of the three alternatives considered within the PTA would notably minimize potential conflicts between the public and military training operations by physically separating them through the relocation of the roadway. The third alternative would not.

- Improve the quality and safety of PTA training activities. The separation of military and civilian traffic would serve to minimize these potential conflicts and would also improve the quality of training operations (ref: FEIS - Part I, 3.1.1.2). With two of the three alternatives through the PTA, the road would be physically separated from training activities, eliminating the need for troops to break from a "tactical" to an "administrative"

mode in order to cross the road, improving the quality of the training operations and enhancing the safety of training personnel.

- Improve overall safety. The proposed action would provide two adequately-sized travel lanes and shoulders, which will eliminate the tendency of motorists to drive in the center of the roadway. The roadway's vertical and horizontal alignments would be corrected to eliminate sharp curves, steep grades, and inadequate sight distances, and would provide more opportunities for vehicles to safely pass. All one-lane bridges and other drainage structures would be replaced with structures adequate to accommodate the new roadway section and pass a minimum 50-year storm. The new drainage structures would minimize hazardous flooding conditions along the road after storm events. In addition, improved pavement markings and roadway signage would be added.

  With two of the alternatives within the PTA, potential conflicts between the traveling public and military training operations would be minimized. With the third alternative, the roadway will not be realigned outside of the training areas and therefore, conflicts would likely increase in the future as traffic grows.

- Enhance operational function and increase the quality of traffic flow. By the year 2014 with the proposed project, LOS would be B. For the same year, LOS E would be expected without implementation of the proposed improvements. The proposed project would provide a number of passing lanes, or pullouts, to enhance motorists' ability to safely pass slow-moving vehicles or convoys.

- Minimize total environmental impact. Specific alternatives were eliminated because their environmental impacts were expected to be substantially more adverse than other alternatives which fulfilled the purpose and need (e.g. W-4, E-1).

- Improve emergency vehicle and firefighting access. As previously noted, poor pavement conditions and roadway geometric deficiencies would be eliminated with implementation of the proposed project, allowing emergency vehicles to respond quickly and safely.

- Provide an improved, alternate east/west access on the Island of Hawai'i. Improvements to Saddle Road would reduce cross-island travel time, maximizing employment, commerce, and recreational opportunities, and promoting island-wide economic growth and development. Tourism would increase in the area since rental car agencies would be expected to lift restrictions of Saddle Road. Reduction in cross-island travel time would provide economic benefit to the County and State of Hawai'i.

  Improvements to Saddle Road would provide an alternative cross-island route in the instance of road closures resulting from natural disasters (e.g. landslides, flooding, volcanic activity and tsunamis).

- Accommodate present and future traffic levels. The proposed project would increase the capacity of Saddle Road to a level consistent with the projected traffic growth for the 20-year planning period.

- Improve pavement condition. With each action alternative, deteriorating pavement would be removed and replaced as the road is rebuilt or realigned.

1.8 PROJECT DEVELOPMENT STATUS AND IMPLEMENTATION SCHEDULE

A formal public comment period began with the issuance of the Saddle Road Draft EIS (DEIS) on November 7, 1997. Two public hearings were held during this comment period to provide information and solicit formal comments on the project. In response to the agency and public comments received on the DEIS, the FHWA consultant team undertook additional studies and analyses as warranted, prepared responses, and incorporated additional information into the FEIS (FEIS - Part III). In consideration of the full record of scientific and technical information developed for the project as well as the public input received, the FHWA selected a *Recommended Alternative,* and a summary of the selection process was incorporated into the FEIS.

If approved, the Record of Decision (ROD) would be issued in the summer of 1999. Assuming that the Recommended Alternative is confirmed in the ROD, roadway design and engineering could begin immediately following the issuance of the ROD and phased construction could begin as early as late 2000, if funds become available. Table 1.8.1, *Implementation Schedule*, provides the projected time period for implementation of the proposed Saddle Road improvements.

TABLE 1.8.1
Estimated Implementation Schedule

Phase	Milepost	Activity	Projected Time Period
A	MP 42 to 28 (PTA-1)	Environmental Planning & Public Involvement	March 1994-August 1999
		Engineering and right-of-way (ROW)	September 1999-April 2000
		Construction	October 2000-June 2002
B*	MP 53.6 to 42 (W-3)	Environmental Planning & Public Involvement	March 1994-March 1999
		Engineering and ROW	April 2001-April 2002
		Construction	October 2002-June 2004

TABLE 1.8.1
Estimated Implementation Schedule

Phase	Milepost	Activity	Projected Time Period
C*	MP 9 to 6 (E-3)	Environmental Planning & Public Involvement	March 1994-March 1999
		Engineering and ROW	April 2003-April 2004
		Construction	October 2004-October 2005
D*	MP 19 to 9 (EX-3)	Environmental Planning & Public Involvement	March 1994-March 1999
		Engineering and ROW	April 2004-April 2005
		Construction	October 2006-October 2007
E*	MP 28 to 19 (EX-3)	Environmental Planning & Public Involvement	March 1994-March 1999
		Engineering and ROW	April 2005-April 2006
		Construction	October 2007-October 2008

* Assumes adequate funds are programmed as required.

1.9 REQUIRED PERMITS AND APPROVALS

A number of permits or other approvals may be necessary prior to implementation of the Recommended Alternative. The following list (Table 1.9.1, *Permits and Approvals*) represents those permits or approvals identified to date. Additional permits might be identified subsequently if project modifications, mitigation measures, or refinements in final design warrant.

TABLE 1.9.1
Permits and Approvals

Permit / Approval	Applicable Activities	Applicable Areas	Regulatory Agency
Clean Water Act (CWA), Section 404 Permit(s)	Discharge of dredged or fill material into waters of the U.S.	Navigable waters of the U.S., which include areas seaward of the mean high water level; rivers, streams, and wetlands; inland waters subject to tidal influences or which are drained by rivers or streams running to the ocean.	Corps of Engineers (USACE)
CWA, Section 401 Water Quality Certification	Discharge to waters of the State.	Waters of the State.	State of Hawai'i Department of Health (DOH), Clean Water Branch
Historic Sites Review	Any construction in the vicinity of a designated historic place or archaeological site.	Sites listed on national or State registers of significant historic resources.	DLNR
State Highways Permit	Any work.	Within State highway ROW.	State of Hawai'i Department of Transportation (HDOT)
Conservation District Use Application (CDUA)	Any use of conservation lands.	Lands designated conservation by the State, including submerged lands.	DLNR
State Land Use (SLU) Approval	Any activity.	State-owned lands throughout the State, including submerged lands.	DLNR
Stream Channel Alteration Permit	Alter stream channels, or the flow of water therein, by changing the shape of the channel, placing materials in or removing materials from a stream channel.	Streams and rivers of the State where specified by law.	DLNR
Permit to Construct an Air Pollution Source	Constructing or installing a new air pollution source or modifying an existing source.	Statewide	DOH

TABLE 1.9.1
Permits and Approvals

Permit / Approval	Applicable Activities	Applicable Areas	Regulatory Agency
National Pollutant Discharge Elimination System (NPDES)	Discharge any pollutant, altering the quality of any discharge, increasing the quantity of any discharge.	Surface streams and coastal waters of the State.	DOH
Subdivision Approval	Dividing or consolidating parcels of land.	Statewide	County
Flood Hazard Controls	Any development.	Flood hazard zones on Flood Insurance Rate Maps prepared by the National Flood Insurance Program.	County
Grading, Grubbing, Excavating and Stockpiling Permits	Any excavation or fill, the removal of vegetation from the surface of the ground, or the purposeful accumulation and set-aside of loose soil.	Statewide	County
Coastal Zone Management Federal Consistency	Project involving Federal funds or lands.	Statewide	State of Hawai'i Office of Planning

CHAPTER 2
ALTERNATIVES

CHAPTER 2 - ALTERNATIVES

Over a two-year period 1994 to 1996, alternatives for improvement of Saddle Road were developed and refined with input and involvement of the Social, Economic, and Environmental Study Team (SEE Team), the Saddle Road Community Task Force (SRTF), government agencies, local residents, landowners, and citizens at large through public meetings. The SEE Team is comprised of representatives from various participating agencies, formed in accordance with the FHWA Action Plan in the initial phases of a project's development. Its purpose is to provide scoping input on the identification of project issues and concerns, purpose and need, and selection of alternatives to be studied. The SRTF is comprised of interested citizens and was formed to provide similar input to project development efforts. This input and evaluation process allowed for early consideration of engineering and environmental issues of concern and resulted in numerous changes to and refinements of the original alternatives.

This chapter summarizes the process of alternatives selection and evaluation, and documents the conclusions reached throughout the process regarding whether each alternative warranted further analysis. It describes those alternatives considered, the No Action Alternative, and those alternatives initially considered but eliminated (ref: FEIS - Part I, 9.2.1 and 9.2.2). Documenting the final results of this process, a *Recommended Alternative* was ultimately selected. The selection of this Recommended Alternative was made with full consideration of the potential impacts of the project and the review of public and agency comments. A legally binding ROD will be prepared for this Recommended Alternative.

2.1 DESIGN PARAMETERS COMMON TO ALL ACTION ALTERNATIVES

The proposed project would upgrade and modernize Saddle Road as a two-lane highway that would meet contemporary design standards for rural arterials and provide enough capacity to safely handle both current and projected traffic volumes up to the year 2014. The logical terminus for the project on the west was determined to be the Mamalahoa Highway (SR 190), a point at which Saddle Road connects with another established transportation route. The logical terminus on the east end was determined to be MP 6 (near Hilo), the point at which Saddle Road has previously been improved and the future point of connection between Saddle Road and the proposed Puainako Street Extension. This EIS addresses improvements to Saddle Road between these logical termini.

Design parameters for Saddle Road were agreed upon at the project outset during SEE Team meetings. The road is to be developed to rural arterial standards, as defined by AASHTO, incorporating design controls presented in Table 2.1.1, *Design Criteria*. Uphill passing lanes, truck escape ramps, scenic pullouts, and military vehicle crossings will be incorporated as needed into project designs to enhance safety and to improve the projected level of service.

TABLE 2.1.1
Design Criteria

Design Speed	80 km per hour[1]
Minimum Curve Radius	230 m
Maximum Superelevation	8 percent
Curves	Simple curves with 67 percent of runoff on tangent
Maximum Grade	8 percent

[1] Design speed may be increased up to 100 km per hour in areas where feasible.

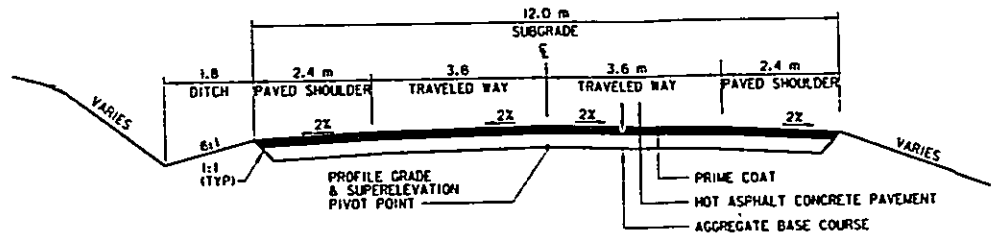
Three typical sections were developed for the project as depicted on Figure 2.1.1, *Typical Sections Proposed.* Typical Section A represents the standard for the majority of the segment lengths, and incorporates two 3.6-m travel lanes, and two 2.4-m paved shoulders. In select locations a passing lane may be incorporated into Typical Section A. Typical Section A applies to the entire project length except for portions of the three alternative alignments which were proposed through the PTA: EX-2, PTA-1, and PTA-3.

Typical Sections B and C were developed as mitigation to minimize fire hazards within vulnerable portions of the study corridor within the PTA (ref: FEIS - Part I, 3.9). In addition to the features included in Typical Section A, Typical Section B would include an additional 2.4-m wide strip of pavement on the north side of the highway, which would serve as a fire break. Between the shoulder and the fire break, a four-strand smooth wire fence with metal posts would be constructed to a height of 1.2 m. At the north edge of the fire break, a 0.23-m extruded asphalt curb would be constructed. Typical Section B applies to an 11.5-km length of PTA-1, an 11.5-km length of PTA-3, and a 3.9-km length of EX-2.

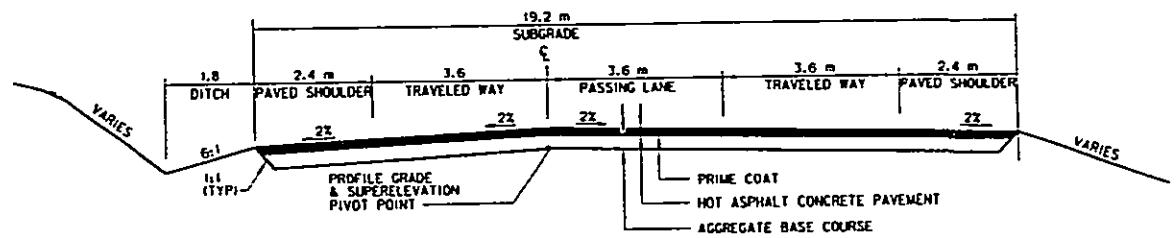
In addition to the features included in Typical Section A, Typical Section C would include additional 2.4-m wide strips of pavement on both the north and south sides of the highway, which would serve as fire breaks. Between the shoulders and the fire breaks, four-strand smooth wire fences with metal posts would be constructed at a height of 1.2 m. At the edges of the fire break, 0.23-m extruded asphalt curbs would be constructed. Typical Section C would be applied to a 5.5-km length of PTA-1, to a 7.6-km length of PTA-3, and to a 3.5-km length of EX-2.

By 2014, with the proposed improvements, Saddle Road is projected for an ADT of 14,000 vehicles, and a LOS B, with some segments functioning at LOS C during peak hour.

Implementing the proposed project within any one section or any combination of sections of Saddle Road would improve travel conditions in those sections whether or not the proposed project is implemented in all sections. Since the segments identified within each section begin and end at a common point on Saddle Road, selection of a particular segment within any one section would not influence the selection within any of the other sections. Because improvement



TYPICAL SECTION A



TYPICAL SECTION A WITH PASSING LANE

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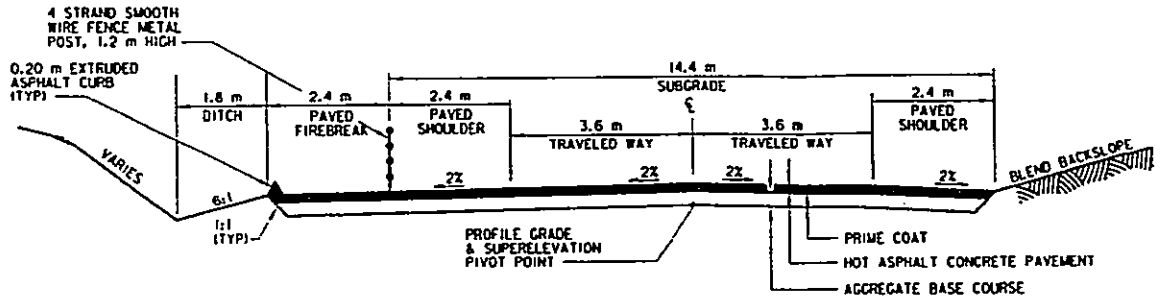
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

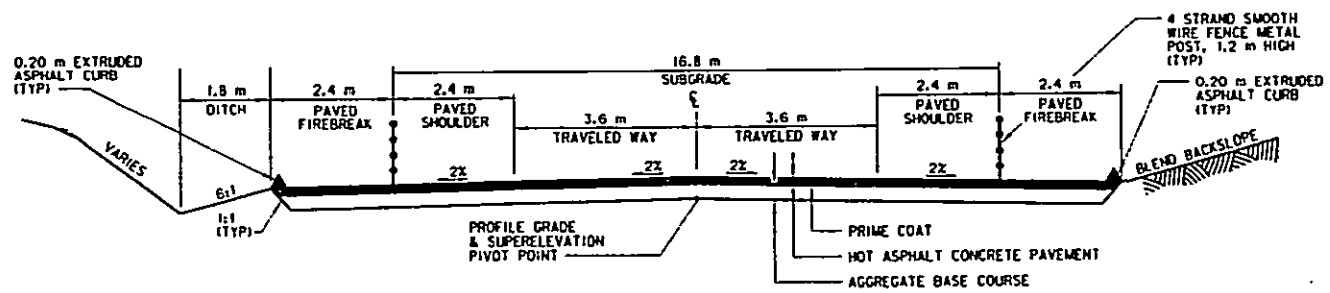
TYPICAL SECTIONS
PROPOSED

FIGURE 2.1.1
SHEET 1 OF 2



TYPICAL SECTION B

PTA-1 STA 10+000 TO PTA-1 STA 21+500
PTA-3 STA 10+000 TO PTA-1 STA 21+500
EX-2 STA 119+100 TO EX-2 STA 123+000



TYPICAL SECTION C

PTA-1 STA 21+500 TO PTA-1 STA 27+270
PTA-3 STA 21+500 TO PTA-1 STA 26+900 (Common to PTA-1)
PTA-3 STA 10+000 TO 12+500
EX-2 STA 129+000 TO EX-2 STA 132+500

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

TYPICAL SECTIONS
PROPOSED

FIGURE 2.1.1
SHEET 2 OF 2

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of each section is not dependent on improvement of the others, the improvements for each section are said to have *independent utility.*

The project can be phased over a number of years as funding becomes available. The MTMC has determined that the design and construction of that portion of the Saddle Road improvements within the approximate limits of the PTA would be eligible for DAR funds. Funds for constructing the DAR section of highway must be authorized and appropriated by Congress. HDOT has agreed to improve the remaining portion of the road over time, as funds become available.

2.2 ACTION ALTERNATIVES IDENTIFIED AND CONSIDERED

For ease of discussion, the project area has been divided into four sections (Figure 2.2.1, *Overview of Segments Under Consideration).* Section I begins at the junction with Mamalahoa Highway (SR 190) and extends east to Saddle Road MP 42. Section II extends from MP 42 to 28. Section III extends from MP 28 to 9, and Section IV extends from MP 9 to the eastern project terminus, MP 6. All four sections are independent with respect to highway design, and, in the context of this EIS, can be evaluated separately.

Formulation of alternatives for Saddle Road in Sections I, II, and IV considered use of the existing road alignment as well as potential new alignments. Within Section III, improvement along the existing alignment was considered the only practicable alternative after much discussion and investigation of potential alternative routes.

Alternative road alignments within each section are referred to as *segments* throughout this document. A total of 20 segments were initially considered and were assumed to be reasonable alternatives at the beginning of the initial study phase of the project. These included W-2, W-3, W-4, W-5, W-6, EX-1, PTA-1, PTA-1B, PTA-2, PTA-3, PTA-3A, PTA-4, PTA-5A, PTA-5B, EX-2, EX-3, E-1, E-3, EX-4, and EX-4A (ref: Figure 2.3.1). "EX" in a segment designation indicates an alternative that generally follows the existing Saddle Road alignment. "W" indicates a new alignment alternative on the west end of the project corridor (Section I). "PTA" indicates a new alignment alternative traversing the PTA area (Section II). "E" indicates a new alignment alternative on the east end of the project corridor (Section IV).

Of these 20 segments, 10 were eliminated from further consideration during the initial study phase by consensus of the SEE Team. These included W-4, W-5, W-6, PTA-1B, PTA-2, PTA-3A, PTA-4, PTA-5A, PTA-5B, and E-1 (ref: FEIS - Part I, 2.3). These alternatives were eliminated because they failed to meet the criteria developed in the purpose and need (e.g., road deficiencies, capacity) or because it was evident without further detailed analysis that the anticipated impacts of their construction were clearly greater than other alternatives. The remaining 10 segments were considered feasible, warranting more detailed analysis (ref: FEIS - Part I, 2.4).

Subsequently, the 10 segments considered feasible were evaluated in full detail by the project team. The team specialists included biologists, botanists, archaeologists, sociologists, economists, land use specialists, water quality specialists, visual resource specialists, and engineers. Each specialist prepared a technical report which documented results of the analysis. Based on results of the technical reports, the SEE Team acted to eliminate two additional segments, Segments EX-1 and EX-4 (ref: FEIS - Part I, 2.3.2.1 and 2.3.2.3, respectively). The remaining eight segments under consideration were W-2, W-3, PTA-1, PTA-3, EX-2, EX-3, E-3, and EX-4A. (ref: FEIS - Part I, 2.4.1 - 2.4.4). In addition, the No Action Alternative is also considered (ref: FEIS - Part I, 2.4.6).

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED

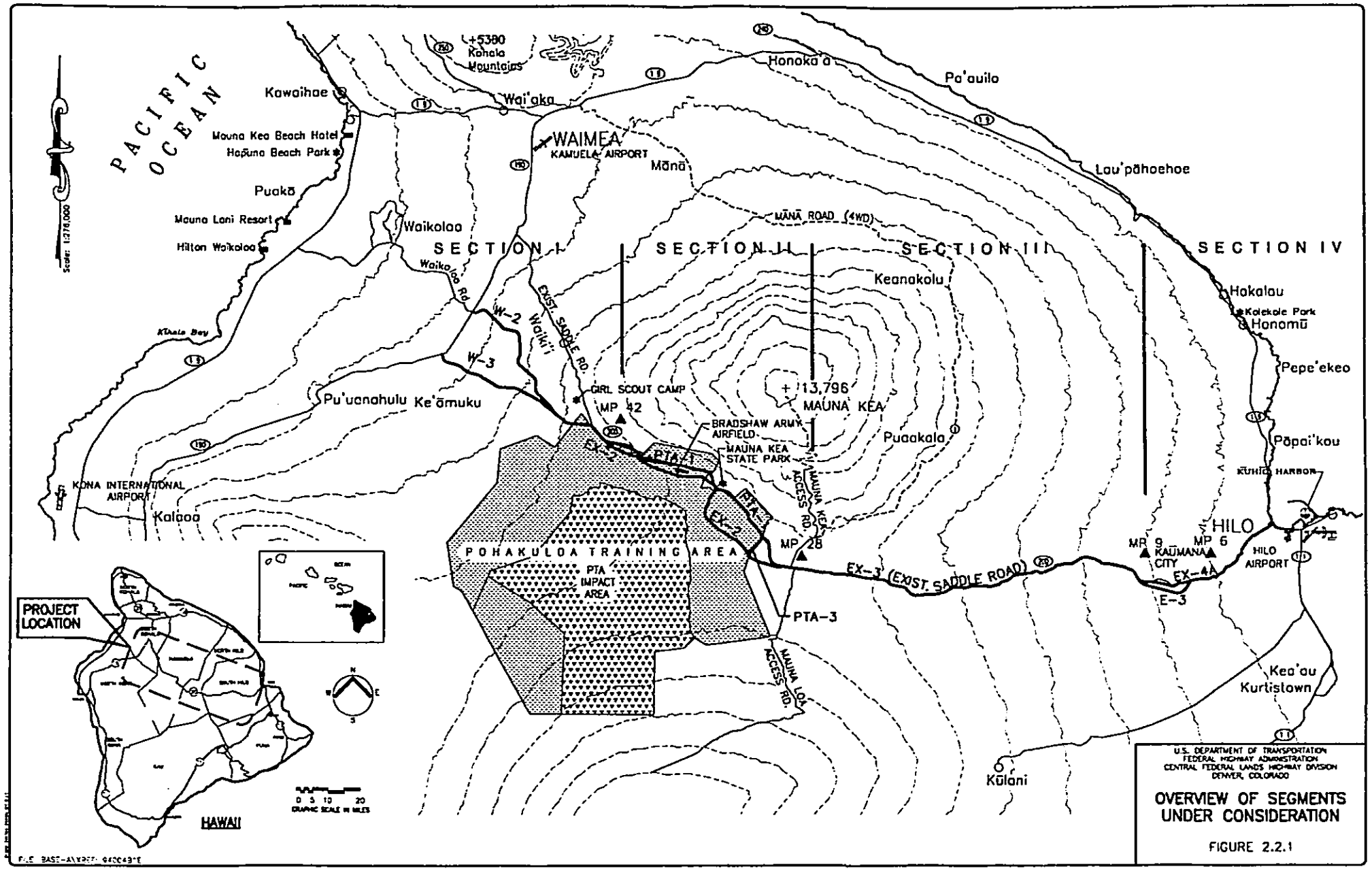
2.3.1 Transportation System Management (TSM) Alternatives and Mass Transit

Transportation System Management (TSM) and mass transit alternatives were not considered reasonable nor feasible to satisfy the purpose and need for the proposed action. Saddle Road is a rural highway. Current and projected traffic levels for this roadway do not justify the development of TSM alternatives, such as high-occupancy vehicle lanes, nor the construction of mass transit facilities. Without improvements to the roadway structure and geometrics, high occupancy vehicle lanes or mass transit facilities could not be developed along Saddle Road. As such, TSM alternatives were eliminated from further consideration.

2.3.2 Segments Eliminated from Consideration

Following evaluation of the 20 alternative segments initially considered, the SEE Team completed a screening process which eliminated from consideration ten alternative segments during the initial study phase (W-4, W-5, W-6, PTA-1B, PTA-2, PTA-3A, PTA-4, PTA-5A, PTA-5B, and E-1). These segments were eliminated because they either did not meet project criteria or because it was evident without further detailed analysis that the anticipated impacts of their construction were clearly greater than other alternatives. They were largely redundant with other alternative segments which initial data indicated would have an order of magnitude less impact.

Subsequent to the assessment of alternative segments by project team specialists, including biologists, botanists, archaeologists, sociologists, economists, land use specialists, water quality specialists, visual resource specialists, and engineers, the SEE Team acted to eliminate two additional segments, EX-1 and EX-4.



OVERVIEW OF SEGMENTS UNDER CONSIDERATION

FIGURE 2.2.1

2.3.2.1 Segments Eliminated from Consideration - Section I

EX-1. Segment EX-1 was evaluated in detail by the technical specialists and the results were documented. EX-1 was eliminated from consideration by the SEE Team after considering the results of these technical studies.

Segment EX-1 would follow along the existing Saddle Road alignment through Section I. It would require the reconstruction of Saddle Road with major grade and alignment improvements to bring it up to standards. Segment EX-1 would extend from the Mamalahoa Highway (SR 190) (10.2 km south of Waimea) to MP 42, covering a length of 19.1 km. This segment would have a maximum grade of 9.1 percent, a base elevation of approximately 786 m, and a top elevation of approximately 1686 m (Figure 2.3.1, *Alternate Segments Considered but Eliminated*).

Construction of EX-1 would require ROW acquisition of approximately 62.0 hectares (ha). It would require the removal of the existing trees which line the road from Waiki'i Ranch to the Mamalahoa Highway (SR 190), while W-2 and W-3 would not. It would require the excavation of 496,873 cubic meters (m^3) of material, and fill of 539,771 m^3. It would generate 42,898 m^3 of borrow. Total estimated construction cost for this segment would be $53,500,000, exclusive of mitigation and utility relocation cost.

With regard to constructability, Segment EX-1 is less desirable than W-2 or W-3, since it would require that Saddle Road traffic be accommodated within the construction zone. It would constitute a complete reconstruction of the existing road, requiring traffic control and restrictions or closures for limited periods during construction activities. This would increase the duration of the construction project and could increase construction costs by 8 percent to 10 percent ($4,000,000 to $5,000,000). Segment EX-1 would require a larger construction footprint to accommodate construction activities and traffic control, and would cost between $14.0 and $16.0 million more than W-2 or W-3.

Segment EX-1 would directly impact the existing residential community of Waiki'i. Community impacts would include increased traffic noise and increased traffic volumes. Higher traffic volumes and speeds, and a wider roadway footprint would create a more intrusive barrier to this community, making crossings of Saddle Road by automobile, bicycles, and pedestrians more hazardous.

Construction of Saddle Road on EX-1 alignment would be expected to impact endangered plants present along this corridor. Construction of Saddle Road on the W-2 or W-3 alignments would be expected to somewhat diminish fire hazard risk to Critical Habitat of the endangered Palila.

Use of Segments W-2 and W-3 would reduce the length, travel time, and fuel consumption for the cross-island commute for people traveling between Hilo and Kailua-Kona and South Kona.

W-4. Segment W-4 swings off of Parker Ranch lands and onto vacant State land, which has never been used for grazing or ranching. The alignment traverses important stands of native dry-land forest and *kipuka*, areas of mature vegetation isolated by more recent lava flows (ref: FEIS - Part I, 3.13). A federally listed plant species occurs in lava flows on W-4. Finally, the alignment might traverse habitats for sensitive species of invertebrates. It would be more costly than alternatives W-2 and W-3 with respect to environmental impact and construction, yet provide no greater reduction in distance from Kona to MP 6 than that of W-3. For these reasons, W-4 was eliminated from further consideration by the SEE Team (Figure 2.3.1).

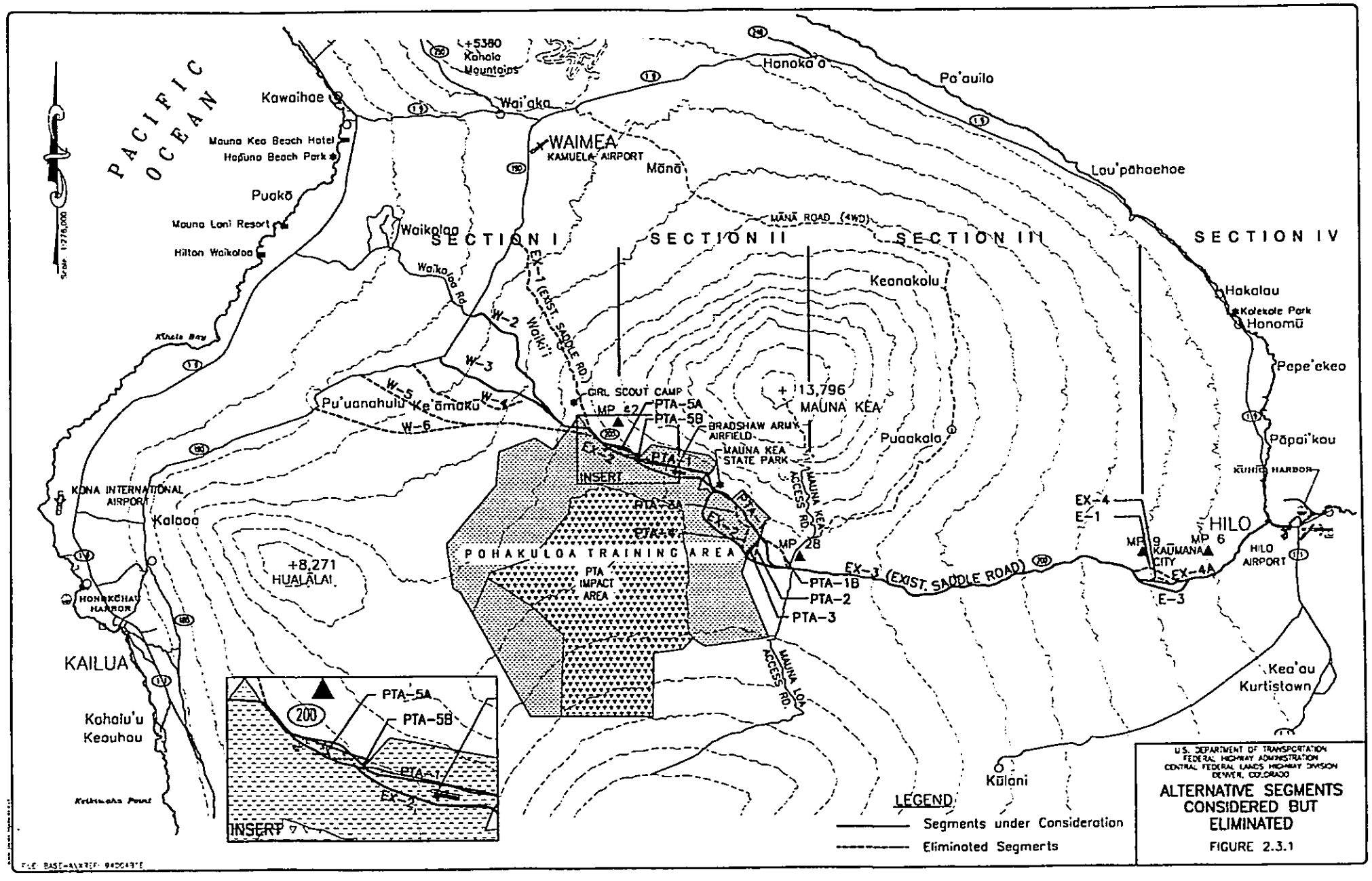
W-5 and W-6. The W-5 alternate segment extended easterly from a point on Mamalahoa Highway (SR 190) near Puuanahulu to approximately MP 42 on the existing Saddle Road. W-6 intersected Mamalahoa Highway (SR 190) approximately 10.2 km north of Palani Junction and joined W-5 from the south. Major concerns were identified with these two segments: potential impacts on hunting and cultural resource areas, open space, threatened and endangered plants and animals, and increased fire danger. Like Segment W-4, Segments W-5 and W-6 swing off of Parker Ranch lands and onto vacant State land, which has never been used for grazing or ranching. These alignments traverse important stands of native dry-land forest and kipuka. A federally listed plant species occurs in lava flows on W-5 and W-6, and the alignments might traverse habitats for sensitive species of invertebrates. These segments would be more costly than W-2 and W-3, with respect to environmental impact and construction. Segments W-5 and W-6 support traffic movements toward Kailua-Kona but significantly increase distances to the South Kohala resort areas, WaiKoloa and Waimea. As a result, it is likely that the existing Saddle Road section between MP 42 and Mamalahoa Highway (SR 190) would be improved as well, further increasing project costs for these alternatives. For these reasons, these two segments were eliminated from further consideration by the SEE Team (Figure 2.3.1).

2.3.2.2 Segments Eliminated from Consideration - Section II

PTA-1B. This alternate segment was part of the original PTA-1 that crossed through HHL. This section of the original PTA-1 was dropped from consideration and replaced by an alignment located farther to the south, due to potential concerns of the Department of Hawaiian Home Lands (DHHL) of splitting pasture area (Figure 2.3.1).

PTA-2 and PTA-4. These two alternate segments represented other variations through the eastern end of Section II. PTA-2 was eliminated because of its impact on the PTA military maneuver area and HHL, and its proximity to PTA-3. PTA-4, located west of PTA-2, was eliminated from further consideration because it was expected to cause a substantial impact on PTA training maneuvers. For these reasons, these two segments were eliminated from further consideration by the SEE Team (Figure 2.3.1).

PTA-3A. This alternate segment is a variation of PTA-1, which altered its location from Station 23+800 to Station 26+600 by moving the alignment further south. The alignment was studied as a possible improvement to PTA-1 through designated Palila Critical Habitat. Detailed study by


PACIFIC OCEAN
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Loni Resort
Hilton Waikoloa
Kīholo Bay
+5380
Kohala Mountains
Wai'aka
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka'a
Pa'auilo
Lau'pāhoehoe
Waikoloa
Waikoloa Rd
SECTION I
SECTION II
SECTION III
SECTION IV
MĀNĀ ROAD (4WD)
EX-1 (EXIST. SADDLE RD.)
Waiki'i
W-2
W-3
W-4
W-5
W-6
Pu'uanahulu
Ke'āmaku
GIRL SCOUT CAMP
MP 42
PTA-5A
PTA-5B
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
+13,796
MAUNA KEA
Keanakolu
Puaakala
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KŪHIO HARBOR
HILO
HILO AIRPORT
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
INSERT
PTA-3A
PTA-4
EX-2
PTA-1
MAUNA KEA ACCESS RD.
MP 28
PTA-1B
PTA-2
PTA-3
EX-3 (EXIST. SADDLE ROAD)
EX-4
E-1
MP 9
KAŪMANA CITY
MP 6
EX-4A
E-3
HONOKŌHAU HARBOR
KAILUA
Kohalu'u
Keauhou
Keikiwaha Point
MAUNA LOA ACCESS RD.
Kea'au
Kurtistown
Kūlani
200
PTA-5A
PTA-5B
PTA-1
EX-2
INSERT
LEGEND
Segments under Consideration
Eliminated Segments
U.S. DEPARTMENT OF TRANSPORTATION
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CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
ALTERNATIVE SEGMENTS CONSIDERED BUT ELIMINATED
FIGURE 2.3.1

the biological and botany team and representatives from the U.S. Fish and Wildlife Service (USFWS) and the Biological Resources Division (BRD) of the U.S. Geological Survey (USGS) revealed that it had about the same impact as the original location of PTA-1. In addition, PTA representatives preferred the original PTA-1, since it would keep their artillery firing points south of the road and greatly improve their ability to conduct their training missions. For these reasons, PTA-3A was eliminated from further consideration by the SEE Team (Figure 2.3.1).

PTA-5A and PTA-5B. PTA-5A and PTA-5B were variations of PTA-1 that altered PTA-1 from Station 12+200 to Station 15+000 by moving south rather than north of Pu'u Ma'au. These changes were not found to materially reduce impacts on the environment, and were not preferred by PTA representatives. Consequently, PTA-5A and PTA-5B were eliminated from further consideration by the SEE Team (Figure 2.3.1).

2.3.2.3 Segments Eliminated from Consideration - Section IV

E-1. This alternate segment begins at MP 9, Section IV, on the existing road, then swings north of the existing road to avoid all the subdivided and developed area along the existing road. The alignment traverses many kipuka and numerous wetlands for 2,750 m. Botanists for the environmental team located sensitive plant species in the area of this segment. This segment would also impact some properties along the existing road at the east end where it ties back into the existing roadway. For these reasons, the SEE Team eliminated this segment from further consideration (Figure 2.3.1).

EX-4. Segment EX-4 would follow along the existing Saddle Road alignment through Section IV. It would extend from MP 9 to MP 6, covering a distance of 4.2 km. It would include the complete reconstruction of Saddle Road with major grade and alignment improvements to bring it up to standard. This segment would have a maximum grade of 6.5 percent, a base elevation of 447 m, and a top elevation of approximately 660 m (Figure 2.3.1).

Construction of EX-4 would require ROW acquisition of approximately 8.6 ha. It would require the excavation of 54,439 m^3 of material, and fill of 51,225 m^3. It would generate 3,214 m^3 of waste material. The total estimated construction cost for this segment would be $9,400,000, exclusive of mitigation costs.

Segment EX-4 was evaluated in detail by the project team technical specialists and the results documented in each of the technical reports prepared for this EIS. It would most directly impact the community of Kaumana. Higher traffic volumes and speeds, and a wider roadway footprint would create a more intrusive barrier to this community, making crossings of Saddle Road by automobile, bicycles, and pedestrians more hazardous. Community impacts would include increased traffic volume and noise. With Segment EX-4, noise levels would approach or exceed national Noise Abatement Criteria (NAC) at 18 receptors, or 40 residences. In comparison, EX-4A would result in noise levels that approach or exceed the NAC at 16 receptor sites, or 29 residences. With E-3, noise levels would not approach or exceed the NAC at any receptors.

Segment EX-4 would require the same number of residential relocations as would EX-4A, but would impact a greater number of property owners with relatively small holdings resulting in substandard lot sizes for the current zoning district. Of the segments identified, EX-4 would result in the greatest quantity of driveways with access directly onto the improved highway. For all of these reasons, the SEE Team eliminated this segment from further consideration.

2.4 ACTION ALTERNATIVES UNDER CONSIDERATION

The remaining eight alternative segments, which were subsequently subjected to more rigorous environmental and engineering evaluation and public review, are listed as follows for each Section of the study area.

Section I:
- W-2
- W-3

(Figure 2.4.1, *Segments Under Consideration - Section I*)

Section II:
- EX-2
- PTA-1
- PTA-3

(Figure 2.4.2, *Segments Under Consideration - Section II*).

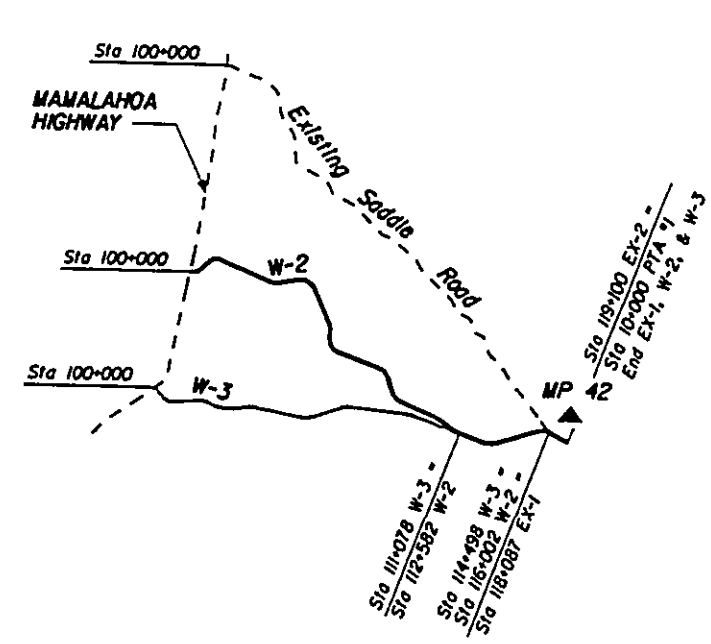
Section III:
- EX-3

(Figures 2.4.6, 2.4.7, and 2.4.8, *Plan Sheet*)

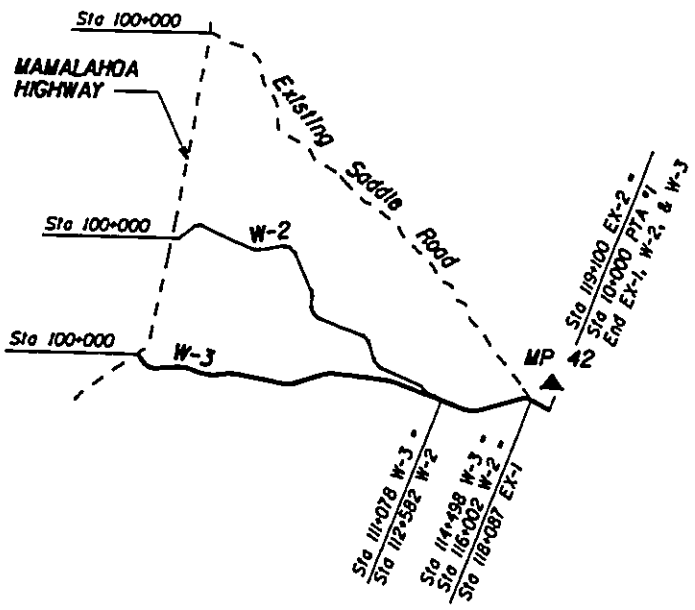
Section IV:
- EX-4A
- E-3

(Figure 2.4.3, *Segments Under Consideration - Section IV*).

Table 2.4.1, *Comparison of Basic Engineering Characteristics*, provides a summary of the key characteristics of each segment. The estimated construction costs outlined in the table for EX-2, PTA-1, and PTA-3 include the cost of constructing Typical Sections B and C within these segments. The mitigation column includes preliminary estimates of the cost of proposed mitigation measures introduced in Chapter 3 of this document, such as ungulate exclosures, archaeological data recovery, mamane habitat restoration, and Palila translocation.



SECTION I
W-2



SECTION I
W-3

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DENVER, COLORADO

SEGMENTS UNDER CONSTRUCTION SECTION I

FIGURE 2.4.1

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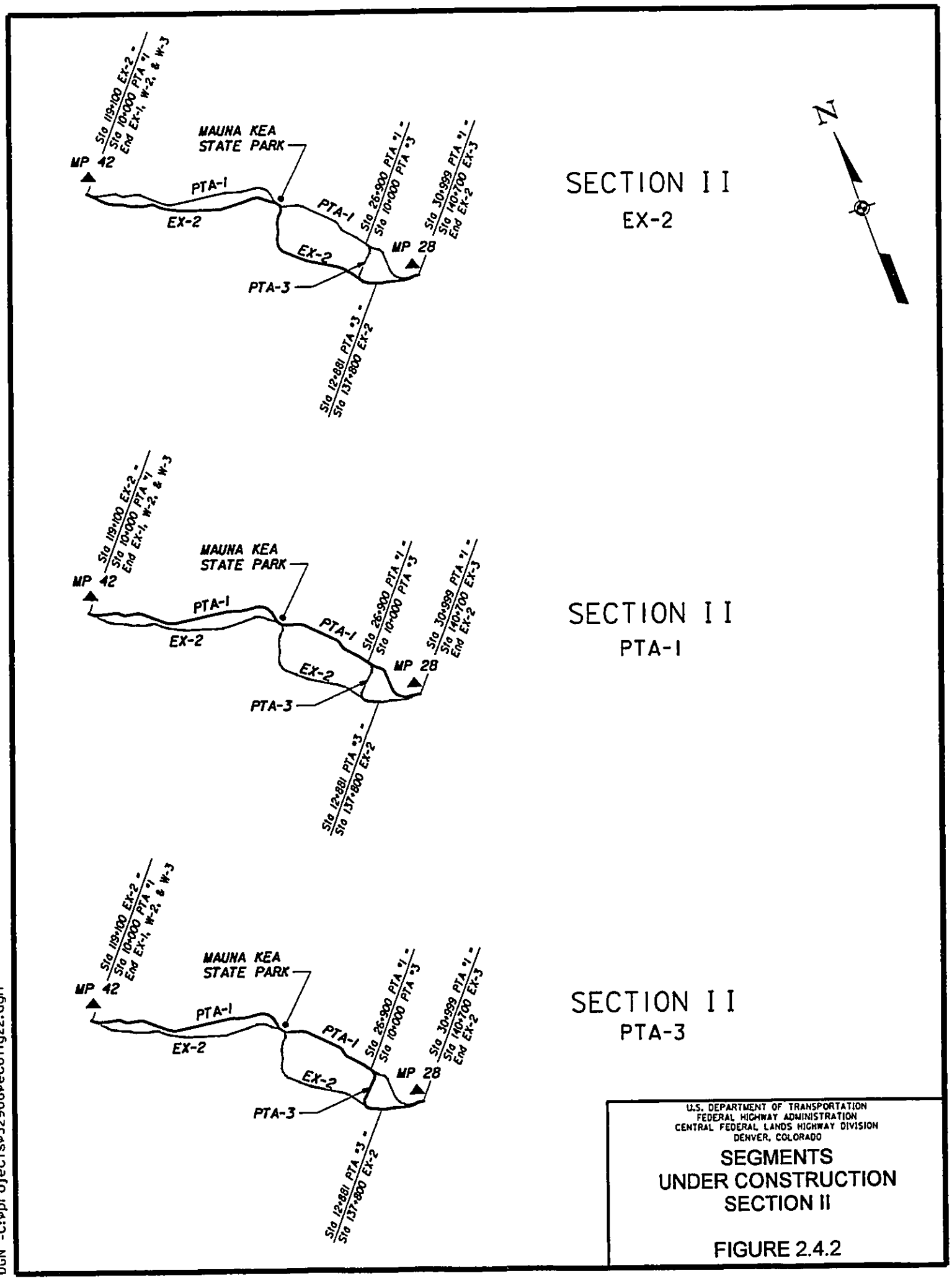

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DENVER, COLORADO

SEGMENTS UNDER CONSTRUCTION SECTION II

FIGURE 2.4.2

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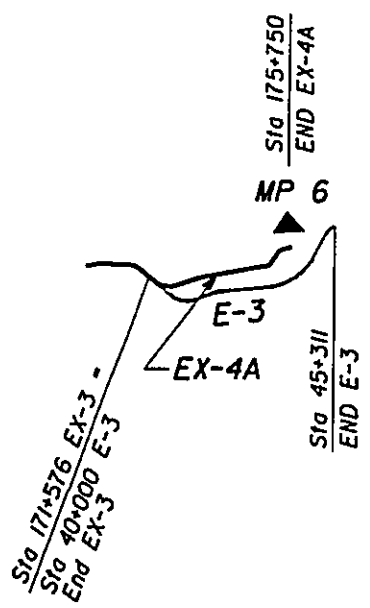
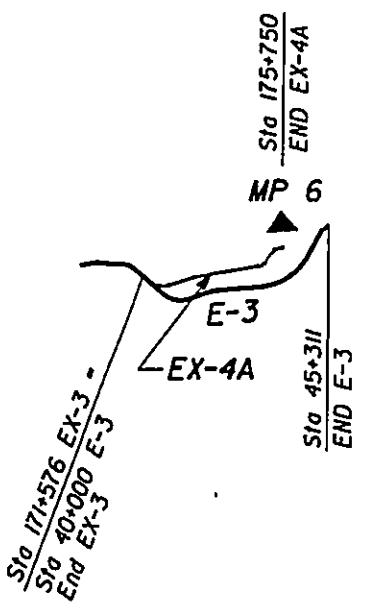


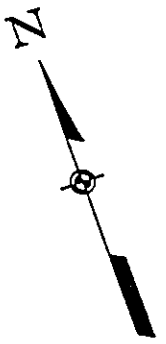
SECTION IV

EX-4A



SECTION IV

E-3



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FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

SEGMENTS UNDER CONSTRUCTION SECTION IV

FIGURE 2.4.3

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Engineering stationing (e.g., 100+000) has been assigned for each segment and is used throughout the EIS to identify specific locations along a segment. Stationing is segment specific, therefore, the segment for which the station applies must be known. Table 2.4.1 provides the stationing associated with each segment. Figures 2.4.4 through 2.4.8 *(Plan Sheets)*, depict the segments and note the stationing numbers referenced on Table 2.4.1.

TABLE 2.4.1
Comparison of Basic Engineering Characteristics

Segments and Corresponding Station Numbers	Length (km)	ROW Req'd (ha)	Max. Grade (%)	Estimated Construction Cost (Million $)	Estimated Mitigation Cost (Million $)[1]	Total Cost (Million $)
Section I - MP 53.6 (Mamalahoa Highway) to MP 42						
W-2: 100+000 - 116+001 118+087 - 119+100	17.0	73	8.0	39.0	0.5	39.5
W-3: 100+000 - 111+078 112+582 - 116+001 (W-2) 118+087 - 119+100 (W-2)	15.5	70	8.0	39.0	0.5	39.5
Section II - MP 42 to MP 28						
EX-2: 119+100 - 140+700	21.6	47	5.2	38.0	5.0	43.0
PTA-1: 10+000 - 12+739 13+200 - 30+999	20.5	83	7.8	38.5	15.0[3]	53.5
PTA-3: 10+000 - 12+739 (PTA-1) 13+200 - 26+900 (PTA-1) 10+000 - 12+881 137+800 - 140+700 (EX-2)	22.1	85	7.8	40.5	15.0[3]	55.5
Section III - MP 28 to MP 9						
EX-3: 140+700 - 171+576	30.9	60	8.0	60.0	1.0	61.0
Section IV - MP 9 to MP 6						
EX-4A: 171+576 - 172+837 20+000 - 21+970 175+005 - 175+750	4.0	12	10.9	15.0	5.0	20.0
E-3: 40+000 - 45+503	5.5	29	8.0	17.0	1.0	18.0

1 Cost estimates are in 1999 dollars and include additional design features for fire prevention, critical habitat replacement lands, special contract requirements in environmentally sensitive areas, and relocation costs.

2 A very short length exceeds 8 percent grade in an area along the existing alignment where potential residential displacements and terrain dictate.

3 Mitigation costs for these alternatives include Palila management and relocation efforts, exlosure fencing, and predator and alien species control (ref: FEIS - Part I, Table 3.18.3.1).

2.4.1 Segments under Consideration - Section I

W-2. Segment W-2 represents an alternate to the existing Saddle Road alignment through Section I. Construction on new location would be required for most of this segment. The east end of W-2 represents the exception, where Saddle Road would be constructed along the existing corridor from Station 118+087 to 119+100. W-2 would extend from Mamalahoa Highway (SR 190) at the Waikoloa Junction to MP 42, covering a length of 17.0 km (Figure 2.4.4, *Plan Sheet*, and Figure 2.4.5, *Plan Sheet*). W-2 would connect Saddle Road directly to Waikoloa Road and reduce the travel distance between Hilo and Kona over that of the existing Saddle Road alignment.

Segment W-2 would have a maximum grade of 8.0 percent, a base elevation of approximately 776 m, and a top elevation of approximately 1686 m. Construction of W-2 would require additional ROW land conversion of approximately 72 ha. The estimated construction cost for Segment W-2 is $39,000,000. The estimated cost for mitigation is $500,000.

W-3. Segment W-3 represents an additional alternate alignment to the existing Saddle Road through Section I. As with Segment W-2, construction on new location would be required for most of this segment, while a reconstruction of Saddle Road would follow the existing corridor for a 1-km portion of W-3 common to W-2 at the east end, Station 118+087 to 119+100 (W-2). W-3 would extend from the Mamalahoa Highway (SR 190) to MP 42, covering a length of 15.5 km (Figures 2.4.4 and 2.4.5). W-3 offers a shorter travel distance between Hilo and Kona than either the existing road or Segment W-2.

Segment W-3 would have a maximum grade of 8.0 percent, a base elevation of approximately 773 m, and a top elevation of approximately 1686 m. Construction of W-3 would require additional ROW land conversion of approximately 72 ha. The estimated construction cost for Segment W-3 is $39,000,000. The estimated cost for mitigation is $500,000.

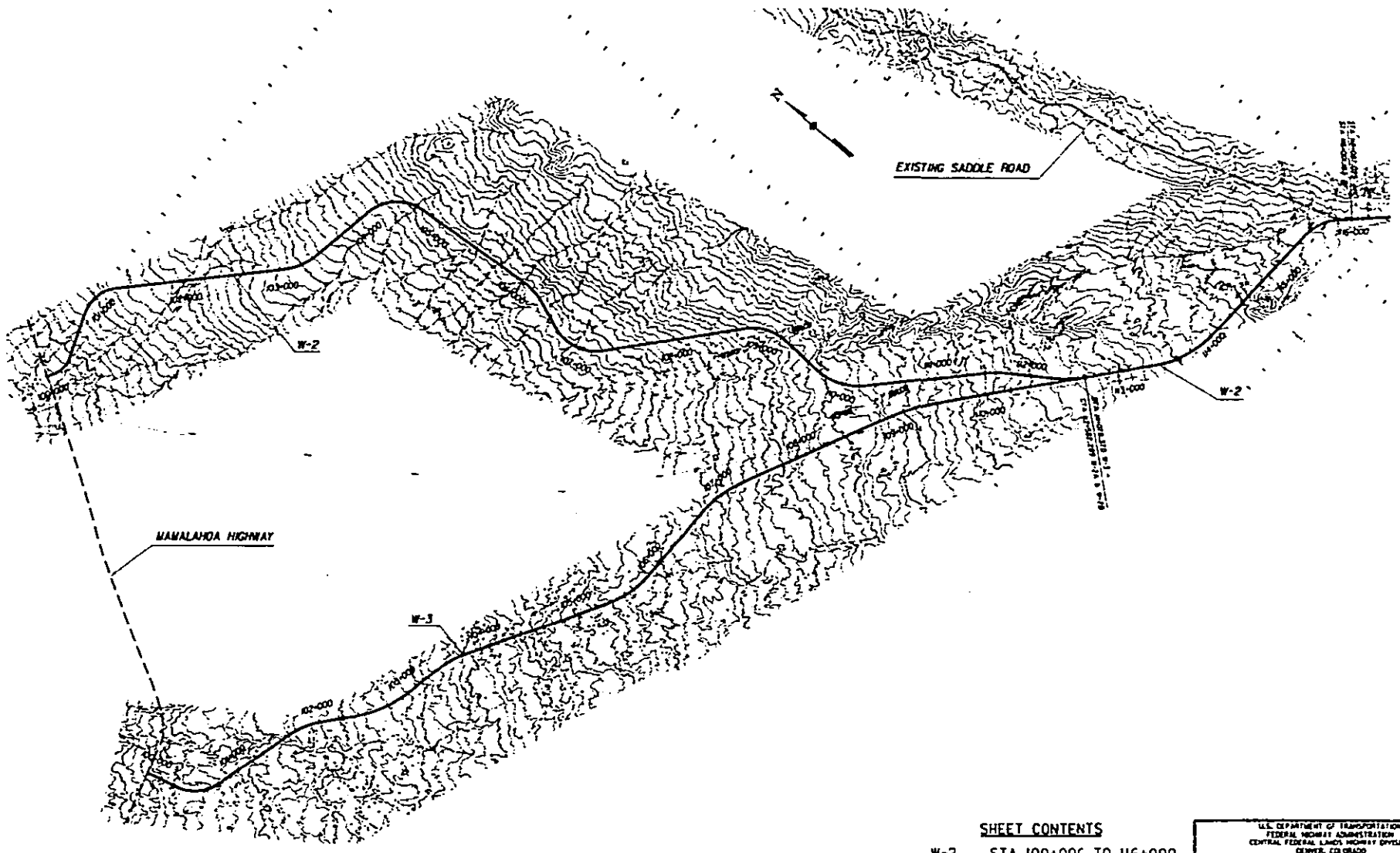
2.4.2 Segments under Consideration - Section II

EX-2. Segment EX-2 includes the complete reconstruction of Saddle Road through Section I to bring it up to AASHTO standards. This segment would be reconstructed along the existing Saddle Road corridor from MP 42 to 28, covering a distance of 21.6 km (Figure 2.4.5, *Plan Sheet,* and Figure 2.4.6, *Plan Sheet*).

Segment EX-2 would have a maximum grade of 5.2 percent, a base elevation of approximately 1686 m, and a top elevation of approximately 2010 m. Construction of EX-2 would require additional ROW land conversion of approximately 47 ha. The estimated construction cost for Segment EX-2 is $38,000,000. The estimated cost for mitigation is $5,000,000.

PTA-1. Segment PTA-1 realigns Saddle Road through Section II. Nearly the entire length of PTA-1 would constitute construction on new location. PTA-1 would extend from MP 42 to MP

SECTION I



SHEET CONTENTS

W-2 STA 100+000 TO 116+000
W-3 STA 100+000 TO 111+073

Scale: 1:40,000

U.S. DEPARTMENT OF TRANSPORTATION
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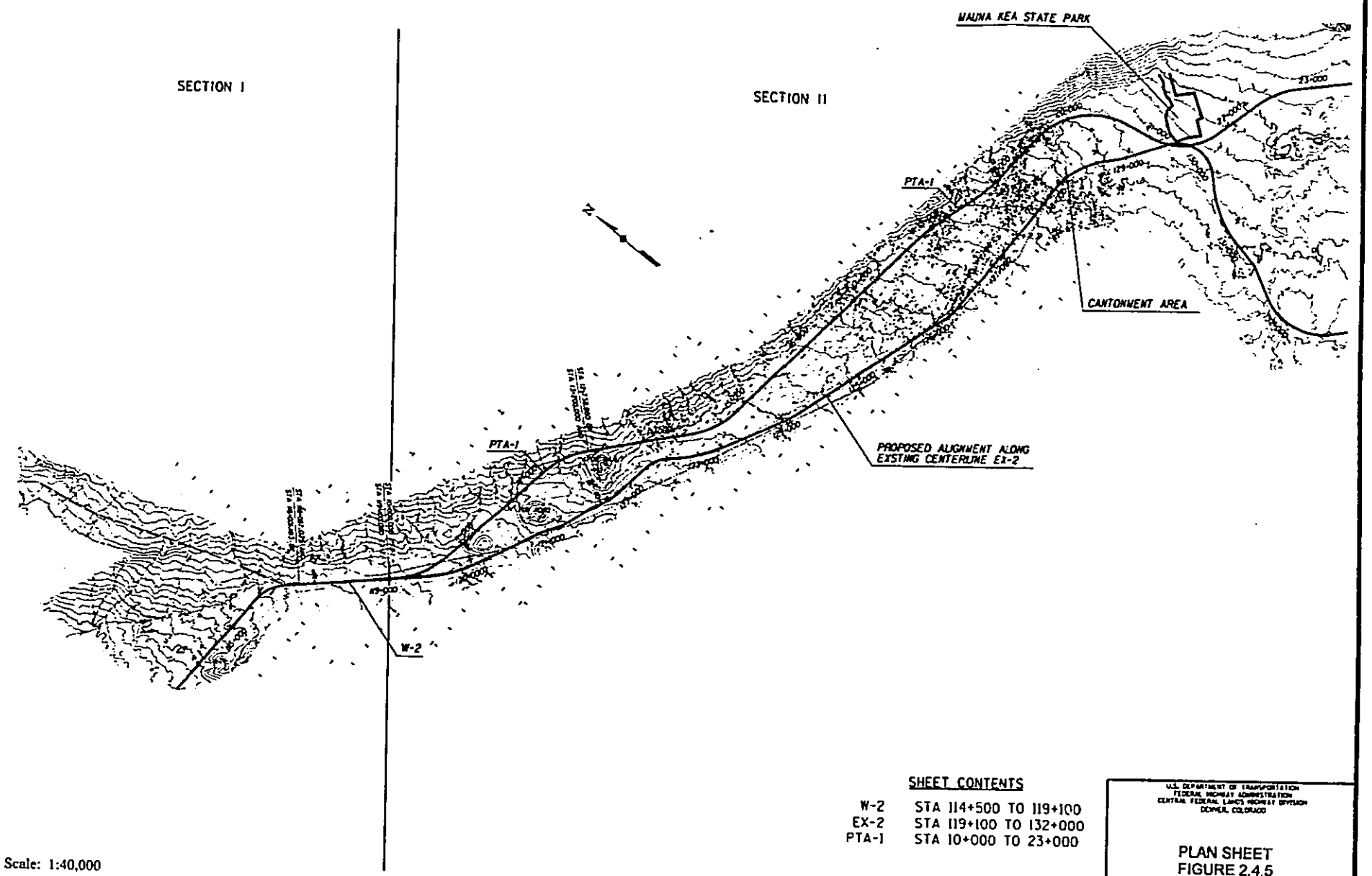
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.4



SHEET CONTENTS

W-2	STA 114+500 TO 119+100
EX-2	STA 119+100 TO 132+000
PTA-1	STA 10+000 TO 23+000

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DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.5

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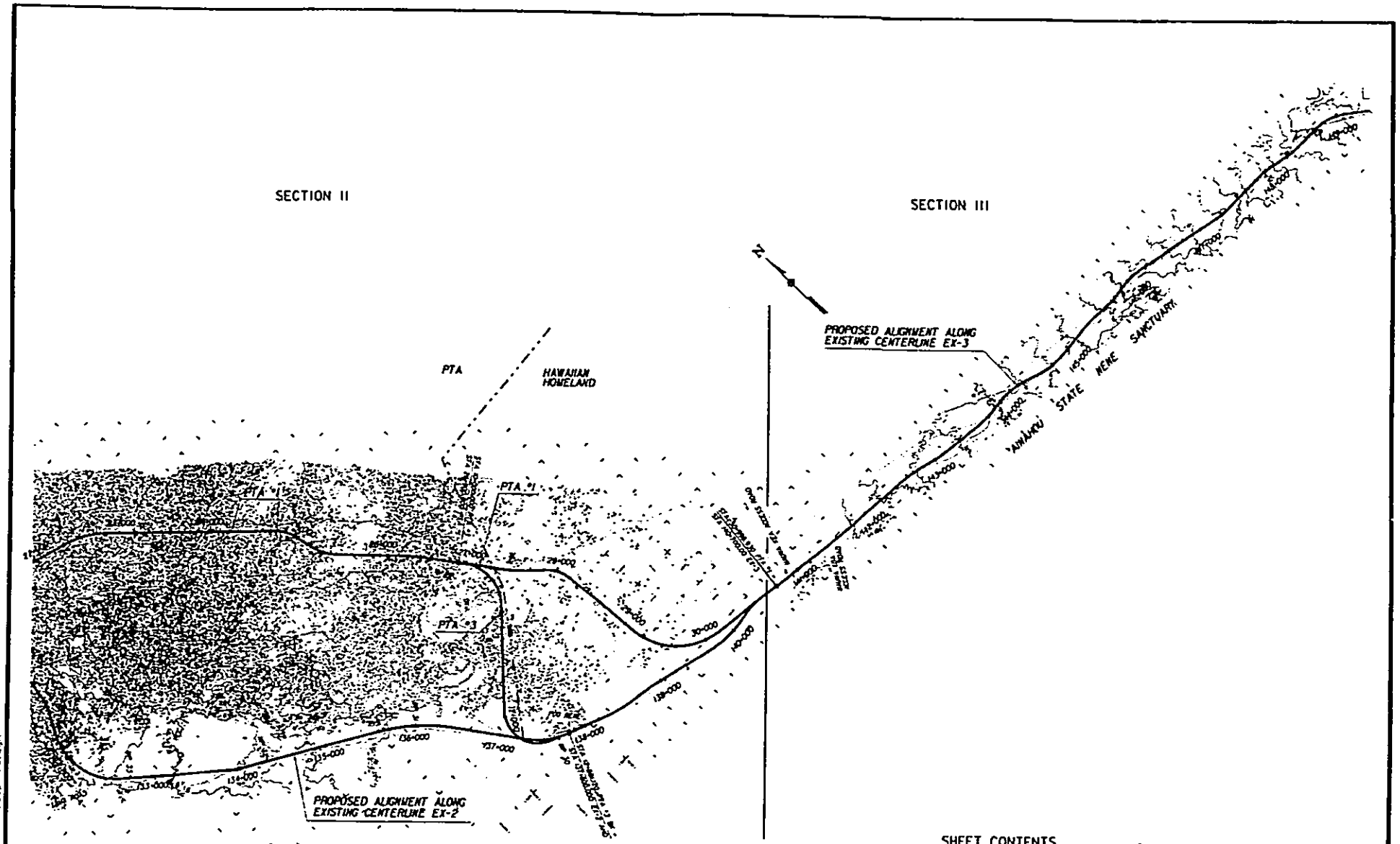

SHEET CONTENTS

EX-2	STA 132+000 TO 140+700
EX-3	STA 140+700 TO 149+000
PTA-1	STA 22+000 TO 30+999
PTA-3	STA 10+000 TO 12+881

Scale: 1:40,000

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PLAN SHEET
FIGURE 2.4.6

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28, covering a length of 20.5 km (Figures 2.4.5 and 2.4.6). Segment PTA-1 would relocate Section II of Saddle Road to the northern boundary of the PTA to avoid or minimize conflict between the traveling public and military maneuvers.

Segment PTA-1 would have a maximum grade of 7.8 percent, a base elevation of approximately 1686 m, and a top elevation of approximately 2055 m. Construction of PTA-1 would require additional ROW land conversion of approximately 83 ha. The estimated construction cost for Segment PTA-1 is $38,500,000. The estimated cost for mitigation is $14,000,000.

PTA-3. Segment PTA-3 realigns the existing Saddle Road through Section II. As with PTA-1, nearly the entire length of PTA-3 would constitute construction on new location. PTA-3 follows alignment common to PTA-1 for much of its length, from Station 10+000 to 26+900 (PTA-1). PTA-3 then deviates from PTA-1, turning southwest toward EX-2. It then shares an alignment common to EX-2 from Station 137+800 to 140+700 (EX-2). PTA-3 would extend from MP 42 to MP 28, covering a length of 22 km (Figures 2.4.5 and 2.4.6). PTA-3 would avoid placing a new roadway on Hawaiian Homelands.

Segment PTA-3 would have a maximum grade of 7.8 percent, a base elevation of approximately 1686 m, and a top elevation of approximately 2055 m. Construction of PTA-3 would require additional ROW land conversion of approximately 85 ha. The estimated construction cost for Segment PTA-3 is $40,500,000. The estimated cost for mitigation is $14,000,000.

2.4.3 Segments under Consideration - Section III

Recent lava flows are located on both sides of the existing road through Section III. No feasible and practicable alternatives to the existing road corridor were identified within Section III.

EX-3. Segment EX-3 includes a complete reconstruction of Saddle Road through Section III to bring it up to AASHTO standards. This segment would be reconstructed along the existing Saddle Road corridor through Section III, from MP 28 to MP 9, covering a distance of 30.9 km (Figure 2.4.6, *Plan Sheet*, Figure 2.4.7, *Plan Sheet*, and Figure 2.4.8, *Plan Sheet*).

Segment EX-3 would have a maximum grade of 8.0 percent, a base elevation of approximately 600 m, and a top elevation of approximately 2007 m. Construction of EX-3 would require additional ROW land conversion of approximately 60 ha. The estimated construction cost for Segment EX-3 is $60,000,000. The estimated cost for mitigation is $1,000,000.

2.4.4 Segments under Consideration - Section IV

EX-4A. Segment EX-4A represents an alternate alignment to the eliminated Segment EX-4 through Section IV. EX-4A would represent a complete reconstruction of Saddle Road on the west and east ends of Section IV, but would split from the existing roadway for a 2-km portion in the middle, following an existing transmission line corridor. This segment extends from MP

9 to 6 and would cover a total length of 4.0 km (Figure 2.4.8). EX-4A was identified in an effort to relocate a portion of Section IV away from existing residential development.

Segment EX-4A would have a maximum grade of 10.9 percent, a base elevation of approximately 474 m, and a top elevation of approximately 600 m. Construction of EX-4A would require additional ROW land conversion of approximately 12 ha. The estimated construction cost for Segment EX-4A is $15,000,000. The estimated cost for mitigation is $5,000,000.

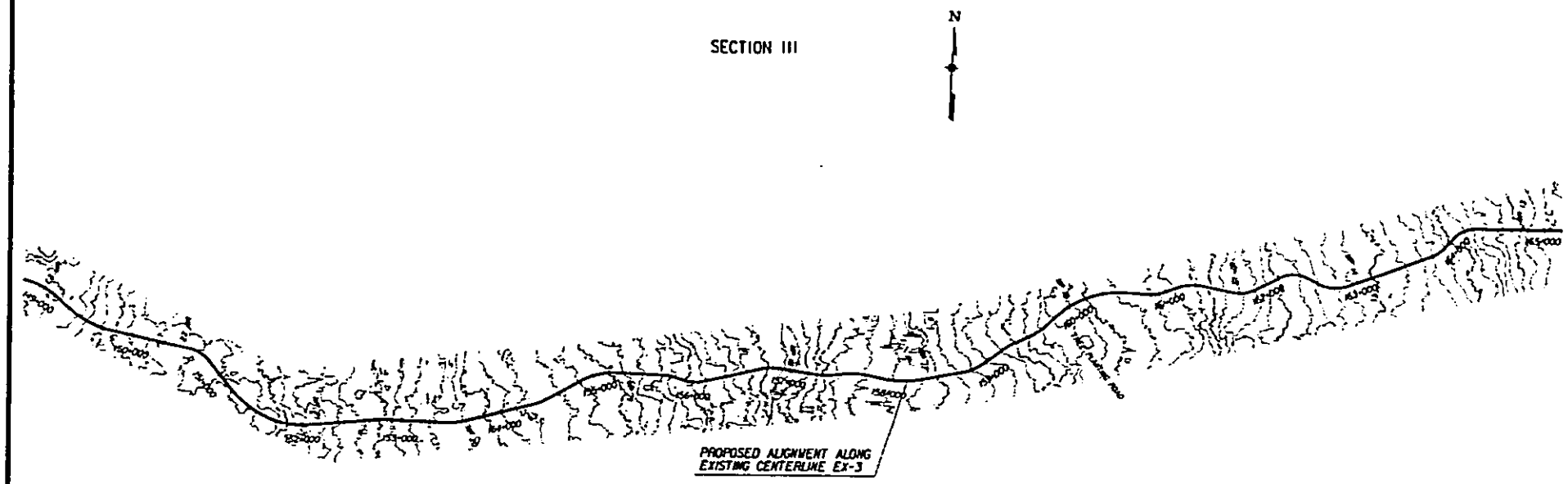
E-3. Segment E-3 represents an alternate alignment to EX-4 through Section IV. E-3 would extend from MP 9 to MP 6, a length of 5.5 km (Figure 2.4.8). This segment was included in an attempt to locate Saddle Road farther from existing development and away from congestion.

Segment E-3 would have a maximum grade of 8.0 percent, a base elevation of approximately 390 m, and a top elevation of approximately 654 m. Construction of E-3 would require additional ROW land conversion of approximately 29 ha. The estimated construction cost for Segment E-3 is $17,000,000. The estimated cost for mitigation is $1,000,000.

2.4.5 Alternative Routes

The 8 segments identified above have been combined into 12 possible alternative routes, referred to in this document as *Alternatives*. These alternatives begin at the junction of Saddle Road with Mamalahoa Highway (SR 190), and terminate at or near MP 6 (near Hilo). Alternatives are designated by the series of segments they include, such as Alternative W-2/EX-2/EX-3/E-3 or Alternative W-3/PTA-3/EX-3/EX-4A.

Implementation of any of the 12 action alternatives would result in a wider roadway with an 80 to 100 km design speed throughout its length, shoulders for increased safety for stopped vehicles, scenic pullouts, uphill passing lanes, and proper signage and striping. The response time of emergency vehicles would be greatly reduced with each alternative due to higher operating speeds. Saddle Road would meet a LOS B throughout most segments after project implementation. Table 2.4.2, *Comparison of Action Alternatives*, presents a summary of the 12 Alternatives, identifying differences among alternatives for the more notable engineering factors.



SHEET CONTENTS

EX-3 STA 149+000 TO 165+000

Scale: 1:40,000

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PLAN SHEET
FIGURE 2.4.7

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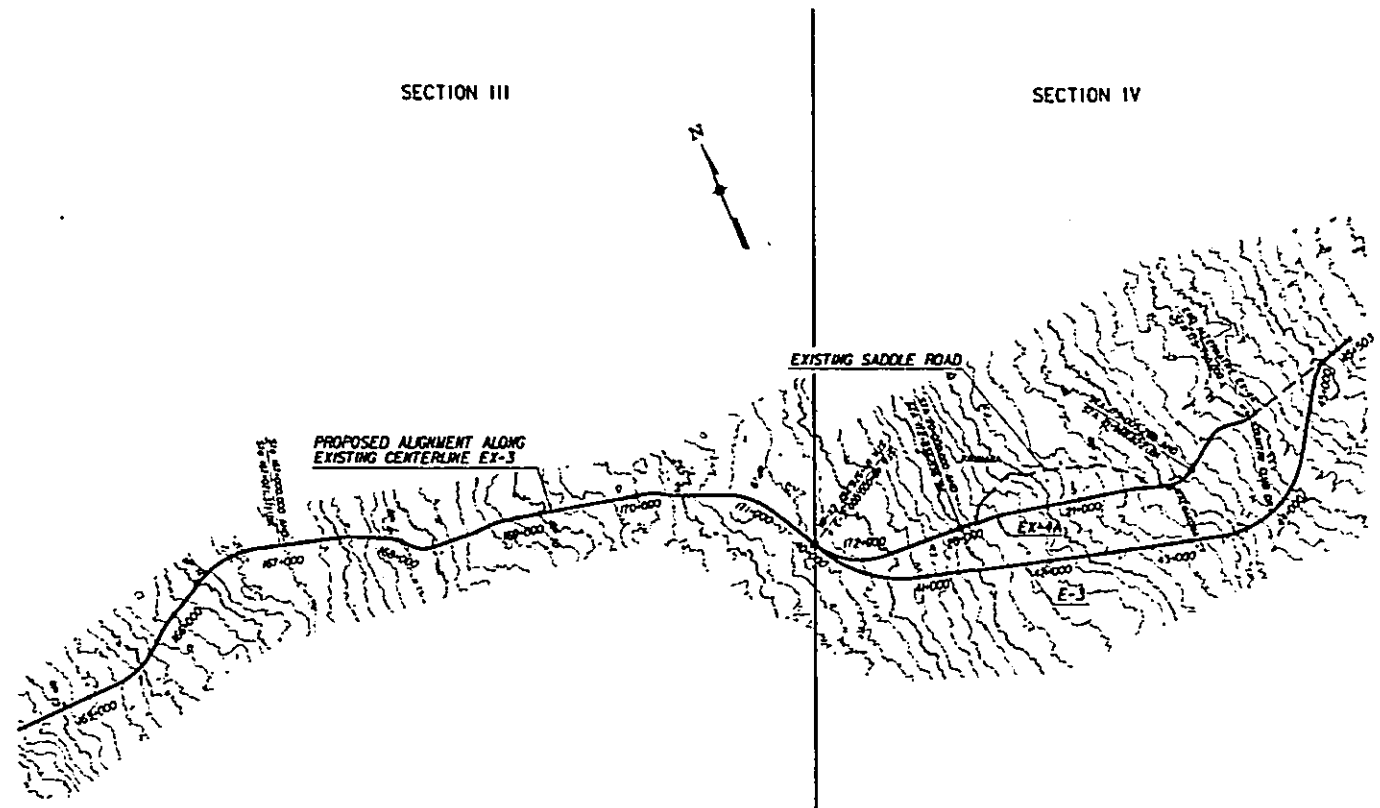

SHEET CONTENTS

EX-3	STA 165+000 TO 171+576
EX-4A	STA 171+576 TO 175+750
E-3	STA 40+000 TO 45+503

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PLAN SHEET
FIGURE 2.4.8

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TABLE 2.4.2
Comparison of Action Alternatives

	W-2/EX-2/EX-3/E-3	W-2/PTA-1/EX-3/E-3	W-2/PTA-3/EX-3/E-3
Total Length	75.0 km	73.9 km	75.5 km
Max. Grade	8.0 %	8.0 %	8.0 %
Grade ≥ 6%	15.3 km	16.0 km	16.0 km
Traffic Maintenance and Construct-ability	Maintenance of traffic required for 72% of alignment, with restrictions or road closures for limited periods. Minor detours required for existing segments.	Maintenance of traffic required for 43% of alignment, with restrictions or road closures for limited periods. Minor detours required for EX-3.	Maintenance of traffic required for 43% of alignment, with restrictions or road closures for limited periods. Minor detours required for EX-3.
ROW Needed	208 ha	244 ha	246 ha
Utility Conflicts	33 power or telephone poles. 50 m of buried water line to be relocated.	45 power or telephone poles. 50 m of buried water line to be relocated.	46 power or telephone poles. 50 m of buried water line to be relocated.
Horizontal Alignment	Follows existing road alignment through Sections II and III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Does not separate traveling public from PTA maneuvers. Minimizes impacts to Kaumana.	Follows existing road alignment through Section III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids developed areas from MP 9 to MP 6. Minimizes impacts to Kaumana.	Follows existing road alignment through Section III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids developed areas from MP 9 to MP 6. Avoids siting new road within Hawaiian Home Lands. Minimizes impacts to Kaumana.
Construction Cost	$154,500,000	$155,000,000	$157,000,000
Mitigation Cost	$7,500,000	$17,500,000	$17,500,000

TABLE 2.4.2 (Continued)
Comparison of Action Alternatives

	W-2/EX-2/EX-3/EX-4A	W-2/PTA-1/EX-3/EX-4A	W-2/PTA-3/EX-3/EX-4A
Total Length	73.5 km	72.4 km	74.0 km
Max. Grade	10.9 %[1]	10.9 %[1]	10.9 %[1]
Grade ≥ 6%	14.4 km	15.1 km	15.1 km
Traffic Maintenance and Construct-ability	Maintenance of traffic required for 76% of alignment, with restrictions or road closures for limited periods. Minor detours for existing segments.	Maintenance of traffic required for 47% of alignment, with restrictions or road closures for limited periods. Minor detours required for existing segments.	Maintenance of traffic required for 47% of alignment, with restrictions or road closures for limited periods. Minor detours required for EX-3.
ROW Needed	191ha	227 ha	229 ha
Utility Conflicts	36 power or telephone poles. 75 m of buried water line to be relocated.	42 power or telephone poles. 75 m of buried water line to be relocated.	43 power or telephone poles. 75 m of buried water line to be relocated.
Horizontal Alignment	Follows existing alignment for Sections II and III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Does not separate traveling public from PTA maneuvers. Reduces impacts to Kaumana when compared to eliminated EX-4.	Follows existing road alignment through Sections I, and III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Reduces impacts to Kaumana when compared to eliminated EX-4.	Follows existing road alignment through Section III. Ties to SR 190 at Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids siting new road within Hawaiian Home Lands. Reduces impacts to Kaumana when compared to eliminated EX-4.
Construction Cost	$152,500,000	$153,000,000	$155,000,000
Mitigation Cost	$11,500,000	$21,500,000	$21,500,000

[1] A very short length exceeds 8 percent grade in an area along the existing alignment where potential residential displacements and terrain dictate.

TABLE 2.4.2 (Continued)
Comparison of Action Alternatives

	W-3/EX-2/EX-3/E-3	W-3/PTA-1/EX-3/E-3*	W-3/PTA-3/EX-3/E-3
Total Length	73.5 km	72.4 km	74.0 km
Max. Grade	8.0 %	8.0 %	8.0 %
Grade ≥ 6%	14.2 km	16.0 km	16.0 km
Traffic Maintenance and Construct-ability	Maintenance of traffic required for 72% of alignment, with restrictions or closures for limited periods. Minor detours required for existing segments.	Maintenance of traffic required for 43% of alignment, with restrictions or closures for limited periods. Minor detours required for EX-3.	Maintenance of traffic required for 43% of alignment, with restrictions or closures for limited periods. Minor detours required for EX-3.
ROW Needed	208 ha	244 ha	246 ha
Utility Conflicts	33 power or telephone poles. 50 m of buried water line to be relocated.	45 power or telephone poles. 50 m of buried water line to be relocated.	46 power or telephone poles. 50 m of buried water line to be relocated.
Horizontal Alignment	Follows existing road alignment through Sections II, and III. Ties to SR 190 4.8 km south of Waikoloa Rd. Satisfies design parameters. Does not separate traveling public from PTA maneuvers. Minimizes impacts to Kaumana.	Follows existing road alignment through Section III. Ties to SR 190 4.8 km south of Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids developed areas from MP 9 to MP 6. Minimizes impacts to Kaumana.	Follows existing road alignment through Section III. Ties to SR 190 4.8 km south of Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids developed areas from MP 9 to MP 6. Avoids siting new road within Hawaiian Home Lands. Minimizes impacts to Kaumana.
Construction Cost	$154,000,000	$154,500,000	$156,500,000
Mitigation Cost	$7,500,000	$17,500,000	$17,500,000

* Recommended Alternative

TABLE 2.4.2 (Continued)
Comparison of Action Alternatives

	W-3/EX-2/EX-3/EX-4A	W-3/PTA-1/EX-3/EX-4A	W-3/PTA-3/EX-3/EX-4A
Total Length	72.0 km	70.9 km	72.5 km
Max. Grade	10.9 %[1]	10.9 %[1]	10.9 %[1]
Grade ≥ 6%	14.4 km	15.1 km	15.1 km
Traffic Maintenance and Construct-ability	Maintenance of traffic required for 76% of alignment, with restrictions or closures for limited periods. Minor detours for existing segments.	Maintenance of traffic required for 47% of alignment, with restrictions or closures for limited periods. Minor detours required for existing segments.	Maintenance of traffic required for 47% of alignment, with restrictions o closures for limited periods. Minor detours required for EX-3.
ROW Needed	191 ha	227 ha	229 ha
Utility Conflicts	36 Power or telephone poles. 75 m of buried water line to be relocated.	42 power or telephone poles. 75 m of buried water line to be relocated.	43 power or telephone poles. 75 m of buried water line to be relocated.
Horizontal Alignment	Follows existing alignment for Sections II and III. Ties to SR 190, south of Waikoloa Rd. Does not separate traveling public from PTA maneuvers. Satisfies design parameters. Reduces impacts to Kaumana when compared to eliminated EX-4.	Follows existing road alignment through Sections I and III. Ties to SR 190 4.8 km south of Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Reduces impacts to Kaumana when compared to eliminated EX-4.	Follows existing road alignment through Section III. Ties to SR 190 4.8 km south of Waikoloa Rd. Satisfies design parameters. Separates traveling public from PTA maneuvers. Avoids siting new road within Hawaiian Home Lands. Reduces impacts to Kaumana when compared to eliminated EX-4.
Construction Cost	$152,000,000	$152,500,000	$144,500,000
Mitigation Cost	$11,500,000	$21,500,000	$21,500,000

[1] A very short length exceeds 8 percent grade in an area along existing alignments where potential residential displacements or terrain dictate.

2.4.6 No Action Alternative

The No Action Alternative would maintain Saddle Road as it is today and would include the completion of short-term, or minor, maintenance and restoration activities. It would not enhance safety, improve level of service, improve operational function, accommodate future traffic levels, nor reduce or eliminate conflicts between the traveling public and PTA military training

maneuvers. With future traffic levels anticipated to rise to 4,000 vehicles per day, all of these identified problems would be exacerbated. Therefore, the No Action Alternative was considered by the SEE Team as non-responsive to the purpose and need of the project.

The major consequences of implementing the No Action Alternative are summarized as follows.

- While funds could continue to be expended for maintenance and restoration, funds for the realignment or major reconstruction of Saddle Road would not be expended. There is no guarantee such funds will be available for continued maintenance.
- The import of borrow or the waste of excavated materials would not be required.
- Saddle Road would not be upgraded to the standards necessary to render a design speed of 80 to 100 km per hour and provide for improved cross-island commuter travel.
- Sharp curves, restricted sight distances, roadside hazards, and inadequate shoulders common to this roadway would not be corrected leading to a potential for higher accident rates as traffic volumes increase.
- No uphill passing lanes, truck escape ramps, or scenic pullouts would be provided to accommodate increased traffic volumes.
- The sight distance needed to safely avoid obstacles on the road or to safely pass slow-moving vehicles would not be improved, level-of-service would deteriorate sharply.
- Steep grades, some in excess of 15 percent, would not be improved, further impacting roadway capacity as traffic volumes increase.
- Poor roadway pavement, which currently encourages motorists to drive in the center of the road, would not be reconstructed and would continue to deteriorate, thus increasing maintenance costs as traffic increases.
- Existing substandard drainage structures and six existing one-lane bridges would not be improved.
- Existing signing and pavement markings would not be improved.
- Conflicts between the traveling public and the PTA military maneuvers would not be reduced or minimized and would increase with projected increase in traffic volume.
- The response time of emergency vehicles to accidents and emergencies would not be improved and would increase due to projected traffic volumes and reduced LOS and operating speeds.

- Traffic volumes would continue to grow with this alternative, but at a slower rate than with the action alternatives. The future traffic volume for Saddle Road with the No Action Alternative has been estimated at 4,400 ADT by the year 2014. With this growth in traffic and without proposed improvements to Saddle Road, the quality of traffic flow on Saddle Road would be expected to deteriorate, from LOS D to LOS E (ref: FEIS - Part I, 1.6). This increased volume on the existing facility would also result in increased maintenance costs for the existing pavement structure, higher accident rates, increased fire risk, and increased noise levels at Waiki'i, PTA, and Kaumana.

- As cross-island traffic increases as a result of the economic expansion of West Hawai'i, there will be increased congestion along SR 19.

An evaluation of the environmental consequences of the No Action Alternative is included in Chapter 3.0 of this EIS (ref: FEIS - Part I, 3.0).

2.5 SELECTION OF FHWA-RECOMMENDED ALTERNATIVE

Following the issuance of the DEIS, the public hearing, and the close of the formal public comment period, and in consideration of the full record of scientific and technical information developed for the project, as well as the public input received, the SEE Team identified Segment W-3 (Section I), PTA-1 (Section II), EX-3 (Section III), and E-3 (Section IV) as their recommendation to the FHWA for improving Saddle Road. The FHWA agreed and has adopted these four segments as the *Recommended Alternative.*

A brief summary of the most notable issues influencing the selection of the Recommended Alternative within each section of the study corridor is presented below. Additional detail is provided throughout the document and within Chapter 3.

2.5.1 Section I

With the selection of the No Action Alternative, no reconstruction of the existing alignment nor construction on a new alignment would be undertaken for Saddle Road within this section, and cross-island motorists would continue to use the existing substandard roadway. With this alternative, the substandard design of the existing roadway would not be alleviated, motorist safety would not be improved, future increased traffic growth could not be safely or efficiently accommodated, and emergency vehicle response times would be increased. The project purpose and need would not be fulfilled. For these reasons, the No Action Alternative was not selected as the recommended alternative.

Perhaps the most notable consideration in the selection of W-3 as the recommended alternative was its efficiency for serving cross-island traffic because the largest percentage of motorists

using Saddle Road are coming from or going to Kona (ref: Terry 1998, FEIS - Part III). For Saddle Road traffic with Kona as its origin or destination, Segment W-3 is 5.9 km shorter than W-2.

Another popular origin and destination for Saddle Road motorists is Waimea. Segment W-3 is 1.5 km shorter than W-2, which partially compensates for the fact that W-3 intersects the Mamalahoa Highway (SR 190) farther from Waimea. Segment W-3 is 2.9 km longer than W-2 for serving Waimea traffic, and would be considered only marginally less convenient. In terms of overall time and fuel savings, Segment W-3 would result in greater benefits to Saddle Road motorists and the community as a whole.

Further, based on the information available on terrain and geology, and the shorter length of W-3, the FHWA determined that Segment W-3 would prove less costly to build than W-2 if final design cost estimates were conducted for W-2. Traffic operations would also be more efficient on W-3 because of less steep grades.

The FHWA also considered public opinion regarding the selection of recommended alternatives. With the proximity of W-2 to Waiki'i Ranch, landowners and residents in this community stated their goal to preserve their pastoral lifestyle and expressed concern that the siting of Saddle Road on the W-2 alignment would result in noise pollution and would impact the commercial viability of their properties. In consideration of community benefits, construction cost savings, and other reasons noted, Segment W-3 was selected as the recommended alternative for Section I.

Table 2.5.1, *Summary of Key Impacts, Section I*, provides an outline of the more notable issues relevant to the selection of the recommended alternative segment in Section I.

TABLE 2.5.1
Summary of Key Impacts, Section I

Resource	No Action	W-2	W-3
Social/ Environmental / Economic Resources			
Land Use	No impact	Potential for induced development along new alignment	Potential for induced development along new alignment
Pedestrian/ Bicycle Access	No improvement	Improved access; enhanced safety for pedestrian and bicycle use	Improved access; enhanced safety for pedestrian and bicycle use
ROW (ROW) Acquisition	No ROW acquisition necessary	73 ha	70 ha

TABLE 2.5.1
Summary of Key Impacts, Section I

Resource	No Action	W-2	W-3
Small Lots Impacted by ROW Acquisition	None	None	None
Residential Relocations Required	None	None	None
Conversion of Special Status Farmlands	None	55.0 ha "other important agricultural lands"	18.6 ha "other important agricultural lands"
Hunting Resources	No loss	None	None
Recreation Resources/ Access	Continued restricted access; minor increase in use	Improved access; notable increase in use	Improved access; notable increase in use
Community Cohesion	Community disruption to Waiki'i Ranch	N/A	N/A
Economic	No improvement to employment; no travel time savings for motorists; increase in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs
Noise	No substantial increase in noise levels; no exceedence or approach of NAC	Substantial increase in noise levels at future development sites; no exceedence or approach of NAC	No substantial increase in noise levels; no exceedence or approach of NAC
Fire Hazard	Increased fire hazard from existing condition with increased traffic volumes	Reduction in risk from fire to Critical Habitat; increased risk to ranchland	Reduction in risk from fire to Critical Habitat; increased risk to ranchland
Visual Impact to Existing Communities	No change from existing condition	Greater visual impact from Waiki'i	N/A - Not visible from existing communities
Geologic Hazard	Volcanic Hazard Zone 8	Volcanic Hazard Zone 8	Volcanic Hazard Zone 8
Native Habitat Resources	No direct impacts	10 ha vegetation, all rare communities	10 ha vegetation, all rare communities

TABLE 2.5.1
Summary of Key Impacts, Section I

Resource	No Action	W-2	W-3
Wetlands Filled	None	None	None
Threatened/ Endangered Species	No impact	No impact; no mitigation	No impact; no mitigation
Modification of Palila Critical Habitat	None	None	None
Historic Archaeological Sites	No impact to sites	1 site; impact mitigated	2 sites; impact mitigated
Traditional Cultural Properties	None	None	None
Criteria for Purpose and Need			
Eliminate Substandard Design	Not fulfilled	Totally fulfilled	Totally fulfilled
Minimize Conflict between Military and Public	Not fulfilled	Totally fulfilled	Totally fulfilled
Improve Quality and Safety of Military Training	N/A	N/A	N/A
Improve Motorist Safety	Not fulfilled	Totally fulfilled	Totally fulfilled
Increase Quality of Traffic Flow	Not fulfilled	Totally fulfilled; marginally worse than W-3 due to steeper grades	Totally fulfilled; marginally better than W-2 due to flatter grades
Improve Emergency Vehicle Access	Not fulfilled	Totally fulfilled	Totally fulfilled
Improve East/ West Access on Island	Not fulfilled	Totally fulfilled; less efficient than W-3 for the largest percentage of motorists (those traveling between Kona and Hilo) [1]	Totally fulfilled; more efficient than W-2 for the largest percentage of motorists (those traveling between Kona and Hilo) [1]

TABLE 2.5.1
Summary of Key Impacts, Section I

Resource	No Action	W-2	W-3
Accommodate Future Traffic Growth	Not fulfilled	Totally fulfilled	Totally fulfilled
Improve Pavement Condition	Not fulfilled	Totally fulfilled	Totally fulfilled
Construction Cost [2] Mitigation Cost Total Cost	$0.0 million $0.0 million Cost of Maintenance	$39.0 million $ 0.5 million $39.5 million	$39.0 million $ 0.5 million $39.5 million
FHWA-Recommended Alternative	No	No	Yes

[1] (ref: Terry 1998, FEIS - Part III)
[2] Planning level cost estimates.

2.5.2 Section II

With the selection of the No Action Alternative, no reconstruction of the existing alignment nor construction on a new alignment would be undertaken for Saddle Road within this section, and cross-island motorists would continue to use the existing substandard roadway. With this alternative, the substandard design would not be alleviated, motorist safety would not be improved, future increased traffic growth could not be accommodated, and emergency vehicle response would not be improved. The project purpose would not be fulfilled. For these reasons, the No Action Alternative was not selected as the recommended alternative.

The most notable consideration in the selection of a recommended alignment within Section II was that EX-2 would not completely fulfill the project purpose and need. With Segment EX-2, only marginal improvements in the quality and safety of military training would be anticipated, and existing conflicts between the military and the public would be only partially removed, by enforced administrative measures and possible grade separations in manuever areas.

In contrast, selection of either PTA-1 or PTA-3 would completely satisfy the project purpose and need. Selection of either of these segments, however, would result in a direct modification of Palila Critical Habitat (41.5 ha for PTA-1, or 46.1 ha for PTA-3). As stated by the USFWS in their Biological Opinion (BO) (ref: FEIS - Part III, BO), however, it is expected that the mitigation measures built into the project design will offset the modifications being made to Palila Critical Habitat and enhance the likelihood of survival and recovery of the Palila.

The most notable difference between PTA-1 and PTA-3 is that PTA-1 is approximately 1.6 km shorter and would provide a more direct and less curvilinear alignment. PTA-1 would be less costly to construct and would impact less native habitat and less Palila Critical Habitat. In consideration of the anticipated benefits of the mitigation measures developed for the Palila and the other reasons noted, PTA-1 was selected as the recommended alternative for Section II.

Table 2.5.2, *Summary of Key Impacts, Section II*, provides an outline of the more notable issues relevant to the selection of the recommended alternative segment in Section II.

TABLE 2.5.2
Summary of Key Impacts, Section II

Resource	No Action	EX-2	PTA-1	PTA-3
Social/ Environmental/ Economic Resources				
Land Use	No impact	Development controlled by CDUP	Potential for induced growth on HHL; Development controlled by CDUP, HHL Master Plan	Development controlled by CDUP
Pedestrian/ Bicycle Access	No improvement	Improved access; enhanced safety for pedestrian and bicycle use	Improved access; enhanced safety for pedestrian and bicycle use	Improved access; enhanced safety for pedestrian and bicycle use
ROW Acquisition	No ROW acquisition	47 ha	83 ha	85 ha
Small Lots Impacted by ROW Acquisition	None	None	None (some temporary structures scheduled to be removed)	None (some temporary structures scheduled to be removed)
Residential Relocations Required	None	None	None	None
Conversion of Special Status Farmlands	None	18.9 ha "other important agricultural lands"	6.7 ha "other important agricultural lands"	6.7 ha "other important agricultural lands"

TABLE 2.5.2
Summary of Key Impacts, Section II

Resource	No Action	EX-2	PTA-1	PTA-3
Hunting Resources	No loss	No notable loss	78 ha loss; 1,864 ha new hunting with mitigation at Pu'u Mali (Figure 3.18.1)	85 ha loss; 1,864 ha new hunting with mitigation at Pu'u Mali (Figure 3.18.1)
Recreation Resources/ Access	Continued restricted access; minor increase in use	Improved access; notable increase in use	Improved access; notable increase in use	Improved access; notable increase in use
Community Cohesion	N/A	N/A	N/A	N/A
Economic	No improvement to employment; no travel time savings for motorists; increase in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs
Noise	No substantial increase in noise levels; no exceedence or approach of NAC	Substantial increase in noise levels; no exceedence or approach of NAC	Substantial increase in noise levels; exceedence or approach of NAC at 3 receptors (military)	Substantial increase in noise levels; exceedence or approach of NAC at 3 receptors (military)
Fire Hazard	Increased fire hazard from existing condition with increased traffic volumes	Reduced fire risk with mitigation; greater suppression buffer than PTA Alts.	Reduced fire risk with mitigation; less suppression buffer than EX-2	Reduced fire risk with mitigation; less suppression buffer than EX-2
Visual Impact to Existing Communities	N/A	N/A	N/A	N/A
Geologic Hazard	Volcanic Hazard Zone 8	Volcanic Hazard Zone 8	Volcanic Hazard Zone 8	Volcanic Hazard Zone 8

TABLE 2.5.2
Summary of Key Impacts, Section II

Resource	No Action	EX-2	PTA-1	PTA-3
Native Habitat Resources	No direct impacts	68 ha vegetation, 41 ha rare communities	73 ha vegetation, 51 ha rare communities	85 ha vegetation, 56 ha rare communities
Wetlands Filled	None	None	None	None
Threatened/ Endangered Species	No impact	No impact	No adverse modification, effect, or take with mitigation No impact to other species	No adverse modification, effect, or take with mitigation No impact to other species
Modification of Palila Critical Habitat	None	None	41.5 ha	46.1 ha
Historic Archaeological Sites	No impact to sites	5 sites; impact mitigated	2 sites; impact mitigated	1 site; impact mitigated
Traditional Cultural Properties	None	None	None	None
Criteria for Purpose and Need				
Eliminate Substandard Design	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Minimize Conflict between Military and Public	Not fulfilled	Partially fulfilled	Totally fulfilled	Totally fulfilled
Improve Quality and Safety of Military Training	Not fulfilled	Not fulfilled	Totally fulfilled	Totally fulfilled
Improve Motorist Safety	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Increase Quality of Traffic Flow	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled

TABLE 2.5.2
Summary of Key Impacts, Section II

Resource	No Action	EX-2	PTA-1	PTA-3
Improve Emergency Vehicle Access	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Improve East/ West Access on Island	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Accommodate Future Traffic Growth	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Improve Pavement Condition	Not fulfilled	Totally fulfilled	Totally fulfilled	Totally fulfilled
Construction Cost (DAR) [1]	$0.0 million	$38.0 million	$38.5 million	$40.5 million
Mitigation Cost	$0.0 million	$ 5.0 million	$15.0 million	$15.0 million
Total Cost	Cost of Maintenance	$43.0 million	$53.5 million	$55.5 million
FHWA Recommended Alternative	No	No	Yes	No

[1] Planning level cost estimates

2.5.3 Section III

With the selection of the No Action Alternative, no reconstruction of the existing alignment nor construction on a new alignment would be undertaken for Saddle Road within this section, and cross-island motorists would continue to use the existing substandard roadway. With this alternative, the substandard design of this stretch of roadway would not be alleviated, motorist safety would not be improved, future increases in traffic growth could not be accommodated, and emergency vehicle response would not be improved. For these reasons, the No Action Alternative was not selected as the recommended alternative.

No reasonable and practicable alternatives to following the existing road corridor (Segment EX-3) were identified in Section III. After much discussion and investigation of potential alternative routes, it was concluded that all other alternatives would provide notably greater impacts to

adjacent resources. For this reason, Segment EX-3 was selected as the recommended alternative for Section III.

Table 2.5.3, *Summary of Key Impacts, Section III*, provides an outline of the more notable issues relevant to the selection of the recommended alternative segment in Section III.

TABLE 2.5.3
Summary of Key Impacts, Section III

	No Action	**EX-3**
Social/ Environmental/ Economic Resources		
Land Use	No impact	Potential for induced development on HHL pursuant to HHL Master Plan; Development controlled by CDUP for other lands
Pedestrian/ Bicycle Access	No improvement	Improved access; enhanced safety for pedestrian and bicycle use
ROW Acquisition	No ROW acquisition necessary	60 ha
Small Lots Impacted by ROW Acquisition	None	None
Residential Relocations Required	None	None
Conversion of Special Status Farmlands	None	None
Hunting Resources	No loss	Minor loss
Recreation Resources/ Access	Continued restricted access; minor increase in use	Improved access; notable increase in use
Community Cohesion	N/A	N/A
Economic	No improvement to employment; no travel time savings to for motorists; increase in accident costs	Increase in employment; travel time savings for motorists; decrease in accident costs
Noise	No sensitive receptors	No sensitive receptors

TABLE 2.5.3
Summary of Key Impacts, Section III

	No Action	EX-3
Fire Hazard	Increase in fire ignition risk with increased traffic	Minor increase in fire ignition risk from that of existing condition
Visual Impact to Existing Communities	N/A	N/A
Geologic Hazard	Volcanic Hazard Zone 2, 7, 8	Volcanic Hazard Zone 2, 7, 8
Native Habitat Resources	No direct impacts	96 ha vegetation, 0.4 ha rare communities
Wetlands Filled	None	2.4 ha; mitigated
Threatened/ Endangered Species	No impact	No direct impact; mitigation commitments for indirect impacts
Modification of Palila Critical Habitat	None	None
Historic Archaeological Sites	No impact to sites	7 sites; impact mitigated
Traditional Cultural Properties	None	Indirect; no mitigation required
Criteria for Purpose and Need		
Eliminate Substandard Design	Not fulfilled	Totally fulfilled
Minimize Conflict between Military and Public	Not fulfilled	Totally fulfilled
Improve Quality and Safety of Military Training	N/A	N/A
Improve Motorist Safety	Not fulfilled	Totally fulfilled
Increase Quality of Traffic Flow	Not fulfilled	Totally fulfilled
Improve Emergency Vehicle Access	Not fulfilled	Totally fulfilled
Improve East/ West Access on Island	Not fulfilled	Totally fulfilled
Accommodate Future Traffic Growth	Not fulfilled	Totally fulfilled

TABLE 2.5.3
Summary of Key Impacts, Section III

	No Action	EX-3
Improve Pavement Condition	Not fulfilled	Totally fulfilled
Construction Cost [1] Mitigation Cost Total Cost	$0.0 $0.0 Cost of Maintenance	$60.0 $ 1.0 $61.0
FHWA-Recommended Alternative	No	Yes

[1] Planning level cost estimates

2.5.4 *Section IV*

With the selection of the No Action Alternative, no reconstruction of the existing alignment nor construction on a new alignment would be undertaken for Saddle Road within this section, and cross-island motorists would continue to use the existing substandard roadway through Kaumana. With this alternative, the substandard design of the roadway would not be alleviated, conflicts between the military and the public would not be improved, motorist safety would not be improved, future increased traffic growth could not be accommodated, emergency vehicle response would not be improved, and East/West access would not be improved. The project purpose and need would not be fulfilled. For these reasons, the No Action Alternative was not selected as the recommended alternative.

The construction of Saddle Road on Segments EX-4A or E-3 would require the fill of jurisdictional wetlands (an estimated 0.4 ha with EX-4A, and an estimated 3.2 ha with E-3). While E-3 would result in the fill of more wetland resources, approximately 2.7 ha of this wetland area consists of degraded habitat (damaged by grazing or other uses) and agricultural fields with very little native vegetation. The highest value and function of those wetlands within the Saddle Road corridor is their contribution to the biodiversity of the native ecosystem. EX-4A would disturb 0.42 ha of native habitat, compared with 0.51 ha of native habitat for E-3. With these considerations, impacts to biological resources are expected to be roughly equivalent between E-3 and EX-4A.

While EX-4A would impact less wetland resources, it bisects the community of Kaumana and would require the relocation of as many as 28 households depending on final design requirements and the acquisition of residential property. It would result in the exceedence or approach of NAC at 29 residences, would cause a substantial increase in noise at 18 additional ones, and would result in serious community disruption. In addition, when considering total costs over the life of the project, EX-4A is the more costly segment, from initial construction and vehicle operating cost perspectives. The FHWA also considered public opinion. Letters from Kaumana residents

and the Kaumana City Association expressed support for the selection of E-3 and opposition to EX-4A (or EX-4). For these reasons, Segment E-3 was selected as the recommended alternative for Section IV. More detailed evaluations and comparisons of these alternatives are given in the following section of this chapter (ref: FEIS - Part I, 2.6, Sections III and IV), and in the Section 404(b)(1) Analysis Report (ref: FEIS - Part III).

Table 2.5.4, *Summary of Key Impacts, Section IV*, provides an outline of the more notable issues relevant to the selection of the recommended alternative segment in Section IV.

TABLE 2.5.4
Summary of Key Impacts, Section IV

Resource Issues	No Action	EX-4A	E-3
Social/ Environmental/ Economic Resources			
Land Use	No impact	Limited potential for induced development	Limited potential for induced development
Pedestrian/ Bicycle Access	No improvement	Improved access for pedestrian and bicycle use; enhanced safety	Improved access for pedestrian and bicycle use; enhanced safety
ROW Acquisition	No ROW acquisition	12 ha	29 ha
Small Lots Impacted by ROW Acquisition	None	51 lots 0.4 ha or less; 13 lots more than 0.4 and less than or equal to 4.0 ha	0 lots 0.4 ha or less; 4 lots more than 0.4 and less than or equal to 4.0 ha
Residential Relocations Required	None	11 - 28	None
Conversion of Special Status Farmlands	None	None	8.79 ha prime farmland
Hunting Resources	No loss	No loss	No loss
Recreation Resources/ Access	Continued restricted access; minor increase in use	Improved access; notable increase in use	Improved access; notable increase in use
Community Cohesion	Community disruption	Serious community disruption	Improved community cohesion

TABLE 2.5.4
Summary of Key Impacts, Section IV

Resource Issues	No Action	EX-4A	E-3
Economic	No improvement to employment; no travel time savings to motorists; increase in accident costs	Increase in employment; increase in accident costs, travel time and fuel consumption relative to E-3	Increase in employment; decrease in accident costs, travel time, and fuel consumption relative to EX-4A
Noise	No substantial increase in noise levels; exceedence or approach of NAC at 3 residences	Substantial increase in noise levels at 18 residences; exceedence or approach of NAC at 29 residences	Substantial increase in noise levels at 14 residences; decrease in noise levels at 49 residences; no exceedence or approach of NAC
Fire Hazard	Effectively the same as existing condition	Decrease from existing condition due to paved shoulders	Decrease from existing condition due to paved shoulders
Visual Impact to Existing Communities	No change over existing condition	Greater visual impact to Kaumana	No impact
Geologic Hazard	Volcanic Hazard Zone 3	Volcanic Hazard Zone 3	Volcanic Hazard Zone 3
Native Habitat Resources	No direct impacts	11 ha vegetation	11 ha vegetation
Wetlands Filled	None	0.4 ha; mitigated	3.24 ha; mitigated
Threatened/ Endangered Species	No impact	No impact	No impact
Modification of Palila Critical Habitat	None	None	None
Historic Archaeological Sites	No impact to sites	1 site; impact mitigated	3 sites; impact mitigated
Traditional Cultural Properties	None	None	None

TABLE 2.5.4
Summary of Key Impacts, Section IV

Resource Issues	No Action	EX-4A	E-3
Criteria for Purpose and Need			
Eliminate Substandard Design	Not fulfilled	Totally fulfilled	Totally fulfilled
Minimize Conflict between Military and Public	Not fulfilled	Partially fulfilled	Totally fulfilled
Improve Quality and Safety of Military Training	N/A	N/A	N/A
Improve Motorist Safety	Not fulfilled	Partially fulfilled	Totally fulfilled
Increase Quality of Traffic Flow	Not fulfilled	Partially fulfilled	Totally fulfilled
Improve Emergency Vehicle Access	Not fulfilled	Totally fulfilled	Totally fulfilled
Improve East/ West Access on Island	Not fulfilled	Totally fulfilled	Totally fulfilled
Accommodate Future Traffic Growth	Not fulfilled	Totally fulfilled; reduced operating characteristics and LOS compared to E-3	Totally fulfilled; better operating characteristics and LOS compared to EX-4A
Improve Pavement Condition	Not fulfilled	Totally fulfilled	Totally fulfilled
Construction Cost [1] Mitigation Cost Total Cost	$0.0 $0.0 Cost of Maintenance	$15.0 $ 5.0 $20.0	$17.0 $ 1.0 $18.0
FHWA-Recommended Alternative	No	No	Yes

[1] Planning level cost estimates

2.6 SELECTION OF LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE, SECTIONS III AND IV

In Sections III and IV, the fill of jurisdictional wetlands will be required for the construction of proposed Saddle Road improvements. To determine the *Least Environmentally Damaging Practicable Alternative* (LEDPA), to address concerns and requirements of EPA, USFWS, and USACE, and to provide a wetland mitigation proposal, a 404(b)(1) Analysis Report was prepared for this project (May 1, 1998). The report was prepared in accordance with the "Guidance Papers to Facilitate the Implementation of the Memorandum of Understanding for the NEPA and Section 404 Integration Process for Surface Transportation Projects in Hawai'i" (June, 1994) and the 40 CFR Part 230 Section 404(b)(1) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material.

A summary of the issues considered in the selection of the LEDPA follow. The 404(b)(1) Analysis Report and associated correspondence provides a more detailed description of the analysis prepared and conclusions reached (ref: FEIS - Part III). The jurisdictional wetlands and determination methodology are fully described in the Technical Volumes (ref: Gerrish 1997, Tech. App. Vol. III).

2.6.1 Section III

No reasonable or prudent alternatives to the existing road corridor (EX-3) were identified within Section III because of the need to minimize impacts to adjacent environmental resources. The EX-3 alignment would require the reconstruction of Saddle Road with major grade and alignment improvements to bring it up to AASHTO standards. The estimated construction cost for Segment EX-3 is $60,000,000.

Alternatives examined during the course of engineering analyses in Section III predominately focused on alignment alternatives that would stay within the existing ROW as much of the existing ROW as possible. No other alternatives were available that would provide such minimal resource impacts, therefore, all alternatives on relocated corridors were immediately discounted. Further, because of the narrowness and substandard curvature of the existing roadway, it is impossible to design a modern arterial roadway section completely within the existing footprint in order to avoid adjacent environmental resources altogether. This is also true for a reduced design speed standard of a collector roadway with minimal lane and shoulder widths. Therefore, a complete avoidance of adjacent wetlands is impossible if a reconstructed roadway satisfying the purpose and need is to be provided in this section. However, in response to comments from the EPA, a modified EX-3 alternative which would minimize adjacent resource impacts by reducing the roadway width and the design speed was investigated.

Modified EX-3 Alternative. Reducing the classification of the facility to a lesser design would reduce adjacent wetland impacts by an estimated 15 to 25 percent. This gain in minimization of

wetland impacts however, is overshadowed by adverse implications to roadway safety, travel time, and traffic capacity.

AASHTO standards refer to design speed as one of the most important factors in the design of a facility so that the roadway will perform its intended function in the transportation system. AASHTO recommends a design speed of 100 km/hr for a roadway functionally classified as a rural arterial. The design speed used for the project in this section is 80 km/hr, 20 percent below the design standard. As previously stated, the lower design speed of 80 km/hr was applied along the EX-3 alignment to allow more curvature, steeper grades, and less cutting and filling in order to minimize impacts to adjacent sensitive environmental resources. Reducing the standard to a lower design speed would negate the project's purpose to provide a more efficient commuter route from Hilo to Kona, Waikoloa, Waimea, and to destinations along Saddle Road.

Reducing the design standards for this alternative to that of a collector, including reduced lane and shoulder widths, would result in a reduction in service flow rates (vehicles per hour) by 36 percent. This operating efficiency reduction is primarily related to the decrease in available passing areas and less width, which usually prompts motorists to drive at slower speeds over longer reaches. This reduction results in the facility operating at capacity or below most of the time with the projected volume of 14,000 vehicles per day. This equates to a decrease in operating speed from 48 mph for the arterial design to less than 35 mph for the minimum collector design; or, an increase in travel time over the 19 mile section from 23.75 minutes to 32.5 minutes per vehicle. For 14,000 vpd, this results in a total lost time of 745,208 hours per year; or a savings of 745,208 hours per year with the selection of the minimum arterial design of 50 mph and full lane and shoulder widths when compared to the minimum collector design standard. The average weighted value of time savings referenced in the DEIS is $24.18 per hour. Assuming constant dollars, total time savings realized in the design year, with the correct design for this alternative's function, are $18,020,000 or approximately $5,620,000 in 1998 dollars using a six percent discount rate.

It can be shown on commuter routes that motorists tend to travel beyond the posted speed limit and safe operating speeds even when traffic or weather conditions make it unadvisable. Coupling this section of roadway at a lower design speed and narrower travelway with other sections at a higher design speed and standard widths would exacerbate accident rates because of this tendency. Accident rates and/or severity would be expected to increase, along with the associated cost in property and lives, rendering the provision of a lower design standard on this section a professionally irresponsible design solution.

It is impossible to know at what rates accidents might stabilize along this section with a reduced design; however, a reasonable and conservative estimate of five percent to 10 percent increase over the state-wide average for 2-lane roads can be made by comparison to other such situations. This would result in a 3.2 to 3.3 accident per million vehicle miles rate (ACC/MVM), or, using the lower estimate, approximately 20 additional accidents per year on this section. This increase would result in an estimated $3,000,000 accident cost/year in the design year, or about

$1,000,000 in 1998 dollars. This does not include potential legal expenses, which could possibly be borne by the State for accidents related to construction of an incongruent segment of roadway.

Annually recurring benefits in 1998 dollars that could be expected to begin accruing in the design year of the proposed project if the higher design standard roadway were constructed are $5,620,000 in time savings and $1,000,000 in accident savings for a total of $6,620,000.

The above numbers are considered to represent a very conservative estimate given the fact that annually recurring benefits would begin to accrue prior to the design year and continue thereafter at an increasing rate because of increasing traffic volumes.

The above analysis indicates that, within Section III, the design proposed for the planned arterial function of the roadway is most responsive to the alternative selection criteria: 1) improving overall safety, 2) increasing the quality of traffic flow, 3) accommodating present and future traffic levels, and 4) providing an improved, alternate east/west access route on the Island of Hawai'i (ref: FEIS - Part I, 1.7). From the transportation needs perspective, reducing the design standard to minimize impacts to adjacent wetlands (including the No Action Alternative), would not completely fulfill the purpose of the proposed project; there are cost, economic, and safety implications that render this alternative less viable as a practicable alternative (40 C.F.R., Subpart B, 230.10 (a)).

The total wetlands that would be filled with the selection of EX-3 is 2.4 ha. Additional information is provided on the description of the wetland resources present and the proposed mitigation in the FEIS 3.11 Waters of the US/Wetlands, and in the 404(b)(1) Analysis Report (ref: FEIS - Part III).

2.6.2 Section IV

Within Section IV, four alternative alignments were initially studied (E-1, EX-4, EX-4A, and E-3). Of these, Segments EX-4A and E-3 were presented as alternatives to be considered in the DEIS. These segments were subsequently compared further with regard to wetland impacts in the 404 analysis. As a result, Segment E-3 was selected as the LEDPA.

With the design year traffic of 14,000 vpd, E-3 would operate within the range of LOS C most of the time, and LOS D during the peak hours. In contrast, EX-4A would operate within the range of LOS D and LOS E most of the time. The main differences in operational characteristics between the two alignments are; 1) Segment E-3 allows almost 100 percent passing area versus virtually none on EX-4A; 2) side friction, i.e., turning movements at intersections and ingress/egress movements at driveways on EX-4A would be considerable versus the potential for virtually complete access control on E-3; and, 3) a more curvilinear alignment on EX-4A would tend to slow motorist operating speeds over greater reaches unless adequate additional acceleration, deceleration, and turning lanes are provided. Both alignments offer approximately the same average uphill grade and identical cross-sections.

Further, on EX-4A there are presently a minimum of four access roads for upper Kaumana subdivision residents along this section of roadway. Sometime after the mid-span life of the facility, at least two of these intersections would need to be signalized at a cost of approximately $500,000 each. By the design year, this would reduce the operation of EX-4A to LOS E (capacity) most of the time, approaching LOS F during the peak hour. The only available remedy for the reduction in operational efficiency for this alternative alignment would be expansion to four lanes. As a result of operational inefficiency along EX-4A, total travel time savings over a 20-year life of the project by selecting E-3 are estimated to be $7,783,000 (1998 dollars).

In addition, it can be expected that accident rates would not decline as precipitously with EX-4A as they would on E-3 where ingress/egress conditions could be controlled. Further, it has been shown that, on commuter routes, motorists tend to travel beyond the posted speed limit and safe operating speeds even when unadvisable to do so because of traffic or weather conditions. Using reasonable extrapolations of existing data (Traffic Study, RUST), accident rates on EX-4A could be expected to be at least 15 percent to 20 percent higher than on alignment E-3. This rate would equate to approximately 3.6 ACC/MVM. This increase could result in an estimated 60 to 70 more accidents over the project life with an estimated cost of $1,300,000 in 1998 dollars.

Additionally, speed changes resulting from acceleration and deceleration maneuvers on EX-4A could be expected to increase fuel consumption for vehicles traveling along this alignment by an estimated 15 percent. For 15 million vehicle miles, assuming an average fuel efficiency of 15 miles per gallon, this results in an additional 1,000,000 gallons of fuel consumed annually by vehicles using EX-4A as compared to E-3. This additional fuel consumption results in an added annual cost of about $608,000 to motorists with the EX-4A alignment (1998 dollars).

There would also be ROW costs associated with EX-4A that would not occur if alignment E-3 is selected. These costs would occur only once and represent residential relocations or property replacements required to construct EX-4A estimated at $500,000. There are also potential future capital improvement costs of improving EX-4A near the design year to a four-lane facility to relieve the capacity situation. These capital expenditures could be expected to cost at least as much as the currently proposed project. This improvement cost is estimated at $10 to $15,000,000 in future dollars, or about $4,000,000 to $5,000,000 (1998 dollars).

Further, EX-4A would cost approximately $2,000,000 more to construct than E-3 because excavation within the existing ROW requires more handling of material with smaller equipment, and because substantial traffic control operations would be required. The additional initial construction costs, increased operating costs, and future improvement costs attributable to EX-4A results in total additional life-cycle costs of approximately $17,000,000 (1998 dollars) over those of E-3. Thus, the dollar benefits, over the project life, of selecting E-3 are significant.

This analysis indicates that, within Section IV, the E-3 alternative is most responsive to the identified alternatives selection criteria of; 1) improving overall safety, 2) enhancing operational function and increasing the quality of traffic flow, 3) accommodating present and future traffic

levels, and 4) providing an improved, alternate east/west access route on the Island of Hawai'i (ref: FEIS - Part I, 1.7). Providing a reduced cross-section along the existing alignment (e.g., EX-4, "No-Action Alternative"), with or without a lower design speed, to minimize impacts to adjacent wetlands and/or eliminate or minimize residential relocations or property replacements, would result in even less desirable operational characteristics with greater economic and safety impacts. From the transportation needs perspective, EX-4A, the No-Action alternative, *or any alternative along these alignments of lesser design*, does not completely fulfill the purpose and need of the proposed project in that it has economic and safety implications that render it less viable as a practicable alternative to alignment E-3 (40 C.F.R., Subpart B, 230.10 (a)).

The EX-4A alignment impacts an estimated 0.4 ha of wetland area and the E-3 alignment approximately 3.24 ha. Within the E-3 ROW, approximately 2.7 ha consist of degraded habitat damaged by grazing or other uses and agricultural fields with very little native vegetation.

Since the highest value and function of the wetlands within the Saddle Road corridor is their contribution to the biodiversity of the native ecosystem, a comparison between EX-4A and E-3 was done to determine the extent of disturbance to native habitat. Results showed that the EX-4A alignment disturbed 0.42 ha of native habitat compared to 0.51 ha of native habitat impact along E-3. The linear meters of native habitat disturbed along the EX-4A alignment is 3634 m as compared to 2150 m along E-3. Thus the impacts to native biological resources were determined to be roughly equivalent between the E-3 and EX-4A alternatives.

Table 2.6.1, *Summary of LEDPA Analysis, Section IV*, provides a summary comparison of Segments EX-4A and E-3.

TABLE 2.6.1
Summary of LEDPA Analysis, Section IV

Resource	Segment EX-4A	Segment E-3
Wetlands	0.4 ha. Entire wetland area is native habitat.	3.2 ha. 84 percent is interspersed disturbed Ohia forest and degraded agricultural wetland.
Native Habitat Adjacent Reach	4.18 km. More than 50 percent is within existing roadway area.	2.15 km
Farmland	No direct loss of farmland	Loss of 8.8 ha of prime farmland
Historic Sites	1 site, impact mitigated	3 sites, impacts mitigated
Socioeconomic Impacts	Requires interim and design year improvements; higher vehicle operating costs	$10M life cycle benefits (1998 dollars) vs. EX-4A
Cost (Incl. ROW Mitigation)	$20,000,000[1]	$18,000,000

TABLE 2.6.1
Summary of LEDPA Analysis, Section IV

Resource	Segment EX-4A	Segment E-3
Cost to Puainako Project	$3,000,000	$0
Relocations	11-28 homes[2]	None
Social Impacts	Construction related impacts to Kaumana. Increased traffic volumes and truck traffic, noise, air pollution, and community disruption.	Reduction in traffic through Kaumana. Increased community cohesion, bicycle and pedestrian opportunities, social interaction, and property values.
Visual Impacts	Unacceptable impact to Kaumana.	No visual impact to Kaumana.
Noise	Exceeds or approaches NAC at 29 residences, substantial increase at 18 residences, abatement not feasible.	No exceedence or approach of NAC. Substantial increase in noise levels at 14 residences.
Safety	Reduced capacity contributes to higher accident rate, restricted local access unacceptable ques created by military convoys; decreased pedestrian/bicycle safety.	No movement of military material through residential areas, safer access to Kaumana Drive, less accidents, increased pedestrian/bicycle safety, local traffic only.
Operational Function and Quality of Traffic Flow	Traffic flow impeded because of numerous driveways and approach roads which must be maintained.	Controlled access and land use; i.e., intersections strategically planned and designed to enhance traffic flow.
Accommodate Present and Future Traffic Levels.	Future widenings may cause relocation of residences and roadway geometric and intersection improvements constrained by development.	Design can be upgraded to provide additional travel and accel/decel lanes, geometrics not constrained; i.e., higher design standards possible.

[1] Actual costs will vary depending on number of homes or uneconomic remnant property taken, final utility relocations, and number of intersections and locations.

[2] The actual number of relocations will vary depending on final intersection designs, lot zoning requirements at time of ROW purchase, and property owner compensatory costs.

CHAPTER 3
AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION MEASURES

CHAPTER 3 - AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION MEASURES

For this EIS, field surveys were conducted of the project alternative segments by a team of resource scientists/specialists. A 60-m wide corridor was surveyed for most disciplines. In a few instances, as noted within this document, the survey area was expanded in width. For segments that would follow the existing Saddle Road alignment, field surveys extended either side of the existing paved surface.

3.1 LAND USE AND RELATED GOVERNMENTAL PLANS AND POLICIES

3.1.1 LAND USE

3.1.1.1 Affected Environment

Existing land uses along the Saddle Road corridor include a mix of residential, agricultural, grazing, open space, public lands, and military training activities (Figure 3.1.1, *Existing Land Use*).

3.1.1.1.1 Ranching

Ranching activities within the project corridor range from small scale operations, such as the Waiki'i Ranch, which manages cattle over a number of lots within a gated residential/agricultural community, to Parker Ranch, the largest ranch in the State with more than 80,900 ha dedicated to grazing. Ranching makes up the primary land use within Section I, with Segments W-2 and W-3 traversing ranch land for nearly their entire length (generally west of MP 44). Ranching is also present on the northern side of Section II and III, between MP 30 and 22. Ranching activity in Section II is located on property under the jurisdiction of DHHL. Ranching within Segment III is located on the north side of Saddle Road. No ranching is present within the project corridor in Section IV.

Parker Ranch. The Saddle Road Project build alternatives in Section I traverse a large tract of Parker Ranch land. These lands are zoned by the County of Hawai'i for Agricultural uses with a minimum lot size of 40 acres (A-40a). These lands are within the State Land Use Agricultural District. While the Saddle Road project would provide an improved access to these lands, it is not anticipated that there will be any increase in development pressure on these lands. The tract of land is already accessible via the existing Saddle Road and the Mamalahoa Highway (SR 190). Consequently, the Saddle Road improvements will not introduce any new opportunities for development of Parker Ranch over those that currently exist. Furthermore, any proposals to reduce the minimum lot size would require review by the State and County through a Land Use District and Change of Zone process, respectively. This will ensure that the full range of impacts will be considered as part of the review process.

There may be some increased opportunities for development of a convenience commercial facility at the Saddle Road-Mamalahoa Highway (SR 190) intersection. However, any such development will be severely limited by the lack of infrastructure, especially water resources. Any such request would require review by the County and would likely entail a General Plan amendment. This will ensure that the full range of impacts will be considered as part of the review process. Furthermore, this potential already exists at the Saddle Road and Waikoloa Road intersections with Mamalahoa Highway (SR 190).

3.1.1.1.2 Military

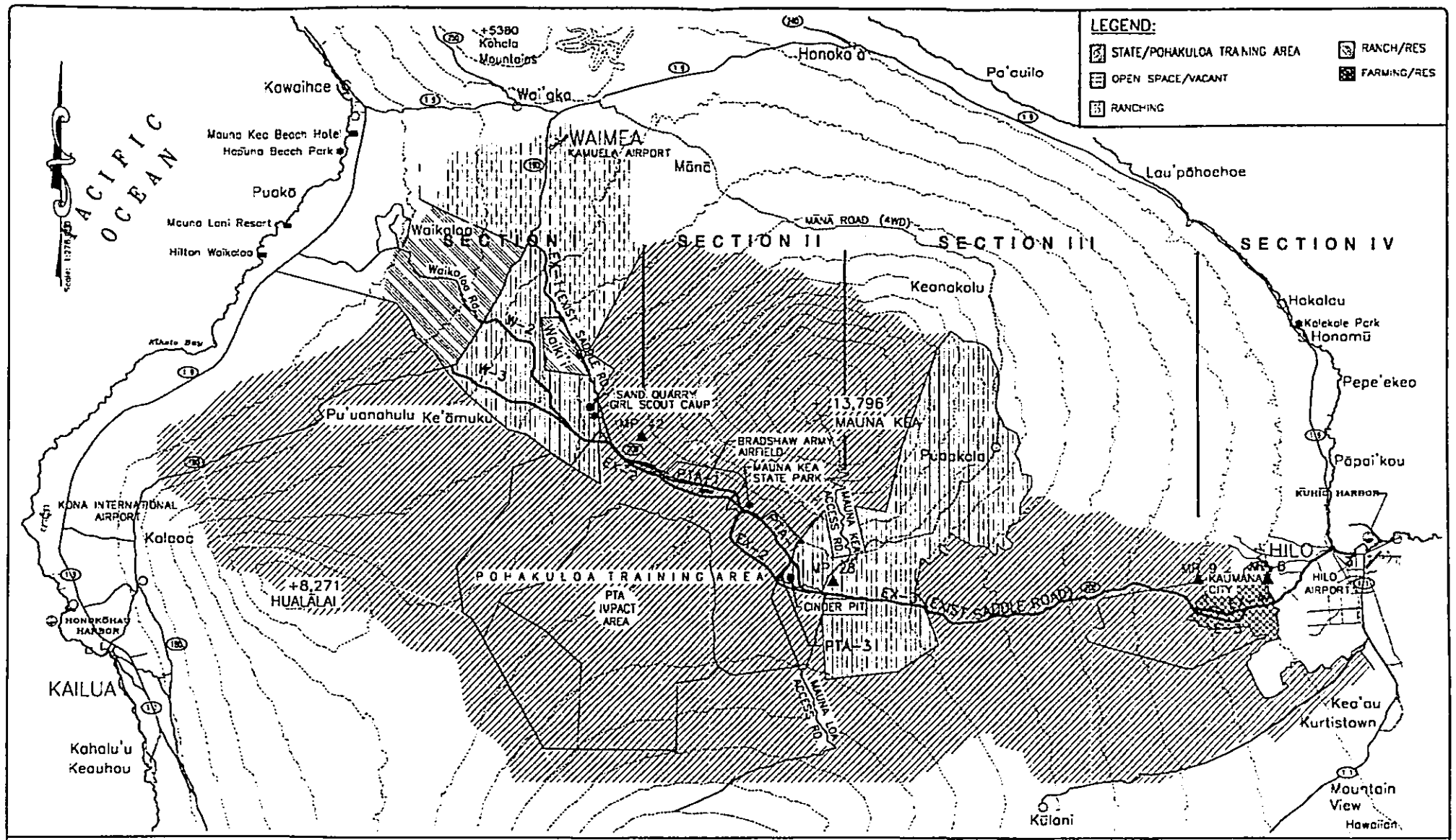
Military land use within the project corridor and vicinity occurs within the PTA, a multi-service training complex operated by the U.S. Army Garrison, Hawai'i (USAG-HI). The PTA consists of approximately 44,100 ha of land, situated in the plateau between Mauna Kea and Mauna Loa. Saddle Road extends through the northern portion of the PTA, for a length of approximately 21 km, MP 43 to MP 30. The existing road separates the PTA cantonment area and the Bradshaw Army Airfield from the majority of its training areas, firing points, and impact zones. Segments EX-2, PTA-1, and PTA-3 are almost entirely within or adjacent to the PTA. The eastern end of PTA-1, Station 26+900 to 30+999, exits the PTA and traverses land owned by the DHHL.

PTA provides a safe, modernized, major training area for the U.S. Army Pacific Command (USARPAC) and other Pacific Command Units. All branches of the armed services located in the Pacific theater utilize PTA, including the DOA, Army Reserves, Marines, National Guard, and foreign allied forces. PTA provides space for field training exercise and annual service practice. It is the only Hawai'i training area capable of supporting coordinated live firing of all assigned crew-served weapons of the infantry company and battalion and artillery in conjunction with live air support. The ranges and firing points at PTA accommodate employment of all the conventional weapons in the Pacific Region. PTA is the only training area in the Pacific that affords training units the opportunity to employ their weapon systems at their maximum standoff range. More than 15,000 military personnel receive training at PTA each year.

A summary of notable PTA facilities follows, including reference to associated future plans.

- Live-Fire Ranges and Maneuver Areas. PTA contains 14 operational fixed live fire ranges, two rotary wing forward arming and/or refueling ranges, unlimited artillery firing points, twenty-four motor points, six drop zones, a helicopter and fighter/bomber gunnery range, strategic aircraft bombing range, and approximately 7,000 contiguous hectares for maneuver training.

- Bradshaw Army Airfield. PTA houses the Bradshaw Army Airfield (Figure 3.1.1). A project to lengthen the existing runway from its existing length of 1,127 to 2,439 m is currently under review by the DOA. The longer runway would allow fully-loaded C-130 aircraft to utilize the airfield.



Source: Okahara & Associates Inc.

EXISTING LAND USE

FIGURE 3.1.1

- Cantonment Area. PTA can support a training deployment of up to 2,400 personnel. The base camp includes 154 buildings, three fully equipped and eight partially equipped with dining facilities, two motor pools, 5.7 million liters (L) of water storage, rations warehouse, bulk fuel facility, chapel, theater, a recreation club including game courts, and a medical facility.

  Due to its proximity to the existing flight path of the airfield, relocation of the cantonment area has been proposed. The site selection process is currently ongoing as of the date of this document. The proposed cantonment area would function at a level similar to the existing facility, with a capacity to house up to 2,400 visiting troops. Additional camping areas would allow the facility to accommodate up to 4,000 troops at one time.

- Infrastructure. PTA is in the process of upgrading its water system, including the construction of a water filtration system to purify water from Pohakuloa Spring. Presently, water is hauled to PTA by truck.

Of the total PTA land area, 20,648 ha are used for the impact area and 13,204 ha for maneuvers. Approximately 9,920 ha are limited in their use due to extensive lava fields and environmental sensitivity.

Approximately 2,024 ha of maneuver area within PTA are situated on the north side of Saddle Road and include Training Areas 1-4 (Figure 3.1.2, *PTA Maneuver Training Areas*). Saddle Road serves as a major barrier between these maneuver areas and firing points situated south of Saddle Road. Portions of Training Areas 1, 3, and 4, and all of Training Area 2 are within the Palila Critical Habitat Area (ref: FEIS - Part I, 3.18).

The types of training activities undertaken in Training Areas 1 through 4 are limited to the following.

- Live fire artillery
- Deliberate attacks
- Unit road march
- Hasty attacks
- Force on force blank fire maneuvering
- Bivouac
- Patrolling
- Land navigation
- Small unit tactics
- Vehicle road marches
- Occupy defensive positions
- Unit command posts
- Airmobile operations

The following limitations are enforced on these training areas due to the sensitivity of surrounding areas.

- No open fires.
- No aerial pyrotechnics
- No field mess operations
- No ground smoke or CS smoke
- No more than 500 men at any time

- No more than five helicopters at one time
- No live ammunition; only artillery authorized

3.1.1.1.3 Residential

Residential and small scale agricultural uses are concentrated on the Hilo, or eastern side, of the project corridor between MP 8 and 5. In addition, there is a mix of ranching and residential uses within Waiki'i Ranch on the western side between MP 49 and 46. The majority of the small residential lots 0.4 ha or less in size are in Section IV along the existing Saddle Road corridor (Segment EX-4A). No other segment under consideration includes any similar sized residential or small agricultural lots.

3.1.1.1.4 Public Lands

Large areas of public lands, which serve as watershed, conservation areas, public hunting units, and recreation sites, are located along the Saddle Road corridor, beginning at MP 22 and extending east to MP 10. Between MP 30 and 22, the Forest Reserve lands are limited to the south side of Saddle Road. A portion of this area is designated by the State of Hawai'i Department of Land and Natural Resources (DLNR) as a sanctuary for the endangered Nene (ref: FEIS - Part I, 3.18).

There are limited opportunities for development of lands along the Saddle Road Corridor. The majority of these lands are under the control of DLNR and are within the Conservation District. As such, any use of these lands for urban activities would be severely restricted. Furthermore, most of these lands are within the State Forest Reserve and are required to be managed for conservation purposes.

The portion of the Saddle Road Project within Section IV extends through a mix of small agricultural uses and open areas. Further development of these areas is limited by the existing land use designation which is agricultural. The lack of water resources in this area further limits development of these lands.

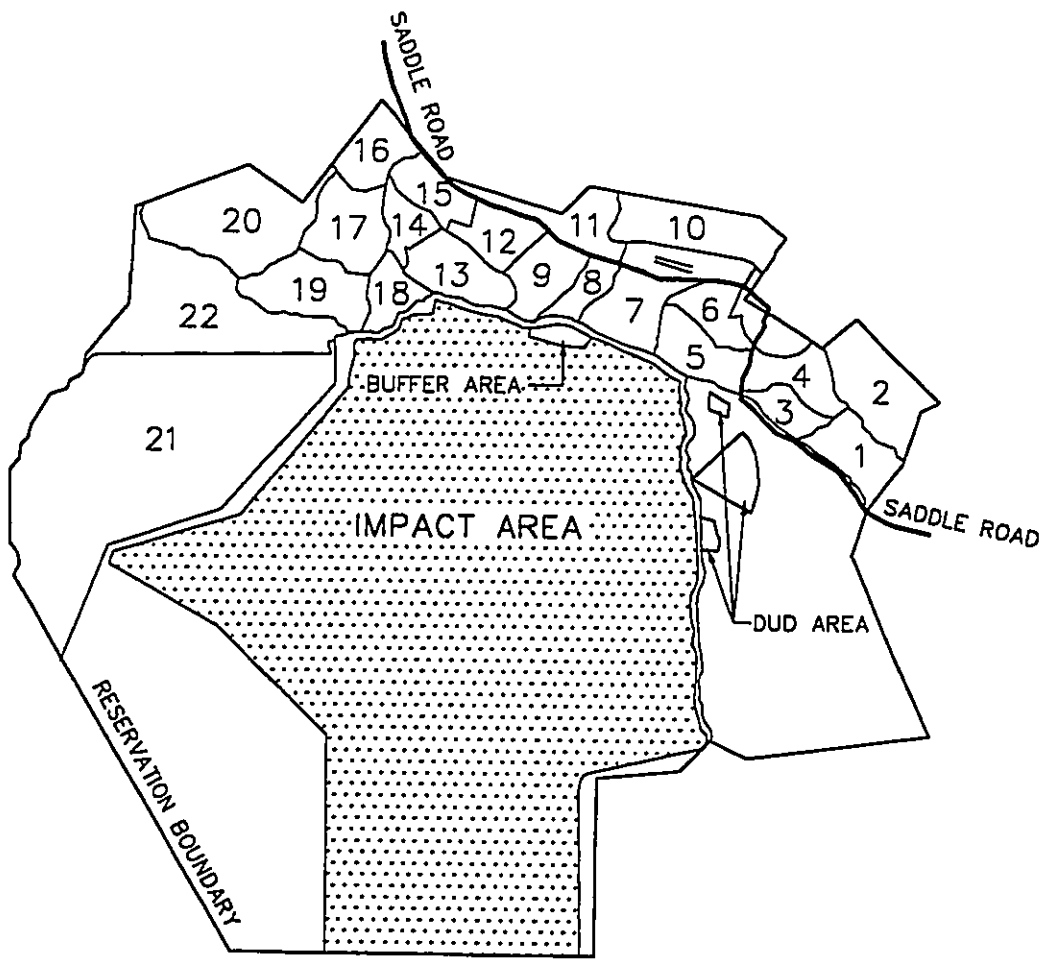
3.1.1.1.5 Astronomy

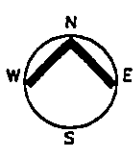
Since 1968, the University of Hawai'i has operated an astronomical facility on Mauna Kea, a 4,206-m-high volcano. Mauna Kea is considered one of the finest astronomical observatory sites in the world. A total of 10 facilities, including the Very Long Base Array Observatory, have already been constructed on Mauna Kea with an additional three facilities under construction or in the final stages of planning.

In order to support and acclimatize the astronomers, technicians and support staff, a mid-level support facility has been constructed at Hale Pohaku at the 2,835-m elevation. This facility

LEGEND

12 TRAINING AREA BOUNDARY





SADDLE ROAD PROJECT
A-AD-601
HAWAII DEFENSE ACCESS ROAD

PTA MANUEVER
TRAINING AREAS

FIGURE 3.1.2

provides sleeping accommodations, offices, kitchen/dining areas, and lounges. The site also includes an interpretive center for disseminating information about Mauna Kea and the astronomical facilities. The Mauna Kea Science Reserve Complex Development Plan, which was completed in 1983, established the overall policies and criteria for the development of astronomical facilities within the Mauna Kea summit area. A revised plan is under development to cover future use of the mountain summit. Access to the observatory is from Saddle Road and the Mauna Kea Access Road.

3.1.1.1.6 Mining and Energy Development

Mining and or energy developments within the project vicinity are limited to two quarries (Figure 3.1.1). One is a sand quarry, approximately 6 ha in size, which is now closed. It is located on the south side of Saddle Road in Section I, west of the Kilohana Girl Scout Camp. Appendix C provides a property map of this land parcel. The second is a cinder pit, located on Pu'u Nene, in Section II.

3.1.1.1.7 Commercial and Industrial Use

There are no commercial or industrial uses within the project area, except for a small convenience store at MP 5, just east of the project's eastern terminus.

3.1.1.1.8 Outdoor Recreation and Hunting

The Saddle Road area provides a number of outdoor recreational resources and opportunities. Public input associated with this project noted that many people drive Saddle Road for recreation and for its scenic resources, and a number of residents hunt, hike, and gather resources in the upland areas. A full discussion of outdoor recreation and hunting is included in the social section of this chapter (ref: FEIS - Part I, 3.3.4).

3.1.1.1.9 Department of Hawaiian Homelands - Humu'ula/Piihonua Tract

DHHL controls approximately 22,700 ha of land on the slopes of Mauna Kea, a portion of which is bisected by the existing Saddle Road corridor. In August 1997, the DHHL released its Draft Humu'ula/Piihonua Master Plan for these lands. This plan is intended to serve as the development plan for approximately 22,700 ha of DHHL lands in this area and north along the Keanakolu Road.

The land use plan includes a mix of homesteading commercial/service oriented business, ecotourism and service facilities, forest, and ranching activities. Table 3.1.1, *Draft Humu'ula/Piihonua Master Plan Proposed Uses*, summarizes the proposed uses identified in this draft plan.

TABLE 3.1.1
Draft Humu'ula/Piihonua Master Plan Proposed Uses

Activity	Area (ha)	Description
Homesteads	**5,071**	A total of 35 to 220+ pastoral lots are proposed ranging in size from 8 to 121 ha.
Pastoral	3,873	The development of future reserve area is dependent on the ability to develop infrastructure, primarily water, to support a more intensive homestead settlement of several hundred lots.
Future Reserve	1,198	
Economic Enterprise	**9,175**	The Economic Enterprise areas consist of lands to be managed by or for the benefit of native Hawaiians. The majority of these lands are identified for agricultural uses, with a focus on forestry.
Commercial	20	Commercial and commercial reserve uses are identified for Saddle Road, and Mauna Kea Access Road junction.
Commercial Reserve	40	Ecotourism activities are targeted to the remote areas to provide unique wilderness experiences.
Ecotourism Areas	NA	
Pasture/Forestry	8,737	
Cinder Quarry	314	
Keanakolu Road ROW	63	
Resource Conservation, Land Management	**8,499**	Lands with low economic or homesteading potential but a high conservation value and currently under State management or contiguous to State of Federally managed lands were identified as conservation lands. This area includes the Ainahou public hunting area and portions of lands within the Mauna Kea Forest Reserve.
Resource Areas	7,681	
Pu'u/Buffer Areas	817	

The Homesteading, Resource Conservation, and the Economic Enterprise activities (with exception of commercial areas) are independent of the Saddle Road project. The homesteading program is a mandate of the Hawaiian Homes Act that created the DHHL and set aside approximately 80,900 ha of land throughout the State of Hawai'i, including the Humu'ula/Piihonua lands for these purposes.

The only activity that may be impacted by the Saddle Road project are those areas identified for commercial/service oriented business. According to the Draft Report, these areas are oriented toward the Saddle Road/Mauna Kea Access Road Junction. These are opportunities for service oriented business to serve the Saddle Road traffic, as well as the nearby PTA and Mauna Kea observatories and related activities.

The commercial developments are proposed within a 20 ha site at the existing Humu'ula Sheep Station, which is situated on the Mauna Kea Access Road, approximately 1,200 m north of its intersection with Saddle Road. Proposed uses include a service station and convenience store, as well as space to support eco-tourism businesses proposed within DHHL lands.

DHHL lands are not subject to land use control by the State or County of Hawai'i. As such, these lands can be developed without regard for existing plans or land use or zoning designations as long as the uses are consistent with the act. The Hawaiian Homes Commission has deferred further consideration of the Draft Humu'ula/Piihonua Master Plan based on comments and input from its native Hawaiian beneficiaries.

The completion of the Saddle Road project will provide increased traffic along this corridor, providing greater potential for a viable convenience commercial facility within the DHHL lands. Such a facility would provide a much needed service for those traveling this remote section of roadway. The use of the existing facilities at the Humu'ula Sheep Station and their location away from Saddle Road will reduce any visual impact of those activities on Saddle Road.

Table 3.1.2, *Land Use by Segment*, summarizes the land use patterns and activities within the project corridor.

TABLE 3.1.2
Land Use by Segment

Section	Land Use	%	Land Use	%	Land Use	%
I	Segment W-2		Segment W-3			
	Open Space	0	Open Space	0		
	Ag/Residential	0	Ag/Residential	0		
	Farming	0	Farming	0		
	State	0	State	0		
	Ranching	90	Ranching	90		
	PTA	10	PTA	10		
	Park Land	0	Park Land	0		
II	Segment EX-2		Segment PTA-1		Segment PTA-3	
	Open Space	0	Open Space	15	Open Space	0
	Ag/Residential	0	Ag/Residential	0	Ag/Residential	0
	Farming	0	Farming	0	Farming	0
	State / DHHL	3	State / DHHL	4	State / DHHL	4
	Ranching	0	Ranching	0	Ranching	0
	PTA	97	PTA	81	PTA	96
	Park Land	0	Park Land	0	Park Land	0

TABLE 3.1.2
Land Use by Segment

Section	Land Use	%	Land Use	%	Land Use	%
III	Segment EX-3					
	Open Space	64				
	Ag/Residential	0				
	Farming	0				
	State	9				
	Ranching	27				
	PTA	0				
	Park Land	0				
IV	Segment EX-4A		Segment E-3			
	Open Space	0	Open Space	0		
	Ag/Residential	0	Ag/Residential	0		
	Farming	80	Farming	72		
	State	20	State	28		
	Ranching	0	Ranching	0		
	PTA	0	PTA	0		
	Park Land	0	Park Land	0		

3.1.1.2 Environmental Consequences

All Action Alternatives. Land use impacts that would result from implementation of the proposed project include temporary construction-related impacts, direct impacts associated with ROW acquisition, and indirect impacts resulting from changes in the character and use of the road.

Construction activities would be expected to result in short-term impacts on land uses adjacent to Saddle Road. These impacts include traffic delays and congestion, construction noise and dust, and community disruption. With W-2, W-3, PTA-1, PTA-3, and E-3, these construction-related impacts would be notably less. Most of the construction work would be completed outside of the existing road corridor, allowing use of the existing road during most of the construction period. Selection of W-2 or W-3 would result in no notable construction-related impacts to the community of Waiki'i. Selection of E-3 over EX-4A would preclude much of the construction-related impacts to developed portions of Kaumana.

Following the construction period, the proposed project would improve the safety and efficiency of Saddle Road, a transportation use. The resulting changes would improve access to land uses directly adjacent to the corridor, and would increase cross-island traffic between East and West Hawai'i.

Improved access on Saddle Road and the resulting increase in traffic levels could result in the indirect increase in use of public areas adjacent to the project corridor. While improved access would be beneficial for many potential users, the associated increased use could potentially increase the degradation of sensitive environments.

W-2 and W-3. Implementation of the proposed project would result in a direct and unavoidable land taking from the ranching operations within Section I of the project corridor. Total direct land impacts to Parker Ranch pasture lands would be 63 ha with selection of Segment W-2, and approximately 62 ha with selection of Segment W-3. These segments extend through the Ke'amuku pasture of Parker Ranch, which totals approximately 9,311 ha of land area. Approximately 3,500 head of cattle are kept in this area, rotated between three large paddocks. Construction of Segments W-2 or W-3 would require the installation of additional pasture fencing, and consequently modification of the layout of existing pastures. The Ke'amuku pasture area is of sufficient size to accommodate these modifications, and impacts on the overall ranching operation are expected to be limited.

W-2 or W-3 would route Saddle Road cross-island traffic off of the existing Saddle Road within Section I, notably reducing traffic levels through Waiki'i Ranch. The abandoned existing Saddle Road serving Waiki'i and other local access needs would be the responsibility of the County of Hawai'i to maintain. HDOT is currently examining funding or cooperative mechanisms to provide assistance to local governments in the maintenance of local roads.

EX-2, PTA-1, and PTA-3. Direct impacts to ranching would occur with the implementation of PTA-1, which extends onto DHHL land. A total of approximately 15.4 ha of DHHL pasture lands may be directly impacted by land acquisition for construction of PTA-1. These lands are currently leased to Parker Ranch for cattle grazing. No direct impacts to ranching/grazing activities would be anticipated with EX-2 or PTA-3.

Implementation of EX-2 would have little or no affect on hunting lands. Direct loss of existing hunting lands would occur as a result of the selection of PTA-1 (78 ha), or PTA-3 (91 ha). PTA-1 and PTA-3 would primarily impact hunting units A and E (Figure 3.3.1, *Recreation Resources*), where hunting for pigs, goats, sheep, and birds is permitted. With regard to the hunting of feral animals, PTA-1 and PTA-3 would result in limited impacts, since the alignments would follow along the margin of feral animal hunting areas. Either PTA-1 or PTA-3 would bisect but not substantially fragment bird habitat.

Implementation of the project would provide for safer travel through PTA by minimizing conflicts between military and civilian traffic. The Army has stated that the improvement of Saddle Road would be desirable from the standpoint of improving the quality of training operations. However, the quantity of training would not be affected by the proposed project.

With PTA-1 or PTA-3 the quality and safety of training activities would be enhanced within certain training areas. PTA-1 or PTA-3 would realign Saddle Road to the northern boundary of

the PTA. This would improve the quality of training operations in adjacent training areas. It would remove the existing Saddle Road as a major barrier between the maneuver areas north of the existing alignment and the firing points situated to the south. Ownership of the existing Saddle Road would be transferred to the military for use as required.

In contrast, construction of EX-2 without the construction of grade separated crossings would degrade training activities as traffic growth occurs. EX-2 would leave Saddle Road as a barrier between maneuver areas and firing points, necessitating continued limitations in training activities and compromising the realism of training. Military personnel and associated ground vehicles would need to cross the road to reach the firing points on the boundary of the impact area. There would be greater restrictions in the conditions of artillery fire.

EX-3. With EX-3 the improved roadway would use much of the existing roadway corridor, therefore, land use impacts would be minimized in this section of the project corridor. ROW acquisition for EX-3 would result in a direct loss of roughly 45 ha of State land, primarily adjacent to Forest Reserve lands, in hunting units B and E, and within the South Hilo Forest Reserve. Impacts to hunting are not anticipated due to the presence of a hunting buffer along the existing road corridor.

The selection of EX-3 will require the acquisition of approximately 10 ha DHHL lands. The completion of the Saddle Road project will provide increased traffic along this corridor, providing greater potential for a viable convenience commercial facility within the DHHL lands. As the same time, such a facility will provide a much needed service for those traveling this remote section of roadway. The use of the existing facilities at Humu'ula Sheep Station and their location away from Saddle Road, will reduce any potential visual impact of those activities on Saddle Road motorists.

EX-4A. Selection of EX-4A would result in the direct conversion of State land and privately-owned residential lands. With the development of an improved Saddle Road on EX-4A, a substantial increase in future traffic volumes is anticipated. Residential property acquisition and residential relocations required for construction of the project on this segment would be minimized because the alignment would be routed along the Hawai'i Electric Light Company, Inc. (HELCO) transmission line corridor, avoiding a relatively dense area of residences along the existing Saddle Road. Over the long term, the anticipated increase in traffic could increase pressures for the development of commercial services, such as service stations or convenience markets.

E-3. The E-3 corridor would convert vacant land, and lands designated for agriculture. The development of an improved Saddle Road along this alignment would open these lands up for development in accordance with existing zoning.

No Action Alternative. With the No Action Alternative, no land would be converted from its existing use to the transportation corridor use. No land acquisition or relocations would be required.

3.1.1.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Access to public use and recreation areas, ranching operations, residences, and the PTA will be maintained at all times during construction.

Discussion of relocation impacts and associated mitigation measures is included in a separate section of this chapter (ref: FEIS - Part I, 3.5).

3.1.2 Current Development Trends

The County of Hawai'i has faced difficult economic times as a result of the end of the sugar production industry on the island and lagging tourism. This in turn has caused a downturn in construction, real estate sales, and development. To a large extent, the economy of the County mirrors that of the State as a whole.

The economies of East and West Hawai'i continue to be very different in character. East Hawai'i relies on the University of Hawai'i at Hilo, the astronomical base facilities, government, and a growing diversified agricultural industry. There is a plentiful supply of affordable housing, although many of the houses in the Puna region are in substandard subdivisions (many without municipal water and paved roads).

West Hawai'i's economy continues to rely primarily on the tourism industry. Technology industries, centered on the Natural Energy Laboratory of Hawai'i and the astronomical base facilities in Waimea, and diversified agriculture continue to be important elements of the economy. Over the past five years, West Hawai'i has been slowly gaining population share from East Hawai'i.

With direct flights from Japan and the continental United States into Kona, tourism in West Hawai'i is starting to grow again. Hotels continue to be renovated and upgraded. The new Four Seasons Resort, which opened in September 1996, is the first new hotel in almost five years.

Tourism in East Hawai'i continues to be dominated by the independent visitor looking for a unique experience. This has resulted in a growing bed and breakfast industry in East Hawai'i and the island as a whole. The Hawai'i Volcanoes National Park in Ka'u, continues to be the largest tourist draw on the island.

With the closing of Ka'u Sugar Company in 1996, sugar cane is no longer cultivated on the island. Once the dominant crop with over 24,000 ha in production in 1990, the plantation closures (including Hamakua Sugar Company, Mauna Kea Sugar/Hilo Coast Processing Company and Ka'u Sugar Company) have created opportunities for diversified agriculture. Trends indicate that the future of the agricultural industry of this area is in small farms rather than plantation agriculture.

Timber is also being considered to replace some of the sugar operations, especially in the Hamakua region on the former Hamakua Sugar Company lands. Ranching continues to be a major industry, with more than $20 million in sales in 1994. This is down significantly from the early 1990's, however, primarily because of the decline in beef prices. Table 3.1.3, *Hawai'i County Statistics, 1991 through 1995*, presents a summary of key statistics on the island's economy and development trends.

TABLE 3.1.3
Hawai'i County Statistics, 1991 through 1995

	Unit	1991	1992	1993	1994	1995
Resident Population	Number	126,127	130,018	133,039	135,255	137,531
Civilian Labor Force	Number	63,800	65,350	65,300	65,956	64,300
Unemployment Rate	Percent	4.5	8.1	7.5	10.8	10.2
Estimated West Bound Visitors	Number	875,600	909,500	875,700	866,300	850,800
Estimated East Bound Visitors	Number	213,000	232,900	244,400	213,3003	215,300
Hotel Inventory	Rooms	9,383	9,170	9,140	9,595	9,558
Hotel Occupancy	Percent	57.2	57.9	58.2	62.4	60.4
Real Estate Resales Single Family Residential	Number Average Price	752 $204,231	764 $196,279	740 $217,911	844 $191,787	791 $196,952
Real Estate Resales Multi-Family Residential	Number Average Price	296 $173,970	250 $193,359	285 $179,957	298 $180,313	274 $188,066
Sugar Production	Tons	182,000	164,000	161,000	147,000	No Data
Diversified Crop Production	Dollars	$105,409,000	$102,035,000	$101,610,000	$102,731,000	No Data
Livestock Production	Dollars	$30,707,000	$28,171,000	$25,699,000	$20,708,000	No Data

Source: Economic Indicators, First Hawaiian Bank Research Department, September, October 1996

While the County's economy is presently very sluggish, the future is very optimistic. According to a recent profile of the island's economy (First Hawaiian Bank 1996), "the Big Island's

economy has suffered through several years of lackluster growth caused by sugar closures, lagging construction, and slow tourism. However, there are signs in 1996 that higher growth is actually coming." The profile concluded that, "short term cyclical aspects shouldn't overshadow the Big Island's long term potential. And even cyclically, the worst is likely to be over."

3.1.3 Governmental Plans, Policies, and Land Use Regulations

3.1.3.1 Hawai'i State Plan

The Hawai'i State Plan (State Plan) was adopted in 1978 and revised in 1986 and again in 1991 as Chapter 226, Hawai'i Revised Statutes (HRS). The plan establishes a set of goals, objectives and polices that are meant to guide the State's long-term growth and development.

Relevant sections of the State Plan, include the following from Section 226-17, HRS, relating to Transportation:

Objective a.1:	An integrated multi-modal transportation system that serves statewide needs and promotes the efficient, economical, safe and convenient movement of people and goods.
Objective a.2:	A statewide transportation system consistent with planned growth objectives throughout the State.
Policy b.1:	Design, program, and develop a multi-modal system in conformance with the desired growth and physical development as stated in this chapter.
Policy b.6:	Encourage transportation systems that serve to accommodate present and future development needs of communities.
Policy b.9:	Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification.
Policy b.10:	Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawai'i's natural environment.

The proposed project is consistent with the transportation policies and objectives of the State Plan. The highway will accommodate both existing and future cross-island traffic in a safe and efficient manner. It will improve the link between existing residential, governmental and service centers in East Hawai'i and major job centers and economic development opportunities of West Hawai'i.

3.1.3.2 Hawai'i State Functional Plans

The State Plan contains 12 separate Function Plans addressing specific areas of concern. The 1991 revision of the Functional Plan for Transportation has several objectives, policies and implementing actions which are relevant to this project including the following.

Objective IA: Expansion of the Transportation System.

Policy I.A.2: Improve regional mobility in areas of the State experiencing rapid urban growth and road congestion.

Objective I.E: Planning and designing State highways to enhance inter-regional mobility.

Policy I.E.1: Design highways with controlled accesses, grade separated crossings, and minimum four-lane divided standards where applicable. Encourage counties to develop local road networks for local travel and access.

Objective II.A: Development of a transportation infrastructure that supports economic development initiatives.

Policy II.A.1: Support State economic development initiatives.

Policy II.A.2: Support tourism and economic development.

The proposed project is consistent with the Objectives and Policies of the Transportation Function Plan. The highway will accommodate both existing and future cross-island traffic in a safe and efficient manner. It will link the existing residential, governmental and service centers in East Hawai'i with the major job centers and economic development opportunities in West Hawai'i.

3.1.3.3 Island of Hawai'i Long Range Land Transportation Plan

The Hawai'i Long Range Land Transportation Plan for the Island was adopted by HDOT in May 1998. This plan updated the Island of Hawai'i Long Range Highway Plan, which was originally developed in 1991. The Long Range Transportation Plan is intended to identify needed land transportation improvements to accommodate traffic demand projections projected for the year 2020 and to prioritize those improvements for funding. This plan serves as the guide to State and County highway planning for the Island of Hawai'i.

The Hawai'i Long Range Land Transportation Plan identified the Saddle Road improvements, extending from Kaumana to Mamalahoa Highway (SR 190), as a Tier 1 project. Tier 1 projects comprise those projects considered higher priority. The goal is to initiate these Tier 1 projects to at least the project development state (detailed planning, preliminary engineering, environmental

studies) by year 2005. Refer to Table 3.1.4 *Hawai'i Long Range Land Transportation Plan Recommended Improvements* for a summary of proposed recommendations.

TABLE 3.1.4
Hawai'i Long Range Land Transportation Plan Recommended Improvements

Facility/Section	Description/Improvements
Saddle Road - Kaumana to John A. Burns Way (Mauna Kea Access Road)	Reconstruct existing two-lane highway to provide geometric design, intersection and safety improvements.
Saddle Road - John A. Burns Way to MP 42	Reconstruct existing two-lane highway to provide geometric design, intersection and safety improvements.
Saddle Road - MP 42 to Mamalahoa Highway	New two-lane highway with separate turning lanes at major intersections (realignment of Saddle Road to intersect with Mamalahoa Highway at or near the Waikoloa Road junction).

Comments and discussion points in the Hawai'i Long Range Land Transportation Plan which supported the Saddle Road Project as a Tier 1 recommendation included the following: 1) links Hilo with West Hawai'i, 2) addresses safety concerns along Saddle Road, 3) provides a more efficient route to West Hawai'i, 4) relieves congestion along other routes (Highway 19), 5) Federal Funds through the DOD are available, and 6) connects Mamalahoa Highway (SR 190) with PTA.

The proposed project and its alignment alternatives are consistent with the project development description for the Saddle Road Project as contained in the Hawai'i Long Range Land Transportation Plan. Projects will be added to the State Transportation Improvement Program in segments as they are programmed.

3.1.3.4 County of Hawai'i General Plan

The County of Hawai'i General Plan is a policy document expressing the broad goals and polices for the long range development of the Island of Hawai'i. The plan was originally adopted by ordinance in 1967 and was most recently amended in 1989. The General Plan is organized into 13 elements, providing goals, policies, standards and recommended courses of action for each. The relevant sections of the General Plan to this project are listed as follows.

Transportation Goals

- Provide a transportation system whereby people and goods can move efficiently, safely, comfortably, and economically.
- Make available a variety of modes of transportation which best meets the needs of the County.
- Provide a system of thoroughfares and streets for the safe, efficient and comfortable movement of people and goods between and within the various sections of the County.
- Provide an integrated State and County system so that new major routes would complement and encourage proposed land uses.

Transportation Policies

- A framework of transportation facilities which would promote and influence desired land use shall be established by concerned agencies.
- The agencies concerned with transportation systems should provide for present traffic and future demands, including mass transit programs for high growth areas.
- The improvement of transportation service shall be encouraged.
- The County shall coordinate with appropriate Federal and State agencies for the funding of transportation projects for areas of anticipated growth.

Specific Courses of Action

- Implementation of the Puainako Extension and Widening Project (ref: FEIS - Part I, 3.1.4)

3.1.3.5 General Plan Land Use Pattern Allocation Guide Map and Facilities Map

While the Hawai'i County General Plan is a policy document, expressing broad goals and policies for the long range development of the island, it also includes a map component. The Land Use Pattern Allocation Guide (LUPAG) map indicates the general location of various land uses in relation to each other and is a graphic depiction of the General Plan's Goals, Polices, and recommended Courses of Action. The Facilities Map identifies existing and proposed roads as well as existing and proposed public, cultural, utility, safety, and transportation facilities. These maps establish the basic urban and non-urban form for areas as well as the primary transportation linkages.

Land uses designated on the LUPAG map are organized into the following categories.

Urban and Rural Designations

High Density:	Commercial, multiple residential and related services.
Medium Density:	Village and neighborhood commercial and residential and related functions.
Low Density:	Single family residential in character, ancillary community and public uses, and convenience type commercial uses.
Resort Areas:	These areas include uses such as hotels, condominium-hotels, and supporting services.
Urban Expansion:	Allows for a mix of high density, medium density, low density, industrial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.
Industrial Area:	These areas include uses such as manufacturing and processing, wholesaling, large storage and transportation facilities, and light industrial uses.

Agricultural Designations

Intensive Ag:	Sugar, orchard, diversified agriculture, and floriculture.
Extensive Ag:	Pasturage and range lands.
Orchard:	Those lands which though rocky in character and content support productive macadamia nuts, papaya, citrus, and other similar agricultural products.

Other Designations

University:	University and support community services.
Open:	Parks and historic sites.
Conservation:	Forest and water reserves, natural and scientific preserves, open lands within the State Land Use Conservation District.

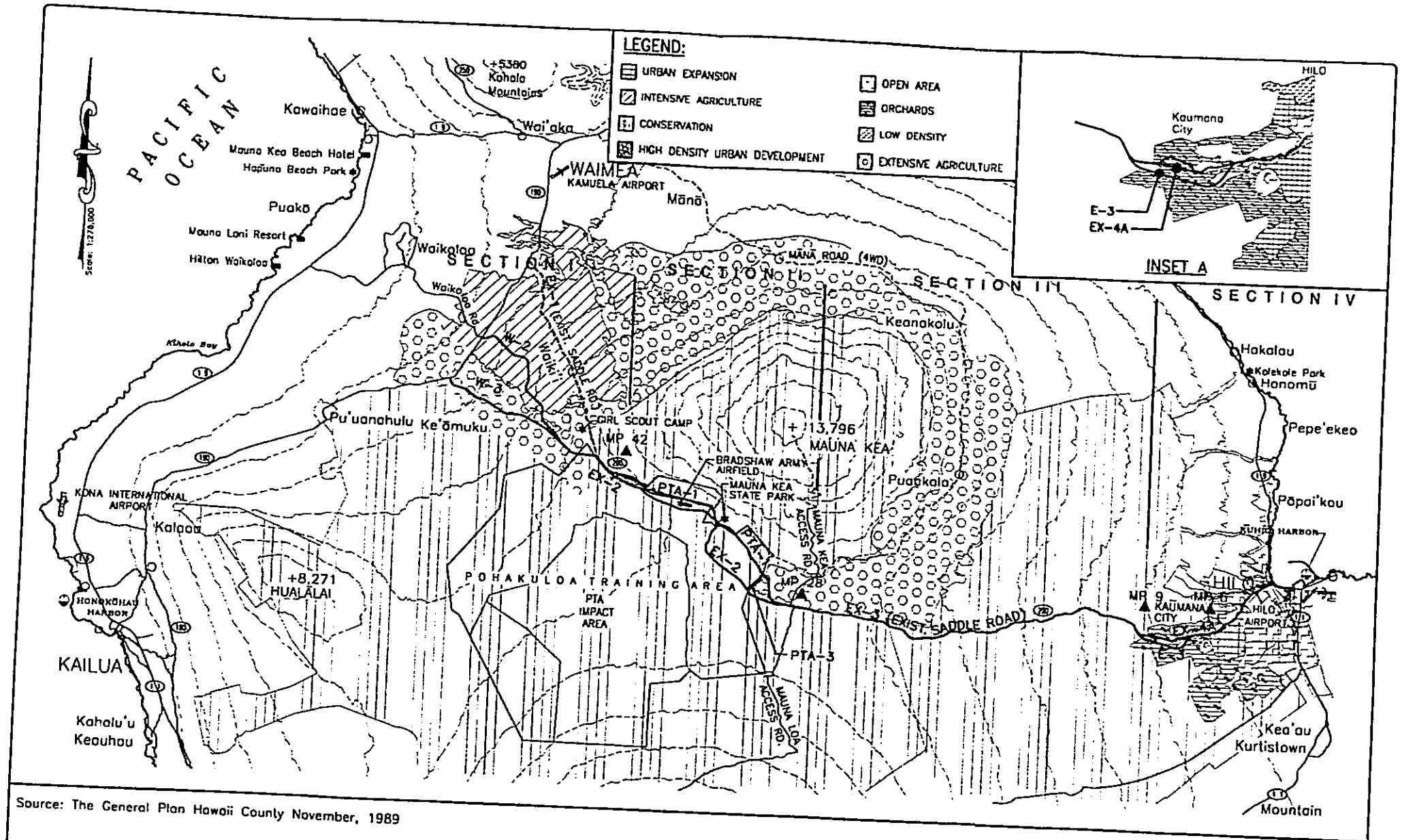
The Saddle Road project extends through areas that have been designed for a mix of Low Density Urban, Agricultural, and Conservation uses by the General Plan LUPAG map. The Low Density Uses are concentrated in the eastern end of the project corridor in the upper Kaumana area between MP 10 and 5. The Agricultural designations extend along the north side of Saddle Road between MP 30 and 22 and along the entire western end, west of MP 44, and including Western Alternative segments W-2 and W-3. The balance of the project area is designated as Conservation, in accordance with the forest reserve uses and State Land Use (SLU) Conservation designation of the lands.

Table 3.1.5, *General Plan LUPAG Categories by Alternative*, provides the percent of each alternative within the various LUPAG land use categories. Figure 3.1.3, *General Plan LUPAG Map Designation*, graphically depicts the LUPAG land use classifications.

The General Plan Facilities map shows existing Saddle Road as a Primary Arterial Roadway which needs to be improved. The General Plan also shows a proposed new road that intersects with Saddle Road at MP 44 and runs in a southerly direction to the Puuanahulu/Puuwaawaa area. This alternative alignment was considered during the scoping phase of the Saddle Road project and rejected because of environmental concerns (ref: FEIS - Part I, 2.3).

TABLE 3.1.5
General Plan LUPAG Categories by Alternative

Section	LUPAG Land Use		LUPAG Land Use		LUPAG Land Use	
I	Segment W-2		Segment W-3			
	Urban Expansion	0%	Urban Expansion	0%		
	Extensive Ag	28%	Extensive Ag	81%		
	Intensive Ag	62%	Intensive Ag	9%		
	Conservation	10%	Conservation	10%		
	Open Area	0%	Open Area	0%		
	Orchards	0%	Orchards	0%		
	Low Density	0%	Low Density	0%		
	High Density	0%	High Density	0%		
II	Segment EX-2		Segment PTA-1		Segment PTA-3	
	Urban Expansion	0%	Urban Expansion	0%	Urban Expansion	0%
	Extensive Ag	0%	Extensive Ag	10%	Extensive Ag	0%
	Intensive Ag	0%	Intensive Ag	0%	Intensive Ag	0%
	Conservation	100%	Conservation	90%	Conservation	100%
	Open Area	0%	Open Area	0%	Open Area	0%
	Orchards	0%	Orchards	0%	Orchards	0%
	Low Density	0%	Low Density	0%	Low Density	0%
	High Density	0%	High Density	0%	High Density	0%



Source: The General Plan Hawaii County November, 1989

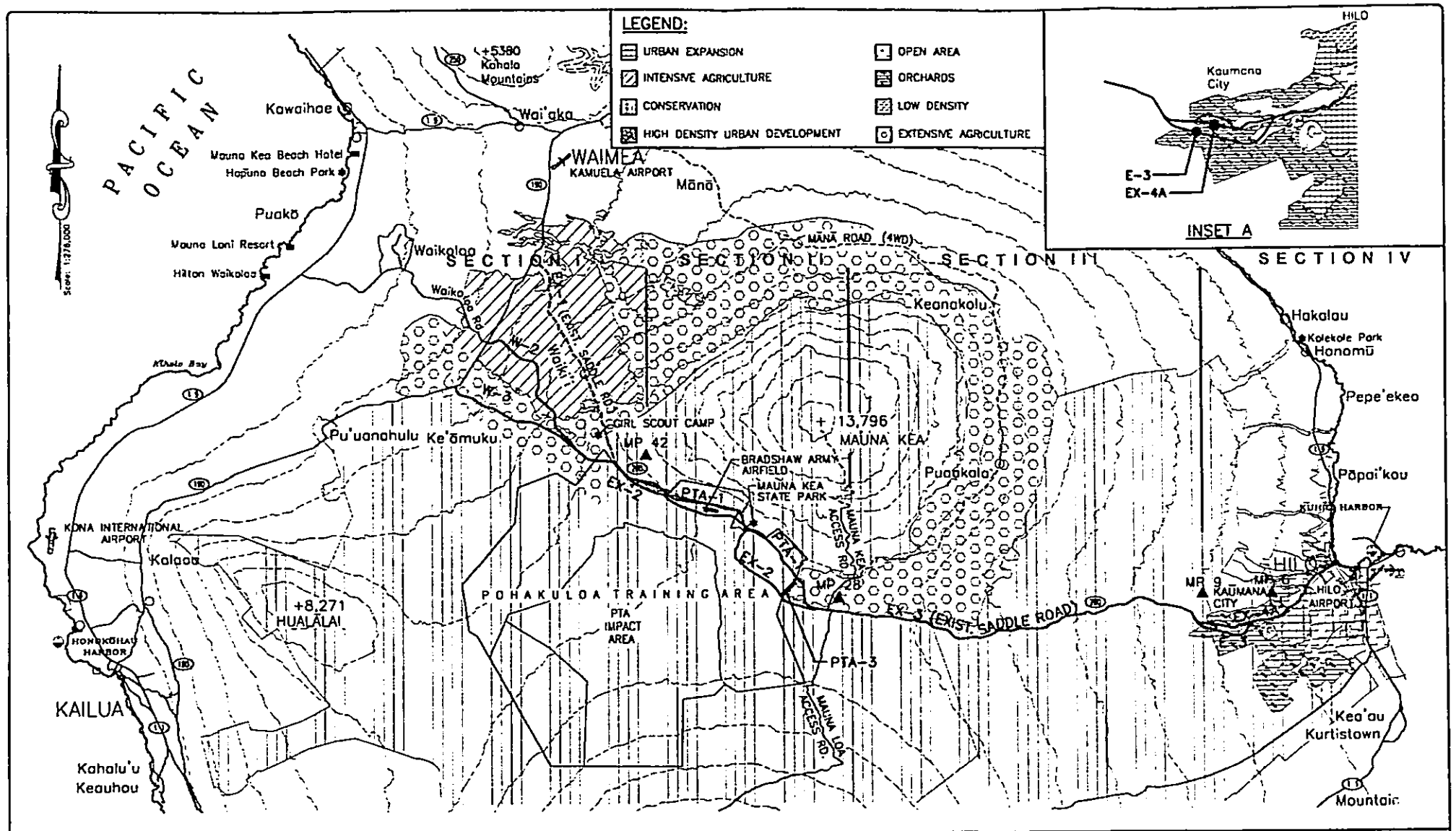
FILE: 3-1-2\REF. 940649'E.BASE-A

GENERAL PLAN LUPAG MAP DESIGNATION

FIGURE 3.1.3

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S) IMMEDIATELY FOLLOWING



Source: The General Plan Hawaii County November, 1989

GENERAL PLAN LUPAG MAP DESIGNATION

FIGURE 3.1.3

FILE: 3-1-2\REF. 940648'E,BASE-A

TABLE 3.1.5
General Plan LUPAG Categories by Alternative

Section	LUPAG Land Use		LUPAG Land Use		LUPAG Land Use
III	Segment EX-3				
	Urban Expansion	0%			
	Extensive Ag	27%			
	Intensive Ag	0%			
	Conservation	73%			
	Open Area	0%			
	Orchards	0%			
	Low Density	0%			
	High Density	0%			
IV	Segment EX-4A		Segment E-3		
	Urban Expansion	0%	Urban Expansion	0%	
	Extensive Ag	0%	Extensive Ag	0%	
	Intensive Ag	0%	Intensive Ag	0%	
	Conservation	29%	Conservation	23%	
	Open Area	0%	Open Area	0%	
	Orchards	71%	Orchards	77%	
	Low Density	0%	Low Density	0%	
	High Density	0%	High Density	0%	

3.1.3.6 Hilo Community Development Plan

The County has prepared community development plans to guide short to medium-term development for various communities including Hilo. The Hilo Community Development Plan (CDP) was adopted by Resolution in May 1975 to guide the planning and development of the City of Hilo.

The following paragraph is a discussion of Saddle Road from the Hilo CDP Transportation Section.

> *"The trans-island Saddle Road connecting Hilo to West Hawai'i is not as well improved as the Belt Highway (Highway 19). In addition, the Saddle Road within Hilo follows an alignment which is congested, narrow and winding. Traffic from the Saddle Road must use Waianuenue Avenue through downtown before making a difficult connection with Bayfront Highway and then proceeding as the other traffic does."*

Although the entire Saddle Road project is not specifically discussed in this development plan, Saddle Road through the Hilo CDP study area (up to MP 10) is recommended for improvement according to the implementation plan.

3.1.3.7 Northeast Hawai'i Community Development Plan

The Northeast Hawai'i Community Development Plan provides a decision making tool for use by the Planning Department and Planning Commission in implementing the County of Hawai'i General Plan over a 15 year period. The Plan was adopted by Planning Commission resolution in February 1979.

The Northeast Hawai'i CDP planning area includes the portions of North Hilo and Hamakua in the saddle between Mauna Kea and Mauna Loa. Accordingly, while the focus of the plan was primarily along the coastal areas of the region, its study area includes portions of the existing Saddle Road alignment, including the section within the PTA. The composite Planning Map includes a recommendation that the existing Saddle Road be improved as a primary roadway within the County.

3.1.3.8 Land Use Regulations for State Land Use Districts

All land within the State of Hawai'i is classified into one of four state land use districts (SLU); Urban, Rural, Agricultural, or Conservation. Chapter 205, HRS, establishes the criteria and objectives for the land use and assigns responsibility for the regulation of these districts. According to Chapter 205, HRS and Chapter 15-15, Hawai'i Administrative Rules (HAR) provides for the classification and regulation of the districts as follows.

Urban District. This district shall include land characterized by "city-like" concentrations of people, structures, streets, urban level of services, and other related land uses. Urban shall include activities or uses as provided by ordinances or regulations of the County within which the urban district is situated.

Rural District. This district shall include areas of land composed primarily of small farms mixed with very low density residential lots, which may be shown by a minimum density of no more than one house per 0.2 ha and a minimum lot size. Rural districts shall include activities or uses as characterized by low density residential lots of not more than one dwelling house per 0.2 ha.

Agricultural District. This district shall include areas of land with a high capacity for agriculture production. It may also include lands surrounded by or contiguous to agricultural lands which are not suited for agricultural production by reason of topography, soils and other related characteristics. Agricultural districts shall include activities or uses as characterized by the cultivation of crops, orchards, forage and forests, farming activities, open area recreational uses, and related activities.

Conservation District. This district shall include areas necessary for protecting watersheds and water sources, preserving scenic and historic areas; providing park lands, wilderness, and beach reserves; conserving indigenous or endemic plants, fish, and

wildlife, including those which are threatened or endangered; preventing floods and soil erosion; forestry; open space areas whose existing openness, natural condition, or present state of use, if retained, would enhance the present or potential value of abutting or surrounding communities, or would maintain or enhance the conservation of natural or scenic resources; areas of value for recreation purposes; and other related activities. Activities within the Conservation district shall be established by the State of Hawai'i Board of Land and Natural Resources.

The Saddle Road project extends through areas that are designated for Urban, Agriculture, and Conservation uses. There are no Rural designated lands within or adjacent to the project corridor. Urban uses are concentrated along the eastern end of the Saddle Road project, in the upper Kaumana area. These designations are limited to areas between MP 7 and 5.

Agricultural Land Use designations are present along the entire western portion of the roadway and alternative alignments (west of MP 44), along the north side of Saddle Road between MP 30 and 22, and in the upper Kaumana area between MP 10 and 5. The balance of the land is designated as Conservation District, including the State-owned Forest Reserves between MP 42 and 9, through the PTA. Table 3.1.6, *State Land Use Classifications by Alternative,* provides the percent of each alternative within the various SLU classifications. Figure 3.1.4, *State Land Use Districts*, graphically depicts these classifications.

TABLE 3.1.6
State Land Use Classifications by Alternative

Section	Land Use Classification	Land Use Classification	Land Use Classification
I	Segment W-2 Agriculture 88% Urban 0% Conservation 12%	Segment W-3 Agriculture 88% Urban 0% Conservation 12%	
II	Segment EX-2 Agriculture 0% Urban 0% Conservation 100%	Segment PTA-1 Agriculture 12% Urban 0% Conservation 88%	Segment PTA-3 Agriculture 0% Urban 0% Conservation 100%
III	Segment EX-3 Agriculture 9% Urban 0% Conservation 91%		

TABLE 3.1.6
State Land Use Classifications by Alternative

Section	Land Use Classification		Land Use Classification		Land Use Classification
IV	Segment EX-4A		Segment E-3		
	Agriculture	57%	Agriculture	66%	
	Urban	25%	Urban	0%	
	Conservation	18%	Conservation	34%	

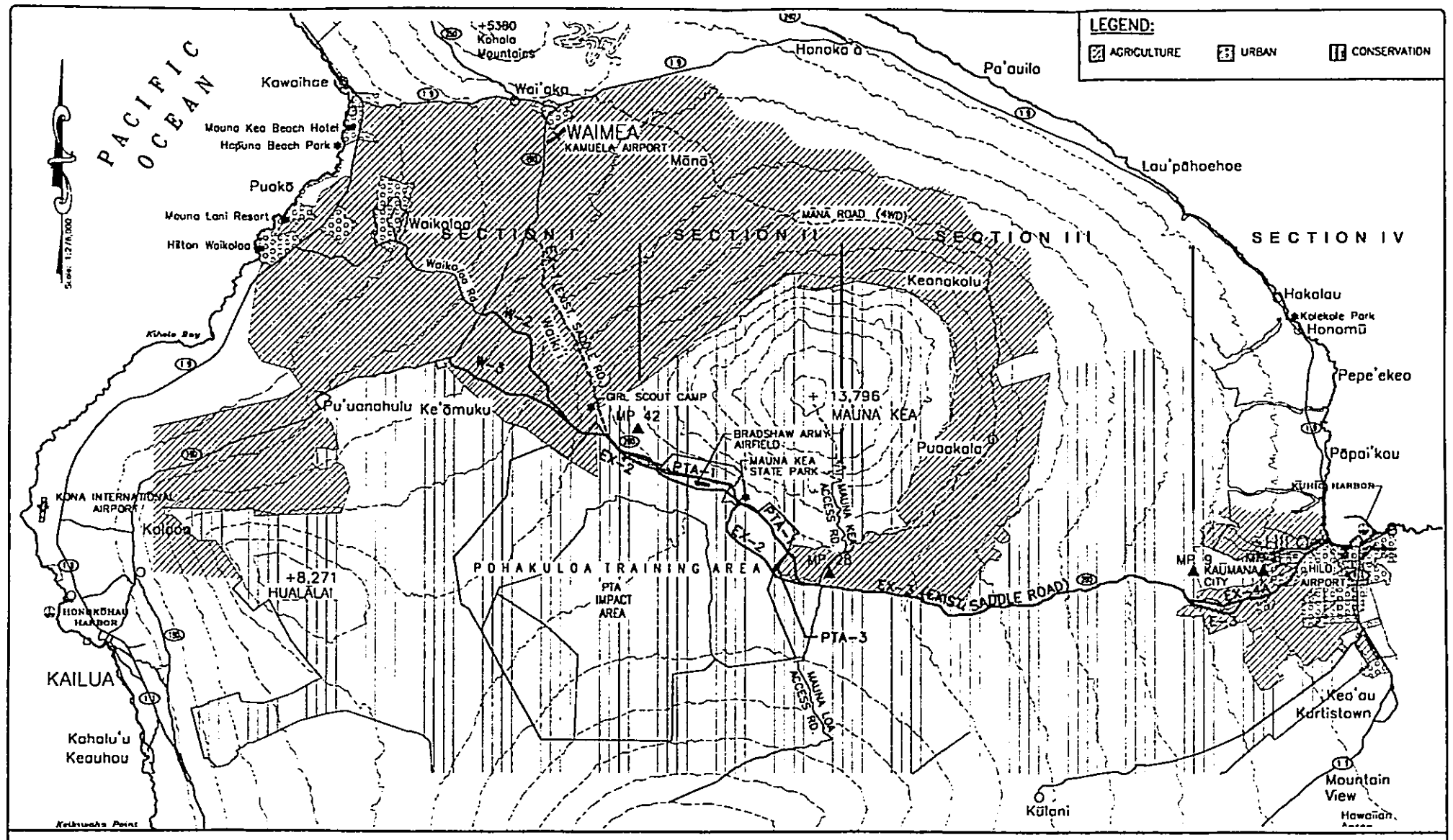
Transportation systems are allowable uses in the SLU Urban, Rural, and Agricultural Districts. However, according to Chapter 13-5, HAR, related to the Conservation District, the following land use may be allowed within the Conservation District, provided a permit from the Board of Land and Natural Resources is first received, stated as follows.

> *"Land uses undertaken by the State of Hawai'i or the counties to fulfill a mandated government function, activity or service for public benefit and in accordance with public policy and the purpose of the conservation district. Such land uses may include transportation systems, water systems, communications systems, and recreational facilities."*

Accordingly, a permit must be approved by the Board of Land and Natural Resources prior to the commencement of construction of any portion of the Saddle Road project within the SLU Conservation District. A map depicting Conservation District subzones within the project vicinity is included (Figure 3.1.5, *Conservation District Subzones*).

3.1.3.9 Hawai'i County Zoning Code

The Hawai'i County Zoning Code as contained in Chapter 25 of the Hawai'i County Code, is the legal instrument that regulates the use of land within the SLU Urban, Agricultural and Rural Districts. The lands within the Saddle Road Project planning area include a mix of Single Family Residential, Agricultural, and Open zoning designations. According to the Zoning Code, roads are considered to be a permitted use in all zoned districts. Table 3.1.7, *Zoning Designation Definitions*, provides the use permitted and the minimum lot size for each zoning designation.



Source: State Land Use Commision

STATE LAND USE DISTRICTS

FIGURE 3.1.4

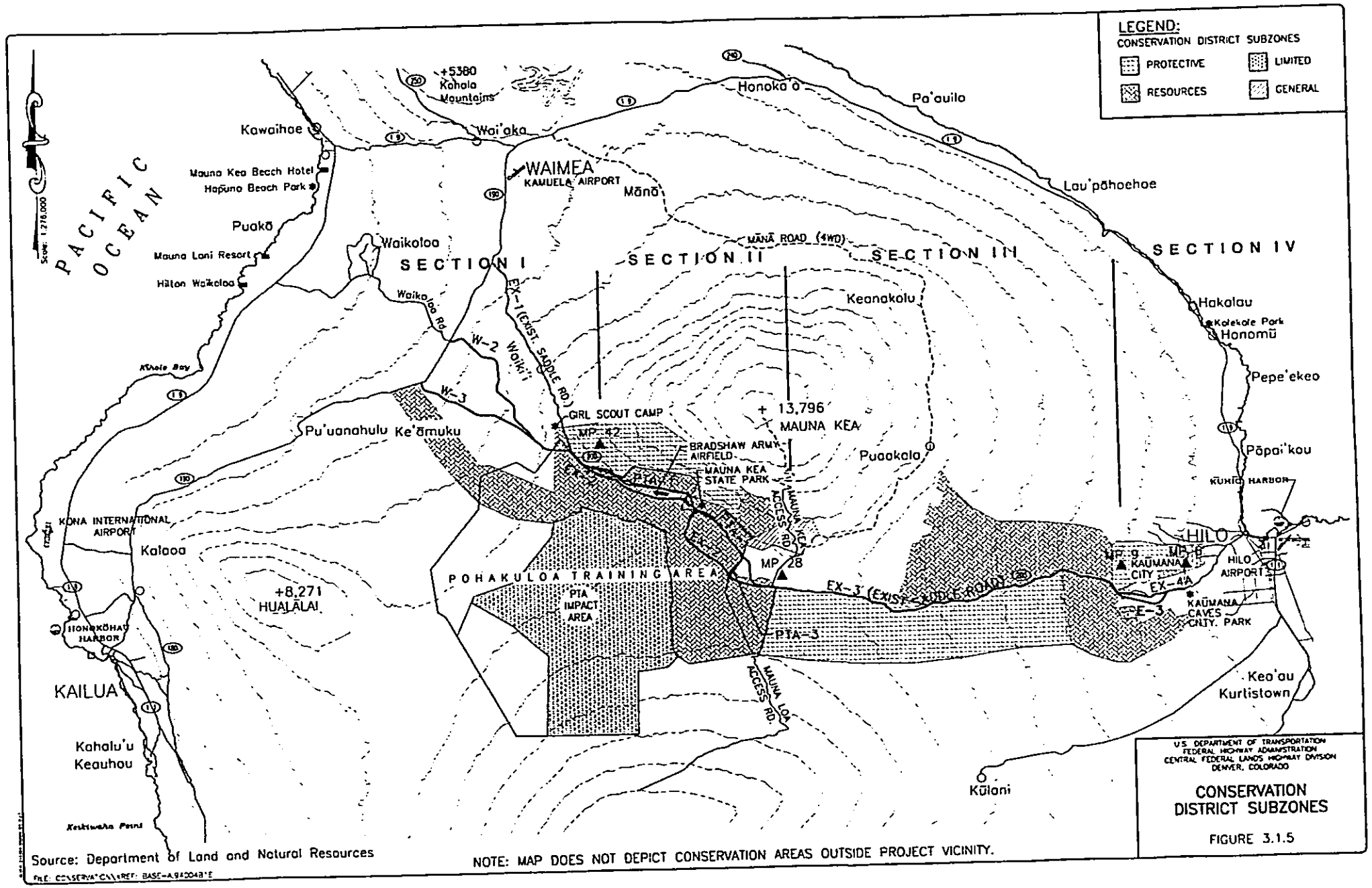

LEGEND:
CONSERVATION DISTRICT SUBZONES
PROTECTIVE
LIMITED
RESOURCES
GENERAL
PACIFIC OCEAN
Scale: 1:276,000
+5380 Kahala Mountains
Kawaihae
Wai'aka
Honoka'a
Pa'auila
Lau'pāhoehoe
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
WAIMEA
KAMUELA AIRPORT
Mānā
Waikoloa
SECTION I
SECTION II
SECTION III
SECTION IV
MĀNĀ ROAD (4WD)
Waikoloa Rd
W-2
W-3
EX-1 (EXIST. SADDLE RD.)
Waiki'i
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KŪHIO HARBOR
Kīhole Bay
GIRL SCOUT CAMP
MP 42
+ 13,796
MAUNA KEA
Pu'uanahulu
Ke'āmuku
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
MAUNA KEA ACCESS RD.
KONA INTERNATIONAL AIRPORT
Kalaoa
HILO
MP 9
MP 8
KAUMANA CITY
HILO AIRPORT
EX-4A
KAUMANA CAVES CNTY. PARK
E-3
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
MP 28
EX-3 (EXIST. SADDLE ROAD)
PTA-3
MAUNA LOA ACCESS RD.
HONOKŌHAU HARBOR
KAILUA
Kahalu'u
Keauhou
Keikiwaha Point
Kea'au
Kurtistown
Kūlani
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
CONSERVATION DISTRICT SUBZONES
FIGURE 3.1.5
Source: Department of Land and Natural Resources
NOTE: MAP DOES NOT DEPICT CONSERVATION AREAS OUTSIDE PROJECT VICINITY.

TABLE 3.1.7
Zoning Designation Definitions

Zoning Designation	Permitted Use	Minimum Lot Size
A-1a	Agriculture	0.4 ha
A-3a	Agriculture	1.2 ha
A-5a	Agriculture	2.0 ha
A-10a	Agriculture	4.1 ha
A-20a	Agriculture	8.1 ha
A-40a	Agriculture	16.2 ha
RS-7.5	Single Family Residential	698 m^2
RS-10	Single Family Residential	930 m^2
RS-15	Single Family Residential	1395 m^2

Table 3.1.8, *Zoning Designations by Alternative*, lists the zoning categories for the project. Figure 3.1.6, *Zoning*, depicts the zoning within the study corridor and vicinity.

TABLE 3.1.8
Zoning Designations by Alternative

Section	Zoning		Zoning		Zoning	
I	Segment W-2		Segment W-3			
	Forest Reserve	0%	Forest Reserve	0%		
	A-40a	100%	A-40a	100%		
	A-20a	0%	A-20a	0%		
	A-10a	0%	A-10a	0%		
	A-5a	0%	A-5a	0%		
	A-3a	0%	A-3a	0%		
	A-1a	0%	A-1a	0%		
II	Segment EX-2		Segment PTA-1		Segment PTA-3	
	Forest Reserve	100%	Forest Reserve	91%	Forest Reserve	100%
	A-40a	0%	A-40a	9%	A-40a	0%
	A-20a	0%	A-20a	0%	A-20a	0%
	A-10a	0%	A-10a	0%	A-10a	0%
	A-5a	0%	A-5a	0%	A-5a	0%
	A-3a	0%	A-3a	0%	A-3a	0%
	A-1a	0%	A-1a	0%	A-1a	0%

TABLE 3.1.8
Zoning Designations by Alternative

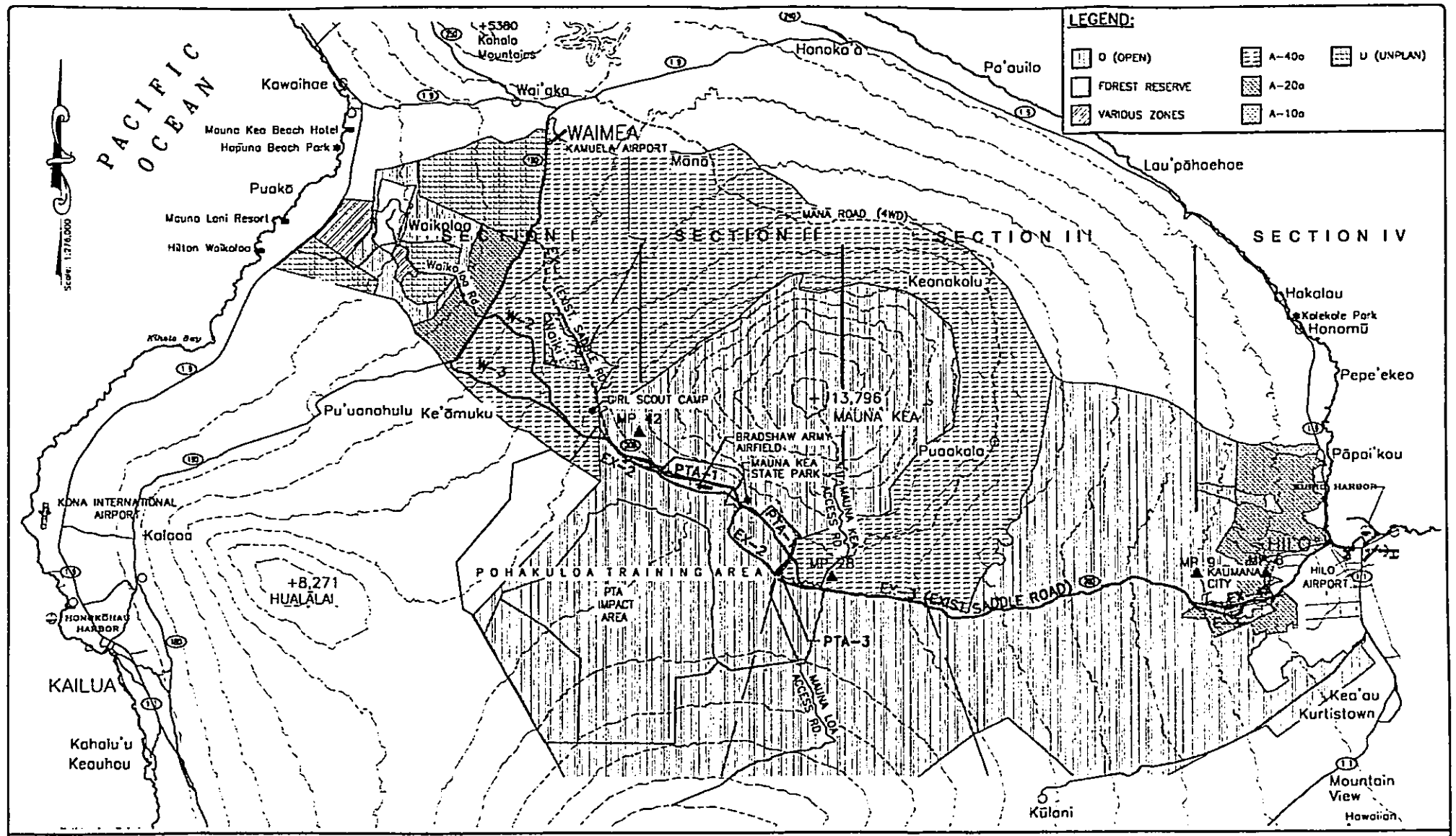
Section	Zoning		Zoning		Zoning
III	Segment Ex-3				
	Forest Reserve	91%			
	A-40a	9%			
	A-20a	0%			
	A-10a	0%			
	A-5a	0%			
	A-3a	0%			
	A-1a	0%			
IV	Segment EX-4A		Segment E-3		
	Forest Reserve	59%	Forest Reserve	22%	
	A-40a	0%	A-40a	0%	
	A-20a	29%	A-20a	41%	
	A-10a	0%	A-10a	9%	
	A-5a	0%	A-5a	0%	
	A-3a	00	A-3a	0%	
	A-1a	0%	A-1a	14%	
	RS-7.5	7%	RS-15	14%	
	RS-10	5%			

3.1.3.10 Consistency of Alternatives with Existing Plans and Policies

The proposed Saddle Road project complies with appropriate State and County land use policies, plans, goals, objectives and controls. It would facilitate implementation of the State Plan, the Transportation Function Plan, the Island of Hawai'i Long Range Highway Plan, the County of Hawai'i General Plan, and the land use controls and regulations as established pursuant to the State Land Use Law and the Hawai'i County Zoning Code. Table 3.1.9, *Conformance with Land Use Plans and Policies*, summarizes the project's conformance with previously described land use plans and policies.

TABLE 3.1.9
Conformance with Land Use Plans and Policies

Agency	Name of Plan	Year Adopted/ Revised	Purpose or Description of Plan	Conformance with Plan or Policy
State of Hawai'i	Hawai'i State Plan	1991	Establishes broad goals, objectives and policies to guide the overall development of the State.	Consistent with State goals on economy/transportation
State of Hawai'i	Hawai'i State Transporation Functional Plan	1991	Establishes guidelines for implementation of the State Plan with respect to Transportation.	Consistent with Plan on regional mobility, land use, economic development.



Source: County of Hawaii Zone Maps

ZONING
FIGURE 3.1.6

TABLE 3.1.9
Conformance with Land Use Plans and Policies

Agency	Name of Plan	Year Adopted/ Revised	Purpose or Description of Plan	Conformance with Plan or Policy
State of Hawai'i	Coastal Zone Management (CZM) Program	1977	Establishes objectives and policies to protect coastal resources and areas.	Project conforms with objectives, policies in all seven CZM resource areas.
State of Hawai'i	Hawai'i Long Range Land Transportation Plan	1991	Identifies and prioritizes major highway system improvements necessary to accommodate future traffic demands.	Consistent with recommendation for realignment or reconstruction of the Saddle Road.
County of Hawai'i	County of Hawai'i General Plan	1989	Long-Range Comprehensive Plan guiding the overall development of the County.	Consistent with Transportation Goals of the General Plan
County of Hawai'i	General Plan LUPAG and Facilities Map	1989	Maps show general location of land uses and roadway networks in relationship to each other.	Project is consistent with Maps which call for improvement of Saddle Road.
County of Hawai'i	Hilo Community Development Plan	1975	Short to medium term guide to implement the General Plan within the Hilo area.	Saddle Road within the Hilo planning area is recommended for improvement.
County of Hawai'i	NE Hawai'i Community Development Plan	1979	Provides short to medium term development guide for the Hamakua region of the County	Plan call for improvement of existing Saddle Road as a primary roadway.

3.1.4 Related Projects

A number of land use and transportation projects are currently in the conceptual planning or development phases in the project corridor or vicinity. The following paragraphs summarize these projects.

- Water Resource Development and Across Island Transmission Line. The Water Resource Development and Across Island Transmission Line project was conceived by the DLNR to address the potential long term water supply/demand imbalance between East and West Hawai'i. The project assesses the ability of East Hawai'i aquifers to support water resource development of 76 million L of water per day; the engineering feasibility of developing an across island water transmission line to West Hawai'i through the saddle between Mauna Kea and Mauna Loa; and the site specific impacts of the development of a water transmission system of this magnitude on the environment.

  The study found that the project was feasible only if a viable end user of the water could be found. The water costs were estimated to range between $0.37 per thousand L to

$2.35 per thousand L (in 1991 dollars), depending on the cost of power, and financing for the $250 to $312 million capital costs.

Further implementation of the project has been deferred until a viable end user can be identified. Although the Water Resource Development and Across Island Transmission Line Project proposes to utilize the Saddle Road corridor for the water line transmission, its implementation is independent of the Saddle Road Project.

- HELCO Transmission Lines. HELCO has two cross island power transmission lines through the "saddle" between Mauna Kea and Mauna Loa. These lines [69 kilovolts (kV) and 138 kV] provide service to the Mauna Kea science facilities, Pohakuloa Training Area, and beyond to West Hawai'i. HELCO installed the 69 kV line in 1957 and the 138 kV line in 1987. The 69 kV poles are 18 to 20 m high, while the 138 kV poles are 24 to 26 m high.

  The HELCO utility easement varies from 45.7 to 61 m and provides a corridor for both existing lines and one additional planned cross island transmission line. This corridor is generally to the north of the existing Saddle Road and is accessed from established unimproved trails and HELCO maintenance roads.

  HELCO is currently in the planning process to expand its cross island transmission capacity through the construction of a third power line within the existing utility corridor. This line would have a capacity of 138 kV, and would be supported on either wood or metal poles.

- GTE Fiber Optic Transmission Line. GTE Hawaiian Tel is installing a fiber optic telecommunications transmission network between Hilo, the astronomical facilities on Mauna Kea, and Waimea. This network will be connected with the existing inter-island fiber optic cable in Kawaihae and will provide additional telecommunications capacity to the island. The fiber optic network extends between Hilo and Waimea via Saddle Road, utilizing existing HELCO transmission lines.

  A Draft Environmental Assessment for GTE Hawaiian Tel Fiber Optic Telecommunication Cable was published in November 1995 with a proposed "Finding of No Significant Impact" for the project.

- Puainako Extension and Widening Project. The FHWA, HDOT, and the County of Hawai'i are proposing to widen and extend Puainako Street in Hilo. The project is intended to improve arterial traffic flow of the State Highway system by providing a direct link between the existing Puainako Street and Saddle Road and to alleviate congested and unsafe traffic conditions on Puainako Street and Kaumana Drive.

The project would involve improving the existing Puainako Street to a four-lane highway between Kilauea Street and Komohana Street. Between Komohana Street and Country Club Road, Puainako Street would be extended a distance of approximately 7.3 km as a two-lane road.

A State EIS was completed for this project in 1993. Completion of a Federal EIS in compliance with NEPA is now required for the project due to the implementation of several design changes (including intersection improvement and widening) and the inclusion of Federal involvement. The Federal EIS process is now underway and a DEIS has been released for public review.

- Highway 190 to Queen Ka'ahumanu Project. HDOT is considering a project which would result in the development of a new or improved roadway connection between Mamalahoa Highway (SR 190) and Queen Ka'ahumanu Highway in the vicinity of Waikoloa Road. This project is undergoing initial consideration, and HDOT has selected a consultant to initiate project scoping; the NEPA process is expected to take about two years.

3.1.5 Land Ownership

3.1.5.1 Affected Environment

Land along the Saddle Road corridor is primarily owned by the State of Hawai'i, including lands within the Hilo and Hamakua Forest Reserves and lands leased to the DOA for the PTA military training activities. These lands are part of the Ceded lands which were transferred to the Territory of Hawai'i from the Hawaiian government at the time of annexation in 1892. In addition, a portion of the land that makes up the PTA was provided to the DOA through Executive Orders from the Governor.

Other major land owners include the DHHL and Parker Ranch. Various landowners also control small holdings within or adjacent to a number of the alternative segments. These small land holdings are primarily concentrated within the Waiki'i Ranch along the existing Saddle Road, and on the eastern end of the corridor in Kaumana.

Table 3.1.10, *Percent Land Ownership by Segment*, summarizes the ownership patterns of the study corridor. Figure 3.1.7, *Land Ownership*, depicts the locations of the Alternatives in relation to land ownership.

TABLE 3.1.10
Percent Land Ownership by Segment

Section	Ownership	%	Ownership	%	Ownership	%
I	Segment W-2		Segment W-3			
	State of Hawai'i	0	State of Hawai'i	0		
	PTA (State Lease)	10	PTA (State Lease)	10		
	DHHL	0	DHHL	0		
	Various	0	Various	0		
	Parker Ranch	90	Parker Ranch	90		
II	Segment EX-2		Segment PTA-1		Segment PTA-3	
	State of Hawai'i	0	State of Hawai'i	0	State of Hawai'i	0
	PTA (State Lease)	100	PTA (State Lease)	88	PTA (State Lease)	100
	DHHL	0	DHHL	12	DHHL	0
	Various	0	Various	0	Various	0
	Parker Ranch	0	Parker Ranch	0	Parker Ranch	0
III	Segment EX-3					
	State of Hawai'i	64				
	PTA (State Lease)	0				
	DHHL	27				
	Various	9				
	Parker Ranch	0				
IV	Segment EX-4A		Segment E-3			
	State of Hawai'i	17	State of Hawai'i	10		
	PTA (State Lease)	0	PTA (State Lease)	0		
	DHHL	0	DHHL	0		
	Various	83	Various	90		
	Parker Ranch	0	Parker Ranch	0		

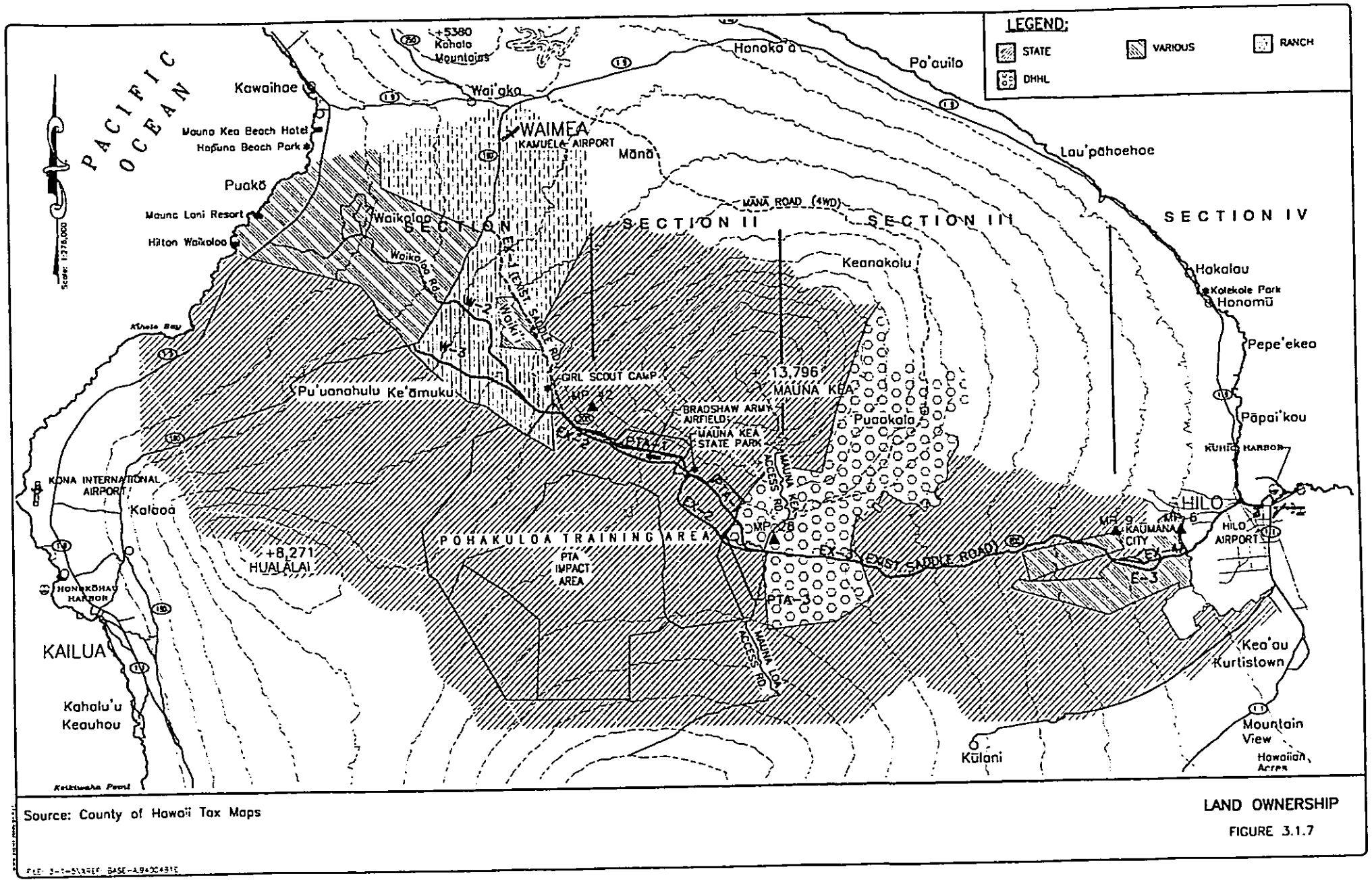
Source: Okahara & Associates, Inc.

3.1.5.2 Environmental Consequences

Discussion of land acquisition and relocation impacts is included in a separate section of this chapter (ref: FEIS - Part I, 3.5).

3.1.5.3 Mitigation Measures

Land acquisition and relocation-related mitigation measures are discussed in a separate section of this chapter (ref: FEIS - Part I, 3.5).



Source: County of Hawaii Tax Maps

LAND OWNERSHIP

FIGURE 3.1.7

3.2 FARMLANDS

3.2.1 Affected Environment

The U.S. Natural Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service, was consulted to determine the soil and agricultural resources present in the project corridor and vicinity. The consultation included formal assessment of the Farmland Conversion Impact Rating evaluation process (Form AD 1006, located in Appendix A).

The agricultural capability of lands throughout the State of Hawai'i were assessed in the 1970s by the U.S. Soil Conservation Service and the State of Hawai'i Department of Agriculture. These lands were mapped as part of the *Agricultural Lands of Importance to the State of Hawai'i* (ALISH) map series.

Three categories of valuable agricultural land were identified through this effort: *Prime Agricultural Lands*, *Unique Agricultural Lands*, and *Other Important Agricultural Lands*. Prime Agricultural Land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods. Unique Agricultural Land has a special combination of soil quality, location, growing season, and moisture supply, and is used to produce sustained high quality or high yields of a specific crop when treated and managed according to modern farming methods. Other Important Agricultural Lands are those lands of statewide or local importance for agricultural use, other than those classified as Prime or Unique.

Prime Agricultural Lands comprise about 4 percent of the island, Unique Agricultural Lands comprise less than 1 percent, and Other Agricultural Lands comprise roughly 18 percent of land area within the County. Unclassified lands account for the remaining 78 percent of the total land area.

3.2.2 Environmental Consequences

All Action Alternatives. No Unique Agricultural Lands are present within the project corridor or vicinity. Table 3.2.1, *Direct Conversion of Agricultural Lands of Importance*, indicates the estimated number of hectares of ALISH classified farmlands directly impacted by each segment. Figure 3.2.1, *Agricultural Lands of Importance*, depicts these classifications.

W-2, W-3, EX-2, PTA-1, and PTA-3. Construction of the improved Saddle Road on Segments W-2, W-3, EX-2, PTA-1, and PTA-3 would directly convert Other Important Agricultural Lands (Table 3.2.1).

EX-3, and EX-4A. Construction of the improved Saddle Road on Segments EX-3 and/or EX-4A, would not result in direct impacts to any ALISH classified farmlands (Table 3.2.1).

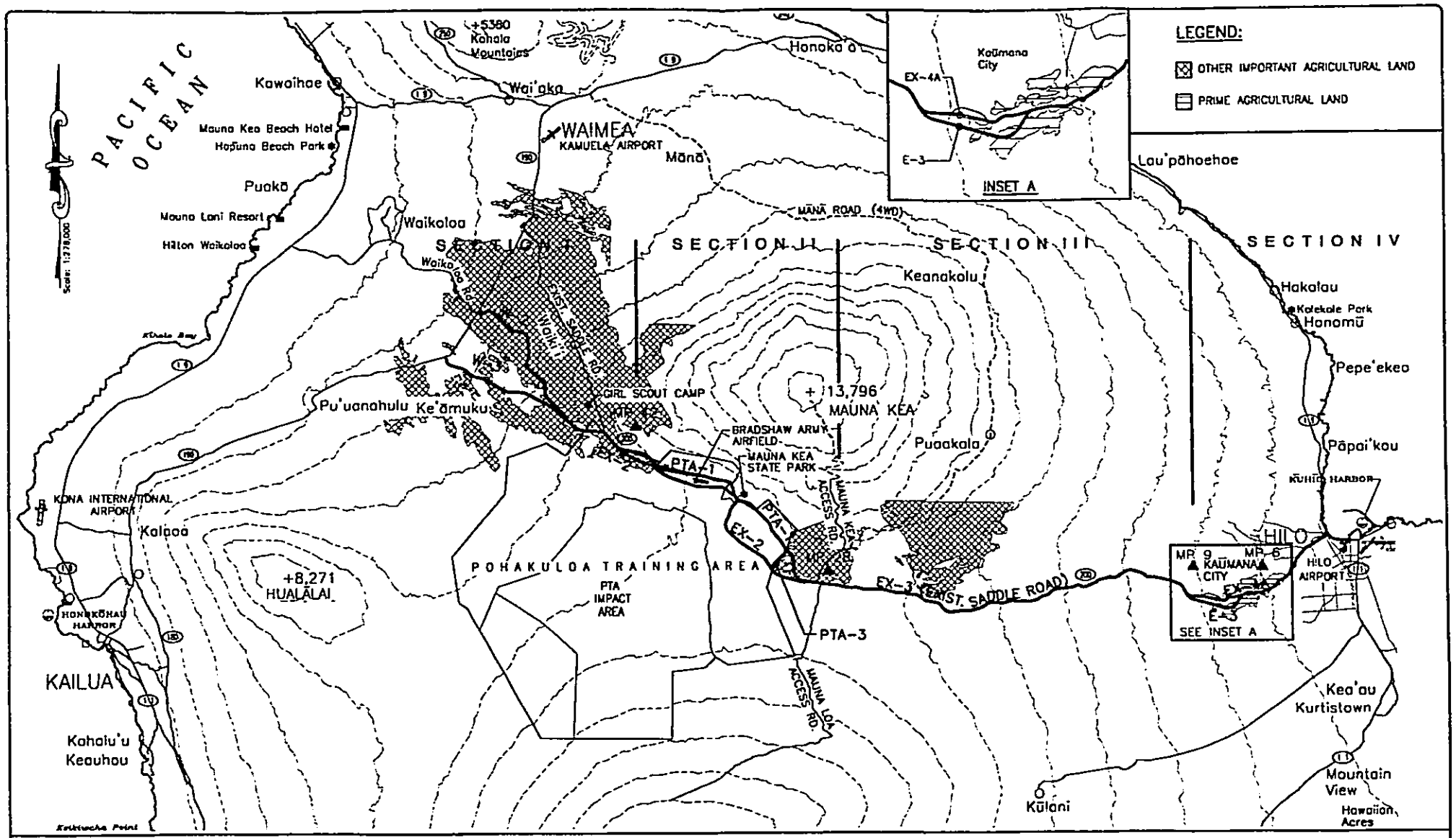
E-3. Construction of Saddle Road on Segment E-3 would directly convert 8.79 ha of Prime Agricultural Land (Table 3.2.1). The Prime Agricultural Lands within Section IV have deep soils and were formally used for sugar cultivation. Much of these lands are currently fallow, although there is increasing use of these lands for diversified agricultural crops, including foliage and taro.

TABLE 3.2.1
Direct Conversion of Agricultural Lands of Importance

Section and Segment	Prime Agricultural Lands (ha)	Other Important Agricultural Lands (ha)
Section I		
W-2	0.0	55.0
W-3	0.0	18.6
No Action	0.0	0.0
Section II		
EX-2	0.0	18.9
PTA-1	0.0	6.7
PTA-3	0.0	6.7
No Action	0.0	0.0
Section III		
EX-3	0.0	0.0
No Action	0.0	0.0
Section IV		
EX-4A	0.0	0.0
E-3	8.79	0.0

In coordination with the NRCS, a Farmland Conversion Impact Rating assessment was completed pursuant to FHWA regulations related to the Federal Farmland Protection Policy Act. The assessment evaluates potential impacts to farmland from implementation of project alternatives. The assessment takes into account the total area of farmland that would be directly converted, potential to indirectly convert agricultural land to non-agricultural uses, impacts to individual farms, and relative size and importance of farms affected.

The Farmland Conversion Impact Rating process rates the potential impact using an ascending scale from 0 to 260 points. If the rating exceeds 160, consideration must be given to the use of non-farmland or the selection of an alternative less harmful to farming activities.



Source: Department of Agriculture, State of Hawaii, Agricultural Lands of Importance to the State of Hawaii Maps, 1976

AGRICULTURAL LANDS OF IMPORTANCE

FIGURE 3.2.1

The farmland ratings for the Saddle Road alternatives ranged from 106 to 145 points. All of the action alternatives are below the threshold rating. Accordingly, impacts to agricultural lands of importance are not expected to be substantial with any of the alternatives under consideration. The Farmland Conversion Impact Rating forms are included in Appendix A.

No Action Alternative. No ALISH classified farmlands would be impacted or converted as a result of the No Action Alternative.

3.2.3 Mitigation Measures

No mitigation measures are recommended for farmland resources.

3.3 SOCIAL

3.3.1 Population and Settlement Patterns

3.3.1.1 Affected Environment

A Social Impact Assessment (SIA) was completed for the Saddle Road EIS. The SIA includes an appendix which addresses potential impacts to hunting, and another which addresses Indigenous Hawaiian Cultural Values (Terry 1997, Tech. App. Vol. V). Following the issuance of the DEIS, a Supplemental SIA was completed which addresses additional issues related to recreation, cross-island travel patterns, and Mauna Kea visitation (ref: Terry 1998, FEIS - Part III).

Table 3.3.1, *Population Trends, 1960 to 1990*, depicts recent population growth for Hawai'i County and the South Hilo, North Kona, and South Kohala Districts. While South Hilo has experienced steady but modest population growth, the populations of North Kona and South Kohala grew rapidly after 1970 as a result of the expanding tourism.

TABLE 3.3.1
Population Trends, 1960 to 1990, Hawai'i County

	1960	1970	1980	1990
Hawai'i County	61,332	63,468	92,053	120,317
South Hilo	31,553	33,915	42,278	44,639
North Kona	4,451	4,832	13,748	22,284
South Kohala	1,538	2,310	4,607	9,140

Sources: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13; Hawai'i County Data Book.

The average daily visitor count for North Kona and South Kona expanded from about 3,500 in 1970, to 8,000 in 1980, and to almost 20,000 by 1995, a nearly six-fold increase in 25 years. In the 1960s and 1970s, accommodation units were divided somewhat equally between Hilo and Kona (Table 3.3.2, *Visitor Accommodation Units, 1960-1994*). However, in more recent years, growth in hotel and condo rooms in Kona and Kohala greatly exceeds that of Hilo.

TABLE 3.3.2
Visitor Accommodation Units, 1960-1994

	1960	1970	1980	1990	1994
Hilo	249	1,204	1,957	1,411	1,246
Kona	270	1,842	3,760	4,096	4,331
Kohala	18	338	462	3,327	3,776

Sources: Hawai'i County Data Book, var. years. Hawai'i State Data Book, var years.

Tourism supplies jobs, a surplus of which induces in-migration and thus increases the resident population. In 1965 the Mauna Kea Beach Hotel opened creating 775 jobs, beginning the era of large-scale resorts. By 1982 there were over 1,000 jobs available at South Kohala resorts, a figure which grew to 4,000 by 1990 and to almost 5,000 by 1996 (Hawai'i County Data Book, various years). Continued expansion of resorts during the next two decades is likely. The *Hawai'i County Data Book 1995* lists almost 3,600 new planned units. If past trends continue, over half will be built in the next five years, swelling the inventory of visitor accommodations by an additional 20 percent.

A large and ever-increasing component of the *de facto population* (defined as the average number of people present on any given day) of Hawai'i County is composed of visitors. In 1980, the de facto population was 98,700, approximately 5,500 (6 percent) greater than the resident population. By 1990, the de facto population had increased to 135,100, approximately 15,000 (12 percent) greater than the resident population (1993 Hawai'i County Data Book: Tables 2 and 106). An increasing number of tourists rent cars on the island. Over time, greater absolute numbers and larger proportions of motorists are visitors.

The Island of Hawai'i is still dominantly rural, with large tracts of open space used for farming and ranching. For the most part, population in the area most directly served and affected by Saddle Road is clustered.

Within South Hilo, population is concentrated in the city of Hilo and former plantation towns near the coast. Kaumana is one of the older suburbs of Hilo that evolved from a plantation town into a collection of subdivisions perched 8 to 10 km above Hilo. The eastern terminus of Saddle Road is located within Kaumana.

Kailua is Kona's largest population center and the area that would be most directly affected by any increased traffic and economic opportunity associated with Saddle Road. In South Kohala, Waimea and Waikoloa are the largest population centers. Waiki'i, which was formerly an isolated ranch, is located on the current Saddle Road and now contains a subdivision of approximately 130 luxury agricultural lots and homes.

Table 3.3.3, *Population of Major Towns in Study Area*, provides the population for each of the centers listed above.

TABLE 3.3.3
Population of Major Towns in Study Area

Location	1990 Population
Hilo	39,737
Kailua-Kona	9,126
Waimea	5,972
Waikoloa	2,248
Kaumana (Upper)	1,243
Waiki'i	50

Source: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics;" Population of Upper Kaumana is approximate and is based on figures for Census Tract 202, Block Group 1; Waiki'i figure is approximate and based on discussion with Waiki'i Ranch residents.

Nearly all population projections undertaken by the State and County agencies assume continued growth in West Hawai'i resorts, which have been the driving force in the County's economic and population growth over the last three decades. The State and County have developed several population projections to help prepare and plan for expected population growth. One that is often cited and used is the M-K Series (Hawai'i State DBEDT 1988). Table 3.3.4, *M-K Series Population Projections*, summarizes the estimates.

These State projections do not include figures on a district-by-district basis. Several district projections are available: the County of Hawai'i General Plan (Hawai'i County Planning Department 1989) and a recent draft report prepared as part of the Land Transportation Masterplan for the County of Hawai'i.

TABLE 3.3.4
M-K Series Population Projections

Population	Hawai'i County	State of Hawai'i
1980 Resident	93,000	968,900
1980 de facto	99,500	1,055,800
1990 Resident	124,600	1,137,200
1990 de facto	134,400	1,269,100
2000 Resident	160,400	1,285,100
2000 De facto	183,000	1,468,600
2010 Resident	206,100	1,435,500
2010 De facto	243,000	1,674,200

Note: Actual 1990 census resident numbers were 1,108,229 for the State and 120,317 for the County.

The population projections to the year 2005 developed for the General Plan were derived from an econometric model designed to account for the relationship between employment and population. Three series were projected, A-C, based on ascending magnitude of economic optimism. Table 3.3.5, *County of Hawai'i General Plan Population Projections, Year 2005*, summarizes the projections from the General Plan.

TABLE 3.3.5
County of Hawai'i General Plan Population Projections, Year 2005

Area	GP-SER. A	GP-SER. B	GP-SER. C
South Hilo	44,115	55,335	65,790
South Kohala	19,203	24,087	28,638
North Kona	43,250	54,250	64,500
Hawai'i County	173,000	217,000	258,000

Source: County of Hawai'i General Plan, 1987. Note: Series A based on modest economic growth, Series C based on vigorous growth, Series B is midway.

The most recent district-by-district population projection effort was undertaken by the State of Hawai'i Land Transportation Masterplan in 1994. This effort is based on linear regression analysis of population growth, adjusted by a detailed review of planned and approved projects on a district by district basis. The resultant estimates are in draft form and have not been adopted by HDOT. Nevertheless, their recent origin, unique methodology and the fact that they extend to the year 2020, render them relevant to this EIS (Table 3.3.6, *Land Transportation Masterplan Population Projections, Year 2020*).

TABLE 3.3.6
Land Transportation Masterplan Population Projections, Year 2020

Area	Population 2020
South Hilo	55,800
South Kohala	25,200
North Kona	44,600
Hawai'i County	209,500

Source: Draft tables from HDOT.

3.3.1.2 Environmental Consequences

Population change is often the basis of broader social impacts. Any substantial increase or decrease in population will engender a wide range of adverse and beneficial impacts to housing, social conditions and public services.

All Action Alternatives. Construction activities associated with the proposed improvements to Saddle Road will create temporary jobs. During peak periods of construction, several hundred workers may be employed on the project. According to data from the State of Hawai'i Department of Labor and Industrial Relations (HDLIR) *Labor Force Data Book*, a construction labor force of between approximately 2,000 and 4,000 is present in Hawai'i County. Most reside within commuting distance of Saddle Road, in the districts of South Hilo and North Hilo, North Kona, South Kohala and Hamakua. A review of HDLIR statistics indicates that during the past 20 years, unemployment rates generally exceeded 8 percent in Hawai'i County. Construction is one of the sectors most often affected by unemployment. While construction workers could conceivably migrate from other areas of Hawai'i or the U.S., the labor force necessary to fill jobs created by construction is available on the island. For this reason, population growth associated with this would likely be negligible. No population gain is expected as a direct result of improvement to Saddle Road.

The indirect results of the Saddle Road improvements on population are more difficult to quantify. Many unrelated and in some cases offsetting factors interact. The relationship between

an improved Saddle Road and more visitors or longer average visitor stays (the two factors that could increase the size of the tourism industry) is not at all clear.

Surveys of visitors were conducted at Kona and Hilo airport departure gates to assess current use and perception of Saddle Road (ref: Terry 1997, Tech. App. Vol. V). When asked if they would have traveled on Saddle Road if it had been safer and more accessible (and presumably permitted under their rental contract), a large majority of visitors indicated that they would probably use it. With improvement of Saddle Road, use of the road by visitors in rental cars and on tour buses would potentially increase. Saddle Road attractions would enhance the overall attractiveness of the island to visitors of both East and West Hawai'i, and road improvements would serve to enhance convenience for the visitor by providing an alternate cross-island route. Saddle Road improvements would be expected to increase cross-island movement of visitors. Whether this added attraction and convenience would actually draw more visitors or lengthen visitor stays on the Island of Hawai'i is not clear.

If additional jobs are created as a result of the project, many of these jobs would likely be absorbed by residents of East Hawai'i, where unemployment is chronically high. In workshops and on surveys conducted for the project, East Hawai'i residents often note that improving Saddle Road would create better access to jobs of West Hawai'i.

In addition to population increases related to tourism, several other sources of population increase were considered. One was the possible expansion of PTA (although there are no plans to do so), which could increase both resident population (through indirect economic impact, leading to more jobs) and de facto population (through more soldiers on the base at any given time). Since there are presently no plans to expand the PTA operations or facilities, this was considered to be an unrelated issue to improving Saddle Road (ref: FEIS - Part I, 3.1.1.2).

Improvements to Saddle Road would be expected to result in an increase in business activity. Potential increases in population related to increases in business activity are expected to be negligible.

Another possible source of population increase is improvement of the quality of life for island residents through provision of safer and better highways. While places with higher quality of life are relatively more favorable to attracting population, the magnitude of any such increase as a result of the Saddle Road improvements is minute in the overall matrix of quality of life factors on the island.

In summary, there is no clear indication that improving Saddle Road would have a noticeable effect on population on the island. While a number of unrelated factors are expected to continue the current rate of population increase into the foreseeable future, improvements to Saddle Road would be expected to *serve*, rather than *induce* population growth. No difference in the induction of population increase would exist among action alternatives.

Only very subtle effects on settlement patterns would be expected to result from implementation of the project. The marginal increase in connectivity between East and West Hawai'i may restrain the tendency of job-seekers to relocate. A larger percentage may opt to commute than would without proposed improvements. No discernable difference in settlement patterns would be anticipated between action alternatives.

No Action Alternative. As with the action alternatives, the selection of the No Action Alternative would have little to no affect on population change. Population increases on the island are anticipated with or without improvement of Saddle Road.

3.3.1.3 Mitigation Measures

No mitigation measures are recommended for population or settlement patterns.

3.3.2 Socioeconomic

3.3.2.1 Affected Environment

The economy of the Island of Hawai'i is just emerging from a slump that began when tourism fell off dramatically and sugar plantations began closing. West Hawai'i's economy is beginning to recover with the rebound in visitor numbers, although investors wary of the hotel/condo glut of the last five years are only now planning further ventures. The Four Seasons Resort, which opened in 1996, is the first major new hotel to open in nearly five years. Direct flights from Japan to Kona began in 1996, and a strong potential exists for direct flights from Korea. Economic diversification in West Hawai'i is evidenced by technology industries associated with the Natural Energy Laboratory - Hawai'i and astronomical base facilities in Waimea, diversified agriculture, and services.

East Hawai'i's economy is notably different. With the closure of sugar plantations, roughly 1,000 former workers were left with few economic options. Almost 25,000 ha were taken out of production. The closing of Ka'u Sugar in 1996 marked the end of the sugar plantation era on the island.

Today, County and State government, the University of Hawai'i at Hilo, several astronomy-based facilities, and diversified agriculture anchor the economy of East Hawai'i. Timber operations, particularly fiber trees, are planned for former sugar lands. Ranching continues to be a major industry. East Hawai'i is noted for its lush tropical agriculture: anthurium, papaya, orchid, foliage, banana, and ginger, among others. While such farms may sometimes be lucrative, the constant battle against invading pests and unpredictable weather have consumed much of the profit from these ventures.

While the economy's performance has been sluggish, current trends suggest an upturn. The First Hawaiian Bank's *Economic Indicators* (Sept./Oct. 1996) cites the potential of silviculture, the

Foreign Trade Zone, the University Park (a site for high tech industries), and the active West Hawai'i tourism industry as reasons for optimism.

Table 3.3.7, *Selected Socioeconomic Characteristics by District, 1990 Census* illustrates selected socioeconomic characteristics of the population in South Hilo, North Kona and South Kohala; those districts most affected by proposed improvements of Saddle Road. The socioeconomic distinction between the more traditional, agricultural economy of East Hawai'i and the modern, tourism-based economy of West Hawai'i is well illustrated by 1990 census statistics for South Hilo and North Kona. East Hawai'i exhibits lower incomes, a more ethnically diverse population, and larger proportions of disabled, elderly, poorly educated, non-working, and impoverished individuals. Household incomes, home prices, and rents are lower in East Hawai'i.

TABLE 3.3.7
Selected Socioeconomic Characteristics by District, 1990 Census

Characteristic	Hawai'i Island	South Hilo	North Kona	South Kohala
Total Population	120,317	39,737	22,284	9,140
Percent Caucasian	39.9	26.7	58.9	52.3
Percent Asian	37.8	59.4	21.9	21.0
Percent Hawaiian	19.2	12.6	16.4	24.2
Percent under 18	28.7	27.2	26.4	29.7
Median Age	34.3	35.2	34.7	32.0
Percent over 65 Years	12.6	13.5	10.1	7.4
Percent 10-64 with Mobility of Self Care Limitation/ Work Disability	13.0	19.9	9.5	8.3
Percent Who Do Not Speak English Well	7.7	12.9	12.1	4.9
Percent over 25 with High School Diploma	77.7	78.4	86.0	88.2
Percent over 16 in Labor Force	64.2	62.1	70.7	66.3
Median Family Income	$33,186	$29,967	$35,364	$41,805
Percent in Poverty	14.2	14.3	9.4	10.3
Percent Lived in Hawai'i in 1985 & 1990	74.5	91.4	73.1	59.2
Percent Owner Occupied Housing	61.1	62.6	55.1	52.5

TABLE 3.3.7
Selected Socioeconomic Characteristics by District, 1990 Census

Characteristic	Hawai'i Island	South Hilo	North Kona	South Kohala
Median Contract Rent Value	$428	$371	$644	$786
Median Home Price	$113,000	$110,700	$211,900	$200,800

Source: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13 and "1990 Census of Population. Housing, Summary Population and Housing Characteristics," 1990 CPH-1-13. Notes: Asian percentage includes non-Hawaiian Pacific Islanders. According to State of Hawai'i Department of Health (DOH) figures from *State of Hawai'i Data Book*, almost half of all marriages for Hawai'i residents involve partners of different ethnic groups. Tallies of ethnic groups in Hawai'i should thus be evaluated with caution.

Note: The values presented for Hilo, North Kona, and South Kohala were based on a combination of applicable census districts and are not necessarily commensurate with those values presented in the Economics Section of this document (Table 3.4.2).

The distinctions between West Hawai'i and East Hawai'i shown in Table 3.3.7, are also clear in Table 3.3.8, *Selected Socioeconomic Characteristics by City or Town, 1990 Census*, which provides a socioeconomic comparison of the urban areas most directly impacted by Saddle Road. Notable differences for many social variables are illustrated by comparing Upper Kaumana with Waikoloa. Upper Kaumana is a very traditional village of long-time residents, with a higher percentage of elderly and Asian residents. A notably higher percentage of residents of Upper Kaumana do not speak English well. Despite more modest incomes in Kaumana, residents enjoy a high rate of home ownership and the neighborhood is perceived as solidly middle-class. Interestingly, the difference between poverty rates for Kaumana and Waikoloa is not large. Census figures for Waiki'i are not available, although it is generally perceived as a wealthy subdivision.

TABLE 3.3.8
Selected Socioeconomic Characteristics by City or Town, 1990 Census

CHARACTERISTIC	Hilo	Upper Kaumana	Waikoloa	Waimea
Total Population	39,737	1,243	2,248	5,972
Percent Caucasian	26.7	26.7	72.7	42.2
Percent Asian	50.4	59.4	13.1	24.6
Percent Hawaiian	19.7	12.6	9.9	31.1
Percent under 18	27.2	27.3	20.9	34.0
Median Age	35.2	37.3	32.8	31.3

TABLE 3.3.8
Selected Socioeconomic Characteristics by City or Town, 1990 Census

CHARACTERISTIC	Hilo	Upper Kaumana	Waikoloa	Waimea
Percent over 65	13.5	19.1	7.2	7.4
Percent 10-64With Mobility or Self-Care Limitation/ Work Disability	13.9	14.5	8.2	7.3
Percent Who Do Not Speak English Well	12.9	16.2	1.4	4.5
Percent over 25 With High School Diploma	78.4	62.6	94.7	84.9
Percent over 16 in Labor Force	62.1	50.0	77.3	72.8
Median Family Income	$29,967	$26,328	$44,444	$37,069
Percent in Poverty	14.3	12.8	9.5	10.4
Percent Lived in Hawai'i in 1985 & 1990	91.4	88.1	50.0	84.2
Percent Owner Occupied Housing	62.6	79.3	41.3	60.6
Median Contract Rent Value	$428	$344	$882	$684
Median Home Price	$113,000	$80,500	$255,100	$171,900

Source: U.S. Bureau of the Census: "1990 Census of Population. General Population Characteristics," 1990 CP-1-13 and "1990 Census of Population. Housing, Summary Population and Housing Characteristics," 1990 CPH-1-13.

The visitor industry in West Hawai'i has attracted workers and entrepreneurs from not only the State of Hawai'i, but also the mainland U.S. and around the world. Sharing economic benefits of tourism jobs with East Hawai'i is hindered by distance and poor road connections between the two sides of the island. Nevertheless, as many as 25 percent of West Hawai'i hotel workers, commute from Hamakua, Hilo and even Puna.

3.3.2.2 Environmental Consequences

All Action Alternatives. Direct and indirect socioeconomic impacts would be effectively the same for each action alternative. Construction of the project would create temporary construction jobs, a beneficial effect (ref: FEIS - Part I, 3.4).

Any impacts to the economy of the Hamakua Coast would be important because Hamakua has been devastated by the loss of its economic base, sugar plantations. For a limited number of general stores and restaurants on the Hamakua Coast, including two gas stations, three general stores, two convenience stores, and three snack shop/restaurants, drive-by traffic constitutes a substantial part of their total business. With improvements to Saddle Road, some commuters

that currently use SR 19 would be expected to use Saddle Road instead. This concern was expressed at the public meetings for the project.

In assessing the magnitude of such an impact, consideration must be given to the overall increase in traffic expected for SR 19. According to traffic projections, which are based on an assumption that Saddle Road will be improved, ADT on SR 19 at various locations in Hamakua will increase from 1992 levels of between 5,000 and 9,000 (depending on location) to between 14,000 and 20,000 by the year 2020 (HDOT in prep.). In the long run, the customer base for roadside businesses will grow substantially rather than decline. Most observers expect that the *Plantation Heritage Corridor Cultural Trail*, an outgrowth of the 1995 Hamakua Strategic Plan, will greatly expand the visitor industry in Hamakua and more than offset any loss in drive-by traffic. With the projections in growth in traffic on SR 19, no decrease in drive-by business would be anticipated; with Saddle Road improvements a slower growth in business may result (ref: FEIS - Part I, 3.4).

With improvements to Saddle Road, more Hilo residents will compete with Hamakua residents for West Hawai'i jobs.

If the project stimulates tourism or intra-island trade, it is likely that some growth in permanent jobs could follow (addressed in greater detail in Section 3.4, Economic).

No Action Alternative. With the No Action Alternative, no temporary construction jobs would be created, and no growth in permanent jobs would be anticipated. No immediately apparent change in drive-by traffic would be expected for the businesses of the Hamakua Coast. Over the next twenty years, ADT on SR19 would increase at a higher rate in the absence of a viable cross-island transportation corridor.

3.3.2.3 Mitigation Measures

No mitigation measures are proposed for socioeconomic impacts.

3.3.3 Community Identity and Cohesion

3.3.3.1 Affected Environment

Vitally important to an accurate characterization of the social fabric of an area are the following concepts which portray social well-being and community cohesion.

- Community decision-making processes and local power structures.
- Relocation of locals away from the community.
- Socioeconomic harmony or polarization.
- Community and regional character or spirit.
- Codes of conduct among and between various social and ethnic groups.

- Relationship with visitors and tourist industry.

The Island of Hawai'i has a rich, multi-ethnic history that has helped to create a strong sense of community identity evidenced in both the people and the landscape. Many native Hawaiian traditions, including cuisine, *luau* and *pa'ina* (ceremonial feasts), and music and dance have been enthusiastically embraced by later arrivals. Native Hawaiian culture is strong and growing in influence. In addition, many traditions of the Japanese, Chinese, Filipino, Portuguese, and Korean immigrant plantation workers have also been perpetuated.

Most long-time Hawai'i (*kama'aina*) families trace their roots to such beginnings and share many deep and wide-ranging bonds. Newer residents, particularly those from the mainland, do not share such links. Nevertheless, celebration of this heritage in such events as hula festivals, plantation days, and rodeos is enthusiastically supported by long-term residents and newcomers alike.

At the same time, however, the sense of community is evolving as new residents (and their values) from outside the island are gradually incorporated. Kama'aina residents often express a longing for the old days and a fear of being disenfranchised. Many towns and villages (particularly Waimea and Kailua-Kona) have been transformed from charming local settlements into bustling visitor and residential communities with numerous wealthy, transplanted mainlanders whose influence in community affairs is not related to their family connection to the land.

Many of those who participated in surveys, meetings and workshops expressed the idea that the Island of Hawai'i makes up one large community, despite the divisive forces of distance, and unequal economies, and that better transportation would enhance mutual community support, and balanced economic growth. In the view of most, steady improvement of an island-wide highway system over the decades has solidified the community. Others expressed the sentiment that Hawai'i County should be two counties instead of one; that the two sides of the island have very distinct destinies.

Individual areas affected by the Saddle Road project have very distinct histories, social makeup and identities. Community workshops and surveys for this project were intended to allow residents to express what they valued about their community and what impacts they expected as a result of improving Saddle Road. The following area characterizations were formed from opinions presented in these surveys.

Waimea. Headquarters for Parker Ranch for over a century and a half, Waimea has a rich history and a dramatic setting in the misty uplands. A substantial area of HHL, supporting farms and ranches, is also present. The last twenty years have produced rapid growth. The charming cattle town is now also an enclave for wealthy transplanted mainlanders and a bedroom community for workers at South Kohala resorts.

Waimea participants tended to emphasize the rural character and heritage of their region, pointing with pride to the "...unique ranching/farming community" but worrying that it is "twice daily assaulted by a long string of traffic."

Waikoloa. Development of Waikoloa, a planned community, started in the 1960s. This windy and dry village has developed an identity of its own, and is distinctly different from the Waikoloa resort area on the coast. Today, working families are more abundant than retirees, and the community continues to expand and diversify. Non-residential land uses are limited but expanding. Waikoloa has the potential to grow as large or larger than Waimea. Waikoloa has a strong community association and a tradition of "self-help."

Waiki'i. Waiki'i's rich ranching tradition and dramatic scenery presented the opportunity for a unique subdivision in the 1980s. All 130 lots have grazing easements and share large common areas. Currently, homes have been built on approximately 20 lots, and several additional homes are present in the area but outside Waiki'i Ranch proper. The arrangement has allowed continuation of ranching activities under the supervision of the lot owner association. In addition to cattle, many residents raise horses and are involved in equestrian activity.

Waiki'i's polo field accommodates a regular schedule of polo matches attracting teams from throughout the state and players from around the world. The Waiki'i Ranch Music Festival, an annual event for the past six years, features some of Hawai'i's top musical performers and is open to the public. Thousands of people attend this two-day music festival event. Proceeds benefit various charities.

Among the valued traits of Waiki'i most commonly mentioned by its residents are the spectacular scenery, cool weather, and seclusion.

Hilo and Kaumana. Hilo's tradition as a major population center is unbroken from pre-Cook Hawai'i to modern times. Hilo is often described as quaint and traditional. Formerly centered on the sugar cane industry, agriculture around Hilo become more diversified with the growth of macadamia, papaya, orchid and foliage industries. The economy is now more dependent on business and government functions headquartered in Hilo, including the University of Hawai'i at Hilo. It is the major commercial center on the Island of Hawai'i and also supports several industrial and commercial districts. Hilo International Airport and a deep draft harbor anchor the island's major shipping center.

Kaumana is a former sugar cane camp that has been annexed as a quiet suburb of Hilo. Upper Kaumana, which would be most directly affected by Saddle Road, contains a mixture of old camp housing and modern subdivisions. One school and a small general store are present.

Kaumana residents feel a strong stake in Saddle Road and have been active participants in meetings, surveys and workshops. As one resident stated, the community is in a "state of transition" from an isolated relic of the plantation era to a growing suburb of Hilo. The

integration with Hilo is convenient: a "location close to the mountains and [not too far from] the shoreline...cleanliness, relatively rural lifestyle...with access to modern day conveniences." Another noted "[We are] separate from downtown Hilo, yet close enough and affordable, especially to owner builders." Preserving Kaumana's "serenity, privacy, low traffic, good neighbors, natural backyard" and "active community associations" is seen as important.

Kailua-Kona. Kona was an important and powerful district in Hawai'i prior to Western contact, the seat of ruling chiefs and the site of productive upland agriculture and teeming shoreline and offshore fisheries. For most of the years since 1850, however, Kona was an isolated, sleepy rural district where scattered coffee farms and cattle ranches were the economic mainstay.

The growth of tourism in West Hawai'i since the 1960s has steadily attracted new residents lured by the physical beauty of Kona and the growing employment and entrepreneurial opportunities. Following Hilo, Kailua is now the second largest population and business center on the island.

In surveys and public meetings, North Kona residents noted the value of climate, scenery and history of this area. Most prominent, however, were statements about the vital economy of West Hawai'i, powered by tourism.

3.3.3.2 Environmental Consequences

All Action Alternatives. Temporary impacts to community identity and cohesion can result from the barriers created by road construction. These impacts would be most pronounced in Section IV, which runs through the community of Kaumana, because construction could interfere with the ability of neighbors to interact. Most of the project area traverses non-residential areas. In these areas, the proposed project would have little impact on community identity or cohesion.

Long-term impacts to community cohesion and identity are associated with two potential aspects of the proposed project. One is derived directly from the realignment or expansion of Saddle Road from its current position within Kaumana. The other is an indirect, island-wide effect, which would be expected to result from the considerable improvement in traveling conditions and reduction in travel time that would occur from the project.

With any of the action alternatives, the physical safety of the road would be substantially enhanced by widening travel lanes, providing passing lanes, pullouts, improving pavement, straightening horizontal curves, and leveling vertical alignment.

Based on results of analysis of driving time with proposed improvements, motorists traveling between East Hawai'i and West Hawai'i would generally find the trip considerably safer and approximately 20 to 30 minutes shorter one way. The implications of this are far-ranging.

With a safer and faster Saddle Road, social interchange would be expected to increase. Families separated by the distances between East and West Hawai'i would find it substantially easier to

travel across the island. Social events occurring either in East or West Hawai'i would draw more participants from both sides of the islands. In addition, potential employees (particularly of the job-rich West Hawai'i resorts) would find the commuting time across island more acceptable. University of Hawai'i students also stand to benefit by a shorter commute between the Kona and Hilo campuses. All of these factors would tend to increase the *community cohesion* of the island as a whole. The value of improving Saddle Road to increase community cohesion of the island was expressed by a majority of survey participants.

Some residents are concerned that improvements to Saddle Road would encourage or facilitate expansion of the observatories on Mauna Kea. Expansion of these facilities is not universally welcomed. Improvements to Saddle Road would benefit observatories by providing a safer faster transportation route to and from the observatory complex; however, the expansion of these facilities is not dependent on the improvement of Saddle Road, but rather on the planning currently underway by the Institute for Astronomy, University of Hawai'i at Hilo (IFA).

W-2 and W-3. Segment W-3 would completely avoid the community of Waiki'i and would not be expected to result in temporary or long-term adverse impacts to local community cohesion. W-2 approaches Waiki'i more closely and is perceived by residents to involve impacts from noise and visual intrusion.

EX-2, PTA-1 and PTA-3. Constructing the improved Saddle Road on any of the proposed segments within Section II would not be expected to result in temporary or long term, adverse impacts to local community cohesion. According to military officials, PTA-1 and PTA-3 promote the training purposes of the PTA and provide a sense of unity for the base. Conversely, improving Saddle Road on the EX-2 alignment would serve as more of a barrier between the cantonment area and training areas currently located across Saddle Road.

EX-3. Improving Saddle Road on the Segment EX-3 alignment is not expected to result in temporary or long-term, adverse impacts to local community cohesion.

EX-4A, and E-3. With regard to cohesion on the community level, segment EX-4A would pass through an established community, Kaumana. Temporary impacts to community cohesion would be anticipated during the construction period because Saddle Road would pass through much of Kaumana.

For EX-4A, the proposed improvements would create a more significant barrier to community cohesion. While the number of travel lanes will not be increased as part of the proposed improvements, roadway width including roadway shoulders will be widened, and traffic speeds and traffic volumes will increase. These changing conditions would cause the roadway to be more difficult and potentially more hazardous for vehicles, pedestrians and bicycles to cross, resulting in increasing interference with social interaction within the community. Impacts related to residential relocations are discussed in the ROW and relocation section of this chapter (ref: 3 FEIS - Part I,.5.2.2).

For these reasons, impacts related to community cohesion would also be expected to be more likely with Segment EX-4A than with Segment E-3. Segment E-3 would avoid much of the existing development of Upper Kaumana by passing south of the upper end.

No Action Alternative. The No Action Alternative would avoid all construction-related impacts. The No Action Alternative would avoid temporary and permanent adverse impacts to individual communities, but would fail to promote community cohesion on the island as a whole.

3.3.3.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- For all construction, and particularly work that will occur near Kaumana, a traffic control plan will be developed to outline the steps needed to minimize congestion and maintain access to adjacent properties at all times during construction.

3.3.4 Outdoor Recreation Resources and Hunting

3.3.4.1 Affected Environment

Saddle Road provides a number of outdoor recreational resources and opportunities. Many of the attendees of the public meetings noted that they drive Saddle Road for recreation and scenery as much as for convenience. Many residents hunt, hike, and gather resources in the upland areas. Recreational resources include the following (Figure 3.3.1, *Recreation Resources*).

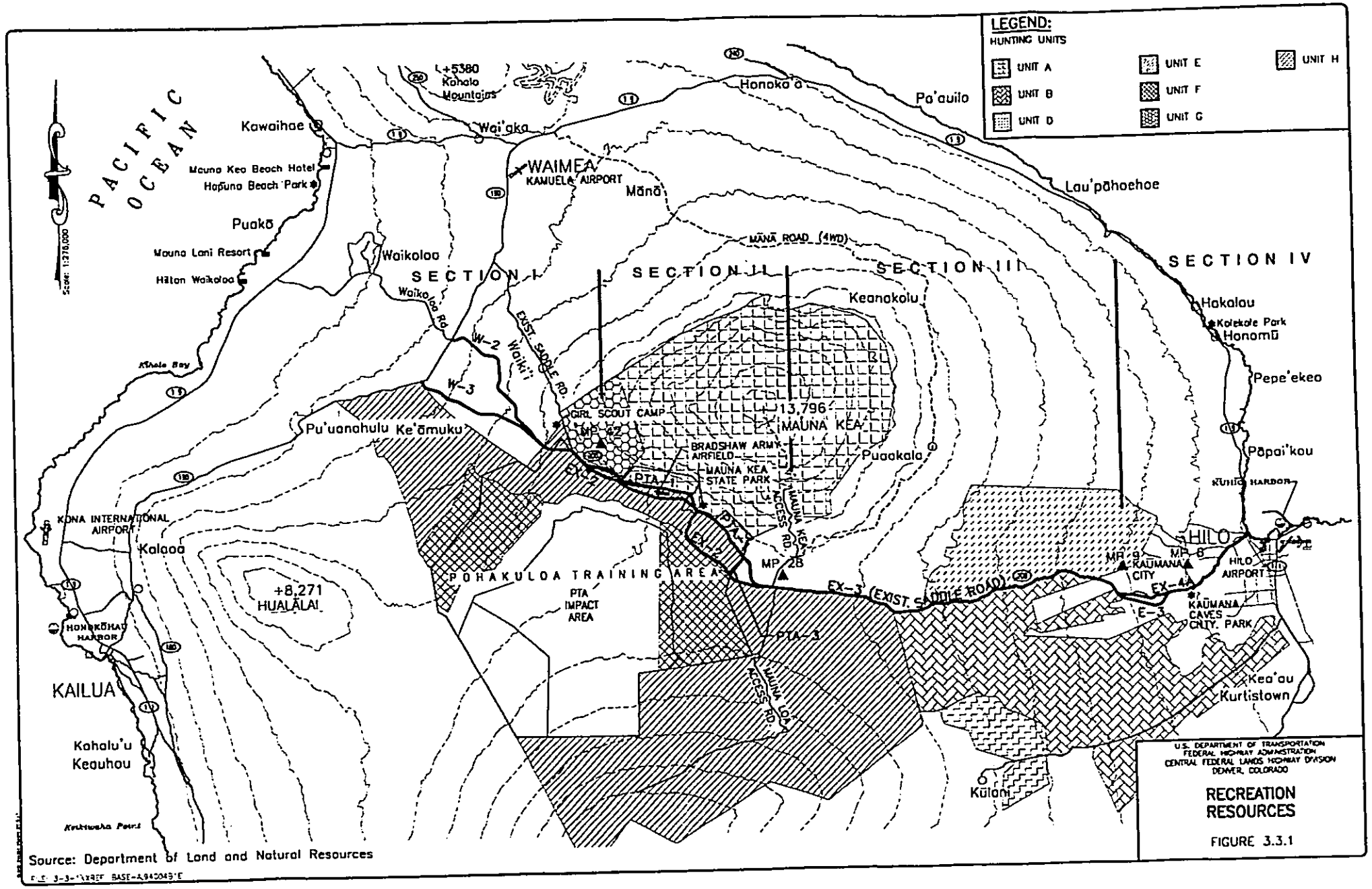
- Mauna Kea State Park
  Associated Activities: Camping, hiking, birding, nearby hunting

- Mauna Kea
  Associated Activities: Alpine Sports and Scenery, Hunting, Astronomy, Cultural Sites

- Mauna Loa
  Associated Activities: Hiking, Hunting

Mauna Kea State Park, a state recreational facility of approximately 8 ha, is the only public park facility within the project vicinity. This facility, operated by the DLNR Division of State Parks, is situated at MP 35, adjacent to PTA. The park includes cabins and dormitory facilities for camping, picnicking, and other recreational activities. According to State Parks records, the 15 cabins at Mauna Kea, which are rented out for a nominal fee, accommodated more than 12,500 user-nights in fiscal year 1995-1996. Day use figures are unknown.

Mauna Kea Support Services report that about 40,000 people per year make use of the Hale Pohaku Visitor Center, which features astronomical and natural history exhibits and stargazing.


LEGEND:
HUNTING UNITS
UNIT A
UNIT B
UNIT D
UNIT E
UNIT F
UNIT G
UNIT H
PACIFIC OCEAN
Scale: 1:270,000
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
Kiholo Bay
+5380
Kohala Mountains
Waiʻaka
WAIMEA
KAMUELA AIRPORT
Honokaʻa
Paʻauilo
Lauʻpāhoehoe
Mānā
MANA ROAD (4WD)
Waikoloa
SECTION I
SECTION II
SECTION III
SECTION IV
Waikoloa Rd.
EXIST. SADDLE RD.
W-2
W-3
Waikiʻi
Puʻuanahulu Keʻāmuku
GIRL SCOUT CAMP
MP 22
EX-2
PTA-1
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
13,796
MAUNA KEA
Keanakolu
Puaakala
MAUNA KEA ACCESS RD.
PTA-2
MP 28
EX-3 (EXIST. SADDLE ROAD)
POHAKULOA TRAINING AREA
PTA IMPACT AREA
PTA-3
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271
HUALĀLAI
HONOKOHAU HARBOR
KAILUA
Kahaluʻu
Keauhou
Kealakekua Point
Hakalau
Kolekole Park
Honomū
Pepeʻekeo
Pāpaiʻkou
KUHIO HARBOR
HILO
HILO AIRPORT
MP 9
MP 8
KAUMANA CITY
EX-4A
KAUMANA CAVES CNTY. PARK
E-3
Keaʻau
Kurtistown
Kūlani
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
RECREATION RESOURCES
FIGURE 3.3.1
Source: Department of Land and Natural Resources

When Mauna Kea has snow, as many as 1,000 vehicles per day make the trip to the summit. Average traffic is about 100 vehicles per day, about half recreational (Terry 1997, Tech. App. Vol. V)(Terry 1998 and Langlas 1998, FEIS - Part III).

Mauna Loa's stark landscape of recent lava flows is used infrequently for recreation, mainly by hunters and hikers.

Recreational activities undertaken within the saddle area include the following.

- Hunting.

Hunting is a long-standing tradition in Hawai'i. For two centuries, Hawai'i's forests and ranges have been hunted for sport and food. Pigs, sheep, goats, and a variety of gamebirds are hunted by rifle or archery in some three dozen units largely concentrated in the central portion of the island. The game resources currently hunted legally in Hawai'i are unique in the United States in that all species were introduced and none are native to the state. In addition to mammals, gamebirds including turkey, pheasants, quails, chukars, and francolins are also present (Terry 1997, Tech. App. Vol. V, Appendix A: Impacts to Hunting). Some three dozen discrete units scattered around the island provide about 300,000 ha of hunting area (Hawai'i County R&D 1994).

For many of the 3,000-plus licensed hunters on the Island of Hawai'i, hunting is more than recreation - it is an integral part of their identity. Hunting connects people to the natural environment and provides an occasion to enjoy and learn from the forests. Hunting is also an important source of food for many families.

A detailed source of information for the social context of hunting is the *Hawai'i Hunter Survey, 1985-1986* (Lum and Ohashi 1989). This project randomly sampled information and opinions from more than 5 percent of the state's licensed hunters. About 95 percent of sample respondents were males. The survey revealed that hunters on the average appeared to have higher incomes than the general population, although about 20 percent of hunters made less than $20,000 per year, and the large majority of hunters worked at blue collar jobs. Each of Hawai'i's many ethnic groups were represented among hunters, with slightly greater proportional representation from the Japanese and Caucasian groups and slightly less representation from Filipino, Chinese and Koreans. Hunters of native Hawaiian ancestry were almost exactly in proportion with the general population.

Most hunters pursued both gamebirds and mammals. According to the survey results, the most popular gamebirds to hunt on the Island of Hawai'i are pheasants and francolins; the most popular mammals are mouflon (a type of wild sheep), pig, and sheep. The most popular species were not necessarily those most frequently harvested because the more popular species are less numerous, accessible or easy to hunt.

Table 3.3.9, *Hunting Units in Central Hawai'i*, provides an overview of hunting areas within the central part of the island, which includes the volcanoes of Mauna Kea, Hualalai and Mauna Loa, and the saddles between them (Figure 3.3.1).

TABLE 3.3.9
Hunting Units in Central Hawai'i

Unit	Location/Remarks	Resource/Arms Permitted
A	Mauna Kea Forest Reserve Elevations of over 2,135 m	Pigs, Goats, Sheep[1], Birds; Archery & Firearms
B	Upper Waiakea Forest Reserve	Pigs, Goats
D	Hilo Watershed	Pigs, Goats, Birds
E	Pu'u Anahulu, Mauna Loa Forest Reserve, 'Ainahou; Humu'ula, Menehune, Ahi, and Kapele in PTA	Pigs, Goats, Sheep, Birds; Archery & Firearms
F	Redleg and Bobcat Trail Sections of PTA	Pigs, Goats, Sheep, Birds
G	Kaohe (SW corner of Mauna Kea)	Pigs, Goats, Sheep[1]; Archery, Firearms (muzzle loader)
J	Pu'u Wa'awa'a Cooperative Game Management Area	Pigs, Goats, Sheep: Archery; Special Pre-Season Hunts.

Source: Island of Hawai'i Recreation Map, State of Hawai'i Division of Forestry and Wildlife (DOFAW).
[1] DLNR is under court order to eliminate sheep from this area. No bag limit, extended hunting periods.

PTA Hunting Units. Much of the land at the PTA has been hunted for many decades. A number of discrete areas of distinctive hunting resources are present. Many areas have limited access because of sparse road networks or military limitations (e.g., impact areas, dud areas, or training). Hunters must call ahead to PTA in order to determine which areas are closed due to training. Closures occur on at least some part of the hunting area within PTA frequently during the bird hunting season. Despite the limitations, hunters consider the game harvests at PTA good.

PTA provides excellent bird hunting in terms of total hunting area and absolute game numbers, although catch effort appears to be somewhat higher than adjacent public bird hunting areas. Goats are the most frequently harvested mammal. Sheep are also important.

PTA has recently instituted programs to track changes in population and movements of goats, sheep and mouflon. PTA hired National Park Service (NPS) personnel to design and implement a sample census, which was conducted on August 8, 1996. Transects were laid out and surveyed from a low-flying helicopter to provide a baseline index to which the results of future aerial surveys could be compared, to assess gross population trends. The researchers counted 239

goats, 85 feral sheep and 9 mouflons, for a total of 333 animals (Katahira and Hoshide 1996). An ongoing program of counts is planned.

Researchers under contract to the PTA also tagged a total of 10 animals (including male and female goats, feral sheep and mouflon) with radio transmitters in April of 1997. Although the program ends in September, a follow-up effort is expected to be funded. The biotelemetry studies will, over the long term, yield important information about animal movement, behavior and ecology. Although initial data suggest that animals do not engage in substantial movements, the early stage of the study precludes drawing conclusions.

Hunting Units Adjacent to PTA. Hunting units adjacent to PTA include Ka'ohe, Pu'u Anahulu, Pu'u Wa'awa'a, Kipuka 'Ainahou, Upper Waiakea Forest Reserve, the Hilo Watershed, and those portions of the Mauna Kea Forest Reserve that are not accessed via PTA. Mauna Kea provides by far the most important bird hunting area, in terms of both total yield and catch per unit effort. Gamebird hunting zones and access points ring Mauna Kea at varying elevations. Pu'u Anahulu is the most important area for both sheep and goats; it is adjacent to and may form a functional unit with the most important sheep and goat hunting areas in PTA (Bobcat and Kapele).

A number of censuses and ecological studies have been conducted for at least some of these regions, including work on the ecology and management of feral sheep (Giffin 1976) and mouflon (Giffin and Walker 1981) on Mauna Kea stands out. These studies indicated that herd patterns are quite variable in size and age and sex structure, and exhibit frequent fluctuation in composition and numbers; a large variety of native and alien plants sustain the animals, which supply all their nutritional and water needs, illustrating the need for standing water; sheep adhere to a definite home range and move daily down the mountain to feed and up to sleep, a round trip distance of about four miles; hunting tends to disrupt the pattern of establishing and maintaining a home range of both species; population fluctuates greatly in response to environmental changes and especially hunting pressure; there is some evidence of interspecies competition, particularly for goats, but the difference in ranges on Mauna Kea made this conclusion somewhat indeterminate.

Censuses of feral sheep on Mauna Kea by DLNR were also mandated by court order in 1979. The latest effort in May 1997 counted 319 sheep. Although census estimates show great fluctuation, because of both population variation and the difficulty of counting sheep in dense cover, the numbers indicate that the programs to eradicate feral sheep have produced a substantial decrease in population. In spring of 1997, DLNR initiated a program to reduce sheep numbers below 150 animals.

Additional Hunting Areas Potentially Affected by the Project: Three additional hunting areas, located outside of the original study corridor, are being considered in this document because they could potentially be affected by mitigation measures related to protection of the endangered Palila: Pu'u Mali, Kipuka 'Alala, and a portion of the Ka'ohe Lease Lands.

Currently, Pu'u Mali is leased by the State of Hawai'i to private ranchers and there is no public hunting. Very few *feral* (animals that have escaped domestication and become wild again) *ungulates* (hoofed mammals) are present, but DLNR believes that enough gamebirds are there to justify adding the area to the Mauna Kea Forest Reserve hunting area.

There is no public hunting at Kipuka 'Alala, and there are no records indicating that hunting was sanctioned there previously. Recent censuses conducted for the Environmental Office at PTA (Katahira and Hoshide 1996) confirm that Kipuka 'Alala supports large herds of feral animals, particularly sheep. Because of the potentially excellent game resources there, DLNR and hunting groups have requested the Army to allow hunting. Concerns related to the abundance of endangered species and several valuable archaeological sites have made it difficult for the army to agree to such requests.

Ka'ohe Lease Lands are currently leased for grazing. This area is immediately adjacent to the core Palila population center. The Ka'ohe Lease Lands have been used for gamebird hunting and are of particular importance to DLNR's youth hunting programs. There are almost no feral ungulates on the property at this time.

- Hiking

Hiking trails accessed by Saddle Road include Pu'u Huluhulu, Power Line Road, the Wailuku River Trail, and Tree Planting Road. According to hikers interviewed, the only directly affected area of particular concern is the Pu'u O'o Trail, where hikers wish to preserve access and parking. Many tour groups using Mauna Kea also hike in the summit region, including the Adze Quarry, Lake Waiau, and Pu'u Wekiu.

- Birding

Birding can be excellent above 900 m on the eastern end of Saddle Road, where many native birds are present. The Pu'u O'o area, particularly the trailhead, is of special concern. Birders also access the forest from other locations on Saddle Road. Preserving reasonable access to the forest is considered important to birders. Long stretches where parking is prohibited would interfere with the freedom of birders to select areas for observation.

- Winter Sports

Winter sports in the area occur exclusively on the summit region of Mauna Kea, which is accessed from Saddle Road. When Mauna Kea has snow, as many as 1,000 vehicles per day make the trip to the summit, about 10 times the average traffic level (ref: Terry 1998, FEIS - Part III).

- Camping

The only designated camping site within the Saddle area is at Mauna Kea State Park. The proposed improvements would not affect the park.

- Mountain/Road Biking

Mountain and road biking on and near the Saddle is popular with a small group of local bicyclists, and attracts national and international riders. The Big Island Mountain Biking Association publishes a map of mountain bike trails that includes Mana Road, which branches off Mauna Kea Access Road about one mile from its origin on Saddle Road. Biking is also popular on Mauna Kea Access Road, Mauna Loa Observatory Road, and on Saddle Road itself. The high altitude rides are particularly valued for training by professional or amateur racers. The US Army has opened Trail 1 in PTA to mountain biking, and a yearly event takes place there. Mountain bikers also use Parker Ranch and the Pu'u O'o Trail. According to local bikers, preservation of the Pu'u Huluhulu parking area would be appreciated. The wide, paved shoulders planned for the improved Saddle Road, would greatly improve conditions for riders using Saddle Road.

- Running

For runners, the Mauna Kea Relay, an annual 100-km road race held annually traverses the entire Saddle Road. The event has attracted between a few dozen and a few hundred runners since its inception in the 1970s. According to observations of regular users of Saddle Road, a small number of runners also train independently on an infrequent basis on Saddle Road.

- Gathering

Gathering of traditional plant material occurs at various locations and times, but is especially common just off the shoulder of the highway between MP 8 and 13 before parties or important ceremonial occasions; such as hula festivals. Maintenance of the corridor of natural vegetation along the road's edge is important to this activity.

- Scientific Research

Field trips and experiments in plant ecology, invertebrate ecology, climatology, and geology are common. Several universities, including the University of Hawai'i at Hilo, the University of Hawai'i at Manoa, and Stanford University have ongoing research projects with total budgets in excess of one million dollars.

3.3.4.2 Environmental Consequences

All Action Alternatives. Temporary impacts to outdoor recreation associated with construction of the project would be anticipated. Construction activities often cause traffic congestion and delays, potentially making access to recreational areas and hunting units less convenient. In addition, construction activities could spook game from some areas. No appreciable difference exists among the alternatives with respect to the potential to temporarily disrupt recreational activities during construction, except that PTA-1 and PTA-3 would cause more game disturbance than EX-2.

With regard to direct, long-term impacts, improvements to Saddle Road would displace native plant gathering, hunting, birdwatching, and hiking areas, but would provide better accessibility to recreational areas within the project vicinity. Greater accessibility of the overall project vicinity would benefit some businesses such as ecotourism ventures. Improvements to Saddle Road would potentially draw more traffic and recreational users into the saddle and onto the mountains. The proposed action would be expected to result in a greater potential for use of roadside areas for education, recreation, and gathering. Access to the hunting areas along Saddle Road would be safer and possibly require less travel time.

Proposed road improvements would result in greater accessibility to Mauna Kea State Park, resulting in a potential increase in visitor use. Use of Mauna Kea State Park as a rest stop would be expected to increase. Any growth in use could be monitored over time by appropriate agencies to determine what, if any, additional facilities would be required to accommodate that growth.

Increasing use of the area could degrade somewhat the quality of the wilderness experience, could begin to cause overcrowding, and could contribute to the usage of off-road vehicles and mountain bikes within the study corridor. Increased use would indirectly contribute to an increase in fire hazard, weed transmission, and soil erosion.

A potential increase in unauthorized traffic to the Mauna Kea summit would be anticipated, increasing road damage, the potential for accidents, and in some cases, the need for rescue operations. In order to assess the potential for increased traffic, a three-day survey of mountain visitors at the Hale Pohaku Visitor's Center was conducted for this project. The intent of the survey was to record the place of residence, trip origin and purpose, and attitudes concerning the existing Saddle Road and potential use of Mauna Kea if the road is improved. The main finding of the survey was that for the overwhelming majority of users (75.3 percent), the condition of Saddle Road was not a factor in their decision to make the trip. Similarly, few respondents (12.2 percent) reported that they would significantly increase their frequency of visits as a result of improvements on Saddle Road. Most (73.6 percent) who were able to estimate how their usage would vary responded that there would be no change to the number of visits they made.

It is acknowledged that a survey gauging opinions of a small sample of visitors can be quite different from actual behavior of a new generation of visitors who will be driving on an improved highway rather than speculating about how they would respond to hypothetical improvements. However, based on the attitudes reported in this survey, use of Mauna Kea would be expected to increase very slightly as a result of improvements in Saddle Road. If current patterns persist, users will focus their activities at the Visitor Center and at the summit. Some scientific investigation, stargazing, and recreational use increases are likely to occur. For a copy of the survey and additional detail refer to Part III of the FEIS (ref: Terry 1998). While mitigation measures to control this traffic would be considered beyond the scope of this project, it may be desirable for the appropriate agency to monitor this unauthorized traffic over time to determine whether further measures should be taken to restrict access (ref: FEIS - Part I, 3.19.3.1.3).

To frame the discussion of impacts to hunting, consideration must also be given to the cumulative net loss of hunting area since 1970. At the Laupahoehoe, Kahaualea and Pu'u Makaala Natural Area Reserves, the management goal for Buffer Zone is open for hunting throughout the year by permit only. Game mammal hunting has been lost, however, on the Mauna Kea Forest Reserve and Ka'ohe Game Management Area due to Federal Court eradication orders. Hunting areas in the Bobcat and Redleg Trail sections of PTA have also been reduced or have been restricted in their access.

The most substantial loss of mammal hunting area resulted from a lawsuit (*Palila v. Hawai'i Department of Land and Natural Resources* 1979) filed by several environmental groups. The final decision, which followed several appeals by the state, dictated that the mamane forest of the Mauna Kea Forest Reserve must be managed for Palila, which depends upon this tree for its sustenance. Since it is widely held that sheep severely browse adult mamane and graze seedlings out of existence, the sheep were required to be removed. DLNR had previously expended considerable effort to introduce mouflons, study mouflon and feral sheep ecology, and manage the mountain for hunting. Although by 1997 not all sheep had been removed from the Mauna Kea Forest Preserve and the area is still open for mammal hunting, the eradication efforts to reduce the numbers of feral animals have deteriorated hunting conditions markedly.

The escalating conflict between promoting hunting and managing land for endangered species and the habitats that sustain them bodes more loss of hunting areas. PTA is formulating an Ecosystem Management Plan (EMP) which includes ungulate control in biologically significant areas. Although the plan is not final and the implementation timetable is not fixed, control efforts would involve a combination of hunting, fencing, and other methods that would degrade hunting conditions over substantial portions of PTA used for hunting. Additionally, the USFWS has reopened consultation under Section 7 of the Endangered Species Act with the U.S. Army concerning all uses at PTA, and most observers predict that a separate set of potentially large areas that are currently hunted would be placed in management regimes that would include reduction of feral ungulates and thus preclude permanent mammal hunting. Mitigation being considered by the USAG-HI for impacts to mammal hunting include hunting access

improvements, water troughs, planting of foliage and cover for ungulates, and animal behavior studies.

W-2 and W-3. No notable impacts to outdoor recreational resources or activities, including hunting, would be anticipated with the selection of Segments W-2 or W-3.

EX-2, PTA-1 and PTA-3. Direct loss of existing hunting lands would occur as a result of the selection of EX-2, PTA-1 and PTA-3. Within Section II, use of EX-2 would have the least impact on outdoor recreation and hunting because it follows the existing road corridor.

Hunting areas that would be impacted by the proposed project within Section II would be within the Mauna Kea and Humu'ula sub-areas within PTA. For the most part these losses involve areas that are already near roadways or military structures or for other reasons do not offer prime hunting. In Humu'ula, however, PTA-1 would involve a loss of approximately 78 ha and PTA-3 would consume about 91 ha near Omaokoili cinder cone. The area would also be bisected by the road, although accessibility would increase. This area offers superior hunting and is particularly suitable for bird hunting with dogs. It has long been part of a favorite area for hunting (refered to by hunters as Trail 1) and has sentimental value to hunters. Also, because it offers easy accessibility to families, the elderly, and those without four-wheel drive vehicles, it is of special concern. The Humu'ula hunting area offers high yields of many gamebirds and also some sheep and pigs. Omaokoili, the area directly affected within Humu'ula, offers little mammal hunting but is considered by many to offer superior bird hunting.

Fragmentation of habitat occurs when an intact area required by an animal population for its nutritional, reproductive, or other needs is divided into fragments that themselves may be too small or widely separated by degraded habitat to support the minimum population size necessary for population health and stability. In dealing with alien wildlife as with the game mammal and bird species at PTA, the focus is to provide a stable supply of sufficient game for hunters. It is important to note that even if the total size of the habitat take may be small, the effects of fragmentation may be large. The discussion that follows considered the effects of how PTA-1 and PTA-3 would bisect the habitat of game mammals and birds within the Humu'ula section of PTA. The maximum area that would be directly taken would be 91 ha of the Humu'ula Unit.

Hunter reported data from PTA for 1996 indicate that only seven sheep and three pigs were harvasted from Humu'ula. This is less than 8.0 percent of pigs. In comparison to other areas of PTA (Bobcat -58 sheep; Kapele 13 pigs) and particularly to State hunting units (Pu'u Anahulu - 113 sheep; Unit B - 243 pigs), these are not substantial harvest numbers. Discussion with hunting officials indicates that 1996 was a fairly representative year in terms of proportions of game mammals taken within various units. Because this area does not support a significant or important population of game mammals, the issue of fragmentation of mammal habitat is not of concern.

In contrast with mammals, bird hunting in the Humu'ula Unit accounted for a substantial amount (23.0 percent) of all birds harvested at PTA in 1996. A wide variety of species were represented in what is probably the most diverse assemblage among the PTA hunting units. Humu'ula compares favorably in terms of both total game harvested and diversity of game resources with the finest of similary-sized State hunting units. However, game bird experts do not believe that highways on the scale of the proposed pose serious obstacles to game bird movement. Birds move freely across roads of similar or larger size. In fact, many hunters report excellent hunting in areas near the existing Saddle Road, Mauna Kea State Park, and other disturbed areas with similarly "fragmented" habitat. Although the road will bisect marginal habitat for game mammals and good habitat for bird hunting, there is no evidence that this division produces fragmentation, i.e., adverse effects to the health and stability of the game bird population.

In addition to direct hunting impacts anticipated from the road construction and implementation, proposed project mitigation measures related to the *taking of Palila Critical Habitat* (Segments PTA-1 and PTA-3) would also affect hunting areas and resources. Indirect (secondary) impacts due to Palila mitigation involve impacts to bird hunting that are clearly beneficial and impacts to mammal hunting which, in the absence of firm facts about mammal behavior and population, may be evaluated as either neutral or slightly adverse. Opening up of approximately 1,864 ha of hunting land at Pu'u Mali, especially when coupled with a predator control program and improved road access from Mana Road, would be a substantial net benefit for bird hunters. The proposed change in the management regime at the Ka'ohe Lease Lands to exclude grazing and include mowing and predator control is regarded by most biologists as beneficial to both Palila and gamebirds. At Kipuka 'Alala, which is proposed to be fenced to exclude feral animals, no existing public hunting areas are directly involved. The removal of feral ungulates at Kipuka 'Alala produces indeterminate effects; however, there is no evidence that substantial adverse effects would occur. Despite the lack of the direct loss of hunting area, some hunters argue that removing Kipuka 'Alala's extensive population of feral animals (in particular, sheep) would affect hunting in other areas. Without a solid understanding of the ecology of the feral animals at PTA, it is difficult to ascertain to what extent the Kipuka 'Alala population is the same as, interacts with, or affects feral sheep in other areas. Definitive answers to this question await a solid understanding of the ecology of the feral animals at PTA founded on repeated censuses and biotelemetry information which will not be available for several years. On the whole, however, secondary hunting impacts resulting from Palila mitigation, where they can be assessed, appear to be largely neutral or beneficial.

EX-3. Segment EX-3 would result in no notable loss of outdoor recreational resources and hunting areas, since it would use the existing road alignment with grade and alignment improvements.

EX-4A and E-3. Loss of outdoor recreational resources or hunting areas would be effectively the same with either EX-4A or E-3. Selection of either Segment EX-4A or E-3 would marginally decrease available hunting area in the Hilo Watershed and Upper Waiakea Forest Reserve due to road widening and straightening in the areas above, or roughly west of, Kaumana.

No Action Alternative. The No Action Alternative would result in no losses of outdoor recreation or hunting areas. No improvements to accessibility would result.

3.3.4.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- To the extent feasible, construction work in the vicinity of the access roads to recreational areas including hunting units will be scheduled for periods of non-peak use. Special consideration will be given to minimizing disruption to hunting units and the access that serves these units for construction activities that occur during the bird hunting season (November through January). This will be detailed in the traffic control plan, part of the construction contract documents.

- The traffic control plan will specify that during construction, access will be maintained at all times to roads that serve recreational areas including hunting units.

- Vehicle pullouts, and interpretive signage will be incorporated where appropriate.

- Scenic pullouts will be constructed and maintained by HDOT along the improved Saddle Road corridor. It is anticipated that two will be developed: one uphill of W-3 and one along EX-3 in the eastern one-half of the study corridor.

- Hunting enhancement activities are being initiated as part of the Ecosystem Management Plan at PTA. These activities include game studies, access improvement, and hunting management elements.

Several mitigation measures should be considered as part of investigations underway as part of the new Master Plan for development and management of Mauna Kea being undertaken by the IFA: 1) increase educational exhibits and programs at Hale Pohaku to inform users of the delicate nature of the resources and to enlist visitors' assistance in preserving them, 2) conduct study to consider restricting access to Mauna Kea at Hale Pohaku to four-wheel drive vehicles only through use of a security guard, a double gate (an improved road with locked gate or electronic card access for authorized personnel, and an ungated by rough four-wheel drive road to limit access by two-wheel vehicles), an admission fee, or other appropriate means, and 3) install appropriate regulatory or interpretive signing at Hale Pohaku and/or at the intersection of Mauna Kea Access Road and Saddle Road.

Emergency call boxes, which will be installed along the corridor within Section II as part of the fire prevention plan, will benefit road users in the case of road emergencies (ref: FEIS - Part I, 3.9.3).

3.3.5 Public Services, Community Centers and Local Business

3.3.5.1 Affected Environment

3.3.5.1.1 Fire, Police, and Emergency Services

Fire and emergency service is provided by the Hawai'i County Fire Department. Full-time stations within 6 km of Saddle Road include one each in Waimea and Waikoloa, and three in Hilo. Backup stations include South Kohala and North Kona. Each station operates round-the-clock with a crew of firefighters and Mobile Intensive Care Technicians. About 80 percent of calls are related to emergency medical services, and 20 percent or less for building, brush, and vehicle fires (Terry 1997, Tech. App. Vol. V).

The Hawai'i Police Department provides all police services for the island. Round-the-clock police stations that serve Saddle Road are located in Waimea and Hilo. Tentative plans are underway for a police substation in Waikoloa. Police do not regularly patrol any section of Saddle Road. Emergency telephones are located at Mauna Kea State Park and PTA. Current plans for future expansion of the HDOT call box system do not include Sections I, III, and IV of the Saddle Road project (Terry 1997, Tech. App. Vol. V).

The PTA maintains 24-hour emergency services with 19 firefighters (responding to about 10 Saddle Road incidents per month), 3 military medics and ambulances (5 incidents per month), and 17 police (3 incidents per month). PTA provides first response to 911 emergencies for all fires, traffic accidents and other emergencies in its vicinity, including at a minimum, the area from MP 46 to 27 (Terry 1997, Tech. App. Vol. V).

3.3.5.1.2 Schools

The closest school to the project corridor is Kaumana Elementary, located at Kaumana Drive at MP 4.5. This school is located outside of the project limits, beyond the site where Saddle Road would connect with the proposed Puainako Street extension (which is expected to siphon off the great majority of traffic from Saddle Road).

3.3.5.1.3 Churches and Community Centers

No churches or community centers are located on Saddle Road within the project limits.

3.3.5.1.4 Local Businesses

No active businesses were identified on Saddle Road within the project limits. Some businesses may be operated out of homes in Kaumana and Waiki'i. Several inactive or defunct nursery wholesale and retail operations are located on Saddle Road. Farming and ranching operations are present near Kaumana, in the saddle, and near Waiki'i (ref: FEIS - Part I, 3.1.1.1.1). Three small

businesses, a general store, mechanic's garage, and a nursery, are located just outside of the project limits at MP 5 in Kaumana.

3.3.5.2 Environmental Consequences

All Action Alternatives. Construction activities would be expected to result in traffic delays and traffic congestion, for those motorists using Saddle Road, including those associated with public services and local businesses. For emergency vehicles serving the Saddle Road corridor, traffic delays within construction zones could be significant without mitigation. Impacts on public services, community centers, and local businesses would be effectively the same with each of the action alternatives.

Direct, long-term, adverse impacts to public services, community centers, and local businesses from the proposed action are not anticipated. With improvements to Saddle Road, long-term impacts are expected to be beneficial in nature.

As a result of increased use of Saddle Road in the future, the demand for certain types of public services is expected to grow. The expected increase in traffic volumes would create a concomitant growth in the need for fire, emergency and police response in the project corridor. The incidence of stranded motorists would be expected to increase. The military, as the entity with the first opportunity to respond in many cases, will be burdened with additional responsibility. The demand for fuel and mechanical assistance will increase. It may be desirable for HDOT and the PTA to investigate opportunities for the provision of an emergency service center.

The increase in traffic is also expected to increase the potential for wildfires in the project corridor, especially in Section II (ref: FEIS - Part I, 3.9).

Beneficial impacts are also anticipated. Proposed improvements to Saddle Road would generally result in a decrease in response time for emergency vehicles responding to Saddle Road incidents. The project would also provide a superior alternate route or evacuation route in case accidents, floods or landslides block SR 19 along the Hamakua Coast. Likewise, if lava flow from Kilauea or the southwest or northeast rift of Mauna Loa cuts off SR 11 in Puna, Ka'u or South Kona, an improved Saddle Road would be an invaluable alternate route. With the proposed project, Saddle Road would become a safer and faster route across the island. With the proposed improvements, and future growth in traffic volumes and use, the maintenance of an express bus between Hilo and Kona may prove feasible.

No Action Alternative. The No Action Alternative would not result in construction-related impacts to motorists associated with public services, community centers, or local businesses. No beneficial impacts to public services and facilities would result with the No Action Alternative.

3.3.5.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Emergency service providers, including the Hawai'i County Fire Department, the Hawai'i Police Department, and the PTA, will be kept informed on the location and schedule of construction along the length of the project.

- Traffic control plans prepared for construction of Saddle Road will include provisions for allowing emergency vehicles to pass through construction zones without delays and to have unimpeded access to roadside facilities at all times.

Fire prevention and suppression measures are discussed in detail in the FEIS - Part I, 3.9, Fire Hazard.

3.3.6 Travel Patterns for Motorists, Pedestrians and Bicycles

3.3.6.1 Affected Environment

Information for this section is derived from the *Traffic Study, Saddle Road, Island of Hawai'i* (Rust 1994), as well as interviews and four community surveys of road users, government and commercial entities, tourists, and the general public.

3.3.6.1.1 Inter-regional Traffic: Sources and Volumes

Saddle Road serves a variety of purposes including access to PTA, Mauna Kea and Mauna Loa, and a connection between East and West Hawai'i. The purposes of travel include recreation, shopping, business, and limited commuting. Astronomers, support staff, and suppliers with bases in Hilo or Waimea use the road as access to Mauna Kea. Ten observatories are currently present, and three more are under construction. Depending on the schedule of activity, between dozens and hundreds of trips per day are associated with astronomy. Hunters, hikers, and recreationalists also use Saddle Road. Many survey respondents stated that they chose to use Saddle Road because it saves time, and many stated a concern with the safety of this route.

Over 12,000 military vehicles made trips to the PTA in 1993, primarily in convoys between PTA and the port at Kawaihae. Because they travel in large convoys at low speed, military vehicles tend to disrupt traffic flow. Military trips comprise approximately 2 to 4 percent of all Saddle Road traffic.

Twenty-five percent of visitors surveyed reported having used Saddle Road, mostly in order to save time. Many who travel the road, however, also take advantage of its attractions. A large number reported visiting Mauna Kea, Mauna Loa, and Mauna Kea State Park. The main reason cited in the survey for not using Saddle Road was the car rental contract prohibition. Few cited

safety as a restricting factor. When asked if they would have traveled on Saddle Road if it had been safer and more accessible (and presumably permitted under their rental contract), a large majority indicated that they would do so. For additional discussions of travel patterns, refer to Section 2.5.1, Section 3.4.3.1, and Part III, Terry 1998.

3.3.6.1.2 Function and Use of Saddle Road in Individual Communities

For communities located along Saddle Road, it functions not only as a cross-island arterial but also as a neighborhood road, avenue for bicycling and walking, and link or barrier to community interaction.

Kaumana. Saddle Road bisects Upper Kaumana. Until the Puainako Street extension is constructed, all Saddle Road traffic will be conducted directly through the community. Many residents have expressed concern at a widespread disregard of the speed limit by cross-island drivers and the danger this creates for elderly drivers and pedestrians. Nevertheless, some residents choose to walk along the lower section of Saddle Road. Many report daily, semi-weekly or weekly walking schedules in Kaumana proper or above MP 8, where the widened shoulders and scenic vegetation provide a pleasant walking environment. Bicycling is not common with the exception of children biking within Kaumana.

Waiki'i. Saddle Road provides the only access to Waiki'i Ranch. Residents report dissatisfaction with the current state of road maintenance, speed limit enforcement, vehicle mix and traffic volumes. Nearly all Waiki'i residents asked about walking or bicycling stated that the current road was too dangerous. Superior alternate pedestrian, bicycle and equestrian pathways exist within the ranch and allow for safe recreation. However, crossing Saddle Road remains a problem.

PTA. The PTA incorporates a total of 44,100 ha. The base camp occupies 40 ha and contains approximately 200 temporary buildings. Bradshaw Army Airfield supports fixed-wing aircraft as large as C-130s. The remaining area is used for military training, with a mission of combat training for units up to brigade strength. Activities include simulated war games, live firing of both small and large caliber weapons, tactical bombing exercises and related activities. The base is used on a rotating basis for short-term training exercises involving between 1,800 and 3,000 DOA, U.S. Marine Corps, Hawai'i National Guard, Army Reserve, Air Force and foreign military personnel. Training activities are in operation approximately 260 days per year.

Saddle Road passes between the base camp/airfield and the principal training areas. The DOA points out that there is a considerable conflict between civilian and military traffic, with the potential for serious accidents. In addition, the efficiency of training is considerably reduced by the current location of the road (ref: FEIS - Part I, 3.1.1.1).

Other Areas. Although not located along Saddle Road, Waimea and Waikoloa Village are indirectly affected by it. The majority of cross-island traffic passes through Waimea instead of

using Saddle Road, increasing traffic volumes, conflicts with pedestrians and bicycles, and possibly accident rates. Waimea residents have expressed a keen interest in the potential of the project to reduce traffic in their area. Conversely, the current terminus of Saddle Road on Mamalahoa Highway (SR 190) discourages its use as a corridor to South Kohala, via Waikoloa Road. Waikoloa residents are also watching the progress of the Saddle Road, and are especially interested in the potential for a terminus at the junction of Waikoloa Road and Mamalahoa Highway (SR 190), which would encourage an increase in coast-bound traffic through their community.

3.3.6.2 Environmental Consequences

All Action Alternatives. Construction activities cause speed limit reductions within the construction zone, inconvenience in accessing driveways and side streets, periodic closures of one or more travel lanes, and resultant delays to "pass-through" traffic. In addition, construction activities present obstacles to vehicles crossing the highway. Construction-related impacts would be short-term and temporary in nature.

Construction would be completed in phases, affecting only a portion of the road at any one time. Construction of segments on the existing road alignment, EX-2, EX-3, or EX-4A, would most directly affect Saddle Road traffic. With the selection of Segments W-2, W-3, PTA-1, PTA-3, or E-3, which do not follow the existing Saddle Road alignment, impacts to motorists, pedestrians, and bicyclists would be less notable since much of the construction work will be physically separated from Saddle Road traffic.

W-2 and W-3. With the selection of Segment W-2 or W-3, the segment of Saddle Road through Waiki'i would be avoided. Temporary, construction-related impacts to the community of Waiki'i would be expected to be minimal. Building Saddle Road on Segment W-2 or W-3 would reduce traffic volumes considerably within the community of Waiki'i. With the W-2 alignment, traffic levels on Waikoloa Road would be expected to increase.

EX-2, PTA-1 and PTA-3. The selection of PTA-1 or PTA-3 would cause the least impact to cross-island traffic from construction activities.

EX-3. Improving Saddle Road within Section III would result in construction-related inconveniences and delays to motorists passing through the area; however, since no communities are located within Segment EX-3, construction-related impacts are not expected to be significant.

EX-4A and E-3. With the selection of Segment EX-4A, construction activities would occur within Kaumana, directly impacting the community with inconveniences and delays to local traffic, bicycles, and pedestrians. Impacts would also occur with the selection of Segment E-3, but to a lesser extent since E-3 diverges from the existing road alignment in the area of Kaumana. The selection of Segment E-3 would cause less impact than EX-4A to cross-island traffic from construction activities. Assuming the completion of the Puainako Street extension, E-3 would

avoid much of the impacts to local traffic, pedestrians, and bicyclists throughout the length of Kaumana Drive.

The increases in traffic volumes projected for Saddle Road would be expected to result in direct, long-term impacts to Kaumana if Segment EX-4A is selected. With EX-4A, local traffic attempting to cross Saddle Road or turning left into traffic from one of dozens of streets and driveways in Kaumana, would be affected by notably greater traffic volumes and associated delays. Increased traffic of the magnitude anticipated would serve to congest local traffic, and would be expected to create more hazardous conditions for crossings by pedestrians and bicyclists.

No Action Alternative. No construction-related impacts would result from the No Action Alternative. With the No Action Alternative, increasing traffic volumes would result in a deterioration of LOS from D to E.

3.3.6.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Whenever feasible, construction activities will be scheduled to avoid construction-related delays on Saddle Road during those annual events known to generate significant cross-island traffic, including the Merrie Monarch Festival, the Ironman Triathlon, the Mauna Kea Relay road race, and the Waiki'i Ranch Music Festival.
- As feasible, construction-related delays will be minimized during normal rush hours for commuters.
- Construction information, anticipated delays, or closures, will be publicized on a regular, on-going basis through posted advertisements, radio and newspaper bulletins, and road signs at each end of Saddle Road and along Mamalahoa Highway (SR 190) and Kaumana Drive in Hilo.

3.3.7 Environmental Justice

Consistent with Title VI of the 1964 Civil Rights Act and Executive Order 12898 on Environmental Justice, all program and project actions and decisions must ensure that minority and low-income populations do not experience disproportionately high and adverse human health or environmental effects and activities. Environmental justice is a term that refers to social inequity in bearing the burdens of adverse environmental impacts. Certain socioeconomic groups in the United States, including ethnic minorities, the elderly, rural residents and others, have historically experienced a disproportionate share of undesirable side-effects from locally undesirable land uses such as toxic waste dumps, landfills, and freeway projects (Terry 1997, Tech. App. Vol. V).

The policy of the FHWA with regard to environmental justice is to address whether any minority or low-income group is disproportionately impacted by a proposed project and identify mitigation measures to avoid or minimize any adverse social impacts. This policy is in keeping with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations.*

In conversations with the Office of Assistant Secretary for Planning and Evaluation at the Department of Health and Human Services (DHHS), it was strongly suggested that the Census Bureau's poverty threshold be used in an analysis of environmental justice rather than DHHS poverty guidelines. Accordingly, the poverty threshold of $13,001 per year (1998 average poverty threshold preliminary estimate for a three person family unit based on 2.86 persons/household as shown in the 1990 Census of Hawai'i County, Hawai'i) was used when evaluating the potential impacts of the project on low-income populations in Waiki'i and Kaumana, the only communities through which the project could pass. Although the census data are currently eight years old, they remain an extremely reliable source of information in older, established neighborhoods in Hawai'i, which have experienced relatively little change in neighborhood character in the 1990s. There are no families below this poverty level in Waiki'i, a predominately high-income ranching subdivision. Although average household incomes are slightly lower in Kaumana, few are in poverty.

In terms of major categories recognized by the U.S. Census, the majority of residents in the State of Hawai'i are Asians/Pacific Islanders (61.8 percent), with the remainder mostly white (33.3 percent). African-Americans comprise 2.5 percent of the population. This breakdown, however, inadequately describes the ethnic makeup as perceived by Hawai'i residents, who distinguish among Native Hawaiians, Samoans, Japanese, Chinese, Koreans, and Filipinos. In addition, more than half of all births in Hawai'i since 1970 involve parents of different or mixed ethnic backgrounds. Consequently, the conventional definition of ehtnic affiliation is problematic in Hawai'i. Discussions of environmental justice in Hawai'i generally involve the Native Hawaiian population, which is usually recognized as disadvantaged in terms of income, health, home ownership, and many other measures of socioeconomic well being.

The only communities affected directly by the presence of Saddle Road are Kaumana and Waiki'i. Residents of the latter are mostly white with above-average incomes. Kaumana is a microcosm of Hilo, with effectively the same low income and ethnic proportions as the island as a whole. In summary, there are only slight demographic differences between the island as a whole and the areas potentially affected in any adverse manner by the proposed Saddle Road improvements.

As a result of the demographics involved and the location of the selected alternatives, there are no concentrations of minority or low-income groups in the project area that will experience disproportionately high and adverse impacts from construction, ROW taking, long-term noise and air quality, and other direct, indirect or cumulative impacts from the implementation of the

Recommended Alternative, which by-passes both Waiki'i and Kaumana (W-3 south of Waiki'i and E-3 south of Kaumana; ref: FEIS - Part I, 2.5).

3.3.8 Native Hawaiian Culture and Values

A study of Native Hawaiian Culture and Values was prepared for the project and is included in an appendix to the Social Impact Assessment (Terry 1997, Tech. App. Vol. V). The methodology included interviews with HHL homesteaders, HHL homestead leaders, native Hawaiians (those eligible for HHL benefits) on the HHL waiting list and living in areas with designated home lands, and those ethnic Hawaiians who are not eligible for HHL benefits.

3.3.8.1 Affected Environment

3.3.8.1.1 Native Hawaiians

Native Hawaiian culture began at least 2,000 years ago when people from other Polynesian lands arrived to *Hawai'i nei* (the archipelago). Hawaiian culture developed independently from the rest of Polynesia, although there was intermittent input by later Polynesian visitors until at least the 1200s when the last of these transoceanic voyages took place. Stages of development of Hawaiian culture include the settlement era and the era of high culture.

- Settlement Era. The settlement era is estimated to have started 25 BC (before the Common Era) to 125 AD and ended about 1100 to 1200. It encompasses settlement from southern Polynesian communities, development of stable water and food sources, and acclimatization of these settlers and their culture to the new environment. These settlers adapted beliefs and practices of their southern islands culture to the Hawaiian islands. Their religious establishment, food culture, societal structure, and clan system were all altered to form a new Hawaiian culture.

- Era of High Culture. The era of high culture includes the refinement of the Hawaiian society in all aspects from 1200 to the time period of around 1800. This era of high culture saw the coalescing of political power through powerful military chiefdoms that at times took over an entire island or multiple islands. The state religion was an integral part of the political structure. This system was the *kapu* system, which became the backbone of the Hawaiian ruling caste and legal system. The *kapu* system regulated behavior and dealt out punishment for infractions. Another parallel system, as powerful as the *kapu*, was the *'aumakua* worship, a worship system that serviced clans and extended families. This family worship utilized deified ancestors as their gods and guardians who were seen as empathetic yet powerful clan and family spiritual agents. These 'aumakua provided security and support of the family system's cultural beliefs and practices.

In 1819, the *kapu* system was abolished by the ruling caste and the Hawaiian Kingdom evolved into a westernized constitutional monarchy. In 1893, the legal government of Queen Lili'uokalani was overthrown from power. A two generation decline in Hawaiian socioeconomic status took place during the 1900s and was not arrested until the Hawaiian Renaissance phenomena began in 1970.

3.3.8.1.2 Hawaiian Home Lands Program

The Hawaiian Homes Commission Act of 1920 (HHCA) of the United States Congress created the Hawaiian Home Lands Program (HHLP), which evolved into the current agency of the DHHL. This law created a land reserve of 80,000 ha to be used by native Hawaiian homesteaders to rehabilitate themselves and, by inference, their culture. Eligibility to receive land depended upon one's native Hawaiian blood quantum. Anyone with at least 50 percent of the blood of those people inhabiting the Hawaiian islands prior to 1778 was eligible to apply for HHLP leasehold land. This act split the Hawaiian race into two groups with differing legal statuses. Those with 50 percent or more Hawaiian blood were now labeled Native Hawaiian. Those with less than 50 percent Hawaiian blood were labeled Hawaiian.

The DHHL's major focus is to facilitate the distribution of 99-year homesteads to the native Hawaiian individual. Currently, the individual native Hawaiian must seek financing to construct improvements on these lands. Most homesteaders look to the DHHL for financial aid since the HHCA and DHHL regulations forbid the mortgaging of the lease as collateral to any lending institution. The DHHL receives its funding from the State of Hawai'i government.

Three categories of leasehold lands were allowed, which include residential homesteads, agricultural/farming homesteads, and pastoral/ranching homesteads. The project corridor is adjacent to or within DHHL pastoral/ranching lands. A few homestead pastoral leases are located near the proposed alignments. Only one of the pastoral leases has a residence. At this time the DHHL has several pastoral general leases to non Hawaiians on the Mauna Kea slopes. The boundary of the homestead pastoral leases can be roughly described as the present Saddle Road, the Mauna Kea observatory access road, the Keanakolu road, the Pu'u 'O'o ranch area, and the lower rain forest area. The DHHL has not developed any planning document or other planning material within the last five years that designates the area of the proposed alignments as other than pastoral lands. Hawaiian Homes lands within the study area are depicted on Figure 3.3.3, *Hawaiian Homes Commission Land.*

3.3.8.1.3 Traditional and Spiritual Native Hawaiian Environment

3.3.8.1.3.1 Vertical Land and the Importance of Place Names

The projected alignments of Saddle Road traverse the *'apana* (political land sections or districts) of Hilo, Hamakua, and Kohala and the *ahupua'a* (political subsections of the 'apana) of Waimea, Waikoloa Uka, Pa'auhau Uka, Ka'ohe, Humu'ula, Pi'ihonua, Ka'umana, Punahoa, and

Ponahawai. The most prominent, celebrated, and religiously important of all areas traversed by the project is Mauna Kea, a natural land feature (ref: FEIS - Part I, 3.19.3.1.3).

The road alignment involves minimal land space from within these land sections, but it travels through the upper region of this island, an area which is considered to have religious importance to Native Hawaiians. An initial investigation into place names reflects the relationship of this area of concern with the indigenous people, their philosophy of life, and their gods.

The popular interpretation of Mauna Kea is "white mountain." Mauna Kea is known around the world, and is regarded by many as the highest island mountain, the highest mountain in the world from below sea level, and the best mountain from which to make astronomical observations. To the Native Hawaiian, Mauna Kea is a *Kupuna*, a grandparent or ancestor, and an *One hanau*, birthplace or home.

Lono-nui-akea was the original name for the Island of Hawai'i. It is the sacred name of the god Lono. Lono is the god of stormy weather, dark clouds, and rain. Throughout Polynesia, two islands were honored as *Ka inoa akua* (the god name, or namesake). The Island of Hawai'i was one of these two.

Hamakua, according to Native Hawaiian oral history was a name given by Hawaiiloa (a legendary navigator who traveled the ocean for many generations) to his youngest son. The 'apana of Hamakua houses the very top of Mauna Kea and stretches to Mauna Loa. The ahupua'a of Ka'ohe is within Hamakua and like this 'apana envelopes the very top of Mauna Kea and stretches to Mauna Loa. The word "Ka'ohe" simply means "the bamboo." Bamboo was a vegetable manifestation of the primordial god Kane and was used as a water carrier. Water trapped in the upright green bamboo was given as offerings to the gods or used medicinally. Ka'ohe was perhaps a description of the many river beds which time and water carved through that section of Hamakua through the process of erosion. These are the land sections on which the very top of Mauna Kea rests.

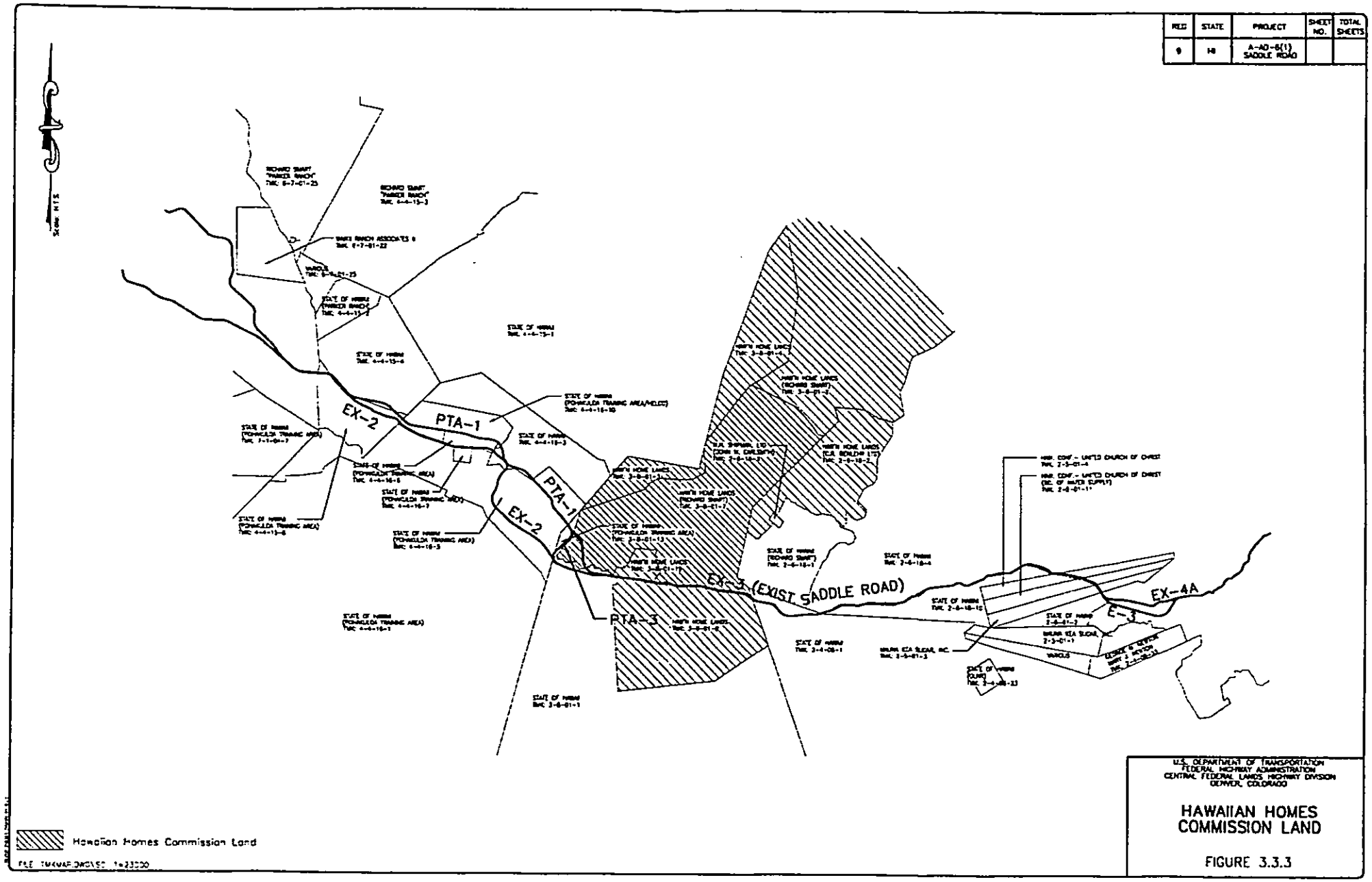
The ahupua'a of Humu'ula parallels Ka'ohe on the Hilo side of the mountain. Humu'ula was a kind of hard red, brown, yellow or green rock. The red and brown rock was probably more commonly found in the uplands, or *Humu'ula ma uka* area.

Another landmark within the project vicinity is Ka Pu'u-a-Pele. The top of this cinder cone marks the joining of the 'apana of Kona, Kohala, and Hamakua. These large cinder cones distinguish land boundaries.

3.3.8.1.3.2 The Hiapo

Wakea and Papa are the original parents of native Hawaiians. Mythologically they are the marriage of sky and earth: Wakea, Sky Father and Papa, Earth Mother. Between the two all things were born. Mauna Kea is the *piko* (center of a beginning or ending) of the island. This

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

HAWAIIAN HOMES COMMISSION LAND

FIGURE 3.3.3

piko is the initial provider of the land mass of Hawai'i mokupuni. Hawai'i was also the *hiapo*, or first island child, of Papa and Wakea. The responsibilities and resources of Hawai'i and Wakea are needed for the growth and well-being of the island and all living forms of this mokupuni.

The *kalo* (taro, a staple food) was Wakea and Papa's first food child and regarded as an elder brother who fed all indigenous natives, or *kanaka maoli* from the beginning of time today. During the time of *ali'i* (chiefs, elite of the society) it was important for them to trace genealogy to the kalo and eventually to Wakea and Papa. When the genealogy could prove the connection they received the status of the senior line or hiapo line. Mauna Kea falls in the senior line genealogy.

3.3.8.1.3.3 The Importance of "Kane-i-ka-wai-ola," Water

The Wakea and Papa beliefs and practices, including the tribute and respect for hiapo and kapuna, extend to contemporary times. Ancestral memory reminds the native Hawaiian that the mountain, like their parents, is the well-spring and provider of physical and spiritual nourishment.

Strands of information from the past are found today in songs and people's actions. Besides land, water is a vital element of life and living. The high mountains attract clouds, then the clouds shed their water and the water soaks into the earth.

The Pohakuloa area has Lilinoe as the female deity of misty rain and heavy fog, while Poliahu is the snow deity which adorns the top of Mauna Kea during the winter. These male and female water forms both belong to the Mauna Kea area.

3.3.8.1.3.4 The Knowledge of Total Environment

The ancestors of Native Hawaiians were island people and used the ocean to travel from island to island. Due to the vastness of the ocean and the limited land base, the measurement for survival was the ability to acquire food. Resources for the acquisition of food included the reef, fresh water, and fertile soil. The Hawaiian moon calendar was devised to assist Hawaiians in gathering and planting on fortuitous days. Using the moon calendar, the forefathers calculated the established cycles of all life forms. It was based on many generations of observation and practice, and it proved successful.

Other forms of traditional literature condone the fact that the ancestors made an effort to understand the intricacy of relationships of diverse life forms. One of the reasons for this was to protect and help sustain the food sources. They recognized a hierarchical order as well as a system of harmony and interaction of all existing life forms known to them.

They observed and made critical analyses of their sky, land, and ocean spaces. Rain, ocean, clouds, wind movement, coral species of the ocean, and seeded plants of the uplands are referred

to within a common bond for generating regrowth or as a food source. Kane was responsible for regeneration, and the ocean currents, rain, wind, and clouds move together to make this possible. For food systems to regenerate themselves, the sky, land, and ocean spaces unite in a harmonic and natural rhythm to maintain the currents of water particles and clean air. This movement is known as *lokahi*. Lokahi is a system of working in unity and harmony. This knowledge was passed on through protocol, cultural practices, songs, and stories.

3.3.8.1.3.5 Horizontal and Vertical Land Divisions

Lokahi is the antithesis of hierarchy. Lokahi is the system which bypasses the hiapo system and does not give precedence to first born or senior line. It is the system which states that everything is equal because everything, no matter how small or large, has a function which is necessary to maintain the overall well being of the whole entity. Native Hawaiian ancestors lived within these two systems and measured everything by this frame of reference.

One example is the division of ocean, sky, and land. These spaces were divided horizontally and vertically. The land division would be of primary concern for the proposed project. The most familiar is the vertical divisions, or sections common to maps of today. The boundary lines run from mountains to the ocean. The vertical boundaries followed mountains, rivers, streams, and cinder cones. These were considered political boundaries because they separated the chiefdomship. Examples of vertical divisions are the districts of Hamakua, Kohala, and Hilo. Smaller divisions (known as ahupua'a) are located within these larger districts. Examples include Waimea, Ka'ohe, Humu'ula, and Pi'ihonua. There are still smaller vertical land sections within the ahupua'a such as Keaukaha and Ke'eke'e.

The natural vegetation growth was the measuring device for the horizontal pattern of the second land division. For this division, vegetation growth dictated land division name changes. The forest, like the coral bed, is the food source and therefore a vital system for the continuum of life and life cycles. The trees house food for birds, insects, animals, and man, and produce seeds for regeneration. The forest provides vegetation used for medicinal purposes, spiritual adornment, housing construction, and many other items.

The development of sugar cane, and other economic crops, replaced much of the natural vegetation known by the ancestors. The following information identifies the horizontal space and the kinds of flora typical to each of these horizontal land areas.

Kuahiwi. Kuahiwi means the mountain top, the backbone of the island, which is too high in elevation for heavy vegetation to grow. It is a very important area because of its height.

Kualono. Kualono is the region near the mountain top. Little vegetation grows in this area. The mamane and naio are the only hardy trees to grow at this height. Both of these are hardwood trees. The flower of the mamane was a specialty for the ali'i because of its shape and yellow

color. When he wanted a special lei he would send his runners to fetch mamane flowers. 'A'ali'i can also be found at this height.

Waoma'ukele. Waoma'ukele is the region named for the wet, soggy ground. This area was located in the rain belt of the island, especially on the ko'olau side of each island. The typical trees of this area are the very large koa, 'ohi'a, varieties of lobelia, and mamane.

Waoakua. Waoakua is the forested region below the waoma'ukele. This area is said to be occupied by spirits of the forest. Man seldom ventured into this area during ancestral times except when a particular kind of tree was needed and could not be found elsewhere. The large trees acquired from the waoakua and the waoma'ukele deserved substantial offerings. This is the region where the forest had a greater variety of trees. Some of the trees found are kolea, ho'awa, kopiko, maile, maua, alani, koa, and 'ohi'a.

Waokanaka. Waokanaka is the forested region *makai* (toward the sea) of the waoakua. This area was frequented by native Hawaiians. They found wood and other materials for weapons, house construction, tools, surfboards, and canoe accessories. They harvested dye, collected medicine, collected bird feathers, gathered vegetation for leis, gathered vegetation for the kuahu, gathered material for making rope, and many other useful things for everyday living. The trees in the waoakua are also found in this area, but the trees of this area may be smaller. Other flora found in this area include pilo, hapu'u, holei, papala, hau kuahiwi, palapalai 'olapa, and mamaki.

Kula. Kula referred to the upland grassy plains. The plants of the kula included'ilima, ma'o, 'ama'u, 'a'ali'i, 'uluhe, and pili.

Kahakai. Kahakai referred to the edge of the ocean. At the kahakai was found the niu, hala, kaunaoa, kamani, hau, milo, naupaka, lama, and alahe'e. All plants were recognized as useful to the Hawaiian.

3.3.8.1.3.6 Philosophy and Relationship to the Forest

A summary of resources and concepts of sufficient importance to potentially affect the quality of life for native Hawaiians and their relationship to the environment, and especially, their relationship to the land are presented as follows.

- Importance of vegetation and the identity of the land sections.
- High cultural value of older or larger trees and kipuka which normally housed older trees.
- Priority to promote new growth through the non disturbance of seed producing forest areas within the waoma'ukele and waoakua. Hawaiians did not penetrate these areas if the trees they needed were available elsewhere.

- Importance of food source and regenerative energy of the forest.
- Philosophy of "a life for a life." When it was necessary to cut a large tree from the high forest, an offering of a human sacrifice was made.
- Importance of Waoma'ukele as a good source of water, and for maintaining the richness of the rainforest.

Native Hawaiians are people whose daily lives and culture are rooted in and integrated with the surrounding natural and biological world. They recognized and practiced respect for hierarchy or hiapo for man and land alike. The mountain is the sacred child of Wakea, and it is the source for the land. The mountains and land were genealogically connected to native Hawaiians through the original ancestor, Wakea and Papa. The mountains or land, water, and sky were a necessary part of the life cycle. The taro was regarded as an older brother of the land and provided sustenance. The coral was also an older brother (of the sea) and was the means through which other food could be acquired. The hierarchical system assigns rank to man, god, and the elements of the environment. Within the hierarchical food system another set of rules apply. The older or larger trees are primary and most important. The other animals that use these trees as their residence or food source are secondary.

The lokahi system complements and maintains the well being of the whole entity. Everything is important because each has a function.

Water was and is necessary for all life forms. Laws for water and the use of water were formulated so all had exposure to water. Water that did not touch ground was highly prized. Such as the water in the lake on Mauna Kea and the water in the piko of the taro leaf. Water that moved underground or over land from the mountain to the sea was sometimes funneled into irrigation channels and fed the older brother kalo and was also treasured. The mountain and the waoma'ukele attracted the atmospheric water.

3.3.8.1.4 Native Hawaiian Cultural Features and Sites

Based on native Hawaiian cultural background and philosophy, the following cultural features and sites were identified within the project corridor: mamane forest (ref: FEIS - Part I, 3.13.1.2.4), kipuka (ref: FEIS - Part I, 3.13.1.3), prehistoric trails (ref: FEIS - Part I, 3.19.1.1), and historic trails (ref: FEIS - Part I, 3.19.1.2).

The cultural value of mamane/naio forest and kipuka is associated with the age and size of the trees (ref: FEIS - Part I, 3.3.8.1.3.6). Prehistoric trails were developed and used by Hawaiians long before Western contact of the 1800s. Historic trails were developed following Western contact, as ranching and tourism increased traffic to and through the Saddle. Two trails intersecting the project area were identified by the archaeological survey (ref: FEIS - Part I,

3.19.2). The Hilo-Pu'u 'O'o Trail is historic, but it probably follows the general route of an earlier prehistoric trail. The Pu'u 'O'o-Volcano Trail is prehistoric.

3.3.8.2 Environmental Consequences

All Action Alternatives. The only native Hawaiian cultural features that would be negatively impacted by the proposed project are the mamane forest and kipuka. None of the other features or sites are seen to have a negative native Hawaiian cultural impact. No known heiau sites, burial sites, water sources, cinder cones, or mountains would be impacted by the proposed alternatives.

Some native Hawaiian groups may have concerns that negative cultural impacts will result from project implementation due to the belief that within the Saddle area there exist detrimental or other such residual forces. Another belief is that intrusion in areas not previously despoiled or developed will result in the release of negative energy, without the proper protocol (ritual) of "release" or "sanctification."

With any of the action alternatives, Saddle Road access will be improved and the number of vehicles using the road will increase dramatically in the future. It is anticipated that with these improvements in access and increased use of Saddle Road some unplanned or unregulated increase in public access to forest or natural areas will occur within the region, potentially resulting in increased degradation of the forest and its resources.

Section I

W-2 and W-3. No known native Hawaiian cultural features or sites are present along Segments W-2 or W-3 and no native Hawaiian cultural impacts are anticipated.

Section II

All action alternatives within this section would directly impact mamane/naio forest vegetation. Loss of mamane/naio forest would be offset by implementation of mitigation proposed for the endangered Palila (ref: FEIS - Part I, 3.18.3). Proposed restoration of Palila habitat would include setting aside 3,908 ha for mamane/naio forest enhancement. Cattle and feral ungulates would be removed from the area. This would ultimately foster the development of mature mamane forest.

No direct negative cultural impact on HHL is expected with implementation of any of the action alternatives. It is not anticipated that any of the action alternatives would diminish the ability of the DHHL to effectively administer its lands.

EX-2. A small portion of the existing Saddle Road through Section II cuts through mamane/naio forest. With the selection of EX-2, the existing road footprint would be widened resulting in

direct impacts to mamane/naio forest vegetation, a negative cultural impact. Using the width of the proposed ROW as the area of greatest potential impact from road construction, the improvements to EX-2 would result in the potential loss of up to 10.8 ha of mamane/naio forest vegetation. The total extent of impact to the forest would be reduced by minimizing clearing limits.

PTA-1. A portion of Segment PTA-1 would cut through the mamane/naio forest. With the selection of PTA-1, a new alignment of Saddle Road would directly impact this mamane/naio forest vegetation, a negative cultural impact. Using the width of the proposed ROW as the area of greatest potential impact from road construction, the construction of PTA-1 would potentially result in the loss of up to 29.7 ha of mamane/naio forest vegetation. The total extent of impact to the forest would be reduced by minimizing clearing limits.

PTA-1 would cross pastoral lands under the jurisdiction of the DHHL. It is not anticipated that implementation of PTA-1 would encourage DHHL to expand pastoral lands in the vicinity of existing mamane forest. At this time, DHHL documents, plans, and policies do not address further pastoral development.

PTA-3. A portion of Segment PTA-3 would cut through the mamane/naio forest. With the selection of PTA-3, a new alignment of Saddle Road would directly impact this mamane/naio forest vegetation, a negative cultural impact. Using the width of the proposed ROW as the area of greatest potential impact from road construction, the construction of PTA-3 would potentially result in the loss of up to 34.3 ha of mamane/naio forest vegetation. The total extent of impact to the forest would be reduced by minimizing clearing limits.

Section III

EX-3. Kipuka are located along the length of the existing Saddle Road through much of Section III. Improvements to Saddle Road through this section would result in adverse cultural impacts unless these kipuka can be avoided. To avoid direct impacts to kipuka from the construction of EX-3, during final design the plans will be adjusted to avoid or minimize impacts to kipuka that harbor native species along this segment.

Section IV

EX-4A and E-3. Kipuka are also located along EX-4A and E-3. During final design the plans will be adjusted to avoid or minimize impacts to kipuka along this segment that harbor native species.

No Action Alternative. No impacts to native Hawaiian cultural values would result from the No Action Alternative.

3.3.8.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Proper cultural protocol will be completed by a native Hawaiian who follows the ways of the old culture to release and sanctify the construction project.

- For Segments EX-2, PTA-1, PTA-3, EX-3, EX-4A, and E-3, impacts to native Hawaiian cultural values (associated with the mamane/naio forest and the kipuka) will be minimized in sensitive areas by limiting the area of impact and the width of ROW needed.

- During final design the alignment for Segments EX-3, EX-4A, and E-3 will be adjusted to avoid or minimize impacts to kipuka that harbor native species.

- BMPs will be used during construction to prevent runoff from damaging kipuka.

The potential for increased runoff into kipuka or other sensitive areas will be mitigated as necessary by use of appropriate drainage structures (ref: FEIS -Part I, 3.11.3). For Segments PTA-1 and PTA-3, mitigation developed for the replacement of Palila Critical Habitat (ref: FEIS - Part I, 3.18.3) serves also to compensate for negative cultural impacts to mamane/naio forest.

3.4 ECONOMICS

East and West Hawai'i differ in their regional economies. Government functions and the University of Hawai'i at Hilo are located on the east end of the island in Hilo, where housing costs are generally lower, while much of the current economic growth and tourism-related growth and employment is occurring in West Hawai'i. Historically, the economy on the eastern side has been based on agriculture, with sugar as the main crop. Other agricultural activities include ranching, flora culture, tropical fruits, macadamia nuts, and coffee. A steady decline in the sugar industry over the past 20 years finally resulted in the closure of the last commercial operations in 1996.

The regional economy on the western side of the island relies mainly on tourism generated from the resorts and ancillary facilities located primarily along the Kona Coast in the districts of South Kohala and North Kona. Overall, economic activities related to tourism have been rapidly expanding since 1980 and expectations are that the economy will continue to expand into the next century.

A declining economy in East Hawai'i has resulted in more people seeking employment in tourism-related activities in West Hawai'i. Currently, there are three routes for travel between Hilo and Waimea/Kailua-Kona. The northern route follows the coastal highway (SR 19) north

from Hilo passing through Waimea and continuing on to Kailua-Kona. The length of the northern route is 87 km between Hilo and Waimea, and 152 km between Hilo and Kailua-Kona. The southern route follows SR 11 southwest from Hilo through Volcanoes National Park and later turns north to Kailua-Kona and Waimea. The distance between Hilo and Kailua-Kona on the southern route is 200 km, and 265 km between Hilo and Waimea. The third route is Saddle Road which extends west and north from Hilo to intersect Mamalohoa Highway connecting with Waimea to the north and Kailua-Kona to the south. The distance from Hilo to Waimea, via Saddle Road, is 97 km and 140 km between Hilo and Kailua-Kona.

Saddle Road is the shortest route between East and West Hawai'i, especially between Hilo and the Kona/Kohala Coast. Although Saddle Road is currently narrow, with steep grades and sharp curves, travel time between east and west is still as low or lower than for the other two routes. Potential impacts resulting from improvements to Saddle Road are discussed under the following headings: employment and income, tourism, time savings, and safety.

3.4.1 Employment and Income

3.4.1.1 Affected Environment

Total employment on the Island of Hawai'i has been expanding since 1980 as expressed in the number of jobs created (Table 3.4.1 *Employment: 1980, 1990, and 1994*). From 1980 to 1994, the number of jobs on the island increased from 38,150 to 57,400, an average annual increase of 3.0 percent. In 1980, according to census information, East Hawai'i generated 26,597 jobs, or almost 70 percent of total island employment. The share of total employment generated on the east side decreased to 63 percent in 1990 and to 60 percent in 1994. The decrease in the total share of employment on the east side is contrasted by gains in West Hawai'i. Total employment on the west side was 11,553 jobs (30 percent of total employment) in 1980, 20,081 jobs (37 percent of total employment on the island) in 1990 and 23,133 jobs (40 percent of total employment) in 1994. The average annual employment growth rate for the 14-year period 1980 through 1994 was 5.1 percent on the west side compared to 1.8 percent on the east side. The overall annual growth rate for the County of Hawai'i was 3.0 percent, and 2.1 percent for the State of Hawai'i during the 14-year period from 1980 through 1994.

TABLE 3.4.1
Employment: 1980, 1990 and 1994

Geographic Area	Number of Jobs		
	1980	1990	1994
County of Hawai'i	38,150	54,365	57,400
East Hawai'i	26,597	34,284	34,267

TABLE 3.4.1
Employment: 1980, 1990 and 1994

Geographic Area	Number of Jobs		
	1980	1990	1994
% of County	70%	63%	60%
West Hawai'i	11,553	20,081	23,133
% of County	30%	37%	40%

Source: 1990 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, Hawai'i; 1980 and 1990 Census Summary Tape File 3A.

Workers in East Hawai'i are faced with declining growth rates in job creation and in the regional economy. At the same time, the regional economy in West Hawai'i appears to be growing at an increasing rate, generating a larger share of island employment. More workers from the east side are responding to the disparity in regional economies by seeking employment in West Hawai'i. As a consequence, cross-island traffic has been increasing and is expected to follow a trend of increasing growth for the next 10 to 20 years.

Income trends for the east and west sides of the island parallel employment trends (Table 3.4.2, *Income Characteristics: 1980 and 1990*). In the South Hilo District on the east side, median income was $20,689 per family in 1980 and grew at an average annual rate of 5.5 percent to reach $35,506 per family in 1990. This compares to a 5.6 percent average annual growth rate for the County of Hawai'i, which had a median family income of $19,132 in 1980 and $33,186 in 1990. In West Hawai'i, the growth rate of median family income was greater than the east side, or the County as a whole. Median family income, between 1980 and 1990, increased from $21,100 to $39,329 in the North Kona District (6.4 percent annual growth rate), from $15,804 to $35,263 in the South Kona District (8.4 percent annual growth rate), and from $15,417 to $40,848 in the South Kohala District (10.2 percent annual growth rate).

TABLE 3.4.2
Income Characteristics: 1980 and 1990

	1980 Median Family Income	1990 Median Family Income	Annual Growth Rate (%)
County of Hawai'i	$19,132	$33,186	5.6
East Hawai'i			
South Hilo	$20,689	$35,506	5.5

TABLE 3.4.2
Income Characteristics: 1980 and 1990

West Hawai'i			
North Kona	$21,100	$39,329	6.4
South Kona	$15,804	$35,263	8.4
South Kohala	$15,417	$40,848	10.2

Source: 1990 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, Hawai'i; 1980 and 1990 Census Summary Tape File 3A.

Note: The values presented for South Hilo, North Kona South Kona, and South Kohala were based on a combination of applicable census districts and are not necessarily commensurate with those values in the Socioeconomics Section of this document (Table 3.3.7).

Increasing employment opportunities in West Hawai'i have resulted in increased income levels in the region. The west side regional economy also provides employment to a portion of the work force residing on the east side of the island which translates into increased income. An estimate of the contribution to median income growth on the east side from employment on the west side is not available at this time. Census data clearly indicate that income growth in West Hawai'i increased at a faster rate than East Hawai'i income growth.

3.4.1.2 Environmental Consequences

All Action Alternatives. Construction activities for any of the action alternatives would generate direct and indirect employment. Activities directly involved in construction would generate direct employment. Expenditure of construction funds will generate related economic activities (e.g., purchase of materials and services for construction, expenditure of earned wages, etc.) which create indirect employment opportunities. An analysis of the construction industry estimated that 24.5 full-time equivalent jobs are generated from every $1.0 million of construction expenditures, and that the ratio of direct employment to total employment is 1.0 to 3.2 (DBEDT 1989).

The construction period for Saddle Road is estimated to be nine years, beginning in 1998 and finishing in 2006. Annual construction expenditures have been estimated as percentages according to the preliminary schedule presented in Table 3.4.3, *Estimated Annual Construction Expenditures.*

TABLE 3.4.3
Estimated Annual Construction Expenditures

Year	Percent of Total Construction Costs
1998	3 percent
1999	10 percent
2000	10 percent
2001	14 percent
2002	14 percent
2003	9 percent
2004	17 percent
2005	15 percent
2006	8 percent

Based on the preliminary construction schedule, the lowest cost action alternative (the alternative consisting of Segments W-2, EX-2, EX-3, and EX-4A, which would cost $157.1 million) would generate from 124 to 674 full-time jobs, depending upon the construction year, and average 428 jobs throughout the nine-year period. The highest cost action alternative (the alternative consisting of segments W-3, PTA-3, EX-3, and E-3, which would cost $167.4 million) would generate from 140 to 689 full-time jobs and average 456 jobs for the construction period. Direct employment would range from 39 to 215 jobs and indirect employment would range from 85 to 474 jobs.

According to analyses of the construction industry (DBEDT 1989), 46.6 percent of the total jobs created by the project would be on the Island of Hawai'i while most of the remaining 53.4 percent would be generated on other islands statewide. The 46.6 percent of total jobs generated on the Island of Hawai'i (124 to 689) through implementation of the action alternatives would be about 1.0 percent or less of the total jobs in Hawai'i County of Hawai'i during 1994 (58,034), the latest year of employment information available (Census 1990). The percentage would be even less during the construction period because the total number of jobs in the County is expected to grow annually, therefore, the 1994 level is most likely already less than actual island employment. Project construction activities will have minimal impact on total island employment.

In addition to construction-related employment, reduced travel inconveniences would increase the attractiveness of employment and income generating opportunities in West Hawai'i for

workers residing in East Hawai'i. Increased permanent employment on both sides of the island would very likely be generated.

Income impacts from the project are also estimated using data from the State of Hawai'i Input-Output Model (DBEDT 1989). The input-output model estimates that $0.832 of income is generated for each dollar spent on construction. Construction costs for the action alternatives range between $157.1 and $167.4 million and would generate an average total income between $14 and $15 million per year, ranging from a low of $4 million in the first year of construction to a high of $23 million in the seventh year of construction. Approximately 60 percent of total income is estimated to be direct income while the remaining 40 percent is either indirect or induced income. Increased income from the project during the construction year of highest expenditures ($23 million) is approximately 1.0 percent of the 1993 total income for the County ($2.3 billion).

Alternatives which use Segment W-2 would increase the distance from Hilo to Waimea over that of the existing Saddle Road by 5.6 km. Alternatives which include W-3 would cause an increase of 9.8 km. Commuters and other travelers, with origins and destinations in Hilo and Waimea, would find that any improvements in travel time on the new Saddle Road are offset with the relocation of this road to Segment W-2 or W-3.

On the other hand, travel distances between Hilo and the resort areas in South Kohala and Kailua-Kona would be shorter than the existing Saddle Road by 9.7 km with alternatives using Segment W-2 and by 16.8 km with alternatives using Segment W-3. Estimated distance from Hilo to Kailua-Kona via an improved Saddle Road would range from 122.2 to 130.2 km, depending on the particular alternative selected.

No Action Alternative. The No Action Alternative would leave conditions of Saddle Road primarily unchanged. Traffic and congestion would increase along all cross-island routes, potentially decreasing the attractiveness of employment and income opportunities in West Hawai'i. Some workers may choose not to seek cross-island employment opportunities and remain on the east side increasing the number of underemployed and unemployed workers, and resulting in a lower growth rate of median family income.

3.4.1.3 Mitigation Measures

No mitigation measures related to employment and income are merited. Impacts would be beneficial.

3.4.2 Tourism

3.4.2.1 Affected Environment

The importance of tourism to the island economy is reflected in the services and retail sectors. Data from the 1990 Census show that the services sector accounted for 36 percent of all island employment followed by the retail sales sector with 19 percent, combining for a total of 55 percent. Total employment in the retail sales and service sectors is comparable between the east side, with 56 percent, and the west side, about 60 percent.

Data for 1995 show that 1,075,870 total visitors came to the Island of Hawai'i with approximately 33 percent visiting the east side and 67 percent visiting the west side. Tourism on the west side of the island began in earnest in the early 1970s with the development of resorts along the Kona Coast. As of 1994, there were approximately 6,000 hotel rooms on the west side compared to about 1,000 rooms on the east side. In addition, there were over 2,400 condominiums, most of which were located on the west side. According to the West Hawai'i Regional Plan, the South Kohala district alone will have 475 additional resort hotel rooms and 12,000 single and multiple residential units built by 2010. As tourism continues to expand, the population of the west side is expected to increase rapidly, following the same trend of the past two decades.

Presently, rental car contracts prohibit travel on Saddle Road. Tourists are obligated to take the northern or southern routes for cross-island travel which requires additional time. Some tourists do not include cross-island trips in their itineraries because of the extra time, while a small portion violate the rental agreement and use Saddle Road.

3.4.2.2 Environmental Consequences

All Action Alternatives. All Action Alternatives would most likely allow rental car companies to remove driving restrictions on Saddle Road. Improvements would decrease the travel time for tourists traveling between the east and west sides of the island. An improved Saddle Road would most likely increase the number of tourists visiting the east side of the island since, at present, only about one-third include the Hilo area in their itineraries. Tourist expenditures would be expected to increase on the east side of the island with increased visitation. Improved travel conditions would also allow greater access to observatory facilities on Mauna Kea, which may adversely impact some scientific processes while allowing greater visitation of the observatories.

No Action Alternative. Under the No Action Alternative, rental car companies would likely continue driving restrictions on Saddle Road. Tourists wishing to visit the east side of the island would have to choose a more circuitous route on SR 11 or SR 19. A low level of accessibility to Mauna Kea facilities would be continued. Fewer tourists would visit the east side of the island and tourism would most likely be less significant in the regional economy.

3.4.2.3 Mitigation Measures

No mitigation measures related to tourism are merited. Impacts would be beneficial.

3.4.3 Time Savings

3.4.3.1 Affected Environment

Important routes used by frequent cross-island travelers are Hilo-Waimea, Hilo-Waikoloa, and Hilo-Kailua-Kona. Three routes can be used for travel to cross-island destinations: SR 19, SR 11 and Saddle Road. However, SR 11 is from 50 km to 150 km longer than the other two routes, and is generally not used by frequent travelers (Table 3.4.4, *Estimated Travel Time in Minutes*).

TABLE 3.4.4
Estimated Travel Time in Minutes

	Estimated Travel Time (Minutes)		
Route/Action Alternative	**Hilo - Kailua-Kona**	**Hilo - Waimea**	**Hilo - Waikoloa**
SR 19	111	66	92
Existing Saddle Road (No Action)	114	82	95
Action Alternatives	84 - 90	67 - 71	64 - 67

Many travelers prefer SR 19 because higher average speeds can be attained and this route is comparable in distance to Saddle Road. Information from the traffic study (Rust 1994) indicates that average speeds of 80 to 85 km per hour are common on SR 19 compared to average speeds of about 70 km per hour on Saddle Road. The distance between Hilo and Waimea is 91.9 km using SR 19 and 95.8 km following the existing Saddle Road alignment. Taking into account the average speeds of 69.7 km per hour for Saddle Road and 83.5 km per hour for SR 19, and the distance for each route, estimated travel time on SR 19 would be 66 minutes compared to 82 minutes using Saddle Road.

The distance between Hilo and Waikoloa is 112.9 km via Saddle Road and 129.7 km via SR 19. Estimated average speeds from the traffic study were 71.6 km per hour using the Saddle Road route and 84.5 km per hour using SR 19. Although the distance between Hilo and Waikoloa is almost 17 km longer using SR 19 the estimated travel time is 2.5 minutes less because road conditions facilitate higher average speeds. Estimated travel time using Saddle Road was 94.6 minutes compared to 92.1 minutes using SR 19.

The distance between Hilo and Kailua-Kona is 139.0 km using Saddle Road compared to 155.8 km where SR 19 is used. The estimated average speed for the Saddle Road route was 73.4 km per hour for a travel time of 114 minutes. Average speed for the SR 19 route was 84.2 km per hour resulting in a travel time of 111 minutes. As was the case with Hilo-Waikoloa, the distance between Hilo and Kailua-Kona is longer using SR 19; however, the travel time is slightly less because road conditions permit attainment of higher average speeds.

Although distances are longer on SR 19 in most cases, consideration of the factors of average speed and travel time lead many cross-island travelers to use this highway as the preferred route. In addition, SR 19 offers more roadside amenities and improved driving conditions. Improvements to Saddle Road will affect travel time for cross-island commuters as discussed in the next section.

3.4.3.2 Environmental Consequences

All Action Alternatives. All action alternatives will decrease travel time and, in some cases, distance for cross-island travelers. The distance between Hilo and Kailua-Kona, and between Hilo and Waikoloa would be shorter with any of the action alternatives over that of the existing Saddle Road. For example, the distance between Hilo and Kailua-Kona is 139.0 km using the existing Saddle Road alignment compared to distances ranging from 122.2 km to 130.2 km for the action alternatives. The distance between Hilo and Waikoloa is 112.9 km under existing conditions compared to distances ranging from 93.4 km to 98.4 km for the action alternatives. Decreased distances coupled with higher average speeds from improved road conditions would result in reduced travel time between these destinations. Travel time under existing conditions along Saddle Road is estimated to be 114 minutes for Hilo to Kailua-Kona and 95 minutes for Hilo to Waikoloa. Under the action alternatives, travel times would decrease to 84 to 90 minutes for Hilo to Kailua-Kona, a savings of 24 to 30 minutes, and to 64 to 67 minutes for Hilo to Waikoloa, a savings of 28 to 31 minutes.

Travel time from Hilo to Kailua-Kona and from Hilo to Waikoloa on Saddle Road under the action alternatives would also be less than SR 19. Travel time on an improved Saddle Road between Hilo and Kailua-Kona would be 21 to 27 minutes less than SR 19, and 25 to 28 minutes less between Hilo and Waikoloa.

The travel distance between Hilo and Waimea would be longer under the action alternatives than for the existing Saddle Road alignment. The existing Saddle Road distance is 95.8 km compared to 99.8 to 104.8 km under the action alternatives. Although distances are slightly longer, travel time would be shorter for the action alternatives than under existing conditions because of higher average speeds. For example, travel time for the existing Saddle Road is estimated to be 82 minutes compared to 67 to 71 minutes for the action alternatives. Reduced travel times under the action alternatives are comparable to the travel time of 66 minutes for motorists using SR 19 between Hilo and Waimea.

Implementation of any of the action alternatives would significantly reduce one-way travel times between Hilo and Kailua-Kona (21 to 27 minutes) and Hilo and Waikoloa (25 to 28 minutes) when compared to SR 19, the lowest existing travel-time route. A potential savings of 40 to 60 minutes for each cross-island round-trip would benefit motorists using Saddle Road, especially frequent travelers. Hilo to Waimea travelers would have two routes with essentially equal travel times from which to choose.

Time savings has an economic value for both business and non-business travelers. Less time spent driving may be used to increase productivity in the work place, increase leisure activities, etc. An exact value is difficult to determine because of the large number of possible activities and associated values. Nevertheless, an estimate has been made of the value of saving 20 to 30 minutes on a one-way trip for travelers using Saddle Road based on available information.

Road users were grouped into business and non-business motorists. Based upon information obtained from the road users survey (Terry 1997, Tech. App. Vol. V), business travelers were assumed to be 27 percent and non-business travelers were 73 percent of total travelers. Each hour saved by business travelers was assumed to be worth $60 while the time of non-business travelers was assumed to be worth $10.93 per hour, the average hourly wage rate in Hawai'i County. The weighted average value or savings was calculated to be $24.18 per hour.

Information from the Traffic Study (Rust 1994) projected that ADT would increase from 900 to 14,000 between 1994 and 2014 with improvements to Saddle Road. Since improvements to Saddle Road are scheduled for completion in 2007, the subsequent analysis of time savings covers the 20-year period beginning in 2007 and ending in 2026. Traffic is projected to increase from 900 ADT in 1994 to 4,400 ADT in 2014 under existing conditions, without improvements to Saddle Road. Using the projected growth rate for traffic on Saddle Road without improvements, it is estimated that a level of 3,175 ADT will be reached by 2007. The Traffic Study projects a traffic level of 14,000 ADT at the end of the 20-year period following improvements to Saddle Road. The value of time savings attributable to improvements has been estimated using traffic projections beginning with 3,175 ADT and growing to 14,000 ADT at the end of 20 years (2007 to 2026).

The value of saved travel time for each year was estimated by calculating the total hours saved per year and applying the weighted value of $24.18 per hour. For example in 2007, a 20-minute savings in travel time per ADT was multiplied by 3,175 ADT resulting in 1,058 hours per day or 386,170 hours per year. The annual value estimate of $9.3 million is obtained through applying $24.18 per hour to 386,170 hours per year. This procedure was repeated for a time savings of 30 minutes per ADT resulting in an annual value of $14.0 million. Annual values were computed for each year of the 20-year period (2007 to 2026), and the present value in 1997 was estimated to be $75.0 million for 20 minutes savings and $112.5 million for 30 minutes savings (present value calculated using 8 percent discount rate). Although the preceding computations are limited because of data limitations, the results give an indication of the relative magnitude that could be expected in the value of decreased travel time.

Other cross-island routes would be affected during and after construction on Saddle Road. During the construction period (1998 to 2006), increased congestion may occur on SR 11 and SR 19 because delays on Saddle Road may cause travelers to seek alternative routes. After construction, traffic would grow at a lower rate on SR 11 and SR 19 because of the increased usage projected for Saddle Road. Traffic on the alternative routes would probably not be less than existing volumes; however, rates of increase are expected to be lower than if no improvements are made to Saddle Road. Increasing traffic volumes would result in corresponding increases in travel. Average travel speeds on Saddle Road will also decrease as traffic volume increases; however, information is insufficient to estimate the associated values.

Additional employment and income would be generated to the extent that values generated through savings in travel time are reinvested in the island economy. The State of Hawai'i Input/Output Model (DBEDT 1989) estimates that 27.9 jobs are generated for each $1.0 million of gross value product (GVP) generated from a cross-section of 60 industries. If the value of savings in travel time was reinvested in the island economy, direct employment would increase by approximately 834 to 1,251 jobs and total employment would increase from 2,093 to 3,139 jobs. Employment is calculated based on the present value of time savings for 20 and 30 minutes. The DBEDT model estimates the ratio of direct employment to total employment to be 1.0 to 2.51. It is estimated that $31 to $47 million would be generated in direct income and that total income would increase by $52 to $78 million based on the DBEDT model assumption that $694,000 of income is generated for every $1.0 million of GVP. Additional income is based on the present value of time savings. The DBEDT model estimates that the ratio of direct income to total income is 0.60 to 1.0.

No Action Alternative. The No Action Alternative would not result in improvements to Saddle Road and cross-island travel time would remain much as it is today. The fact that less traffic would be attracted to Saddle Road may very likely result in increased congestion on existing routes (e.g., SR 19). Increased ADT would mean higher congestion on all routes which would increase travel time for all motorists, resulting in higher travel time costs.

3.4.3.3 Mitigation Measures

No mitigation measures related to time savings are merited. Impacts would be beneficial.

3.4.4 Safety

3.4.4.1 Affected Environment

The current LOS D reflects the numerous design deficiencies of Saddle Road (ref: FEIS - Part I, 1.6). With these design deficiencies passing demand is very high, and safe passing opportunities are limited, leading to platooning of vehicles and unsafe passing maneuvers.

Although safety is difficult to quantify, one indicator used in the highway systems is the ACC/MVM of travel. Accident data for Saddle Road were provided by HDOT for the nine-year period 1986 through 1994. A total of 626 accidents were reported during the nine-year period. Of these, five had fatalities, 315 resulted in injuries (excluding fatalities), and 306 involved property damage only (Rust 1994).

Saddle Road was divided into three separate reaches in order to estimate ACC/MVM values. Reach 3 extends from the Mamalahoa Highway (SR 190) to MP 36, a total of 17.7 miles; Reach 2 extends between MP 36 and 19, a total of 16.6 miles; and Reach 1 extends between MP 19 and 5, a total of 13.7 miles. Traffic counts for 1986 and 1994 were used to estimate the number of annual vehicle miles driven on each reach. For example, Reach 3 had a traffic count of 791 ADT in 1986 and 1,080 ADT in 1994 for a 4.0 percent annual growth rate. Traffic counts for intervening years between 1986 and 1994 were estimated using the average annual rate of increase for each reach. Reach 2 had a traffic count of 420 ADT in 1986 and 817 ADT in 1994 and an annual growth rate of 8.7 percent while Reach 1 had a traffic count of 488 ADT in 1986 and 877 ADT in 1994 for an average annual increase of 7.6 percent.

Daily traffic count data were multiplied by 365 days per year and the length of each reach to estimate total annual vehicle miles. For example, the 1986 traffic count of 488 ADT for Reach 1 was multiplied by 365 days per year and by 13.7 miles to estimate a total of 2,440,244 miles traveled during the year. The number of accidents per million miles traveled is estimated by dividing 2,440,244 by 1,000,000 and dividing the result into 28, the number of accidents in Reach 1 during 1986. The result is 11.47 ACC/MVM. This exercise was repeated for each reach throughout the nine-year period and is summarized in Table 3.4.5, *Accidents per Million Vehicle Miles, Saddle Road, 1986 to 1994.*

The average accident rate for rural two-lane highways throughout the State of Hawai'i is about 3.0 ACC/MVM. The average 5.43 ACC/MVM for Saddle Road is 81 percent higher than the State average. Although accident data will vary on an annual basis, it appears that a downward trend has occurred in ACC/MVM on Saddle Road since 1990, which peaked at 8.41 ACC/MVM. The most significant decrease is observed in Reach 1 where ACC/MVM rates of 13.0 have been reduced to the 4.0 to 5.0 range in recent years. Indications are that recent road improvements undertaken in Reach 1 have contributed to the decrease in ACC/MVM rates; however, no data are available to analyze this assumption.

TABLE 3.4.5
Accidents per Million Vehicle Miles, Saddle Road, 1986 to 1994

Year	Reach 3 MP 53.7 to 36	Reach 2 MP 36 to 19	Reach 1 MP 19 to 5	Total Distance MP 53.7 to 5
1986	2.94	8.25	11.47	6.34
1987	2.06	7.38	11.93	5.89

TABLE 3.4.5
Accidents per Million Vehicle Miles, Saddle Road, 1986 to 1994

Year	Reach 3 MP 53.7 to 36	Reach 2 MP 36 to 19	Reach 1 MP 19 to 5	Total Distance MP 53.7 to 5
1988	3.05	5.09	13.33	6.18
1989	4.65	6.09	9.78	6.36
1990	5.79	8.01	13.48	8.41
1991	3.82	2.72	5.74	4.01
1992	3.38	4.14	9.23	5.15
1993	1.63	3.87	4.59	3.09
1994	2.44	4.04	4.33	3.43
Average	3.31	5.51	9.32	5.43

The monetary value of accidents is quite variable because many factors are specific to the individual accident such as extent of injuries, fatalities, medical needs and litigation. Accident information for 1986 to 1994 indicates that 5 of the 626 total accidents, or about one percent, included a fatality. Injuries occurred in 315, or 50 percent, of the total number of accidents and property damage occurred in 306, or 49 percent. Information contained in the Roadside Design Guide (AASHTO 1996) estimates that fatal accidents average approximately $1,000,000 (1996 dollars) per occurrence, injury accidents average $72,000 per occurrence, and property damage accidents average $1,875 per occurrence. The 1994 estimate of 900 ADT and the 1986 to 1994 average rate of 5.43 ACC/MVM can be used to estimate that 86 accidents would occur during the year. Combining the percentage distribution of the types of accidents with accident costs makes it possible to estimate costs associated with different accident rates or levels of safety. An accident rate of 5.43 ACC/MVM and 900 ADT for Saddle Road total cost of accidents would equal $4,035,000.

Improvements to Saddle Road are expected to reduce the accident rate on Saddle Road to a level comparable with the State average rate of 3.00 ACC/MVM. A reduction in the accident rate from 5.43 ACC/MVM to 3.00 ACC/MVM would reduce the number of accidents for 900 ADT to 47 and the corresponding accident cost to $2,205,000. In monetary terms, proposed safety improvements to Saddle Road would reduce accidents costs by $1.8 million for a traffic volume of 900 ADT. The annual difference in accident costs can be computed for each year of the useful life of the improvements to provide an indication of the value of the proposed improvements.

According to the Traffic Study (Rust 1994), traffic is estimated to increase over the 20-year period (1994 to 2014) from 900 ADT to 4,400 ADT under existing conditions on Saddle Road. It is assumed that with no improvements to Saddle Road, the 9-year average rate of 5.43

ACC/MVM will continue throughout the 20-year period. With the proposed improvements to Saddle Road, it is assumed that the accident rate will average 3.00 ACC/MVM for the same 20-year period. The difference in the annual cost of accidents between the two accident rates was estimated for each year of the 20-year period. The present value of the difference for each year of the 20-year period was computed to be $43.1 million (8 percent discount rate), which represents the monetary benefits attributable to improved safety. According to this brief analysis, road improvements that increase safety would have an important monetary benefit in addition to the other non-monetary benefits of reduced accident rates.

3.4.4.2 Environmental Consequences

All Action Alternatives. Improvements to Saddle Road are planned to raise the LOS from E to B. An improved LOS will decrease delays and platooning of vehicles resulting in increased levels of safety. The ACC/MVM rate is expected to be reduced from an average 5.43 to near the State average of 3.0 ACC/MVM. The monetary value of reducing the accident rate from present levels to the State average is estimated to have a present value of $43.1 million over a 20-year period.

No Action Alternative. The No Action Alternative would result in a higher average number of accidents for Saddle Road than experienced statewide. Traffic platooning and delays would increase as the volume of traffic increases, subjecting motorists to lower levels of safety. Existing accident rates on Saddle Road are estimated to cost $43.1 million more than rates corresponding to the State average over a 20-year period.

3.4.4.3 Mitigation Measures

No mitigation measures related to safety are merited. Impacts would be beneficial.

3.5 RIGHT-OF-WAY AND RELOCATION

3.5.1 Affected Environment

The existing ROW for Saddle Road varies along the corridor, but is typically 25 to 30 m in width. In a number of places, the existing ROW is not centered on the existing roadway.

3.5.2 Environmental Consequences

3.5.2.1 Right-of-Way

ROW acquisition or take for this project was estimated based on preliminary engineering. Table 3.5.1, *Total Estimated Right-of-Way Take by Segment*, summarizes the total ha of ROW that would need to be acquired in order to construct the improved Saddle Road.

TABLE 3.5.1
Total Estimated Right-of-Way
Take by Segment

Segment	Approximate Take (ha)
W-2	73
W-3	70
EX-2	47
PTA-1	83
PTA-3	85
EX-3	60
EX-4A	12
E-3	29

When land acquisition is necessary from properties of relatively small size, potential impacts to landowners are presumed to be greater because a higher percentage of the property holding is impacted. In some cases, land acquisition could limit the feasible uses on a property. In Section IV, selection of EX-4A or E-3 would result in the taking of property from landowners with smaller holdings. With selection of EX-4A, without adjustment or refinement of the preliminary alignment, ROW acquisition would impact 51 lots of 0.4 ha or less, 13 lots of between 0.4 and 4.0 ha, and 41 lots of more than 4.0 ha. With selection of E-3, without adjustment or refinement of the preliminary alignment, ROW acquisition would impact no lots of 0.4 ha or less, 4 lots of more than 0.4 to 4.0 ha, and 43 lots of more than 4.0 ha. If these alternatives are selected, final design will minimize the number of small properties impacted.

3.5.2.2 Relocations

3.5.2.2.1 Residential Relocations

Residential relocations potentially necessitated by the project would be limited to Segment EX-4A, Section IV, through Kaumana. Without making adjustments or refinements in the preliminary alignment, it is anticipated that as many as 28 homes may need to be relocated. If the road alignment could be adjusted slightly to the south in this portion of the corridor, relocations may be reduced by 50 percent. Segment E-3 would lnot require residential relocations.

There is a supply of available housing, both for sale and for rent, in the Hilo area to replace potential displaced households. Table 3.5.2, *Available Residential Units, Hilo*, provides a summary of the number of homes currently available for sale and rent in the Hilo area. Hilo

contains a sufficient supply of vacant housing within similar characteristics to absorb the households potentially displaced by the project.

TABLE 3.5.2
Available Residential Units, Hilo

	Homes for Sale	Homes for Rent
Number of Homes	258	86
Price Range	$53,000 - $949,000	$550 - $900[1]
Median Price	$205,000	$750[1]

[1] Price estimates are for three-bedroom houses.
Source: Sales figures from Multiple Listing Service, March 1996 data. Rental figures from April 14, 1996 Hawai'i Tribune Herald classified ads.

A full inventory of available relocation housing will be conducted prior to acquisition. The inventory will identify the most recent vacancy and market values of relocation housing. Detailed inspection of affected households and interviews of residents to be relocated will be conducted after the preferred alternative is selected and construction schedule is determined. Specific housing and community characteristics will be determined based upon the requirements of those households identified for actual relocation. Replacement housing will be determined on the basis of current market availability and costs for the relocation resource area.

3.5.2.2.2 Other Relocations

Other potential relocations would occur with the selection of PTA-1 or PTA-3, in Section II. Segment PTA-1 and PTA-3 would extend through the PTA cantonment area. The proposed ROW would impact 13 existing structures in this area. These structures are primarily quonset huts, which were erected in the 1950s and are considered temporary structures. The affected buildings and their uses are identified in Table 3.5.3, *Potential Relocations within PTA*.

TABLE 3.5.3
Potential Relocations within PTA

PTA Building Number	Current Use
T-151	Dining Facility
T-151A	Dining Facility
T-153 - 157	Billets
T-160	Enlisted Club

TABLE 3.5.3
Potential Relocations within PTA

PTA Building Number	Current Use
T-201 - 202	Billets
T-203	Latrine/Shower
T-205	Visiting Unit Commander's Quonset
T-209	Cafeteria

The DOA has indicated that buildings could possibly be relocated to an area on the west side of Pu'u Pohakuloa outside of the Bradshaw Army Airfield's safety zone. The razing of existing buildings, the construction of new buildings, and associated environmental studies and documentation will be completed by the DOA.

3.5.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Any relocation necessitated by the project would be completed in accordance with Federal Uniform Relocation and Real Property Acquisition Policies Act of 1970 (P.L. 91-646), as amended, and applicable State regulations.

Since 1971, the acquisition of private land for government programs and projects has been subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act (URARPAPA) of 1970 (amended and updated by Congress in 1987). The URARPAPA provides for fair and equitable treatment of persons whose property will be acquired, or persons who will be displaced because of Federally funded programs or projects.

The URARPAPA has three parts or Titles. Title I contains general provisions and definitions. Title II has provisions for relocation assistance for persons displaced because of Federal and federally assisted programs. Title III, the Uniform Real Property Acquisition Policy, contains the provisions for consistent treatment of owners whose private property is acquired by the Government.

In those cases were government agencies need to acquire private property for public programs or projects, they may do so under the "power of eminent domain" (the right of a government to take private property for public use). However, just compensation must be paid for private property acquired for federally funded programs or projects. All Federal, State and local public agencies, in addition to others receiving Federal financial assistance for public programs and projects

requiring the acquisition of real property, must comply with the policies and provisions set forth in the URARPAPA and its amendments.

The acquisition of private property does not need to be directly federally funded for the rules of URARPAPA to apply. If Federal funds are used in any phase of the program or project, the URARPAPA must be complied with. Its rules encourage acquiring agencies to negotiate with property owners in a prompt and amicable manner so that litigation can be avoided.

Examples of provisions of the act include the following.

> All displaced residential households will be provided with advisory assistance. This includes distribution of available rental listing specific to their needs and assistance in searching for and securing replacement dwelling units.
>
> All eligible households to be relocated will be provided with a moving assistance payment. This may be in the form of actual reasonable moving costs and related expenses, or under certain circumstances, a fixed payment.
>
> All eligible rental households to be relocated will be provided with Relocation Assistance housing payments to supplement any difference between the rent they currently pay and the calculated cost of their replacement unit. Rental households will be advised that they may convert any rental supplement payments to a down payment for the purpose of purchasing a replacement dwelling. Exercising this option is contingent on each household's ability to qualify for then needed financing on a replacement unit.
>
> All eligible homeowners will be provided with a housing payment supplement should the replacement cost exceed the acquisition cost of the displaced dwelling.

Specific relocation measures and considerations related to Palila mitigation replacement lands are discussed in Section 3.18.3.

3.6 PEDESTRIAN AND BICYCLE FACILITIES AND USE

3.6.1 Affected Environment

Saddle Road is not currently used regularly or extensively by bicyclists or pedestrians, or other non-motorized modes of transportation. Substantial change in elevation along the length of the road, foggy and rainy weather (especially on the eastern side), and the lack of adequate shoulders produce difficult conditions for bicyclists.

There are no developed bike or pedestrian trails within the project corridor. From the project terminus on the western end to MP 19, there are unpaved shoulders. Between MP 19 and 11,

there are 1.2-m paved shoulders which can accommodate bike and pedestrian traffic. There are paved shoulders of varying width on the existing Saddle Road between MP 8 and 6.

During surveys of the road conducted on various occasions, including the Traffic Survey conducted in May of 1994, no bicyclists were observed. The use of the corridor by walkers and runners is limited to the eastern end in the Kaumana area, and within the PTA.

Saddle Road currently provides access to two identified mountain bike trails. One trail is the access road to Ahumoa/Pu'u La'au which intersects existing Saddle at MP 43. The other trail is the Keanakolu Road which intersects with the Mauna Kea Access Road near its terminus at MP 28. Neither trail traverses the existing road or any proposed segment.

According to local sources, Saddle Road is currently used by serious bicycle road racers for training purposes, including those training for the Ironman Triathalon. Usage of this type is on a non-regular basis, and is generally more concentrated in the months leading up to the Triathalon. The Mauna Kea Relay, a 100-km road race held annually in April, traverses Saddle Road. This 100-km relay and ultra-marathon begins in Hilo and terminates in Waimea. The event has attracted between a few dozen and a few hundred runners since its inception in the 1970s.

Pedestrian use of the shoulders occurs during gathering of traditional plant material. This is especially frequent before hula festivals between approximately MP 22 and 8. In addition, DOA personnel occasionally jog or walk on the Saddle Road near the PTA (Section II).

In the airport survey of visitors, about 3 percent of those who traveled on Saddle Road stated that they had biked at some point along the way, although respondents may have inadvertently counted bicycling experiences in other parts of the island.

3.6.1.1 Government Plans and Policies Related to Bicycle and Pedestrian Facilities

- Bike Plan Hawai'i

  HDOT's bicycle masterplan, *Bike Plan Hawai'i* (HDOT 1994), identifies Saddle Road as a "Future Proposed Bike Route." This route is identified as a *Priority III*, which is expected to be implemented beyond a 10-year planning horizon. It is identified as a *Class B* facility, which indicates that significant work would be required to upgrade the existing facility to appropriate standards. To satisfy appropriate standards, the bike path must be a minimum of 1.2 m in width, and must have appropriate drainage facilities.

- County of Hawai'i General Plan

  The County of Hawai'i General Plan is a policy document expressing the broad goals and polices for the long range development of the Island of Hawai'i. The plan was originally adopted by ordinance in 1967, and was most recently amended in 1989. The General

Plan is organized into thirteen elements, with goals, policies, standards and recommended courses of action for each. The Transportation Element of the General Plan establishes the following policy with regard to pedestrian and bicycle facilities.

"The County shall encourage the development of pedestrian and bicycle facilities within designated areas of the community."

3.6.2 Environmental Consequences

All Action Alternatives. Construction activities often present obstacles to pedestrians and bicyclists crossing the highway, and can temporarily prevent use of the road for walking or biking in the immediate vicinity of construction work. With the exception of the Kaumana area, use of Saddle Road by bicyclists is limited. Construction-related impacts would be short-term and temporary in nature.

The design parameters and controls that would be implemented with the proposed project would markedly improve safety characteristics of Saddle Road. Even though traffic volumes would increase in the future, widened, paved shoulders proposed for the project would minimize the hazards to pedestrians and bicyclists using Saddle Road, and would enhance safety.

With the proposed construction of wider travelways and paved shoulders along the entire corridor with any of the action alternatives, use of Saddle Road by bicyclists and pedestrians would be expected to increase. While recreational ridership may increase, due to the steep grades and inclement weather, much of the increased ridership will likely be from expert riders training for races and competitions.

The one area where significant usage would possibly occur is in commercial bike tours which transport bicyclists to upper segments of the road. Currently, one tour operator conducts tours from the Mauna Kea Observatories approximately once per month. Upon improvement of the road, it is possible that such usage could increase, including use of the Mauna Kea Access Road as well. Riders would then coast downhill to a pick-up point at either end of Saddle Road. This is already a significant recreation/visitor activity elsewhere in Hawai'i.

W-2 and W-3. The construction of Saddle Road on the W-2 or W-3 alignments would be expected to result in a long-term decrease in traffic volumes within Waiki'i, since through traffic will use the new alignment, enhancing the opportunity for rural bicycling on this stretch of Waiki'i Road.

With the construction of W-2 or W-3, 2.4-m paved shoulders would be built on both sides of the roadway, providing an improved surface for bicyclists and pedestrians.

EX-2, PTA-1 and PTA-3. The selection of PTA-1 or PTA-3 would result in fewer construction-related impacts to cross-island traffic than would EX-2. Most of the construction work would be completed on the new PTA-1 or PTA-3 alignment, away from the existing road.

With the selection of any segment, a 2.4-m paved shoulder would be built on both sides of the roadway, providing an improved surface for bicyclists and pedestrians using Saddle Road. With portions of EX-2, PTA-1, and PTA-3, however, an additional paved strip adjacent to and outside of the new roadway shoulder would be constructed as part of the fire prevention plan (ref: FEIS - Part I, 3.9). This additional paved strip would be available for use by bicyclists and pedestrians. With PTA-1, Station 10+000 to 21+500, a designated, 2.4-m paved strip or bikeway would be constructed outside of the paved shoulders on one side of the roadway. For PTA-1, Station 21+500 to 27+270, and for PTA-3, Station 10+000 to 12+500, designated, 2.4-m, paved strips or bikeways would be constructed outside of the paved shoulders on both sides of the road. With EX-2, Station 119+100 to 123+000, a designated, 2.4-m, paved strip or bikeway would be constructed outside of the paved shoulders on the north side of the road; from Station 129+000 to 132+500, a designated, 2.4-m paved strip or bikeway would be constructed outside of the paved shoulders on both sides of the road.

EX-3. Improving Saddle Road within Section III would result in construction-related inconveniences and delays to motorists passing through the area; however, since no communities are located within Segment EX-3, construction-related impacts on pedestrians and bicyclists are not expected to be significant.

With the construction of EX-3, 2.4-m paved shoulders would be built on both sides of the roadway, providing an improved surface for bicyclists and pedestrians using Saddle Road.

EX-4A and E-3. With the selection of Segment EX-4A, construction activities would occur within the community of Kaumana, directly impacting the community with the inconveniences and delays to bicyclists and pedestrians. Impacts on the community would also occur with the selection of Segment E-3, but to a lesser extent since E-3 diverges from the existing road alignment in the area of Kaumana.

If EX-4A is selected, the projected increase in traffic volumes on Saddle Road will produce direct, long term impacts to upper Kaumana. Increased traffic of the magnitude anticipated would serve to congest local traffic, and would be expected to create more hazardous conditions for crossings by pedestrians and bicyclists.

With the construction of EX-4A and E-3, 2.4-m paved shoulders would be built on both sides of the roadway, providing an improved surface for bicyclists and pedestrians using Saddle Road.

With the completion of the Puainako Street extension, construction of E-3 would avoid much of the impacts to local traffic, pedestrians, and bicyclists. On the other hand, congestion along Kaumana Drive would increase substantially by the year 2014 without the Puainako Street

Extension. However, the Puainako Project is planned to be completed far in advance of the improvement of the entire Saddle Road. Selection of E-3 would promote local pedestrian and bicycle traffic within upper Kaumana.

No Action Alternative. No construction-related impacts would result from the No Action Alternative. With the No Action Alternative, increasing traffic volumes would result in a deterioration of LOS from D to E, and an increasing hazard for pedestrians and bicyclists using or crossing Saddle Road. With the No Action Alternative, bike paths would not be constructed along any portion of Saddle Road.

3.6.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Within Segment EX-4A, create provisions for pedestrian and bicycle crossings of Saddle Road during construction periods.

3.7 AIR QUALITY

3.7.1 Affected Environment

3.7.1.1 Standards

The Federal Clean Air Act of 1970 established National Ambient Air Quality Standards (NAAQS) for six pollutants. These pollutants, referred to as the "Criteria Pollutants," include carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead. Carbon monoxide is a colorless, odorless gas which primarily affects the cardiovascular system; vehicular emissions are a major source. Nitrogen dioxide is a gas with a yellowish-orange to reddish-brown appearance, depending upon its concentration, which impairs the respiratory system; major sources are power plants and vehicular emissions. Ozone is created through a complex reaction of hydrocarbons and oxides of nitrogen with sunlight at the primary catalyst; ozone affects the respiratory system. Sources of the ozone precursors include vehicle emissions, power plants, and service stations. Particulate matter refers to small aerosols which are suspended in the atmosphere and may cause irritation and damage to the respiratory system; vehicular emissions and the resuspension of road dust by vehicular activity are sources. Sulfur dioxide is a colorless gas generated by the combustion of sulfur-containing fuels, primarily affecting the respiratory system; major sources are power plants. Lead and its compounds damage the cardiovascular, renal, and nervous systems; the primary source is vehicular emissions associated with the use of leaded gasoline.

Two Federal Standards exist for most of the criteria pollutants. The primary standard defines levels deemed ". . . necessary, with an adequate margin of safety, to protect the public health."

The secondary standard defines levels ". . . necessary to protect the public welfare. . ." These standards are set forth in Title 40 of the Code of Federal Regulations, Part 50 (40 CFR Part 50). The promulgation of these standards, however, does not prohibit any State from establishing air quality standards which are more stringent. The Federal Standards are also subject to periodic review and revision as deemed necessary by the Administrator of the Environment Protection Agency (EPA).

In 1987, the standard for particulate matter was revised by the EPA from total suspended particulate matter (TSP), aerosols with diameters up to approximately 45 micron, to those aerosols with aerodynamic diameters of 10 micron or less. This new standard was referred to as PM_{10}. The NAAQS and the State of Hawai'i Standards for this and the other criteria pollutants are presented in Table 3.7.1, *Federal and State Ambient Air Quality Standards*. The annual standards are not to be exceeded; the remaining standards are not to be exceeded more than once per year, with the exception of ozone and PM_{10}. Compliance with the Standards for these pollutants is determined by the number of days during any three consecutive years that the respective standard is exceeded and is not to exceed an average of 1.0 days for any three-year period. The State of Hawai'i Standards are similar to the NAAQS except for carbon monoxide and nitrogen dioxide, which are more stringent.

TABLE 3.7.1
Federal and State Ambient Air Quality Standards

Pollutant	Averaging Time	Federal Standards		State Standards
		Primary $\mu g/m^3$(ppm)	Secondary $\mu g/m^3$(ppm)	$\mu g/m^3$(ppm)
Carbon Monoxide*	1-hr. 8-hr.	40 (35) 10 (9)	** **	10 (8.8) 5 (4.5)
Nitrogen Dioxide	Annual	100 (0.05)	100 (0.5)	70 (0.037)
Ozone	1-hr.	235 (0.12)	235 (.12)	100 (0.05)
PM10	24-hr. Annual	150 50	150 50	150 50
Sulfur Dioxide	3-hr. 24-hr. Annual	** 365 (0.14) 80 (0.3)	1300 (.5) ** **	1300 (0.5) 365 (0.14) 80 (0.03)
Lead	Calendar Quarter	1.5	1.5	1.5

ppm = parts per million
* mg/m^3(ppm)
** No Standard
Source: 40 CFR Part 50. DOH 1997. EPA-600/4-77-027a, May 1977.

The Clean Air Act Amendments of 1990 authorized the EPA to designate those areas that had not met the NAAQS as *"non-attainment"* and to classify them according to their degree of severity. States that fail to attain the NAAQS for any of the criteria pollutants are required to submit State Implementation Plans (SIP's) which outline those actions which will be taken to attain compliance. There are no non-attainment areas in the State of Hawai'i.

In late 1996, EPA proposed new standards for both particulate matter and ozone (Federal Register; December 13, 1996). EPA proposed to revise the PM_{10} standard, to add standards for particles with diameters of 2.5 micron or less ($PM_{2.5}$), and to revise the method for the determination of exceedances. For ozone, it was proposed that the attainment of the standard would be based on 8-hour averages rather than on 1-hour averages. In addition, the level of the ozone standard would be lowered from the present 0.12 parts per million (ppm) to 0.08 ppm, and the method for the determination of exceedances would also be revised. The new standards have been approved (Federal Register; July 18, 1997).

3.7.1.2 Pollutant Levels

Levels of the criteria pollutants are monitored by DOH, Clean Air Branch at twelve locations on the Islands of Oahu, Kauai, and Maui; no State monitoring sites currently exist on the Island of Hawai'i. The most recent published data available from these locations is for the period 1991 through 1993. A review of these data indicated that at most locations neither the Federal nor the State Standards had been exceeded for most of the pollutants. There was one exceedance of the Federal 24-Hour Standard for PM_{10} in Kapolei, Oahu; two exceedances of the State 1-Hour Standard for carbon monoxide at each of the DOH and West Beach, Oahu sites; and sixteen exceedances of the State 1-Hour Standard for ozone on Sand Island, Oahu.

Discussions with the Clean Air Branch indicated that HELCO has collected air quality data on the Island of Hawai'i. Subsequent discussions with HELCO resulted in the acquisition of data summaries for the period 9/10/92 through 12/31/93. A summary of the concentrations obtained near Puna, Hawai'i during 1993 is presented in Table 3.7.2, *Air Quality Summary 1993, Maximum Ambient Concentrations at Puna, Hawai'i - $\mu g/m^3$(ppm)*. These values represent the maximum concentration obtained during the various time intervals defined by the NAAQS. None of the values exceed either the Federal or State Standards. Concentrations of these pollutants along the Saddle Road alignment may be considered to be no higher and probably lower than those listed in Table 3.7.2 due to the rural nature of the alignment area.

TABLE 3.7.2
Air Quality Summary 1993, Maximum Ambient Concentrations at Puna, Hawai'i - $\mu g/m^3$(ppm)

Pollutant	Averaging Time	Maximum Concentration $\mu g/m^3$(ppm)	Percent of Standards	
			Federal	State
Carbon Monoxide*	1-hr 8-hr	0.800 (0.7) 0.343 (0.3)	2% 3%	8% 7%
Nitrogen Dioxide	Annual	2 (0.001)	2%	3%
Ozone	1-hr	92 (0.047)	40%	92%
PM_{10}	24-hr Annual	32 14	21% 28%	21% 28%
Sulfur Dioxide	3-hr 24-hr Annual	585 (0.22) 117 (0.045) 5 (0.002)	45% 32% 6%	45% 32% 6%
Lead	Calendar Quarter	NA	--	--

* mg/m^3(ppm)
NA - Not Available
Source: HELCO, July 1997. DOH 1997. EPA-600/4-77-027a, May 1977.

3.7.2 Environmental Consequences

The air quality analysis performed for assessing impacts from the proposed Saddle Road improvements focused on vehicle emissions of carbon monoxide (VSI 1997, Tech. App. Vol. VI). Other pollutants, such as particulate matter (PM_{10}) and oxides of nitrogen are also components of vehicular emissions; however, the impacts of carbon monoxide are most easily assessed and provide a convenient measure of air quality impact. Ozone, nitrogen oxides, and hydrocarbons are pollutants that are regional in nature, and as such, meaningful evaluation at the project level is not possible. The EPA is currently developing procedures for analyzing microscale particulate pollution impacts, but since guidance is not available at this time, an analysis for PM_{10} was not performed. The analysis concentrated on the local impact of carbon monoxide emissions estimated for the existing conditions, and for the No Action and Action Alternatives in 2014.

3.7.2.1 Methodology and Assumptions

The 1990 Clean Air Act Amendments (CAAA) and NEPA require that air quality impacts be addressed in the preparation of environmental documents for any proposed project. The level of effort utilized to evaluate these impacts may vary from a simplified qualitative description to a detailed microscale analysis depending on factors such as the type of document to be prepared, the project location and size, meteorological conditions, air quality attainment status of the area, and State Air Quality Standards. For an Environmental Impact Statement, "the air quality discussion . . . should normally include at least the results of a simplified CO analysis (FHWA, August 1993)." A simplified analysis can utilize look-up tables to estimate emission factors and nomographs to estimate carbon monoxide concentrations. If 1-hour concentrations obtained using this screening technique are less than 15 ppm, a more detailed analysis should not be needed. A simplified approach to evaluate the air quality impacts associated with the proposed action was selected due to the attainment status of the area, its rural nature, the relatively small traffic volumes, lack of major intersections, and estimated level of service.

The emission factors were obtained using the EPA model MOBILE5a. To provide a conservative estimate of resulting concentrations, an attempt was made to utilize worst case inputs to the model. The roadway alignment and ROW widths were identified and used to determine average source height, roadway and widths, and receptor locations for input into CAL3QHC (Rust 1994). For screening purposes, the alignment was assumed to be east-west; the minimum reported travel lane and ROW width for the current and design year conditions were utilized to provide a conservative estimate of resulting CO concentrations. Traffic volumes for the years 1996 and 2014 were based on the current and projected ADT, respectively, and were adjusted to provide a peak-hour volume (Rust 1994). An average vehicle speed of 80 km per hour was assumed for the current and the 2014 No Action Alternative, and 88 km per hour for the 2014 action alternatives. Receptors were located at the ROW and at increasing intervals of 10 meters out to 100 meters from the roadway centerline. The selection of each of the meteorological conditions was based on the need to estimate the maximum carbon monoxide concentrations obtainable under poor dispersion conditions.

3.7.2.2 Results

Predicted maximum one-hour concentrations of carbon monoxide were calculated for receptors at various distances from the roadway centerline for the current traffic conditions and configuration; for the estimated traffic conditions in 2014 without the project; and for the estimated traffic conditions and proposed improvements in 2014.

Before comparing the predicted concentrations with the one-hour standard, however, a background concentration must be added. It is anticipated that background levels of CO along Saddle Road are very low due to the rural nature of the area, the low maximum value obtained near Puna by HELCO, and the background concentration recommended by the DOH for a Draft EIS prepared for the Kealakehe Parkway in north Kona. For the air quality analysis prepared for

that DEIS, a value of 0.3 ppm was recommended by the DOH as a background CO concentration; this value is also used to represent the background CO concentration along Saddle Road (FHWA 1995). Maximum 1-hour concentrations predicted for the Saddle Road alignment are presented in Table 3.7.3, *Maximum Predicted 1-Hour Concentrations of CO (ppm)*[1]; no separate 8-hour analysis was prepared due to the low 1-hour values obtained (FHWA 1993).

TABLE 3.7.3
Maximum Predicted 1-Hour Concentrations of CO (ppm)[1]

Distance from Roadway Centerline (m)	1996 Configuration	2014 No Action	2014 Action
10	0.4	0.6	NA[2]
20	0.4	0.5	0.9
30	0.4	0.4	0.8
40	0.4	0.4	0.7
50	0.3	0.4	0.6
60	0.3	0.4	0.6
70	0.3	0.4	0.6
80	0.3	0.4	0.5
90	0.3	0.4	0.5
100	0.3	0.4	0.5

[1] includes 0.3 ppm as background
[2] within the ROW

3.7.2.3 Environmental Consequences

All Action Alternatives. Predicted maximum 1-hour concentrations for 2014 associated with the proposed improvements to Saddle Road may increase slightly over the No Action Alternative due to the increase in the predicted traffic volume; however, predicted concentrations are extremely low and do not exceed either the Federal or State Standards. Short-term impacts to CO may occur during construction due to the interruption of normal traffic flow. Efforts should be made to reduce queuing, especially during the peak hours of travel. Short-term impacts to PM_{10} may also occur during the construction phase, but these may be reduced through the use of watering or other dust-control measures.

Temporary, localized impacts to air quality would be anticipated during construction, associated with the generation of fugitive dust and the emissions generated by construction equipment and vehicles.

No Action Alternative. Under the No Action Alternative, maximum predicted 1-hour concentrations of CO for 2014 may increase slightly over current conditions due to the increased traffic volume predicted for 2014. The predicted 1-hour concentrations, however, neither exceed nor approach the Federal and State Standards.

With the No Action Alternative, no construction-related impacts to air quality would occur.

3.7.2.4 Conformity

Since 1977 Federal agencies and Metropolitan Planning Organizations (MPO) have been required by Section 176c of the Clean Air Act to ensure that all transportation projects conform with the approved air quality State Implementation Plans. The Clean Air Act Amendments enacted in 1990 defined conformity to a SIP as meaning "conformity to a SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS" (Federal Register, November 30, 1993). The conformity determinations for Federal actions related to transportation projects must meet the requirements of 40 CFR Part 51, subpart T. There are no non-attainment areas in Hawai'i and resulting SIP; however, the Saddle Road Project is included in the Hawai'I Long Range Land Transportation Plan as a Tier 1 project and will be added to the State Transportation Improvement Program in segments as projects are programmed.

3.7.3 Mitigation Measures

Mitigation Measures Applicable to Multiple Project Sections

- Standard dust control and construction equipment emission control measures will be implemented as necessary to reduce temporary impacts to air quality during construction activities. Water or a dust palliative will be applied as necessary to minimize particulate pollution. Areas to receive such treatment will include unpaved access roads, staging sites, and construction areas where the movement and operation of construction equipment produces airborne dust. Construction equipment will meet all applicable emission standards.

3.8 NOISE

3.8.1 Affected Environment

Ambient noise levels along Saddle Road within the project corridor are generally low, reflecting the light traffic volumes on Saddle Road and the undeveloped and unpopulated nature of much of

the landscape. Noise levels in the vicinity of PTA can be periodically high in association with military training activities (e.g., live firing of artillery) and low-flying aircraft, including helicopters and jet fighters.

3.8.1.1 Noise Fundamentals

Noise from roadway vehicles is generated by the engine, exhaust, tire-roadway interaction, brakes, vehicle vibration, and air disturbance. Roadway traffic noise is influenced by vehicle speed, vehicle volume, auto-truck mix, and roadway geometrics. The effects of traffic noise on surrounding areas depends on the noise levels generated, background noise levels, intervening terrain, and nature of land uses.

Noise from a highway can be approximated with a model. The magnitude of noise reaching a particular structure is inversely related to the distance from the source. Noise levels are also reduced as sound waves are diffracted around or blocked by obstacles in their path. Sound waves travel over different paths, over different distances and arrive at a particular spot (receptor) at different times. This results in a constantly changing noise level at any receptor. To quantify a noise level, an average noise level over a specified interval of time can be used. This average over a 1-hour period is referred to as the $L_{eq(h)}$.

Noise levels are described by a logarithmic scale in units of decibels (dB). The human ear perceives noises of different frequency in different ways. The A-weighted decibel scale (dBA) approximates human perception of the overall noise spectrum and is therefore used in most noise studies. All noise levels in this report are in terms of peak hour dBA L_{eq}. Small changes in noise levels (3 dBA or less) are not noticeable by the average person. Because human hearing approximates a logarithmic scale, a 10 dBA increase in noise level is generally perceived as a doubling of the sound.

3.8.1.2 Methodology

The FHWA has adopted Noise Abatement Criteria (NAC) that establish acceptable hourly, A-weighted decibel levels (dBA) for various land use activity categories. These criteria are set forth in 23 CFR 772 and implemented in Hawai'i's Noise Analysis and Abatement Policy (HDOT 1996). For the purposes of this study, noise levels were considered to have an impact when they approached or exceeded the NAC, or when the predicted noise levels substantially exceeded the existing noise levels. Table 3.8.1, *NAC, Hourly A-Weighted Sound Level - Decibels (dBA)*, summarizes the FHWA NAC for various land use categories (Activity Categories).

Noise abatement measures were considered for receptors with noise levels expected to approach or exceed the NAC or with expected substantial increases in noise. Noise levels within one decibel of the NAC were considered to "approach" the criteria. Within the project corridor, the most restrictive land use is Category B, with an NAC of 67 dBA L_{eq}. For Category B, an

approach of the NAC was considered to be a noise level of 66 dBA L_{eq}. Category B land uses include residences, parks, churches, motels, and hotels. A substantial increase was defined as a predicted noise level at least 15 dBA L_{eq} greater than the existing noise level.

The commercial and industrial land uses within the project corridor fall within Category C, with an NAC of 72 dBA L_{eq}. No Category A lands, for which serenity and quiet are of extraordinary significance and serve an important public need, are located within the study area.

TABLE 3.8.1
Noise Abatement Criteria, Hourly A-Weighted Sound Level - Decibels (dBA)

Activity Category	$L_{eq(h)}$[1]	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR 772. [1] ($L_{eq(h)}$) = Average noise level over a one-hour period.

FHWA has developed the Highway Traffic Noise Prediction Model to estimate existing and future highway noise levels. The STAMINA/OPTIMA computer program, which is based on the FHWA Highway Traffic Noise Prediction Model, was used for the analysis.

Noise modeling was conducted using existing traffic data and projected traffic data for 20 years in the future. Modeling results establish the noise conditions for existing conditions, the year 2014 with the proposed project, and 2014 with No Action Alternative (Rust 1997, Tech. App. Vol. VI). Noise levels were modeled at 45 locations, at sites of selected sensitive land uses near the existing or proposed highway in developed areas of Sections I, II and IV. The locations modeled are referred to as modeled receptor sites, and have been numbered within each of the three geographic areas for identification purposes. In some cases, a modeled receptor site provides noise data for more than one sensitive receptor. (*Sensitive receptors* are sites where land uses sensitive to noise could potentially be adversely impacted by noise increases from a project.) The number of sensitive receptors affected is noted within the results.

3.8.2 Environmental Consequences

All Action Alternatives. Implementation of any of the action alternatives will result in impacts from construction activities. These impacts would be considered short-term and localized. Construction-related noise impacts would be most notable in developed areas, particularly areas considered sensitive to noise (e.g., EX-4A).

Section I

One modeled receptor site was located in Section I (Figure 3.8.1, *Section I Modeled Receptor Sites*). Modeled receptor site R1 represents a residence at the Waiki'i Ranch, located about 48 m north and east of existing Saddle Road. The existing noise level at R1 is 48 dBA. Table 3.8.2, *Existing and Future Noise Levels (dBA) at Modeled Receptor Sites, Section I*, summarizes the change in noise levels anticipated with the proposed alternative segments and with the No Action Alternative.

W-2 and W-3. With the selection of Segments W-2 or W-3, Saddle Road traffic would be routed off of this portion of the existing road, and therefore, traffic noise associated with the implementation of W-2 or W-3 would not adversely affect future noise levels at this modeled receptor site (Table 3.8.2).

No Action Alternative. With the No Action Alternative, Saddle Road traffic would continue to use this segment of Saddle Road. With growth in traffic volumes, noise levels at this residence would be expected to increase to 55 dBA L_{eq}. This increase would not approach or exceed the NAC (Table 3.8.2), nor would it be considered a substantial increase over the existing noise level.

TABLE 3.8.2
Existing and Future Noise Levels (dBA) at Modeled Receptor Sites, Section I

Modeled Receptor Site	Number of Receptors Represented	Existing Road 1994	W-2 2014	W-3 2014	No Action 2014
R1	1	48	No Effect	No Effect	55

All values expressed as peak hour dBA L_{eq}.

Section II

Six modeled receptor sites were located within Section II (Figure 3.8.2, *Section II Modeled Receptor Sites*). R1 represents a group of barracks located just north of existing Saddle Road on the south side of the PTA. The existing noise level for R1 is 48 dBA L_{eq}. PR1 and PR2 are located at the north side of the PTA, close to Segment PTA-1. The existing noise level for each of these modeled receptor sites is 33 dBA L_{eq}. R2 represents a residence located north of Saddle

Road at Mauna Kea State Park. The existing noise level at R2 is 48 dBA L_{eq}. R3 and R4 represent two groups of cabins at Mauna Kea State Park, a total of 11 sensitive receptors. The existing noise levels are 42 dBA L_{eq} at R3 and 38 dBA L_{eq} at R4. Table 3.8.3, *Existing and Future Noise Levels (dBA) at Modeled Receptor Sites, Section II*, summarizes the change in noise levels anticipated with the proposed alternative segments and with the No Action Alternative.

EX-2. With the selection of EX-2, Saddle Road would be improved on its existing alignment through Section II. For 2014, noise levels at the six modeled receptor sites would increase, ranging from 47 to 61 dBA L_{eq} (Table 3.8.3). Noise levels at these modeled receptor sites would not approach or exceed the NAC. A substantial increase would occur at R1and PR1.

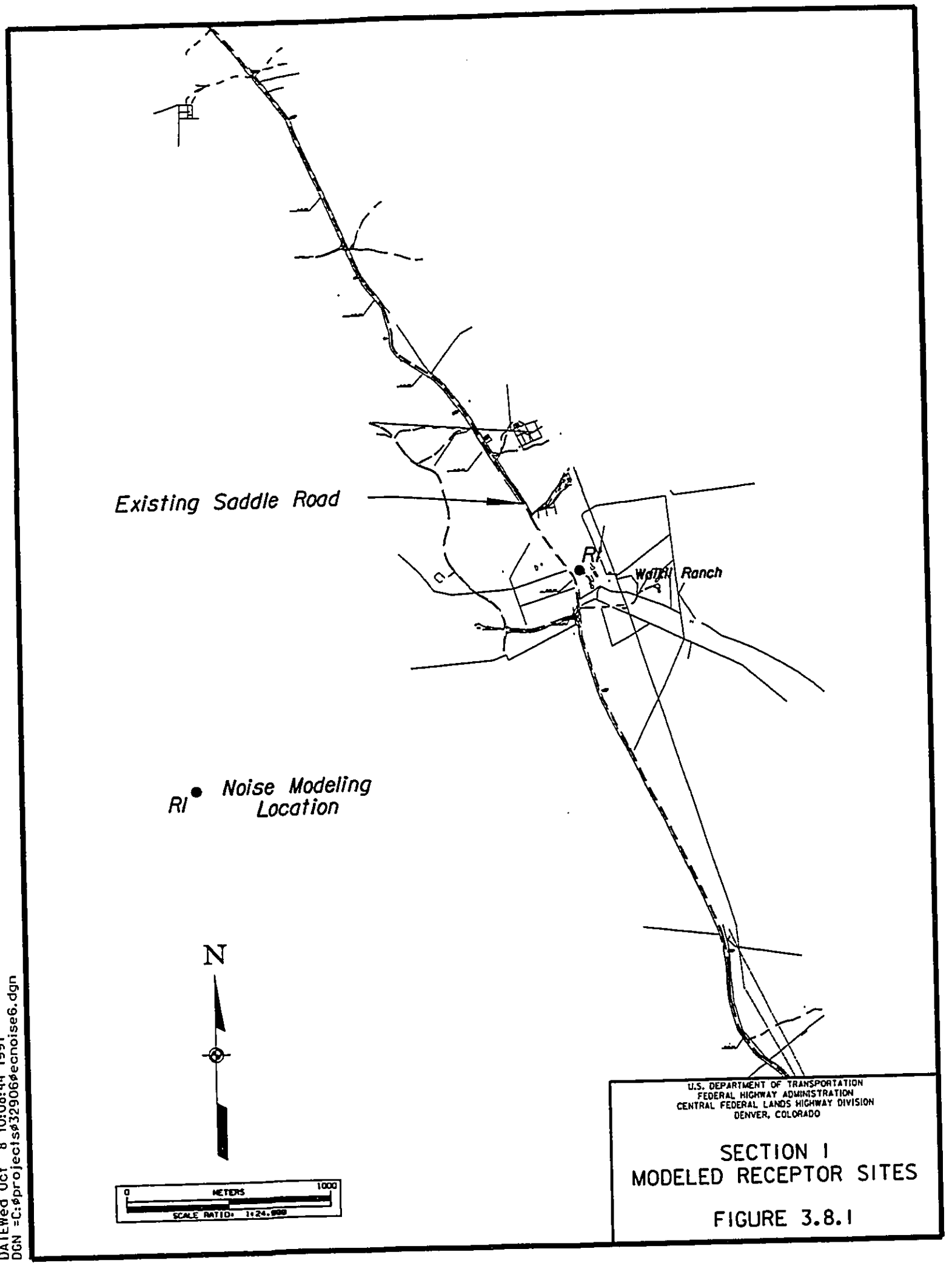
PTA-1 and PTA-3. With the selection of PTA-1 and PTA-3, Saddle Road traffic would be routed off the existing road. Noise levels would remain at approximately the same levels at R1, and would increase at the other receptors (Table 3.8.3). For 2014, the NAC would be exceeded at PR2 and substantial increases would occur at PR1, PR2 and R4 with implementation of alternative Segments PTA-1 or PTA-3. Three barracks at the PTA would experience noise levels ranging from 65 dBA L_{eq} (PR1) to 68 dBA L_{eq} (PR2). One group of eight cabins at the Mauna Kea State Park (R4) would experience a substantial increase of 16 dBA L_{eq}.

No Action Alternative. With the No Action Alternative, Saddle Road traffic would continue to use this segment of Saddle Road. With growth in traffic volumes, the noise levels for the year 2014 would increase at all six modeled receptor sites , ranging from 40 to 55 dBA L_{eq}, although none would approach or exceed the NAC (Table 3.8.3), nor experience substantial increases above the existing noise levels.

TABLE 3.8.3
Existing and Future Noise Levels (dBA)
at Modeled Receptor Sites, Section II

Modeled Receptor Site	Number of Receptors Represented	Existing Road 1994	EX-2 2014	PTA-1 2014	PTA-3 2014	No Action 2014
R1	Group of Barracks	46	61	48	48	53
PR1	Group of Barracks	33	48	65	65	40
PR2	3	33	47	68	68	40
R2	1	48	60	60	60	55
R3	3	42	56	56	56	49
R4	8	38	52	54	54	45

All values expressed as peak hour dBA L_{eq}



SECTION I
MODELED RECEPTOR SITES

FIGURE 3.8.1

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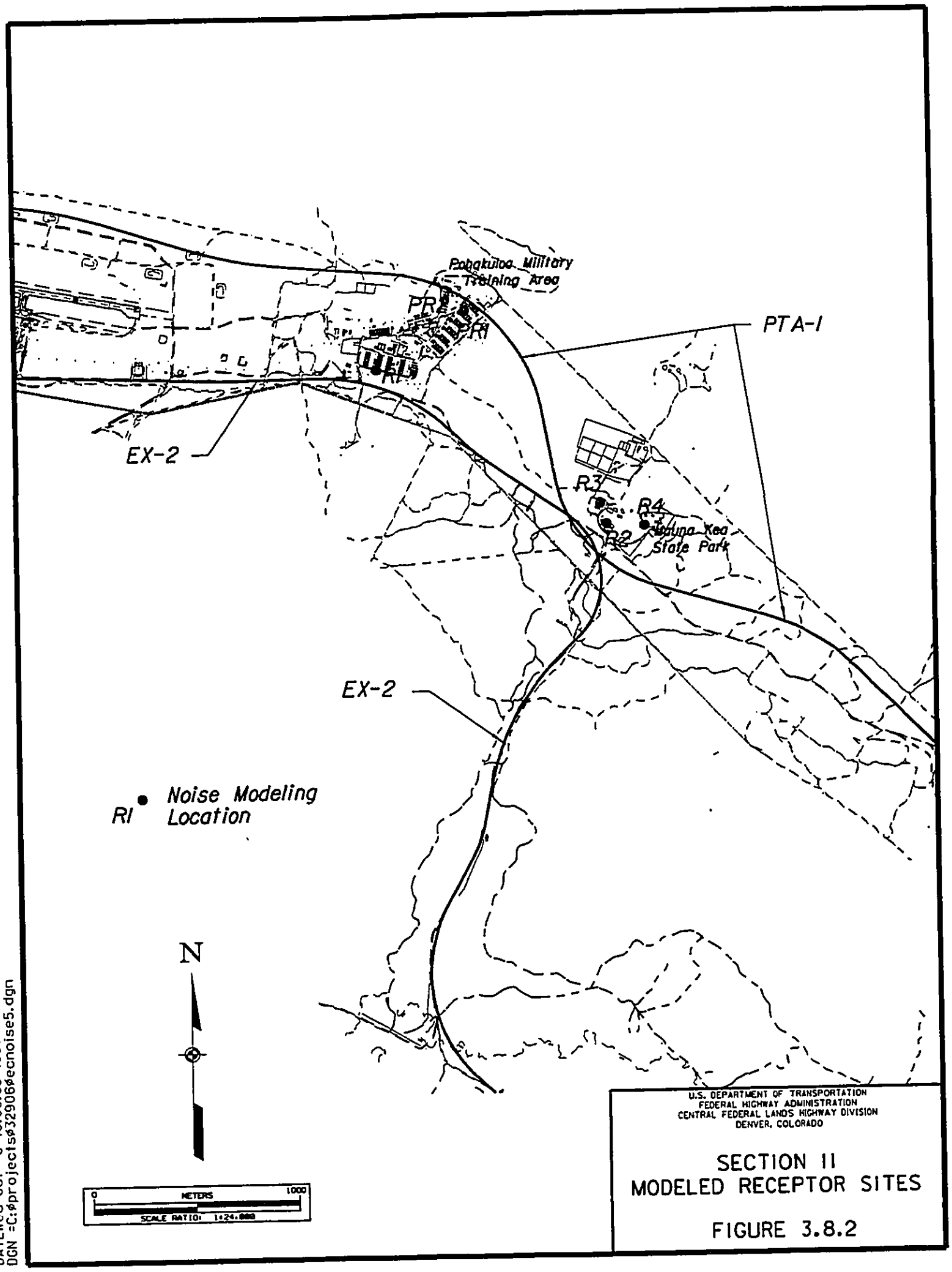

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SECTION II
MODELED RECEPTOR SITES

FIGURE 3.8.2

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Section III

No noise sensitive land uses, or corresponding receptors, are located within Section III of the project corridor.

Section IV

Thirty-seven modeled receptor sites were modeled within Section IV (Figure 3.8.3, *Section IV Modeled Receptor Sites*). R2, R4 and R9 represent three groups of second-tier residences (houses not located immediately adjacent to the roadway) located between 66 and 104 m from the proposed centerline of Segment EX-4A. Existing noise levels at these modeled receptor sites range from 44 to 47 dBA L_{eq}. R11 represents a location about 10 m from the ROW of Segment EX-4A at the State-owned Hilo Forest Reserve. The existing noise level at this modeled receptor site is 52 dBA L_{eq}. Modeled receptor sites E3-1 through E3-5 represent 14 residences located near Segment E-3. Existing noise levels range from 29 to 36 dBA L_{eq}. The remaining 28 modeled receptor sites represent a total of 52 residences located on properties that abut existing Saddle Road. The existing noise levels for these modeled receptor sites range from 44 to 60 dBA L_{eq} [Table 3.8.4, *Existing and Future Noise Levels (dBA) at Modeled Receptor Sites, Section IV*].

EX-4A. With the selection of EX-4A, Saddle Road would be improved on its existing alignment through most of Section IV, but would diverge from this alignment to follow an existing transmission line. For 2014, noise levels at all but three of the modeled receptor sites locations (R5e, R6a, and R7) would increase, ranging from 44 to 73 dBA L_{eq}. Noise levels would approach or exceed the NAC at 17 modeled receptor sites (29 residences); of these 17 sites, 7 (13 residences) would experience substantially increased noise levels. Substantial increases in noise would occur at 18 additional residences where noise levels would not approach or exceed the NAC.

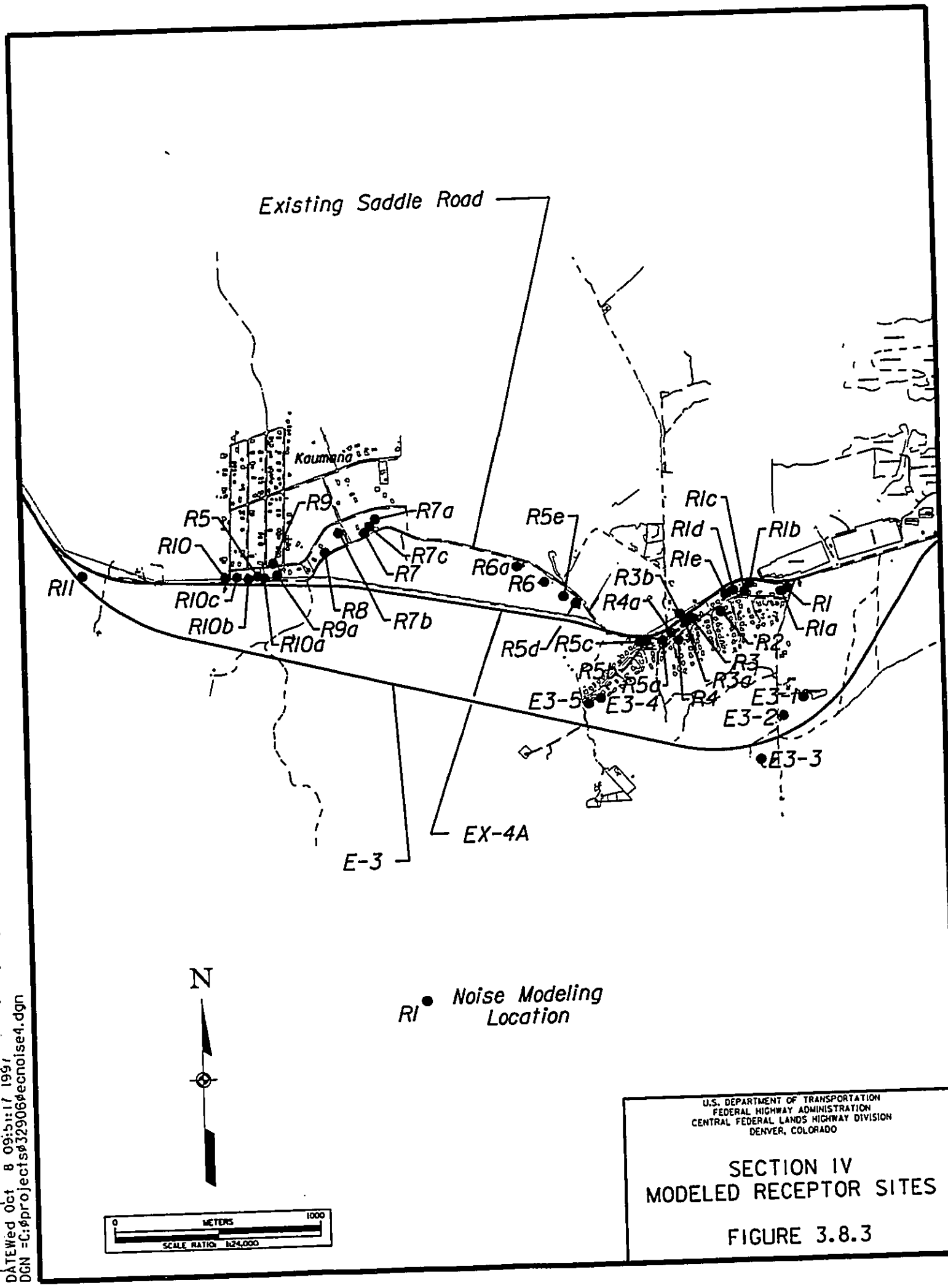
E-3. With the selection of E-3, Saddle Road traffic would be routed off of this segment of the existing road. Noise levels would decrease at 25 modeled receptor sites, would remain at the same level at 2 modeled receptor sites, and would increase at 10 modeled receptor sites. Selection of E-3 would produce substantial noise level increases of 22 to 34 dBA L_{eq}, at modeled receptor sites E3-1 through E3-5, but noise levels would not approach or exceed the NAC at any of the modeled receptor sites (Table 3.8.4).

No Action Alternative. With the No Action Alternative, Saddle Road traffic would continue to use this segment of Saddle Road. With growth in traffic volumes, the noise levels for the year 2014 would increase at all 37 modeled receptor sites. Two modeled receptor sites (R1b, R5e)(representing three residences) would approach or exceed the NAC (Table 3.8.4), but substantial increases over existing noise levels are not anticipated at any of the modeled receptor sites.

Table 3.8.5, *Summary of Noise Impacts on Noise-Sensitive Receptors*, identifies the number of noise-sensitive receptors that would be expected to approach or exceed the NAC, or to experience substantial noise increases.

TABLE 3.8.4
Existing and Future Noise Levels (dBA)
at Modeled Receptor Sites, Section IV

Modeled Receptor Site	No. of Receptors Represented	Existing Road 1994	EX-4A 2014	E-3 2014	No Action 2014
R1	1	54	66	49	61
R1a	2	51	64	49	58
R1b	2	59	73	48	66
R1c	4	50	65	48	57
R1d	1	54	68	48	61
R1e	4	55	68	47	62
R2	Group	44	60	48	51
R3	2	55	70	48	62
R3a	3	54	69	48	61
R3b	1	54	69	48	61
R4	Group	44	59	50	51
R4a	3	54	69	49	61
R5	1	53	67	51	60
R5a	2	52	66	50	60
R5b	1	55	69	50	62
R5c	3	54	68	50	61
R5d	3	54	61	48	61
R5e	1	60	57	47	67
R6	1	53	57	47	60
R6a	1	55	55	46	62
R7	2	57	53	46	65
R7a	1	49	52	46	56
R7b	1	47	54	47	54
R7c	2	51	52	46	58
R8	2	56	57	48	63
R9	Group	47	61	50	54
R9a	3	54	65	51	61
R10	1	55	70	53	62
R10a	1	56	68	52	63
R10b	1	54	69	52	61
R10c	2	52	67	52	59
R11	0	52	66	65	59



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SECTION IV
MODELED RECEPTOR SITES

FIGURE 3.8.3

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TABLE 3.8.4
Existing and Future Noise Levels (dBA)
at Modeled Receptor Sites, Section IV

Modeled Receptor Site	No. of Receptors Represented	Existing Road 1994	EX-4A 2014	E-3 2014	No Action 2014
E3-1	4	31	46	60	38
E3-2	1	30	45	64	37
E3-3	1	29	44	62	36
E3-4	5	36	52	58	43
E3-5	3	35	51	59	42
Total	66	--	--	--	--

All values expressed as peak hour dBA L_{eq}. All modeled receptor sites represent residences except for R11. R11 represents areas in a forest reserve.

TABLE 3.8.5
Summary of Noise Impacts on Noise-Sensitive Receptors

Section and Segment	No. of Receptors at 66 dBA or Greater	No. of Additional Receptors with Substantial Noise Increases
Section I		
W-2	0	0
W-3	0	0
No Action	0	0
Section II		
EX-2	0	2 groups of barracks
PTA-1	3	8 + 1 group of barracks
PTA-3	3	8 + 1 group of barracks
No Action	0	0
Section III		
EX-3	0	0
No Action	0	0
Section IV		
EX-4A	29	18
E-3	0	14
No Action	3	0

3.8.3 Mitigation Measures

No mitigation measures are recommended for noise abatement for the reasons summarized as follows.

W-2 and W-3. No mitigation measures are recommended for W-2 or W-3 because noise levels would not approach or exceed the NAC, and no substantial increases in noise levels are anticipated.

EX-2. Noise mitigation measures are not recommended for EX-2, because of additional noise generated by periodic military exercises at the PTA, the sporadic occupancy of the affected barracks, and plans to relocate the barracks.

PTA-1, and PTA-3. Consideration of noise mitigation measures, i.e. noise barriers, would be warranted if PTA-1 or PTA-3 is selected. The state Noise Analysis and Abatement Policy (Hawai'i DOT, 1996) indicates, however, that noise abatement measures must be reasonable and feasible. The policy states that barriers must provide substantial noise reductions of at least 5 dBA.

A barrier placed along the ROW edge at heights ranging from 3 to 7 m was considered. The noise reduction provided by this barrier ranged from 1 dBA for a 3 m barrier to 3 dBA for a 7 m barrier. Based upon these results, it was concluded that the barrier considered was not effective at reducing noise levels at the receptor. The modeled receptor site is elevated several meters above the proposed roadway, and it would not be feasible to construct a barrier high enough to provide 5 dBA noise abatement. Therefore, a noise abatement barrier for this location is not recommended.

EX-3. Noise mitigation measures are not recommended for EX-3, because no sensitive receptors would be affected by traffic noise increases along this segment.

EX-4A. Consideration of noise mitigation measures is warranted if EX-4A is selected. Among the options for mitigating highway noise, construction of a noise barrier is the only one with the potential to mitigate noise in this case. Unfortunately, construction of a solid, uninterrupted noise wall would not be possible because it would block a number of existing approach roads that provide access to residential properties along Saddle Road. Constructing a noise barrier with openings or gaps to accommodate intersecting roadways would have a limited effect on reducing traffic noise levels for homes in the vicinity of these intersecting roadways. Noise reduction benefits of a noise barrier would be further compromised in the area of Country Club Lane because of the higher elevation of homes in close proximity to the south side of the road. For these reasons, mitigation measures are not considered reasonable or feasible and are not recommended for EX-4A.

E-3. Consideration of noise mitigation measures for E-3 is warranted. The Noise Analysis and Abatement Policy (Hawai'i DOT, 1996) indicates that noise abatement measures must be reasonable and feasible. The policy states that barriers must provide substantial noise reductions of at least 5 dBA and that abatement costing $35,000 per residence or less is a reasonable cost.

Table 3.8.6, *Barrier Analysis for Alternative E-3*, gives the results of a barrier analysis conducted for Modeled receptor sites E3-5. Barriers at three locations placed along the ROW edge and having heights ranging from 3 to 7 m were considered. Costs for the barriers were estimated based on a unit cost of $323 per m^2.

TABLE 3.8.6
Barrier Analysis for Alternative E-3

Receptor	Barrier Height					
	0 m	3 m	4 m	5 m	6 m	7 m
	Noise Level (dBA)					
E3-1	60	60	60	60	60	60
E3-2	64	64	60	59[1]	58[1]	57[1]
E3-3	62	62	62	62	62	62
E3-4	58	57	56	54	53[1]	52[1]
E3-5	59	58	57	55	53[1]	52[1]

[1]Represents a noise reduction of at least 5 dBA.

The barriers considered were not effective at reducing noise levels at Modeled receptor sites E3-1 and E3-3. At these locations, the road surface would be constructed on fill several meters high, effectively creating a somewhat elevated roadway where it would not be feasible to construct barriers high enough to provide 5 dBA noise abatement. Further, the cost of barriers 3 m high of sufficient length to provide the 5dBA abatement and placed on the roadway fill was prohibitive at approximately $100,000 and $300,000 per receptor, respectively. Therefore, noise abatement barriers for these locations are not recommended.

A 5 m barrier would be adequate to produce a 5 dBA noise level reduction at Modeled receptor site E3-2, while taller barriers would be necessary to produce similar reductions at Modeled receptor sites E3-4 and E3-5.

Further analysis suggests that a barrier that would produce a noise reduction of at least 5 dBA at Modeled receptor site E3-2 would have to be approximately 444 m long and 5 m high. This barrier configuration would produce a 5 dBA reduction to 59 dBA, which would still represent a substantial increase over existing noise levels. It is estimated that such a barrier would cost approximately $698,000 to construct and would benefit a single receptor. This would not be cost effective, and a noise wall at this location is not recommended.

Analysis of a barrier designed to provide 5 dBA noise abatement for Modeled receptor sites E3-4 and E3-5 suggests that such a barrier would have to be about 570 m long and could vary in height

from 7 m at its east end to 5 m at the west end. This barrier configuration would produce a 5 to 6 dBA reduction to 58 or 59 dBA, which would still represent substantial increases over existing noise levels. It is estimated that such a barrier would cost approximately $1,095,000 to construct and would benefit eight receptors, or about $137,000 per receptor. This would not be cost effective, and a noise wall at this location is not recommended.

3.9 FIRE HAZARD

3.9.1 Affected Environment

Fire poses a grave threat to Hawaiian ecosystems by converting native habitats into grasslands dominated by nonnative species. As in other tropical areas, fires in Hawai'i are usually caused by human activity. Because few native Hawaiian animals or plants are adapted to wildfires, they generally perish when exposed to fire. Native shrubs and trees may recover from fire to some degree, but native plant communities are often overwhelmed by more aggressive alien species. Many nonnative species, such as fountain grass, are *pyrophytic* (fire adapted) and thrive in the aftermath of fires. Unlike native shrubs and trees, many alien grasses recover quickly, increasing in ground cover and biomass after a fire. Fires encourage nonnative fountain grass, by stimulating growth from the base of clumps and encouraging seed production. The establishment of pyrophytic grasses increases the threat of additional fires. Fire represents a major disturbance, which encourages conversion of native-dominated communities into alien-dominated plant communities.

Sections I and II traverse extremely dry habitat. Most of the project area within Section I has already undergone transition into alien-dominated plant communities. Within Section II, native-dominated plant communities ('aweoweo shrubland, hard-stemmed lovegrass grassland, 'A'ali'i shrubland, and mamane/naio forest) are extremely vulnerable to destruction by wildfire. Fire has been identified as the single greatest threat to the continued survival of the endangered Palila (ref: FEIS - Part I, 3.18.1) and other sensitive species which rely on the native dominated plant communities. Sections III and IV are not highly susceptible to fire hazard, as they are characterized by heavy rainfall.

3.9.2 Environmental Consequences

The proposed project would increase the likelihood of wildfire caused by human activity. Improvement of the road would substantially increase the number of vehicles traversing the area. Fires have been ignited by cigarettes thrown from car windows and by the hot catalytic converters of vehicles pulling off of the pavement in grassy areas. During construction, the use of construction equipment would increase the risk of fire ignition. After completion of the construction phase of the project, there would be a permanently heightened risk of wildfire.

Section I

While implementation of either W-2 or W-3 would increase the fire hazard by increasing the number of vehicles traversing this fire-prone area, locating the road south of the existing alignment would move the fire hazard farther from Palila Critical Habitat. Since most of Section I has already undergone transition into alien-dominated plant communities, little change in vegetation type is anticipated.

Section II

Implementation of EX-2, PTA-1, or PTA-3 in Section II would increase the risk of wildfire, especially in dry native habitats. The PTA-1 alignment would create the greatest risk to particularly sensitive areas, as it is close to the slope of Mauna Kea. Fighting fires with conventional methods is difficult due to rugged topography and the lack of access roads.

Sections III and IV

It is not anticipated that implementation of EX-3, EX-4A, or E-3 would substantially increase the risk of wildfire.

No Action Alternative. No construction-related increase in the fire hazard would result from the No Action Alternative. With an increase in the number of vehicles using Saddle Road, the risk of wildfire would be expected to increase, although to a lesser extent than with the action alternatives.

3.9.3 Mitigation Measures

Mitigation Measures Applicable to All Project Sections

- The PTA Fire Department, with primary responsibility for responding to and fighting fire within the PTA, has upgraded their fire fighting capabilities. Key improvements include construction of six 302,800-L dip tanks, the purchase and deployment of 2 Humvee pumper trucks, and one new 7,570-L tank truck. In addition the USAG-HI in its PTA Fire Management Plan has agreed to stockpile and maintain the fire fighting equipment necessary to supply an 86-man fire fighting detail (USAG-HI 1997).

- In an effort to develop effective fire management regimes for the three Palila mitigation sites, a fire ecologist will be contracted on a temporary basis to create a fire model(s) consistent with current methodology for high altitude xeric plant communities.

- Following the fire modeling exercise, the fire ecologist will develop a comprehensive fire management plan complete with risk assessment protocols and guidelines to be consistent

with Palila habitat recovery goals for use by the PTA and other fire-fighting entities (ref: Rana 1997, Tech. App. Vol. III). The plan will be designed to offset the increased risk of wildfire and associated threat to the existing viable Palila population on the west slope of Mauna Kea, as well as the three Palila mitigation sites. The plan will contain a fuels management plan, complete with fuels management goals, objectives, and methods.

Section II Mitigation Measures

The standard typical section proposed for this roadway (Typical Section A) consists of two 3.6-m travel lanes with 2.4-m paved shoulders. To minimize the increased risk of fire to Palila Critical Habitat, two additional typical sections were developed for vulnerable portions of the study corridor within the PTA (Typical Sections B and C). In addition to the features included in Typical Section A, Typical Section B would include an additional 2.4-m wide strip of pavement on the north side of the highway, which would serve as a fire break. Between the shoulder and the fire break, a four-strand smooth wire fence with metal posts would be constructed at a height of 1.2 m. At the north edge of the fire break, a 0.23-m extruded asphalt curb would be constructed (ref: FEIS - Part I, 2.1).

In addition to the features included in Typical Section A, Typical Section C would include additional 2.4-m wide strips of pavement on both the north and south sides of the highway, which would serve as fire breaks. Between the shoulders and the fire breaks, a 4-strand smooth wire fences with metal posts would be constructed at a height of 1.20 m. At the edges of the fire breaks, 0.23-m extruded asphalt curbs would be constructed (ref: FEIS - Part I, 2.1).

The rationale for the specific components of the modified sections proposed above are as follows: Typical Section B will provide 4.8 meters of non-flammable verge on the north side of the roadway to trap a burning cigarette or match thrown from a moving vehicle. The curbing at the edge of this paved fire break will stop small burning objects from coming into contact with flammable vegetation. The proposed 4-strand smooth wire fence strung between 1.20-m high metal posts will prevent vehicles from unauthorized excursions into the fire-prone habitat found within this section further reducing the chance of an unplanned fire ignition. The emergency telephone system will aid in rapid response to fires and rapid suppression of any such incident along the roadway. The addition of a second 2.4-m paved shoulder within Typical Section C will provide additional fire prevention for Palila Critical Habitat. The physical fire mitigation proposed will greatly reduce the risk of fire to two populations of the federally listed threatened plant species *Silene hawaiiensis* (ref: FEIS - Part I, 3.18.1)

- With the selection of Segment PTA-1, Typical Section B will be incorporated from Station 10+000 to 21+500. Typical Section C will be incorporated from Station 21+500 to 27+270.

- With the selection of Segment PTA-3, Typical Section B will be incorporated into one portion of PTA-3 that is common to PTA-1, from Station 10+000 to 21+500 (PTA-1).

Typical Section C will be incorporated into one portion of PTA-3 that is common to PTA-1, from Station 21+500 to 26+900 (PTA-1), and one portion of PTA-3 that is distinct to PTA-3, from Station 10+000 to 12+500.

- With the selection of Segment EX-2, Typical Section B will be incorporated from Station 119+100 to 123+000. Typical Section C will be incorporated from Station 129+000 to 132+500.

- With the selection of Segment EX-2, PTA-1, or PTA-3, emergency call boxes will be installed on the north side of the road along the entire length of Section II. The emergency call box system will aid in rapid response to fires and rapid suppression of any such incident. Emergency call boxes will be spaced at approximately 2 km intervals.

- The PTA Fire Department will install and maintain two fire risk signs along Saddle Road, one each at the east and west boundary of PTA. Sign information will be based upon the National Fire Danger Rating System and will be updated daily.

3.10 WATER RESOURCES

3.10.1 Affected Environment

Water resources and drainage characteristics occurring along the length of the project are diverse. One contributing factor to this variation from one end of the project to the other is the amount of rainfall received. Rainfall rates within the project corridor range from less than 500 mm in Sections I and II, to a high of more than 5,000 mm per year on the eastern end of the project (ref: FEIS - Part I, 3.12.1.1).

On the Island of Hawai'i, infiltration of the substrate is high, especially in the areas of recent lava flows. The topography is pseudokarstic and infiltration of surface water serves to recharge the island's basal groundwater aquifers. In general, streams develop slowly because of high permeability of the surface materials. Sheet flow is prevalent due to slow development of the soil mantle.

No perennial rivers or streams occur in the project corridor, nor within the watersheds tributary to the Saddle Road culverts and bridges. Ephemeral stream courses occur on the windward and leeward slopes of Mauna Loa, Mauna Kea, and in the saddle between Mauna Loa and Mauna Kea. The alternative alignments cross several major ephemeral (intermittent) drainages, locally referred to as gulches.

The western portion of the project area (Sections I and II) has several large ephemeral drainages including Waiki'i, 'Auwaiakeakua, Popo'o, Pohakuloa, and Waikahalulu Gulches, along with several unnamed drainageways. The drainages on the west side of the study corridor originate on

the steep slopes of Mauna Kea and cross the existing Saddle Road at a number of bridges, culverts, and dips in the road. In section III, east of the Mauna Kea access road, drainage generally flows unchannelized parallel to the roadway. There are no drainage crossings between the Mauna Kea access road and the Kaumana area. On the eastern end of the project (Section IV), one ephemeral drainage would be crossed by the road.

Since there are no perennial stream channels within the Saddle Road study corridor, no baseline data on surface water quality are available. All of the drainages within the study corridor ultimately discharge to the ocean or to littoral springs through subsurface flow. No intermediate lakes or ponds are present within the region.

The only baseline water quality data available for the study corridor are the result of required water sampling of a number of deep wells which supply drinking water. In Sections I and II, groundwater is very deep. An existing supply well at the Waiki'i Ranch subdivision is in excess of 840 m deep. The well is located within 60 m of the existing Saddle Road and meets all of the Federal standards for safe drinking water. There is no recorded contamination associated with this well despite its vicinity to Saddle Road.

According to the County, there are no areas within the project vicinity designated as principal or sole source aquifers under Section 1424(e) of the Safe Drinking Water Act.

3.10.2 Environmental Consequences

All Action Alternatives. Construction of the proposed roadway improvements might have limited, short-term effects on surface water quality, particularly an increase in suspended sediments during and shortly after precipitation events during the construction phase. In much of Sections I, II, and IV, construction of cuts and fills would remove vegetation, disturb soils, and change overland flow characteristics, intensifying the effects of natural erosion, until soils stabilize.

Water will be consumed in the construction process. The specific source of water to be used for construction will be the responsibility of the contractor. Several potential water sources exist in the area, any combination of which would provide adequate supply without impacting existing needs. Parker Ranch has a water system which is supplied by the Department of Agriculture's Hamakua ditch system. It is possible that some of this water may be available, however, approval is needed from the State. Alternately, County water can be trucked from Waimea or Hilo. There are existing springs on private lands on the east end of the project near MP 8 that may be available. There are also private water systems at Waiki'i Ranch and the PTA, which may have some additional capacity for construction purposes. Permission is required from the ranch or the PTA in order to use these sources.

Regarding long-term effects, implementation of the action alternatives would result in an increase in the extent of impermeable road surface due to a widened road and paved shoulders.

An enlarged area of impermeable surfaces would increase surface water runoff during precipitation events. In addition, due to the geometry of roadways, an improved road would be expected to collect and concentrate stormwater runoff, potentially changing overland flow to a series of point sources. Use of the existing alignment would result in less total impermeable surface area than the new alignments.

Stormwater discharges to intermittent stream channels are regulated by the EPA through the Clean Water Act (CWA) and the National Pollutant Discharge Elimination System (NPDES) program. Stormwater runoff from the roadway will be tributary to stream channels during construction of the road as well as after construction is complete. During construction of the roadway, there is potential for degradation of stormwater quality from sediment as well as from construction materials mixing with stormwater.

Potential sources of pollution from the roadway after construction include solids, heavy metals, and organics from fuels and motor oils. With an increase in the number of vehicles using Saddle Road, automobile accidents and vehicle breakdowns are expected to increase. With an increase in vehicle incidents, the potential for chemicals and petroleum residues to be deposited on the roadway would be expected to increase. Stormwater flowing over impermeable surfaces may pick up petroleum residues, and, if not controlled, transport them off-site. Contaminated stormwater could degrade the quality of surface waters or filter through soils and degrade groundwater resources.

To determine the likelihood that runoff from Saddle Road would impact groundwater quality, a review was made of other existing wells and shafts in the project corridor (ref: FEIS - Part I, 3.10.1) and elsewhere on the island. Wells or well shafts located adjacent to major highways that have been in existence for more than 20 years have experienced no known detrimental effects from surface runoff contamination. For example, the Kahaluu well shafts located adjacent to Kamehameha III Road and Kuakini Highway in Kona, with a depth to groundwater of between 180 and 250 m, has no record of groundwater quality contamination. Groundwater testing of all of the deep wells of the County of Hawai'i's Department of Water Supply has not indicated any signs of groundwater contamination. Because similar wells positioned near highways have shown no signs of groundwater contamination and because best management practices (BMPs) will be employed to control runoff (ref: FEIS - Part I, 3.10.3), impacts to groundwater quality from the proposed project are not expected to be significant.

W-2. W-2 would require construction of culverts across the ephemeral 'Auwaikeakua and Popo'o Gulches. This segment would also include construction of a two-lane bridge over the ephemeral Waiki'i Gulch. Six minor ephemeral drainages would be crossed using culvert pipes.

W-3. W-3 would cross three major ephemeral drainage, necessitating the use of culvert pipes.

EX-2. EX-2 would include construction of culverts across three ephemeral drainages.

PTA-1. PTA-1 would include construction of arch culverts across five ephemeral drainages. This segment would also cross four minor ephemeral drainages using culvert pipes.

PTA-3. PTA-3 would include construction of arch culverts across five ephemeral drainages. This segment would also cross four minor ephemeral drainages using culvert pipes.

EX-3. EX-3 would not intersect any perennial rivers or streams or ephemeral drainages.

EX-4A. EX-4A would intersect one ephemeral drainage, necessitating construction of an arch culvert or equivalent structure.

E-3. E-3 would intersect one major and two minor drainages, necessitating construction of an arch culvert or equivalent structure.

No Action Alternative. With the No Action Alternative, road widening, and major grade and alignment improvements would not be undertaken. No construction-related impacts to water quality, including erosion and sedimentation, would result, and no modifications would be made to existing ephemeral drainages along the corridor. There would be no increase in impermeable surfaces. However, because the existing drainage structures under Saddle Road are inadequate, storm water will continue to overtop the road, resulting in erosion and increased risk to motorists during flooding events.

With an increase in the number of vehicles using Saddle Road, automobile accidents and vehicle breakdowns are expected to increase, although to a lesser extent than with the action alternatives. With an increase in vehicle incidents, the potential for chemicals and petroleum residues to be deposited on the roadway would be expected to increase. Stormwater flowing over impermeable surfaces may pick up petroleum residues, and, if not controlled, transport them off site. Contaminated stormwater could degrade the quality of surface waters or filter through soils and potentially impact groundwater resources. Soil materials help to naturally filter and clean the runoff water as it filters down to the groundwater.

Although there is no empirical data regarding the effects of pollutants from the highway on the groundwater, according to the U.S. Department of Transportation publication "Retention, Detention, and Overland Flow for Pollutant Removal from Highway Storm Water Runoff: Interim Guidelines for Management Measures," all highway runoff contains pollutants, but pollutant loading does not always cause a problem for receiving waters. The document sites studies that monitored highway pollutant impacts to receiving waters at sites with ADT volumes from 7,400 to 135,000 vpd. Results showed that runoff from lower ADT rural highways did not cause discernable toxic stress to aquatic biota. Few significant impacts were detected for roadways with less than 30,000 ADT. The Saddle Road project is estimated to be 14,000 ADT in the year 2014.

In Sections III and IV, storm water runoff infiltrates through cracks in the pahoehoe lava substrate which is otherwise impermeable. There is a new well currently being drilled adjacent to the existing Saddle Road at MP 7.9 within Section IV. The Recommended Alternative in Section IV is E-3, which is greater than 400 m from the well site. The project is not expected to perceptibly impact the quality or quantity of the ground water.

3.10.3 Mitigation Measures

In order to comply with the CWA, measures must be provided both during and after construction to prevent pollutants, including sediment and hazardous chemicals, from degrading the quality of stormwater runoff. As required by EPA regulations on stormwater discharges, stormwater pollution prevention measures will be required for the Saddle Road project both during and after construction (ref: FEIS - Part I, 1.9). The Stormwater Pollution Prevention Plan (SWPPP) will include the following types of BMPs.

Mitigation Measures Applicable to All Project Sections

- Practices that prevent erosion, including the stabilization of cut and fill slopes by vegetative as well as non-vegetative means.
- Practices that trap pollutants before they can be discharged such as silt fences and sedimentation basins.
- Practices that prevent the mixing of pollutants from construction materials and storm water, such as providing protected storage for chemicals, paints solvents, and other toxic materials.
- During construction, erosion will be minimized by applying temporary measures that will reduce the velocity of the runoff and retain sediment on-site. Examples of these measures may include but are not limited to: silt fences, check dams, mulching, culvert outlet protection, and sedimentation basins. Construction materials will be stored in a protected area with measures in place to contain and clean-up spills.
- Permanent pollution control measures will be applied to minimize degradation of stormwater quality after construction of the road has been completed. These measures include but are not limited to the following examples: providing velocity reducers and/or settlement basins at culvert outlets, vegetating slopes, minimizing the steepness of slopes where possible, providing stream bank stabilization where required, and managing the use of chemicals for roadway maintenance.
- For Segments W-2 and W-3, cut slopes will be revegetated to reduce highway runoff pollution.

- If a major hazardous spill were to occur within the Saddle Road corridor, clean up efforts would be coordinated through both the County of Hawai'i Civil Defense agency and the State of Hawai'i Department of Health (DOH).

Permitting requirements are provided in the Permits section of Chapter 1 (ref: FEIS - Part I, 1.9). During final design of individual project segments, SWPPPs will be prepared as part of Section 401 permitting and submitted to DOH in accordance with USACE Section 404 permit procedures.

3.11 WATERS OF THE U.S./WETLANDS

A Wetlands Determination Report was prepared for this project (ref: Gerrish 1997, Tech. App. Vol. III). The study area for this wetlands study was a corridor 60 m wide, 30 m either side of the surveyed and staked center-line, east of MP 19, along those segments with the potential to contain wetlands (Segments EX-3, EX-4A, and E-3). A 404(b)(1) Analysis Report was also prepared for Sections III and IV to address alternative allignments, impacts to wetlands, and mitigation [ref: FEIS - Part III, 404(b)(1)].

3.11.1 Affected Environment

Two botanical resource surveys were conducted for this project: one for Sections I and II, and one for Sections III and IV. The survey of the dry, leeward side of the study corridor (Sections I and II) found no areas with hydrophytic vegetation, leading to the conclusion that no wetlands occur within this part of the project area (Char 1996, Tech. App. Vol. I). Consultations with the USACE, USFWS, and EPA, including four site visits, support the finding that no waters of the U.S. are within these two project sections.

Waters of the United States (U.S.) is a regulatory term referring to surface waters that are under the jurisdiction of the USACE. Surface waters include streams, streambeds, rivers, lakes, reservoirs, arroyos, washes, and other ephemeral watercourses and wetlands. Any actions that result in effects on waters of the U.S. require compliance with the CWA Section 404. Wetlands, as defined by the USACE, are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation adapted for life in water-saturated soils. Wetlands are classified as "Special Aquatic Sites" and are considered waters of the U.S.

Regulatory or *jurisdictional wetlands* ("wetlands") are those areas that meet the wetland criteria of the 1987 Delineation Manual (USACE 1987). According to the manual, a wetland is identified by three essential parameters: "hydrophytic vegetation," "hydric soil," and "wetland hydrology." Determinations of hydric soils and wetland hydrology were made by personnel of the USACE during a site visit. The USACE advised that, *because of the ubiquity of hydric soils and wetland hydrology, presence of hydrophytic vegetation could be used throughout the study area as the critical parameter to determine the presence of regulatory wetlands.* In this report,

all areas with hydrophytic vegetation are determined to be regulatory wetlands, and are referred to simply as wetlands.

Sections I and II

Regarding special aquatic sites, there are no wetlands, mud flats, vegetated shallows, coral reefs, or riffle and pool complexes, within Sections I and II of the study corridor (Char 1996, Tech. App. Vol. I). No other waters of the U.S. are located within Sections I or II of the study corridor (USACE letter dated August 22, 1997, FEIS - Part II, 1.4.4, and EPA letter dated August 12, 1998, FEIS - Part II, 1.4.5).

Sections III and IV

The botanical survey of the eastern, windward part of the project area (Sections III and IV) indicated that *hydrophytic vegetation* does occur here (Palmer 1997, Tech. App. Vol. I). Review of other environmental documents and biological research publications support the conclusion that wetlands would be likely found only in Sections III and IV (DLNR 1995, Gerrish 1991, Mueller-Dombois 1977). A Wetlands Determination Study was undertaken for the project within Section III and IV (Gerrish 1997, Tech. App. Vol. III).

The study area was further limited to the area east of MP 19 (below 1540 m elevation) based on visual reconnaissance, prior familiarity with the area and the documents cited above. *Hydrophytic vegetation* does not occur within the Saddle Road project area above this elevation because of the prevailing rainfall gradient. Within this area, three major native vegetation types occur: 'ohi'a forest,'ohi'a scrub, and koa-'ohi'a forest. Appendix B contains a table providing scientific nomenclature for plants used in this discussion.

'Ohi'a Scrub. This is a simple, early succession vegetation dominated by 'ohi'a and uluhe. The 'ohi'a trees are usually less than 10 m tall. The uluhe forms dense, tangled mats 1 m or more high. Plant diversity is low. 'Ohi'a Scrub occurs throughout the study area on the 1881 and 1855 lava flows. This vegetation type corresponds with New Lowland Wet Forest, New Lowland Wet Shrubland, New Montane Wet Forest, and New Montane Wet Shrubland (ref: FEIS - Part I, 3.13.1.2).

Koa-'Ohi'a Forest. This is the forest type on older lava substrates (kipuka) between 370 and 900 m elevation. Koa grows up to 25 m tall, dominating the upper canopy. 'Ohi'a usually forms a slightly lower canopy. The understory includes hapu'u and various native small trees, shrubs and ferns. This vegetation type is described as Old Montane Wet Forest in Section 3.13.1.2.8; on soils mapped as Ke'ei Extremely Rocky Muck (rKGD).

'Ohi'a Forest. 'Ohi'a Forest occupies the older lava substrates above 900 m elevation within the study area. Within the Saddle Road corridor, koa is found only below 900 m and above 1700 m. The 'ohi'a Forest in the study area has a variably closed canopy of 'ohi'a up to 20 m tall and a

dense understory of hapu'u and a diversity of other native plants. 'Ohi'a Forests of the study area are described as Old Montane Wet Forest and Old Montane Mesic Forest (ref: FEIS - Part I, 3.13.1.2).

At low elevation within Segment E-3, close to Hilo, the primary vegetation has been disturbed or removed by residential and agricultural uses. Two of these vegetation types altered by human activity are described below.

Disturbed 'Ohi'a. This designation is used for areas where the vegetation has been seriously degraded by grazing, logging or other uses. The landscape is still visually dominated by 'ohi'a trees, uluhe, and other native plants. But these native elements exist within an irregular mosaic of grassy clearings. Cattle were observed actively grazing in many areas and the vegetation and soil surface show their influence. This vegetation type occurs in areas with soil mapped as Ke'ei Extremely Rocky Muck and Kaiwiki series soils, and is classified as Old Lowland Wet Forest, described as originally containing koa (ref: FEIS - Part I, 3.13.1.2.6).

Agricultural. These areas are, or until recently were, in intensive agricultural use. The primary native vegetation has been completely removed, except in ravines or on other rough land. The Agricultural type is found on deep ash soils mapped as Kaiwiki Series (KaC, KaD, KaE).

Wetland Characteristics. Wetlands were present on all of the 'ohi'a forest, approximately 15 percent of the 'ohi'a scrub, and less than 2 percent of the koa-'ohi'a forest, within the study area. Extensive areas of wetlands were also present in the disturbed 'ohi'a vegetation.

None of the wetlands within the study area are characterized by obligate species. In general, wetlands within the study area are barely distinguishable from the surrounding uplands. These wetlands exhibit only minor variations in the proportions of wetland plants present when compared with the surrounding upland areas. Standing water, where present, is generally limited to small pockets. These wetland pockets, or microsites, are interspersed throughout upland biological communities, forming a continuous mosaic. The wetlands are usually small depressions one to several meters in diameter formed in impervious lava basins or in cracks between lava slabs that have become plugged. For this reason, traditional delineation methods cannot be used.

Hydrophytic Vegetation is plant cover that is dominated by plant species known to tolerate hydric soils and other wetland conditions. The dominant plants are those species that are most common on the site and have the greatest biomass. The USFWS maintains a list of plant species known to occur in wetlands, the National Wetlands Inventory (NWI). Plant species that occur in wetlands less than 1 percent of the time are *Upland* (UP) plants and are not included in the NWI. All other plants are listed, with a *wetlands indicator status* (NWI status) given. Four NWI status categories, with sub-categories are used.

- Obligate (OBL) species: found in wetlands more than 99 percent of the time.

- Facultative Wetland (FW) species: found in wetlands 67 to 99 percent of the time.
- Facultative (F) species: found in wetlands 34 to 66 percent of the time.
  Subcategory F- species: found in wetlands 33 to 50 percent of the time.
  Subcategory F+ species: found in wetlands 51 to 66 percent of the time.
- Facultative Upland (FU) species: found in wetlands 1 to 33 percent of the time.

A plant community with more than 50 percent of the dominant species in the categories OBL, FW, F+ or F has *hydrophytic vegetation.*

Within the native plant communities of Section III and IV, the NWI status of all plants found within communities that would be impacted range from *upland* to *facultative+*, no obligate or facultative wetland species. The wetland study found that the vegetation changes were in the form of shifts in the percent cover and dominance of species, never in the presence or absence of any species. This is an indication that soil conditions and the vegetation form a continuum; areas with microsites that have all three criteria of jurisdictional wetlands present are quantitatively, but not qualitatively, different from surrounding 'upland' sites. While it is reasonable to state that the wetland microsites may have unknown biological function, the data available do not support that position. The only taxonomic group of organisms systematically sampled within the wetland zone is vascular plants; the plants do not show a qualitative response to the wetlands. The response of other groups, such as invertebrates and microorganisms, is not known. The response of plants to drainage conditions can be described as that of 'generalists,' i.e., they are facultative plants. Since other organisms are often dependent upon the plant species present, in this case, ubiquitous native generalists, no support is given for the view that the wetland microsites would have a unique, but unseen, flora or fauna.

3.11.2 Environmental Consequences

Sections I and II

No wetlands or other waters of the U.S. are located within Sections I or II of the study corridor therefore, no impacts to waters of the U.S. will result from project implementation.

Sections III and IV

All Action Alternatives. Direct impacts to wetlands from excavation activities are anticipated in most of Section IV and 6 to 8 km of Section III with the construction of the roadway. All such construction activity, when occurring in a wetland, would constitute filling and would require a permit under Section 404 of the CWA. Because of possible avoidable impacts to special aquatic sites, a 404(b)(1) Analysis Report was prepared to address functional aspects of the wetlands [ref: FEIS -Part III). Indirect impacts to wetland vegetative communities could result from introduction of alien species during construction. Adverse impacts to wetlands might also be caused by the increased use of Saddle Road. These indirect impacts could include increased pollutants entering wetlands and increased disturbance of wetland habitat due to improved access

and increased use of Saddle Road. Indirect and cumulative impacts to wetlands in the context of native ecosystems is discussed fully in this FEIS - Part I, 6.0.

The implementation of the proposed action would increase runoff at the edge of the roadway due to increased area of pavement. On the young lava flows, this runoff is expected to rapidly infiltrate and have no noticeable impact. Within the kipuka, the added runoff might not immediately infiltrate and could cause limited soil erosion or increase local soil water-logging.

Early in the process of alternative segment selection, botanists identified the forests on older kipuka substrates as biologically more diverse and sensitive than the 'ohi'a scrub vegetation of the young lava flows. Earlier alternatives E-1 and E-3 through extensive sections of kipuka were rejected by the SEE Team in favor of the current E-3 location (ref: FEIS - Part I, 2.3.2.3, Section IV). Although young lava flows do contain wetlands, all evidence indicates that the kipuka are the more valuable and more sensitive biological resource.

As presented in detail in the 404(b)(1) Analysis Report, no distinct wetland biological functions are known for any of the wetlands within the study area. These wetlands do not provide necessary habitat for any native wetland plant species. All native species found within these wetlands can be found in nearby uplands as well. The wetlands of the study area have no special function in maintaining the plant diversity of the study area. The wetland vegetation types detected in this study are widespread throughout the forest reserves of windward Hawai'i, a vast area.

There are no known relationships between wetlands of the study area and any native animals. There is little potential for adverse impact to native animals in the part of the study area that contains wetlands (ref: FEIS - Part I, 3.14). Disturbance of kipuka has the potential for some adverse impact on endemic birds, invertebrates, and plants.

The wetland vegetation types detected in this study are widespread throughout the koa-'ohi'a forests of windward Hawai'i, an area upwards of 300,000 ha. None of these wetlands contain any unique combination of plant species.

The biological value of these wetland areas is not associated with their wetland qualities. These areas are valuable only as part of a large expanse of native rain forest vegetation. This rain forest is biologically significant, in part, because it is a large, ecologically intact native ecosystem. Consistent with USFWS policy, the biological function of the larger diverse rain forest ecosystem, complete with wetland microsites, is the resource that should be the focus of protection efforts.

Hydrological function of the specific wetlands areas of the study area are not distinct from the surrounding upland areas. Hydrological considerations, such as flood control and groundwater recharge do not appear to be disproportionately dependent upon areas of wetland. Furthermore,

the wetland areas to be filled are dispersed and of small local extent, and filling is not expected to have detectable impact.

EX-3. Total estimated disturbance of wetlands within Segment EX-3 as a result of project implementation is 2.40 ha or 23,955 square meters (m^2). Of this total, 0.27 ha (2,735 m^2) are within kipuka, 2.12 ha (21,220 m^2) are within young lava flows (Figure 3.11.1, *Wetland Key Map*, and Figures 3.11.2 and 3.11.3, *Wetland Types and Wetland Conditions - Segment EX-3*). For Segment EX-3, all wetlands are within native habitats. Wetlands within the study area have no identified specific biological or hydrological functions.

EX-4A. Total estimated disturbance of wetlands within Segment EX-4A as a result of project implementation is 0.40 ha or 4,012 m^2. Of this total, 0.01 ha (144 m^2) is within kipuka, and 0.39 ha (3,868 m^2) are within young lava flows (Figure 3.11.4, *Wetland Types and Wetland Conditions - Segment EX-4A*). For Segment EX-4A, all wetlands are within native vegetation, mostly 'ohi'a scrub. Wetlands within the study area have no identified specific biological or hydrological functions.

E-3. Total estimated disturbance of wetlands within Segment E-3 as a result of project implementation is 3.24 ha (32,400 m^2). Of this total, 0.01 ha (144 m^2) are within koa-'ohi'a forest, 0.5 ha (5,040 m^2) are within ohi'a scrub, the remaining 2.72 ha (27,216 m^2) are within agriculturally-disturbed vegetation (Figure 3.11.5, *Wetland Types and Wetland Conditions - Segment E-3*).

While Segment E-3 would impact a considerably larger area of wetland than EX-4A, the significance of these impacts is best evaluated in the context of the vegetation types affected. For Segment E-3, only 0.51 ha (5,040 m^2) are within native habitat, compared with 0.40 ha (4,012 m^2) with EX-4A. The additional 2.72 ha of disturbed vegetation impacted by E-3 offers little biological value because of the highly degraded nature of the vegetation and the continuing agricultural land use. Therefore, from the standpoint of direct, construction-related impacts on native habitat resources, Segments EX-4A and E-3 could be considered roughly comparable (0.4 ha versus 0.5 ha).Wetlands within the study area have no identified specific biological or hydrological functions. In an effort to avoid residential relocations and other serious environmental impacts associated with Segment EX-4A, several alternatives that would by-pass Kaumana were identified. The E-3 alternative is considered the LEDPA of the possible by-passes of upper Kaumana [ref: FEIS - Part I, 2.0 and Part III, 404(b)(1))].

No Action Alternative. No impacts to wetlands or waters of the U.S. would result from the No Action Alternative.

3.11.3 Mitigation Measures

Section III and IV Mitigation Measures

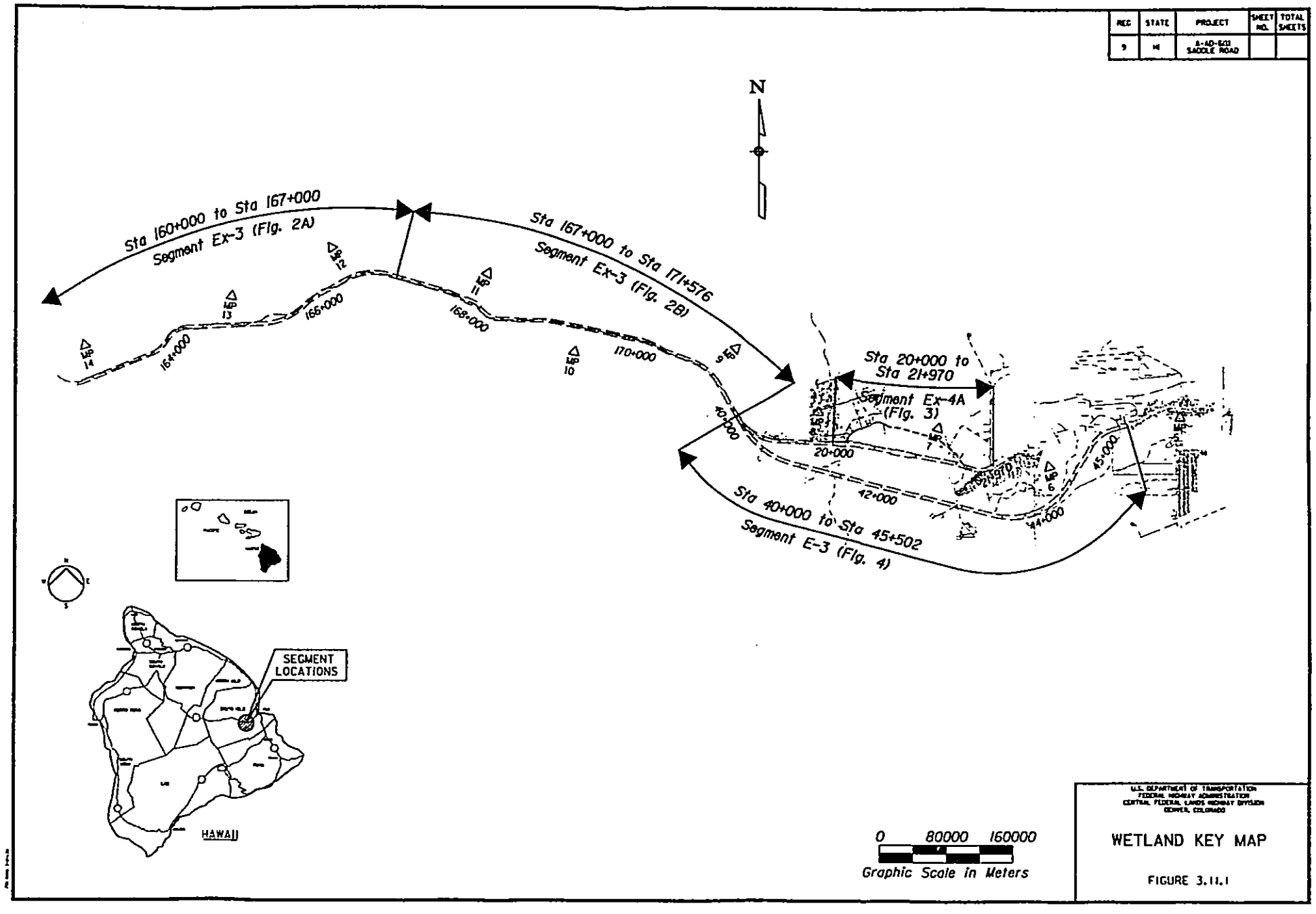
In-kind replacement of the wetlands would not be feasible. These wetlands are created by successional processes on natural lava flows, and take their character from the underlying flows. There is no known way to create such a physical substrate containing the physical complexity of natural flows. Furthermore, displacement of upland native vegetation in or near the study area, to create replacement wetlands would be an unacceptable disturbance of native vegetation.

Use of a 'wetland' model, based on the regulatory framework of Section 404 of the Clean Water Act will not protect the biological resources of the project area. Although jurisdictional wetlands do occur in the project area and a Department of the Army Permit is required, a focus on protection of the wetlands and mitigation of their fill could result in harm to the environment. A focus on wetlands implies that they are of more significance than upland areas, either outside the wetland zone or those interspersed within the wetland mosaic. This position has been refuted by both USFWS and DOFAW in their comments that the more diverse forest communities should always be avoided, even at the expense of greater wetland fill. The biological values of the region have not been associated with jurisdictional wetlands, except within the regulatory framework. A focus on wetland sites and microsites is an unworkable model since they are embedded in an equally valuable upland vegetation, and the wetland microsites are not seen as viable plant stands.

Therefore, after much discussion with the EPA, it was agreed that a combination of restoration and preservation measures applied within and adjacent to the ROW of E-3 and focusing on native habitat containing wetland microsites would best fulfill mitigation requirements for a "no net loss" solution. It is anticipated that some restored areas will contain wetland pockets very similar to those in the surrounding area, but creating such pockets is not the primary goal of restoration. It is the goal of the restoration efforts that restored and preserved habitat will be provided during the development of future projects to offset the area of wetlands within the footprint of alternative segments EX-3 and E-3. It was also determined that 404 permitting will be initiated by HDOT on this section, in conjunction with a re-evaluation of Section 404(b)(1) issues, when funds have been programmed to advance a project.

A complete discussion of the rationale for mitigation to areas containing wetland microsites is contained in the response to Comment A51, FEIS - Part II. Specific wetland mitigation commitments are as follows.

- Restoration measures, consisting of enabling *native vegetation* to cover areas of disturbance in all areas not essential to the operation and maintenance of the roadway, will be implemented within the ROW. Restoration may also include acquisition and/or preservation of lands outside of the ROW to offset unavoidable impacts on wetland and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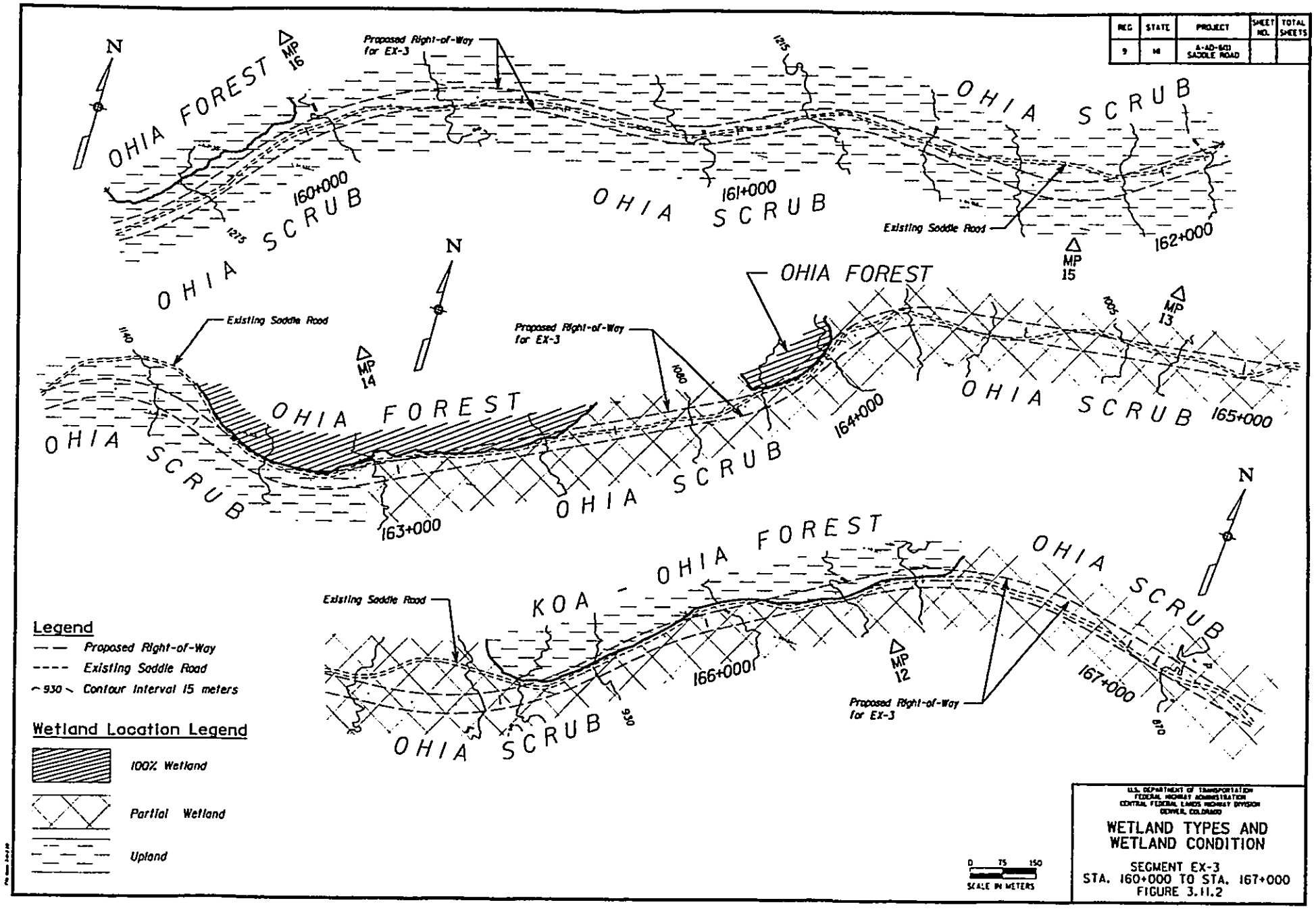
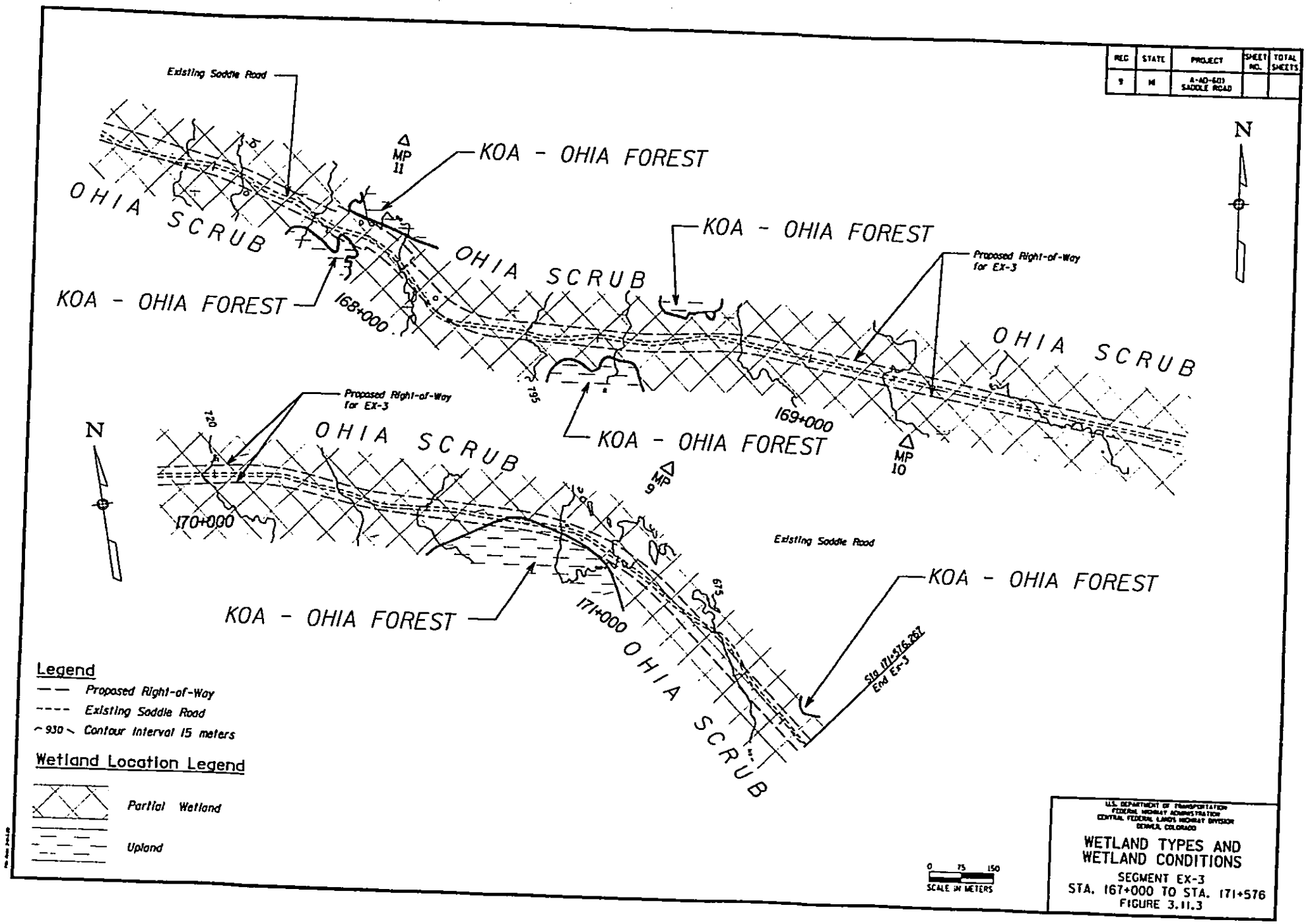
PROJECT
SHEET NO.
TOTAL SHEETS
9
HI
A-AD-603
SADDLE ROAD
N
Sta 160+000 to Sta 167+000
Segment Ex-3 (Fig. 2A)
Sta 167+000 to Sta 171+576
Segment Ex-3 (Fig. 2B)
Sta 20+000 to
Sta 21+970
Segment Ex-4A
(Fig. 3)
Sta 40+000 to Sta 45+502
Segment E-3 (Fig. 4)
164+000
166+000
168+000
170+000
20+000
42+000
44+000
45+000
SEGMENT
LOCATIONS
HAWAII
0 80000 160000
Graphic Scale in Meters
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
WETLAND KEY MAP
FIGURE 3.11.1



REG
STATE
PROJECT
SHEET NO.
TOTAL SHEETS
9
HI
A-AD-6(1) SADDLE ROAD
N
OHIA FOREST
MP 16
Proposed Right-of-Way for EX-3
1215
OHIA SCRUB
160+000
1275
OHIA SCRUB
161+000
OHIA SCRUB
Existing Saddle Road
MP 15
162+000
N
OHIA FOREST
Existing Saddle Road
1140
MP 14
Proposed Right-of-Way for EX-3
1080
1005
MP 13
OHIA FOREST
OHIA SCRUB
164+000
OHIA SCRUB
165+000
OHIA SCRUB
163+000
OHIA SCRUB
N
KOA - OHIA FOREST
OHIA SCRUB
Existing Saddle Road
166+000
MP 12
Proposed Right-of-Way for EX-3
167+000
930
870
OHIA SCRUB
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Wetland Location Legend
100% Wetland
Partial Wetland
Upland
0 75 150
SCALE IN METERS
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
WETLAND TYPES AND WETLAND CONDITION
SEGMENT EX-3
STA. 160+000 TO STA. 167+000
FIGURE 3.11.2

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-603 SADDLE ROAD		



Legend

- Proposed Right-of-Way
- Existing Saddle Road
- 930 Contour Interval 15 meters

Wetland Location Legend

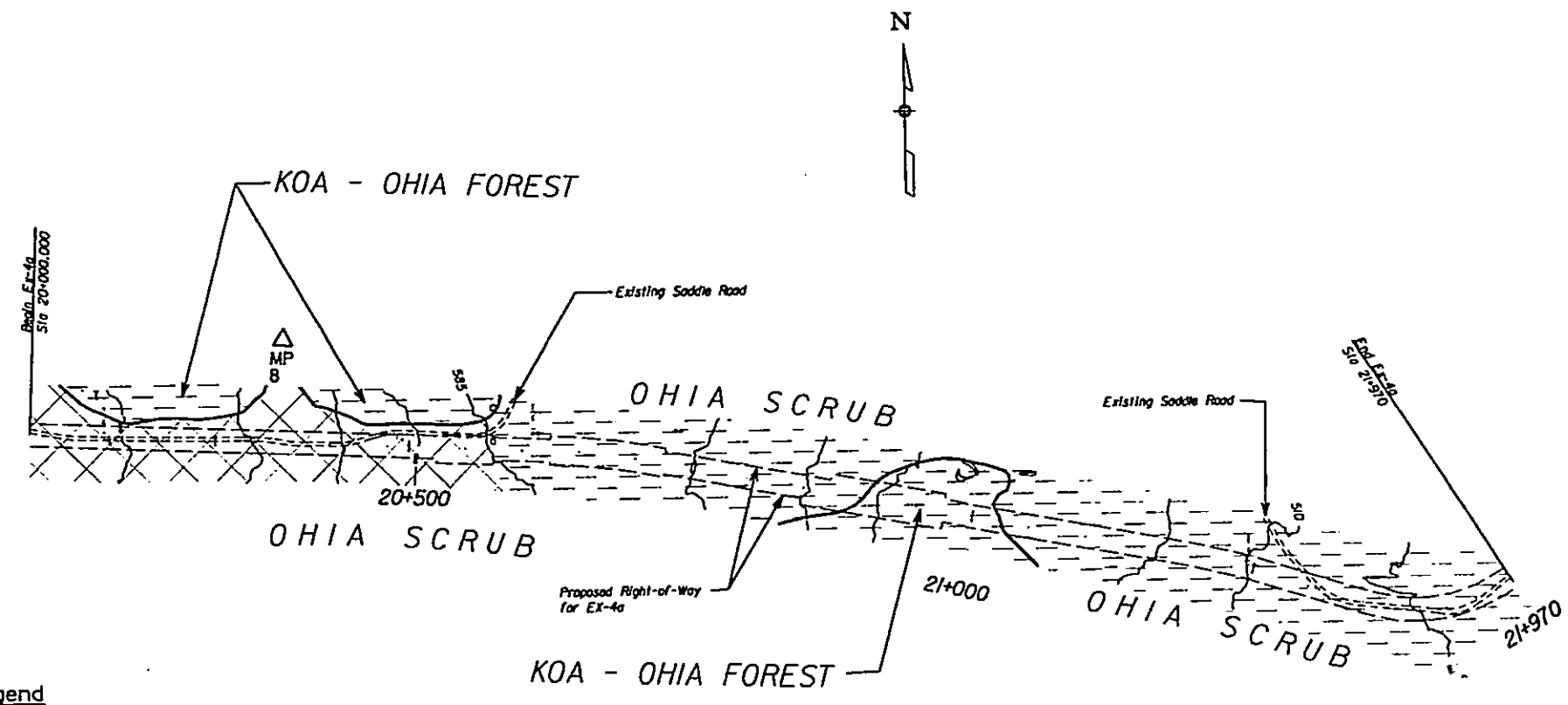
- Partial Wetland
- Upland

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND WETLAND CONDITIONS

SEGMENT EX-3
STA. 167+000 TO STA. 171+576
FIGURE 3.11.3

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(7) SADDLE ROAD		



Legend

— — Proposed Right-of-Way

- - - - Existing Saddle Road

~930~ Contour Interval 15 meters

Wetland Location Legend

Partial Wetland

Upland

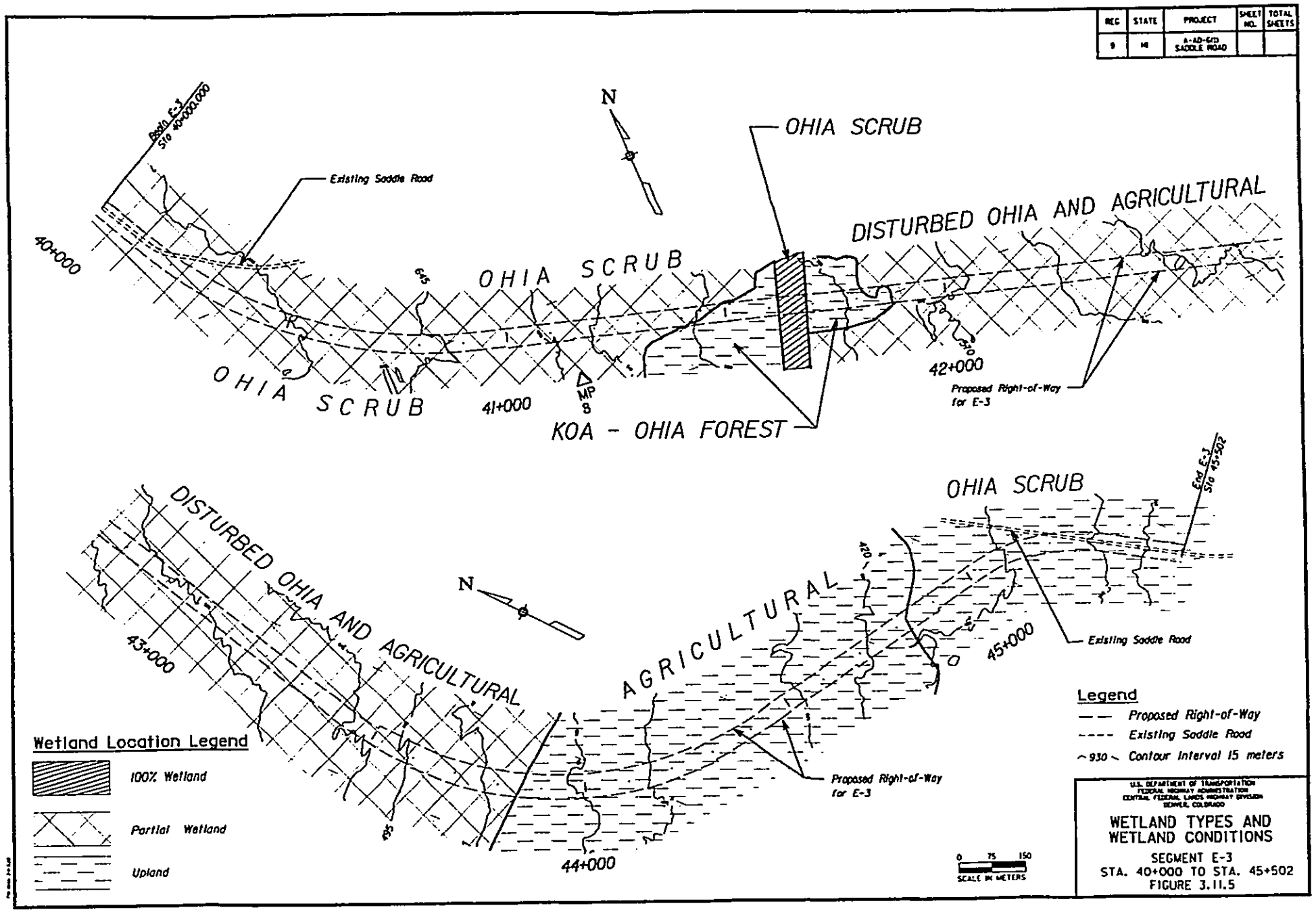
0 75 150
SCALE IN METERS

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND
WETLAND CONDITIONS

SEGMENT EX-4a
STA. 20+000 TO STA. 21+970
FIGURE 3.11.4

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND WETLAND CONDITIONS

SEGMENT E-3
STA. 40+000 TO STA. 45+502
FIGURE 3.11.5

aquatic areas disturbed by the roadway footprint*. Areas that may be considered for restoration include the following.

1. Construction damage outside of the footprint of the completed roadway; e.g., staging areas.
2. The cut/fill slopes, created by grading, up to the edge of the grassy shoulders.
3. Any other distrubed areas, such as currently existing parking areas and service roads (completed in consultation with HELCO and DLNR to determine the minimum access required, applied within the ROW).
4. Any abandoned segment of the existing Saddle Road, pavement to be removed.
5. Any uneconomic remnants of ROW requiring purchase in disturbed agricultural lands.
6. Lands that can be practicably transferred or acquired and preserved or restored for the purpose of offsetting impacts to values and functions of wetland and aquatic areas. Areas that are adjacent to or nearby the areas of impact and that include areas of similar habitat or function would be considered more appropriate for such transferral or acquisition than areas that are farther removed or dissimilar in nature. Such compensatory mitigation parcels may be transferred to resource agencies or non-profit groups whose long-term interest in habitat protection would make them more appropriate managers of the properties; however, the maintenance of these areas, once transferred, would not be the responsibility of the roadway project owner.

* The *roadway footprint* is defined as all areas within the ROW that are regularly maintained for the safe and efficient operation of the roadway.

- Contamination of surrounding kipuka, wetlands, and watershed due to drainage, run-off, and pollutants will be minimized through the implementation of BMPs.

- The potential for increased runoff into kipuka or other sensitive areas will be mitigated as necessary by use of appropriate drainage structures.

- Specific design criteria will be utilized during final design of the selected alternative in Sections III and IV to afford avoidance or minimization of impacts to kipuka and the wetlands within them.

Mitigation measures developed for threatened and endangered species will fence off kipuka from the adjacent ROW to prevent damage during construction (ref: FEIS - Part I, 3.18.3, Section III Mitigation Measures and Section IV Mitigation Measures).

In accordance with Executive Order 11990, Protection of Wetlands, and in coordination with the USACE, USFWS, and EPA (ref: FEIS - Part III, 404(b)(1) Analysis Report and Associated Correspondence), the FHWA has determined that there are no practicable alternatives to the

encroachment on wetlands described herein and that all measures have been included to minimize harm to these wetlands.

3.12 CLIMATE, GEOLOGIC HAZARDS, AND SOILS

3.12.1 Affected Environment

3.12.1.1 Climate

The climate of Hawai'i is generally characterized by mild and fairly uniform seasonal temperatures; cloudy, humid conditions along the eastern coast; and a general dominance of trade-wind flow from the northeast. The rugged configuration of the island, however, produces large variations in climatic conditions. Precipitation amounts vary widely and both precipitation and temperature are affected by elevation, distance from the ocean and exposure to the trade winds.

The Saddle Road alignment encompasses a large variation in elevation, ranging from 390 m, Segment E-3, to 2055 m, Segments PTA-1 and PTA-3. Likewise, climatological conditions are also varied along the alignment, with the eastern portion typically cloudy and humid and the western section clear and dry. The most pronounced variation occurs in the amount of precipitation received. Mean annual precipitation amounts range from approximately 5,000 mm per year in the east to 400 mm per year in the west. The cloudy, humid conditions and high rainfall of the east side of the study corridor result from its windward position and increasing elevation. The maximum rainfall along the corridor occurs at 675 m elevation.

At elevations below 2000 m in Hawai'i temperatures decline at a fairly even rate of approximately 2.5 degrees Celcius (C) per 500 m of increasing elevation. At Hilo, near the eastern terminus, the annual average temperature is near 23 ^{0}C. At Kulani Camp, to the south of the alignment (1583 m), the mean January and August temperatures are 12 and 14^{0}C, respectively (NOAA 1974)

The wind patterns on the island are also complex due to the mountainous nature of the terrain. Although the trade winds are fairly constant, this flow is disrupted by the terrain and often replaced by winds from passing storms or local upslope/downslope wind conditions.

The distribution of winds along the Saddle Road alignment are likely to be quite varied. Based on wind data from the Hilo Weather Service, surface winds on the eastern project terminus occur nearly fifty percent of the time from the south through the west, average wind speeds are in excess of 6 knots, and calms account for less than four percent of the observations. Extremely strong winds are rare; wind speeds of 7.4 to 11.1 km per hour are more common.

3.12.1.2 Geologic Formations

The following information on geologic formations is based on site reconnaissance and literature research for a preliminary geotechnical evaluation conducted for the Saddle Road EIS (C.W. 1996) and information provided by the National Speleological Society (Halliday 1997).

Hawai'i, the largest island of the Hawaiian Archipelago, covers an area of approximately 16,360 km^2. The island was formed by the activity of five shield volcanoes: Kohala (long extinct); Mauna Kea (activity during recent geologic times); Hualalai (last erupted in 1801); and Mauna Loa and Kilauea (both still active).

The proposed project is located along the southern flank of Mauna Kea, the second oldest of the five volcanoes. Mauna Kea is considered a dormant volcano, which has not erupted in historical time. Mauna Loa remains active to this date and is responsible for the fresh lava flows visible from the existing road. The Humu'ula Saddle, located between Mauna Kea and Mauna Loa volcanoes, was formed by lavas erupted from both volcanoes which coalesced and formed this broad upland apron. The majority of the surficial ash and cinder deposits located within the project area were erupted from cinder vents associated with the volcanism of Mauna Kea. The alignment of these cinder vents suggests possible buried rift zones.

The majority of the surficial soil and rock of the project corridor is believed to be derived from three main volcanic events referred to as the lava flows of the Hamakua and Laupahoehoe Volcanic Series associated with the Mauna Kea Volcano, and the Kau Volcanic Series associated with the Mauna Loa Volcano. Recent historic eruptions from Mauna Loa have flowed north toward Mauna Kea, where they were diverted down slope to the east. They typically consist of *pahoehoe lava.*

Pahoehoe is characterized by a smooth, rope-like or billowy surface and an internal structure of vesicular (porous) rock. Cavities are commonly encountered within pahoehoe lavas. Most cavities are formed when the lava remains in a molten state and may represent lava tubes (intra-flow cavities), blisters, and pockets (inter-flow cavities). The proposed roadway alignments are generally underlain by four types of geologic materials, including Volcanic Ash Deposits (VA), Cinder Sand Deposits (VC), 'A'a Lava Flows (ALF), and Pahoehoe Lava Flows (PLF).

Volcanic ash deposits generally consist of near-surface brown to light brown silty fine sand and sandy silt soils intermixed with some 'a'a basalt rock. In general, volcanic ash deposits were observed as a dry and powdery soil cover, deposited in layers primarily as volcanic air-fall deposits generated from pyroclastic vents associated with Mauna Kea Volcano. Volcanic ash material is easily erodible.

Cinder sand deposits generally consist of poorly-graded to well-graded coarse sand and gravels, pumice cobbles, and volcanic ash, underlain by basalt rock formation. The surface is typically

barren and fairly level, rainfall is high and surface runoff is low as evidenced by a general lack of erosional drainage features in these materials.

'A'a lava flows generally consist of light gray to grayish brown basalt with clinker material and occasional dense basalt layers. The material forms a rough and broken ground surface with high relief consisting of mounds or piles of very spiny plates and blocks of rock piled in tumbled heaps. Lava tubes and void spaces may occur within the interior of 'a'a flows, although less prevalent than those found in pahoehoe lava. 'A'a rock is generally easier to excavate except where the core of the flow is encountered. The core of the flow often requires greater effort to excavate, including blasting and intensive chipping and ripping.

Pahoehoe flows generally consist of more fluid lavas of dense basalt interbedded with relatively small clinker seams. The rock varies from highly vesicular to massive with lava tubes, blisters, and other void spaces. Voids are commonly encountered in pahoehoe flows during excavation work. The pahoehoe rock is typically devoid of soil cover except in the forested areas of the eastern project area. Table 3.12.1, *Geologic Material, Saddle Road Study Corridor*, identifies the primary geologic material by segment.

TABLE 3.12.1
Geologic Material, Saddle Road Study Corridor

Segment	Station Numbers	Predominant Geologic Material
W-2	Station 100+000 - 114+500	Volcanic Ash
	Station 114+500 - 116+002	Cinder with some 'A'a
W-3	Station 100+000 - 101+600	'A'a
	Station 101+600 - 103+600	Volcanic Ash
	Station 103+600 - 107+000	'A'a
	Station 107+000 - 111+078	Volcanic Ash
EX-2	Station 119+100 - 130+800	Cinder with some Volcanic Ash
	Station 130+800 - 139+200	'A'a
	Station 139+200 - 140+700	Pahoehoe
PTA-1	Station 10+000 - 11+500	Cinder with some Volcanic Ash
	Station 11+500 - 14+000	Cinder and 'A'a with some Volcanic Ash

TABLE 3.12.1
Geologic Material, Saddle Road Study Corridor

Segment	Station Numbers	Predominant Geologic Material
	Station 14+000 - 27+790	Cinder with some Volcanic Ash
	Station 27+790 - 29+270	Volcanic Ash and Cinder
	Station 29+270 - 30+999	Pahoehoe
PTA-3	Station 10+000 - 11+500 (PTA-1)	Cinder with some Volcanic Ash
	Station 11+500 - 14+000 (PTA-1)	Cinder and 'A'a with some Volcanic Ash
	Station 14+000 - 26+900 (PTA-1)	Cinder with some Volcanic Ash
	Station 10+000 - 11+800	Cinder with some 'A'a
	Station 11+800 - 12+881	'A'a with some Cinder
	Station 137+800 - 139+200 (EX-2)	'A'a
	Station 139+200 - 140+700 (EX-2)	Pahoehoe
EX-3	Station 140+700 - 143+000	Pahoehoe
	Station 143+000 - 144+700	'A'a
	Station 144+700 - 147+000	Pahoehoe
	Station 147+000 - 156+000	'A'a
	Station 156+000 - 171+576	Pahoehoe
EX-4A	Station 171+576 - 172+837	Pahoehoe
	Station 20+000 - 21+970	Pahoehoe
	Station 175+005 - 175+750	Pahoehoe
E-3	Station 40+000 - 45+311	Pahoehoe with thin soil cover

Source: (C.W. 1996).

3.12.1.3 Geologic and Volcanic Hazards

The Island of Hawai'i is geologically the most active of the Hawaiian Archipelago. Many volcanic eruptions and earthquakes have been recorded on this island in historic times. Faults,

rift zones, lava flows, lava tubes, and vents are present. Historical records of lava flows and seismic events provide some indication of the relative risk in various geographic areas of the island (USGS 1977). While the entire island is considered a geologic hazard area, degrees of risk have been established in zones across the island. The USGS has classified the island into Lava Hazard Zones 1 through 9, in order of decreasing risk (Figure 3.12.1, *Lava Hazard Zones*).

The Lava Hazard Zone of highest volcanic risk, Zone 1, includes those areas where more than 25 percent of the land has been covered by lava since 1800. Zone 1 areas are immediately adjacent to the calderas and major rift zones of the active volcanoes Mauna Loa and Kilauea. Zone 2 areas represent lava flow inundations of 15 to 25 percent since 1800, and zone 3 represents inundations of 1 to 15 percent. Zone 2 and 3 generally characterize areas of increasing distance downslope of active volcanoes.

Lava Hazard Zones within the project corridor range from Zone 2 through Zone 8. The portion of the project from the Mamalohoa Highway to PTA crosses geologically older slopes of the dormant volcano Mauna Kea, within the relatively low risk Lava Hazard Zones 7 and 8. These zones reflect no lava flow activity in the past 750 years.

The portion of the project from PTA (Section II) to the eastern project terminus, traverses the Mauna Loa volcanic shield in the Humu'ula Saddle between Mauna Loa and Mauna Kea. Mauna Loa is an active, basaltic volcano with at least 39 summit and flank eruptions recorded historically since 1832. The eastern portion of the study corridor, roughly from the PTA to the eastern project terminus, is more at risk from volcanic activity than the western portion due to the greater volcanic activity of Mauna Loa. Lava Hazard Zone 2 and to a lesser extent Zone 3 are located within this portion of the study corridor.

3.12.1.4 Soils

The following general information on soils is based on a U.S. Department of Agriculture (USDA) Soil Survey of the Island of Hawai'i (USDA 1973). Soil type abbreviations which begin with an "r" (such as rHLD) are classified based only on reconnaissance-level surveys.

KaC - Kaiwiki Silty Clay Loam, 0 to 10 Percent Slopes

The Kaiwiki series consists of well-drained soils formed in volcanic ash. The surface layer is dark brown silty clay loam about 0.4 m thick. The subsoil is dark brown and dark reddish brown silty clay loam about 1.2 m thick. This soil is strongly smeary and dehydrates irreversibly into fine gravel-size aggregates. These soils are found on uplands at elevations ranging from 244 to 458 m. These soils occur in areas which receive from 3,810 to 5,080 mm of rainfall annually, and have a mean annual temperature of 21 degrees C.

This soil occurs on nearly level to moderately sloping uplands. It forms in a series of layers of volcanic ash. The soil is very strongly acid to moderately acid in the surface layer and

moderately acid to strongly acid in the subsoil. Permeability is rapid, runoff is slow, and erosion hazard is slight.

KaD - Kaiwiki Silty Clay Loam, 10 to 20 Percent Slopes

The Kaiwiki series consists of well-drained soils formed in volcanic ash. The surface layer is dark brown silty clay loam about 0.4 m thick. The subsoil is dark brown and dark reddish brown silty clay loam about 1.2 m thick. This soil is strongly smeary and dehydrates irreversibly into fine gravel-size aggregates. They are on uplands at elevations ranging from 244 to 458 m. These soils occur in areas which receive from 3,810 to 5,080 mm of rainfall annually, and have a mean annual temperature of 21 degrees C.

This soil occurs on moderately sloping to moderately steep uplands. It formed in a series of layers of volcanic ash and has a banded appearance. The soil is very strongly acid to moderately acid in the surface layer and moderately acid to strongly acid in the subsoil. Permeability is rapid, runoff is slow, and erosion hazard is slight.

KaE - Kaiwiki Silty Clay Loam, 20 to 35 Percent Slopes

The Kaiwiki series consists of well-drained soils formed in volcanic ash. The surface layer is dark brown silty clay loam about 0.4 m thick. The subsoil is dark brown and dark reddish brown silty clay loam about 1.2 m thick. This soil is strongly smeary and dehydrates irreversibly into fine gravel-size aggregates. They are on uplands at elevations ranging from 244 to 458 m. These soils occur in areas which receive from 3,810 to 5,080 mm of rainfall annually, and have a mean annual temperature of 21 degrees C.

This soil occurs on steep uplands. It formed in a series of layers of volcanic ash and has a banded appearance. The soil is very strongly acid to moderately acid in the surface layer and moderately acid to strongly acid in the subsoil. Permeability is rapid, runoff is slow, and erosion hazard is slight.

KTB -Ke'eke'e Loamy Sand, 0 to 6 Percent Slopes

The Ke'eke'e series consists of somewhat excessively drained soil that developed in alluvium from volcanic ash and cinders. The surface layer is very dark gray and very dark grayish brown loamy sand, silt loam, and fine sand about 0.2 m thick. The subsoil is dark brown silty clay loam about 0.2 m thick. The substratum is stratified sand and loam. Elevations range from 1,678 to 2,440 m. These soils occur in areas which receive annual rainfall of 508 to 762 mm, and have a mean annual temperature of 11 degrees C.

This soil occurs on nearly level to gently sloping uplands in the Humu'ula Saddle between Mauna Kea and Mauna Loa. It formed in alluvium from volcanic ash and cinders. The surface

layer is mildly alkaline and the substratum is strongly alkaline to very alkaline. Permeability is rapid, runoff is slow, and the hazard of soil blowing is moderate to severe.

KZD - Kilohana Loamy Fine Sand, 12 to 20 Percent Slopes

The Kilohana series consists of somewhat excessively drained loamy fine sands that formed in volcanic ash, sand, and cinders. The surface layer is very dark brown loamy fine sand about 0.3 m thick. Below this is a very dark gray fine sand. It is underlain by volcanic ash, sand, and cinders at a depth of about 1.1 m. Elevations range from 1,525 to 1,983 m. These soils occur in areas which receive 508 to 1,016 mm of rainfall annually and have a mean annual temperature of about 11 degrees C.

This soil occurs on moderately steep uplands. It formed in volcanic ash, sand, and cinders. There are cemented layers of sand in the lower part of the profile in some places. The soil is alkaline throughout the profile. Permeability is rapid, runoff is slow, and erosion hazard is slight.

PVD - Pu'u Pa Extremely Stony Very Fine Sandy Loam, 6 to 20 Percent Slopes

The Pu'u Pa series consists of well-drained soils formed from volcanic ash. The surface layer is very dark brown extremely stony very fine sandy loam about 0.2 m thick. The next layer is dark brown and dark yellowish brown very stony very fine sandy loam about 0.9 m thick. It is underlain by fragmental 'a'a lava. Elevations range from 305 to 763 m. These soils occur in areas which receive 508 to 889 mm of rainfall annually and have a mean annual temperature of 21 to 22 degrees C.

This soil is moderately deep to deep to fragmental 'a'a lava. The soil is deep to underlying bedrock. It formed in volcanic ash on moderately sloping to moderately steep uplands. The soil is moderately acid to slightly acid in the surface layer and neutral in the subsoil. The surface layer is silt loam in places. Permeability is moderately rapid, runoff is medium, and erosion hazard is moderate.

rHLD - Huikau Extremely Stony Loamy Sand, 12 to 20 Percent Slopes

The stony phase of the Huikau series consists of somewhat excessively drained soils formed in volcanic ash, pumice, and cinders. Stones cover 3 to 15 percent of the surface. The surface layer is very dark brown extremely stony loamy sand about 0.1 m thick. Subsoils are stratified dark reddish brown sandy loam and loamy sand about 0.3 m thick. Subsoils are alternating layers of black volcanic ash, cinders, and pumice. Elevations range from 1,830 to 2,745 m. These soils occur in areas which receive mean annual rainfall of 381 to 635 mm and have a mean annual temperature of about 10 degrees C.

This soil occurs on moderately steep uplands. It formed in volcanic ash, pumice, and cinders. The surface layer has been removed by erosion and the remaining layer consists of stratified sand and cinders. Stones cover 3 to 15 percent of the surface. Subsoils are alternating layers of black volcanic ash cinders and pumice to a depth of 1.5 m or more. Permeability is very rapid, and the runoff is slow. The hazard of blowing soils is severe.

rKED - Kaimu Extremely Stony Peat, 7 to 25 Percent Slopes

The Kaimu series consists of well-drained, thin organic soils over 'a'a lava. The surface layer is very dark brown extremely stony peat about 0.1 m thick. It is underlain by fragmental 'a'a lava. Elevations range from 0 to 305 m. These soils occur in areas which receive 1,016 to 1,524 mm of rainfall annually and have a mean annual temperature of about 23 degrees C.

This soil that is shallow to fragmental 'a'a lava, but deep to underling bedrock. It occurs on moderately sloping to moderately steep uplands. The soil is neutral in reaction. Permeability is rapid, runoff is slow, and erosion hazard is slight.

rKGD - Ke'ei Extremely Rocky Muck, 6 to 20 Percent Slopes

The Ke'ei series consists of well-drained, thin organic soils overlying pahoehoe lava bedrock. The surface layer is very dark brown muck about 0.3 m thick. It is underlain by pahoehoe lava bedrock. They are at elevations ranging from 305 to 1,068 m. These soils occur in areas which receive 2,286 to 3,810 mm of rainfall annually and have a mean annual temperature of between 17 and 18 degrees C.

This soil overlying pahoehoe lava bedrock. It occurs on moderately sloping to moderately steep uplands. This soil is strongly acid. Although the organic soil is rapidly permeable, the underling pahoehoe lava is very slowly permeable, except where water moves rapidly through cracks. Runoff is medium and erosion hazard is slight.

rLV - Lava Flows, 'A'a

This unit consists of 'a'a type lava flows. The lava flow is a mass of clinkery, sharp, jagged fragmental lava. There is practically no soil covering, and vegetation is bare except for mosses, lichens, and ferns, and few shrubs and small trees. This unit is found on rough undulating to steep topography.

rLW - Lava Flows, Pahoehoe

This unit consists of pahoehoe type lava flows. The flows are relatively smooth and have a ropy glazed surface. The lava has a billow, glass surface that is relatively smooth. In some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. The

land is typically bare of vegetation, except for mosses and lichens. In higher rainfall areas, shrubs have gained a foothold in cracks and crevices.

rVS - Very Stony Land

This unit consists of 'a'a lava that has a thin covering of volcanic ash that locally extends deep into cracks and depressions. From 50 to 90 percent of the surface area is covered with stones and boulders. 'A'a lava outcrops are common. The slope is between 10 and 15 percent. Between the lava outcrops and in the cracks of the lava, the soil material extends to a depth of 0.1 to 0.5 m. The soil is deep in localized areas. Erosion hazard is slight.

WLC - Waikoloa Very Fine Sandy Loam, 6 to 12 Percent Slopes

The Waikoloa series consists of well-drained soils formed in volcanic ash. The surface layer is dark reddish brown very fine sandy loam about 0.3 m thick. It is underlain by about 0.3 m of dark brown very fine sandy loam. The subsoil consists of dark brown and dark reddish brown very fine sandy loam, silty clay loam, and sandy loam. Elevations range from 458 to 1,373 m. These soils occur in areas which receive 508 to 762 mm of rainfall annually and have a mean annual temperature of between 16 and 18 degrees C.

This soil occurs on moderately sloping uplands. The surface layer is neutral, and the subsoil is mildly alkaline. Permeability is moderate, runoff is medium, and erosion hazard is moderate.

WMC - Waimea Very Fine Sandy Loam, 6 to 12 Percent Slopes

The Waimea series consists of well-drained soils formed in volcanic ash. The surface layer is dark brown and very dark brown very fine sandy loam and loam about 0.4 m thick. The subsoil is dark brown silt loam about 0.6 m thick. It is underlain by weathering hard basalt bedrock at depths of about 1.1 m. Elevations range from 610 to 1,830 m. These soils occur in areas which receive 635 to 1,143 mm of rainfall annually, and have a mean annual temperature of between 15 and 17 degrees C.

This soil occurs on moderately sloping uplands. Soil reaction is neutral in the surface layer and mildly alkaline in the subsoil. Included in mapping are small areas where the surface layer is extremely stony. Permeability is moderately rapid, runoff is slow, and erosion hazard is slight.

Table 3.12.2, *Generalized Soil Types, Saddle Road Study Corridor*, identifies the more common soil types found in or near the project corridor and identifies the segments in which these soils are most likely to occur.

TABLE 3.12.2
Generalized Soil Types, Saddle Road Study Corridor

Segments	Soil Types
W-2	KZD, PVD, rKED, rVS, WLC, WMC
W-3	KZD, PVD, rKED, rVS, WLC
EX-2	KTB, rLV, rLW, rVS
PTA-1	KTB, KZD, rHLD, rLV, rVS
PTA-3	KTB, KZD, rHLD, rLV, rVS
EX-3	rKGD, rLW
EX-4A	rKGD, rLW
E-3	KaC, KaD, KaE, rKGD, rLW

Source: USDA, 1970.

3.12.1.5 Speleological Resources

Speleological resources, such as lava tube caves and pseudokarst, occur within the project vicinity. In Hawai'i karsts or pseudokarsts are associated with all known caves.. However, only small portions of karstic and pseudokarstic terrains are cavernous. Lava tubes are present; however, lava tube caves are relatively uncommon. Most tubes are too short, too small, fragmented, or debris-filled to be considered caves.

Lava tubes are characteristic of relatively young pahoehoe lava flows and are important landforms on young volcanoes such as Mauna Loa. Since Saddle Road stays mostly on Mauna Loa lavas, construction of the proposed project would be expected to encounter numerous lava tubes. While caves are more common under pahoehoe lava, some are buried beneath 'a'a and other substrates. Often, if a flow is known to contain a cave, there is a high probability that other caves also occur in the same flow.

3.12.2 Environmental Consequences

All Action Alternatives. The proposed project would have no impact on climate along the corridor or within the region. Geologic hazards within the study corridor include low-lying areas with potential flooding hazard, steep slope with potential instability and landslides, soft soils or wetlands with potential fill ground subsidence, and known faults that may traverse the proposed roadway segments. Based on the site reconnaissance and literature research conducted

for the project, no significant geologic hazards were observed or identified along the proposed segments, except along portions of the proposed Segment E-3.

Due to the presence of volcanic and seismic hazards within the study corridor, the proposed improved Saddle Road could be directly damaged in the future by lava flows and earthquake activity, temporarily resulting in road closures to repair damage or rebuild affected sections. This risk exists with or without implementation of the proposed action, since Saddle Road is an existing transportation corridor through this region. In the case of volcanic or seismic damage to the road, fiscal impacts with the action alternatives would be greater than the No Action Alternative, because of the additional dollars expended in road improvements.

The volcanic ash soils, when wetted, have relatively low strength characteristics and are highly susceptible to erosion in a dry state. If in-situ moisture contents are high enough, these soils become fluid and lose strength temporarily when remolded or disturbed (thixotropic soils). PVD and WLC present a moderate erosion hazard, KTB presents a moderate to severe soil blowing hazard, while rHLD presents a severe hazard to soil blowing.

During construction activities, grubbing and earth work will expose the soil to increased erosion potential. Soil erosion impacts would be localized, and short-term, and would be associated with precipitation events during the construction phase.

With the action alternatives, the road surface and shoulders will be paved. No notable, long-term increase in soil erosion is anticipated with implementation of the action alternatives.

Information available on the project area reflects the potential presence of caves and lava tubes throughout the project vicinity, in all sections. Because most lava tubes have no entrance or remain unknown, they cannot be surveyed before construction begins. Accidentally breaking through the roof of hidden caves would be hazardous to workers and detrimental to the cave and its resources. Breaks into caves would change the airflow patterns in the cave, usually making them less suitable for cave animals. Clearing vegetation for staging areas and other uses related to the road construction, would reduce the amount and quality of food entering the cave ecosystem. Many Hawaiian cave animals are dependent on native plant species on the surface above their cave habitats. Changing water flow patterns and infiltration rates may desiccate some caves or flood others. Chemical spills and runoff may enter caves and have devastating effects on the fauna. The road may seal caves making them no longer available for study or enjoyment. Other caves may be made more accessible to human visitors, which could be detrimental to cave resources that are highly vulnerable to human disturbance.

Recent research has shown that many cave animals on the Island of Hawai'i have differentiated within different caves, so that each cave may harbor a distinct and unique fauna found no where else. These cave systems are vulnerable to above-ground disturbance, as well as to direct and indirect disturbance within the caves. Portions of numerous additional caves may lie hidden

beneath the proposed road alignments and some of these may be broken into or impacted during construction.

Notable caves, known along Saddle Road that could be directly affected are portions of the 1881 Lava Flow (Kaumana Cave), Don's Cave, and Strawberry Cave. Known caves of the project vicinity are described as follows. (Not all caves have entrances, so precise locations of caves cannot be determined. Additional cave passages may exist beneath the proposed alignments. Not all lava tubes drain, and therefore, not all form caves.)

Bradshaw Field Cave. Bradshaw Field Cave is located within 50 m of the PTA-1 and PTA-3 alignment at Station 16+600. It is a surface tube in a small isolated Mauna Kea spatter cone (volcanic vent) near the western end of the Bradshaw Army Airfield. The PTA-1 and PTA-3 alignment crosses the spatter cone, indicating a high likelihood of lava tubes or caves in the immediate vicinity. The cave is a dusty low crawlway about 15 m long between two entrances. The passage ranges from 0.3 to 0.6 m high and from 0.6 to 2.0 m wide. The air temperature in the cave was 21.5 degrees C, indicating a strong climatic influence from the entrances. The cave probably continues both up- and down-slope on the cone, but no other entrances were found.

1935 Lava Flow Cave A. 1935 Lava Flow Cave A is located near the EX-2 alignment from Station 139+600 to 140+860. The identified cave entrances are located from 10 to 150 m from this alignment. Several small pit entrances occur in the 1935 flow near Pu'u Huluhulu. The more significant of these range in size from 1 to 3 m in diameter up to 2 m deep. They were all sealed and entered no true cave, but most contained small shelter caves where wind borne organic material has accumulated.

1935 Lava Flow Cave B. 1935 Lava Flow Cave B is located near the EX-3 alignment at Station 141+880. The cave entrances are located within 10 m of this alignment. An area similar to the 1935 Lava Flow Cave A was found on the 1935 lava flow about 1 km east of Pu'u Huluhulu, and several small entrances were investigated. A small cave about 10 m long and 0.6 to 1.2 m high was found connecting two entrances in a roofed over portion of a lava trench. The cave was entirely in twilight and dry.

Strawberry Cave. The entrance to Strawberry Cave is about 30 m north of the existing alignment near Station 148+240 in a small vegetated kipuka. Smaller sinkholes in the kipuka are sealed, but indicate the existence of passages beneath. In the main entrance, a small crack leads through the breakdown to a small upslope passage which goes a short ways under the a'a flow on the surface. The main passage goes downslope for about 270 m. The passage is 2 to 5 m wide and 1 to 4 m high. Most of the floor is obscured by breakdown blocks, and the ceiling is unstable in places. A breakdown pile and row of ceiling drips possibly mark approximately where the cave goes under the existing Saddle Road about 75 m from the entrance. The deep cave is wet with numerous ceiling drips and moist walls characteristic of the deep zone environment. The winter effect (cold dry air sinking into the cave) from the large downward

sloping entrance passage is relatively strong. The air temperature was relatively cool at 12 degrees C.

Don's Cave. The entrance pit to Don's Cave is located 50 m north of the existing alignment on Segment EX-3 at Station 156+760. The pit is only a 1.5- by 0.6-m hole 2.4 m deep and is completely overhung, requiring a ladder or rope to enter. The downslope passage is sealed, but upslope the cave enters a small room 10 m in diameter and 1 to 2 m high. The room is festooned with 'ohi'a roots dangling from floor to ceiling. The air is still and humid and typical of a deep zone environment in spite of being close to the small entrance. The air temperature at the back of this room was 16.5 degrees C. A low 'a'a crawl, 0.4 m tall and 4 m long leads upslope to at least two similar but larger rooms which are more humid and with numerous roots.

1881 Lava Flow (Kaumana Cave). Kaumana Cave is in the 1881 lava flow which parallels or lies under Saddle Road near the eastern end of the project area. The main entrance to Kaumana Cave proper is about 5 km east of the project area, but the cave is known to extend 3 km upslope towards the project boundary and may extend to any portion of the project area sited on the cavernous 1881 lava flow. Much of the surface of the 1881 flow in this area is built up as a subdivision, and cave passages, if they exist, may already be altered. If Segment E-3 is selected, the road will traverse the 1881 flow for a length of about 1 km. If Segment EX-4A is chosen, the new road will also traverse parts of the 1881 flow. Kaumana Cave is a large and biologically significant cave . It is possible that road construction will discover or open new entrances to the system.

No Action Alternative. No impacts to climate or geologic resources and no soil erosion are anticipated with the No Action Alternative.

3.12.3 Mitigation Measures

Deflection berms or barriers are one way facilities can be protected from lava flows. Due to the road's length and linear nature, it would not be cost effective to construct such barriers. Also, the construction of barriers would result in a substantial increase in the disturbance or loss of sensitive biological resources along the corridor.

Mitigation Measures Applicable to All Project Sections

- Prior to construction, a field review with representatives of the BRD/USGS and the Hawai'i Speleological Society will be conducted to determine the probability of caves or lava tubes in the construction corridor. Final design and/or construction techniques will be developed to avoid or minimize impacts.

- In the case that a cave or lava tube is encountered during construction, all construction activity will cease immediately at the location in question and the Project Engineer will be notified. Consultation will be conducted with appropriate resource or regulatory

personnel to ensure that unique biological, cultural, or geological resources associated with these features are adequately protected, or investigated and documented.

- During final design, significant caves will be identified in consultation with appropriate regulatory agencies, and where feasible, the overburden over significant caves will be reinforced; passages will not be crushed and filled.

- When current access to exceptional caves would be blocked by the project, bypass conduits will be installed to allow continued access.

- Construction specifications would be incorporated to minimize potential hazards of caves to construction workers.

Section I Mitigation Measures

- During the rainy season, following completion of construction, slopes and denuded areas within Section I (Segments W-2 and W-3) will be revegetated with a grass such as kikuyu to minimize soil erosion. Reseeding of disturbed areas within Sections II, III, and IV (Segments EX-2, PTA-1, PTA-3, EX-3, EX-4A, and E-3) is not recommended.

3.13 VEGETATION

Two surveys of the botanical resources were conducted for the proposed project (Char 1996 and Palmer 1997, Tech. App. Vol. I). The first survey covers the western portion of the study area, from the Mamalahoa Highway (SR 190) to the Mauna Kea Access Road, and includes Sections I, II, and some of Section III. The second survey covers the eastern portion of the study area, from the Mauna Kea Access Road to the eastern project terminus, and includes the majority of Section III and Section IV (Figure 3.13.1, *Biological Resources).*

Both the westside and eastside botany surveys included a search of pertinent botanical studies and the Nature Conservancy's Hawai'i Natural Heritage Program data base (Heritage Database). Topographic maps and aerial photographs of the study area were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points. Soil survey maps were also studied. Field investigations consisted of a 100-percent pedestrian survey of the study area by project botanists. For the westside botany survey, pu'u, rocky ridges, and steep-sided gulches near or adjacent to the project area where rare plants likely occur were also investigated. Surveys for the westside botany study were completed between March 1995 and April 1996. Surveys for the eastside botany study were completed between September 1995 and November 1996. A field review was made of the Segments EX-2, PTA-1, and PTA-3 with USFWS representatives and the PTA biologists in December 1995.

3.13.1 Affected Environment

Nine vegetation types were identified within the westside study area. The vegetation types are divided into two categories, *nonnative vegetation* types and *native vegetation* types. Nonnative vegetation types are dominated by introduced or alien species. Native vegetation types are dominated by plants that occur naturally in the Hawaiian Islands. These may be *endemic* (native only to the Hawaiian Islands); or they may be *indigenous* (native to the Hawaiian Islands but also naturally occurring elsewhere). The four nonnative vegetation types include fountain grass/mixed shrubland, pasture land, eucalyptus/pine plantings, and ruderal community. The five native vegetation types include hard-stemmed lovegrass grassland, 'aweoweo shrubland, 'a'ali'i shrubland, mamane/naio forest, and pioneer vegetation on lava flows.

Twelve vegetation types were identified within the eastside study area. The two nonnative vegetation types include lowland wet herbland and lowland wet grassland. The ten native vegetation types include lowland wet forest, lowland wet shrubland, montane wet forest, montane wet shrubland, montane mesic forest, montane mesic shrubland, montane dry forest, montane dry shrubland, montane dry grassland, and subalpine dry shrubland.

3.13.1.1 Nonnative Vegetation Types

3.13.1.1.1 Fountain Grass/Mixed Shrubland

This vegetation type occurs primarily on Pu'u Pa series soils (ref: FEIS - Part I, 3.12.1.4). Fountain grass cover varies from 40 to 70 percent. Shrubs of 'a'ali'i, 'akia, koa haole, and smaller forbs comprise the remaining plant cover. Fountain grass, native to northern Africa, forms wiry-stemmed, dense tufts 1 to 1.5 m tall, while the shrub cover varies in height from 1 to 2.5 m tall. Other species which may be locally common to occasional in this vegetation type include the introduced grasses such as natal redtop, buffel grass, Bermuda grass, kikuyu grass, and pitted beardgrass. The weedy forbs are more abundant during the rainy season and tend to be found in the small pockets of damp soil among the rocky outcrops. These include Spanish needle, weed verbena, field madder, Childing pink, allseed, hairy horseweed, galinsoga, and wahlenbergia.

Fountain grass/mixed shrubland may be dissected by numerous stony ridges and knolls in places. In these areas, a few remnant pockets of native shrubland may be found. Besides the 'a'ali'i and 'akia, which are common and widespread through this vegetation type, these stony ridges support a few plants of 'ulei, sandalwood, pua kala, naio, dubautia, 'ala'ala wai nui, mamane, and pukiawe. This vegetation type is used for grazing cattle and horses, so most of the native components have suffered grazing damage.

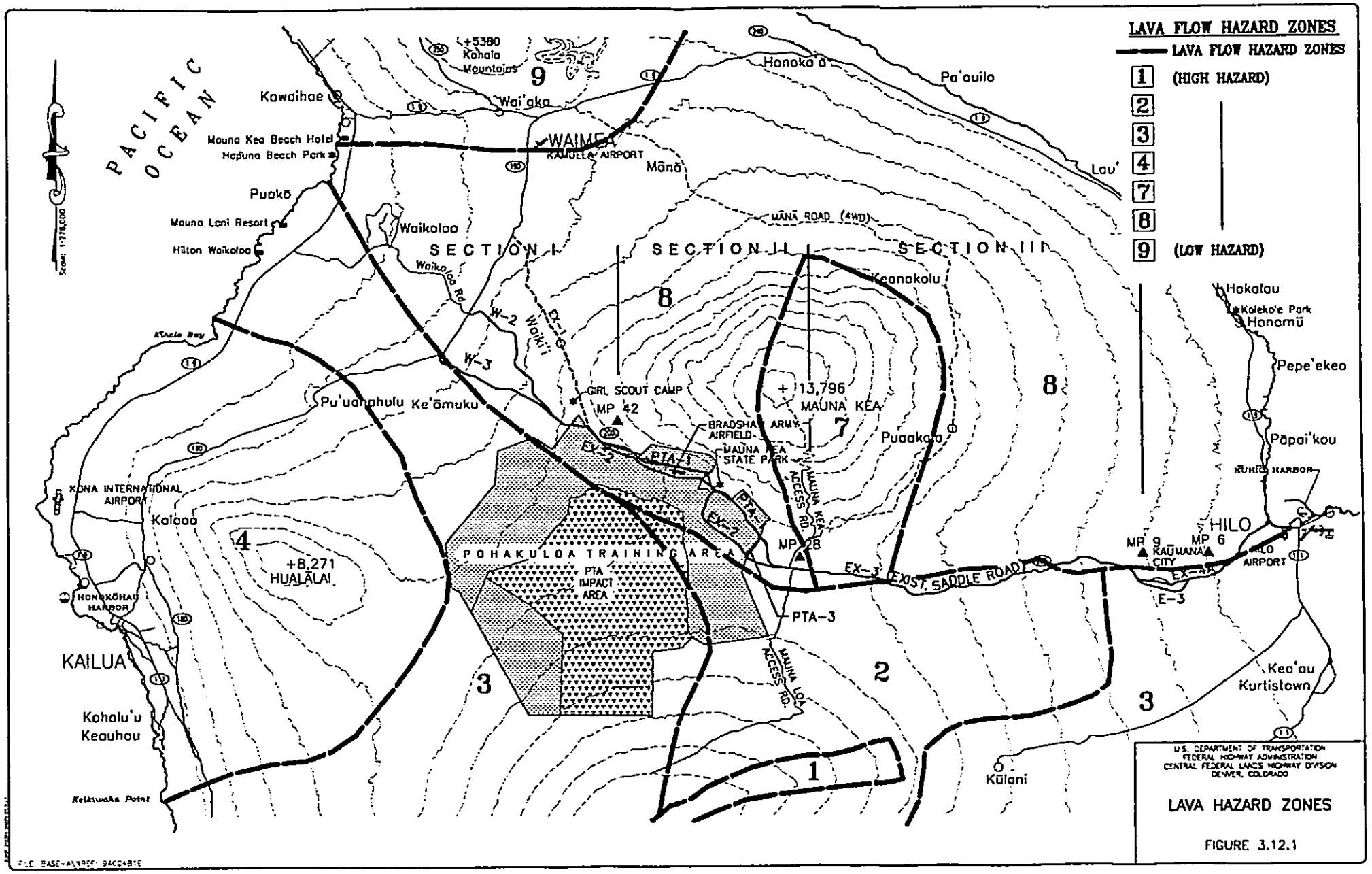
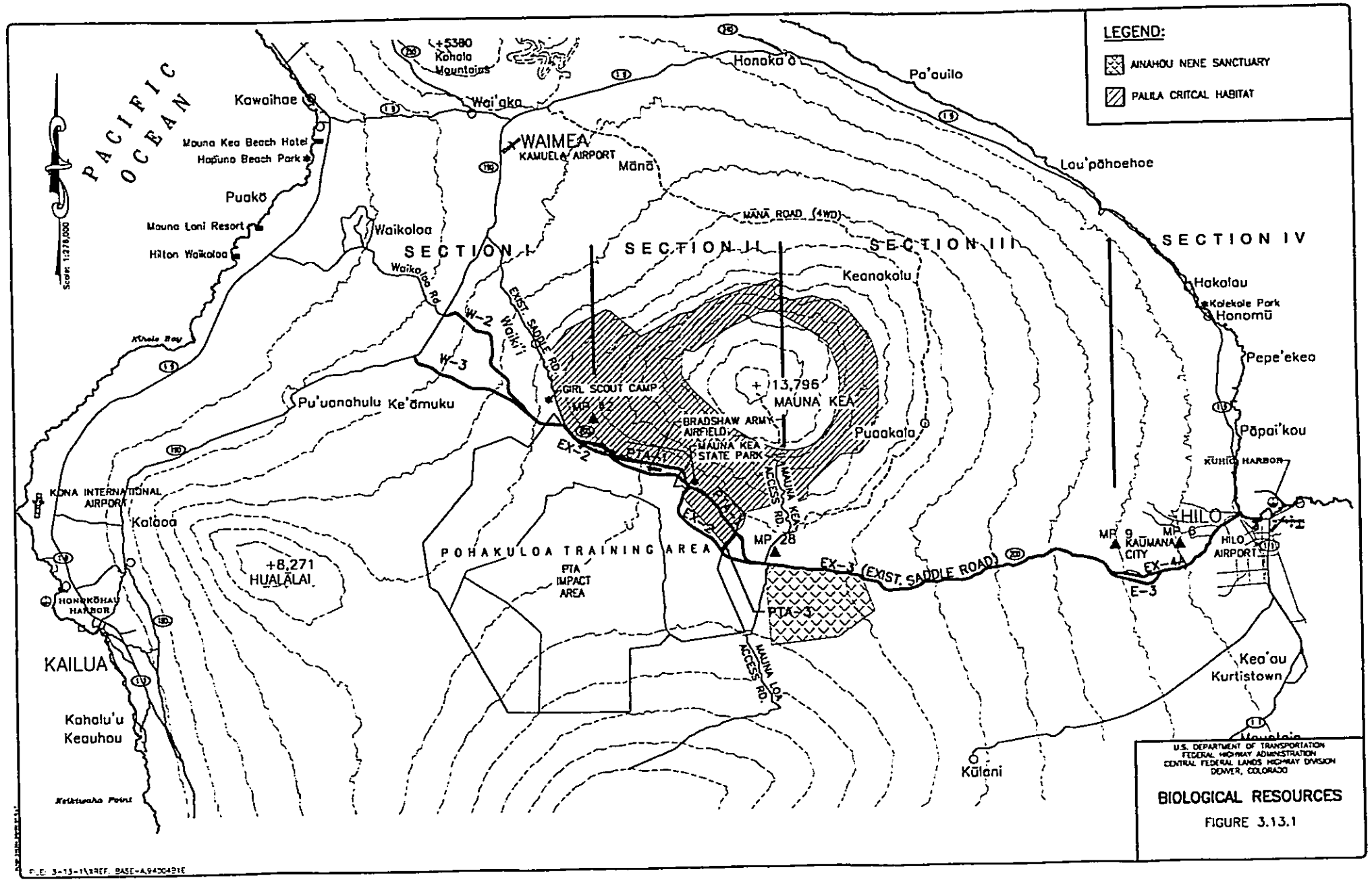

LAVA FLOW HAZARD ZONES
LAVA FLOW HAZARD ZONES
1 (HIGH HAZARD)
2
3
4
7
8
9 (LOW HAZARD)
PACIFIC OCEAN
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
Waikoloa
Waikoloa Rd.
Kīholo Bay
+5380 Kahala Mountains
Wai'aka
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka'a
Pa'auilo
Lau'
MĀNĀ ROAD (4WD)
SECTION I
SECTION II
SECTION III
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KUHIO HARBOR
HILO
HILO AIRPORT
MP 9
MP 6
KAUMANA CITY
E-3
Kea'au
Kurtistown
Kūlani
Pu'uanahulu
Ke'āmuku
GIRL SCOUT CAMP
MP 42
+13,796
MAUNA KEA
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
MAUNA KEA ACCESS RD.
Puaakala
MP 28
EX-3 (EXIST. SADDLE ROAD)
PTA-3
MAUNA LOA ACCESS RD.
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
HONOKŌHAU HARBOR
KAILUA
Kahalu'u
Keauhou
Keikiwaha Point
W-2
W-3
EX-1
EX-2
PTA-1
PTA-2
EX-4
1
2
3
4
7
8
9
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
LAVA HAZARD ZONES

FIGURE 3.12.1


LEGEND:
AINAHOU NENE SANCTUARY
PALILA CRITCAL HABITAT
PACIFIC OCEAN
Scale: 1:278,000
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Loni Resort
Hilton Waikoloa
Kihole Bay
+5380
Kohala Mountains
Wai'aka
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka'ō
Pa'auilo
Lau'pāhoehoe
Waikoloa
Waikoloa Rd
SECTION I
SECTION II
SECTION III
SECTION IV
MĀNĀ ROAD (4WD)
Keanakalu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KŪHIO HARBOR
HILO
HILO AIRPORT
MP 9
MP 6
KAŪMANA CITY
EX-4A
E-3
W-2
W-3
Waiki'i
EXIST. SADDLE RD.
GIRL SCOUT CAMP
MP 42
+13,796
MAUNA KEA
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Pu'uanahulu
Ke'āmuku
EX-2
PTA-1
PTA-2
PTA-3
MAUNA KEA ACCESS RD.
MP 28
EX-3 (EXIST. SADDLE ROAD)
MAUNA LOA ACCESS RD.
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
HONOKŌHAU HARBOR
KAILUA
Kahalu'u
Keauhou
Keikiwaha Point
Kūlani
Kea'au
Kurtistown
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
BIOLOGICAL RESOURCES
FIGURE 3.13.1

3.13.1.1.2 Pasture Land

Pasture land vegetation is found on areas with deep Waimea series soils (ref: FEIS - Part I, 3.12.1.4). Kikuyu grass, a native of tropical Africa, is the most abundant grass in this vegetation type. It is widely cultivated as a range grass in Hawai'i. Other range grasses found here in lesser numbers include African dropseed, buffel grass, cocksfoot, rescue grass, Bermuda grass, and Dallis grass. Leguminous species include bur clover, Spanish clover, black medick, white sweet clover, and white clover. Most of the pasture grasses and legumes were deliberately introduced and planted to improve the pastures. Together, they form a low mat, 10 to 30 centimeters (cm) in depth.

There is some variation in this vegetation type. On the Waiki'i Ranch lands, there are large areas where African dropseed is dominant or at least codominant with the kikuyu. A somewhat wetter variant of the pasture land vegetation is found on the DHHL property on the east end of Section II. The pasture is a patchwork of various, mostly temperate, grass species. In some places, velvet grass may be codominant with kikuyu or sweet vernalgrass. On areas with thin, stony soils, hairy oatgrass is abundant. Perennial ryegrass is locally abundant in low lying areas. Rocky ridges and outcrops, and the gulches which cross the pastures throughout the study area, provide habitat for a few native plants such as mamane, 'a'ali'i, naio, pilo, hard-stemmed lovegrass, 'ulei, and kolea. A number of weedy forbs also occur in these places.

3.13.1.1.3 Eucalyptus/Pine Plantings

Scattered throughout the western portion of the study area, primarily on the pasture lands, are plantings of various eucalyptus and pine species. Frequently, they are composed of blocks of a single species, either a eucalyptus or Monterey pine. Along the existing Saddle Road within Section I, there are large blocks of mixed plantings which include swamp mahogany, Sydney blue gum, silk oak, tsugi, black wattle, and Cook pine. Generally, these planted forests are very dense, and ground cover is sparse, usually consisting of the elements from the adjoining pasture land vegetation. In some places, the plantings are very heavily used by cattle for resting and there is almost no ground cover. These plantings of introduced tree species occupy only a small portion of the study area and are largely botanically uninteresting.

3.13.1.1.4 Ruderal Community

A weedy mixture of introduced grasses and forbs is found on more or less frequently disturbed areas such as alongside the existing Saddle Road, on cinder cones which have been mined, and on some areas with active use within the PTA. Many of the species found within this community are well-adapted to living under conditions which include periodic maintenance of roadsides, vehicular and pedestrian traffic, and bulldozing. A number of these weedy species are either confined to these sites or are much more abundant there. The existing Saddle Road shoulder is maintained by periodic mowing. Where it passes through pasture land, the roadside vegetation is usually kikuyu grass with pockets of Kentucky bluegrass, cocksfoot, and rescue

grass at the higher elevations; and fountain grass, natal redtop, and buffel grass on the lower elevations. In the PTA, the roadside community is composed of a mixture of kikuyu grass and a large assortment of mostly weedy species, many of them annuals. Some of the more frequently observed plants include Bermuda grass, fountain grass, telegraph plant, woolly mullein, black mustard, natal redtop, golden crown-beard, and lepidium.

The cinder quarry areas also support this community type. On the quarry at Pu'u Nene, the following species are abundant to common: evening primrose, woolly mullein, rabbit-foot clover, sweet vernalgrass, black mustard, and several species of brome. Because the quarry areas are less frequently disturbed than the roadside, they support a number of more woody components which include poha, castor bean, sourbush, koa haole, hairy abutilon, fuzzy rattlepod, and apple of Sodom. Fountain grass is usually common on these quarry areas. A few eucalyptus trees, most likely planted, are found on some of the quarries.

Within those portions of the PTA that fall within the study area, the ruderal community is associated with maneuver areas, dirt roads, and trails. These areas may be open and dominated by introduced grasses such as fountain grass, natal redtop, and needlegrass; or they may be largely barren with scattered patches of weedy plants which include puncture vine, golden crown-beard, cheese weed, pin clover, needlegrass, and saltbush.

The ruderal community is the most diverse of the vegetation types within the study area, but it is composed primarily of weedy, introduced species, most of which are annuals. The ruderal community is highly transient due to the frequent disturbances, and species occurrence and composition are always in a state of flux. These disturbed sites are also very often sites of new weed introductions, some of which may have the potential to disrupt native ecosystems.

3.13.1.1.5 Lowland Wet Herbland

Lowland wet herbland occurs in the eastern portion of the project area below Country Club Road in E-3. These lands were in cane sugar production until recently. Characteristic species include rattlepod, white ginger, yellow ginger, glorybush, hilahila, and sugarcane.

3.13.1.1.6 Lowland Wet Grassland

Lowland wet grassland occurs below Ola'a Flume Road and Country Club Road on Segment E-3 and are now grazing lands. Characteristic species include California grass, nutgrass, marsh purslane, molasses grass, Dallis grass, and Glenwood grass.

3.13.1.2 Native Vegetation Types

3.13.1.2.1 Hard-stemmed Lovegrass Grassland

Hard-stemmed lovegrass forms a low, dense, almost monodominant cover up to 0.7 m tall on the alluvial flats and cinder cones within the study area. This habitat is unique to the saddle area of the Island of Hawai'i. Scattered native shrubs such as 'a'ali'i, ko'oko'olau, dubautia, and 'ulei may be present, especially where the grassland merges with 'a'ali'i shrubland along the lower Mauna Kea slopes. 'Aweoweo and other components of the 'aweoweo shrubland may be present where the grassland merges with this vegetation type on the alluvial flats. Low-statured mamane and naio trees are occasionally found scattered here and there within this grassland type. The dense grass cover generally tends to exclude most of the smaller forbs, but the grassland located between the PTA and the Kilohana Girl Scout Camp is somewhat more disturbed due to pig activity; pig trails and rooted up areas are frequently found. Plants of stinking everlasting and bedstraw are locally abundant on these open, disturbed sites.

3.13.1.2.2 'Aweoweo Shrubland

'Aweoweo shrubs form an open to closed scrub cover, 1 to 2.5 m tall, on the alluvial flats within the study area. This shrubland is found primarily on alluvial deposits belonging to the Ke'eke'e series soils (ref: FEIS - Part I, 3.12.1.4). Occasionally, 'aweoweo shrubland may also be found on cindery soil at the base of cinder cones. This vegetation type is not very diverse, consisting almost exclusively of 'aweoweo shrubs with a variable assortment of mostly weedy, introduced forbs which include telegraph plant, lepidium, black mustard, needlegrass, pin clover, and bur clover. In many places though, barren soil predominates. The 'aweoweo shrubland forms a complex mosaic with the surrounding hard-stemmed lovegrass grassland, 'a'ali'i shrubland, and mamane/naio forest. Widely scattered mamane and naio trees can be found in this shrubland where it adjoins this forest type. Within the study area, constituents from the 'aweoweo shrubland and the hard-stemmed lovegrass grassland often overlap.

3.13.1.2.3 'A'ali'i Shrubland

'A'ali'i shrubland is generally found on weathered pahoehoe flows with very shallow or little soil and also on cinder cones in the study area. It grades into open scrub mamane/naio forest and into hard-stemmed lovegrass grassland along the western portion of the PTA-1/PTA-3 alignment. The 'a'ali'i shrubland on and adjacent to the alignment corridors tends to form a fairly dense cover from 1.5 to 2 m tall. Mamane and naio trees are found scattered throughout the shrubland. A few small stands of 'akoko can be found in rocky areas and in small gulches. Other shrubs which occur here include ko'oko'olau, dubautia, 'aweoweo, pukiawe, and 'ulei. Scattered patches of grasses such as the native hard-stemmed lovegrass and alien fountain grass are occasional, although the hard-stemmed lovegrass may become abundant in places. Several small gulches formed by runoff from the slopes of Mauna Kea cross this shrubland as well as the neighboring hard-stemmed lovegrass grassland on the study area. These gulches provide a

damper, shadier microhabitat where a number of temperate, introduced species are found. These include petty spurge, small-flowered catchfly, shepard's purse, thyme-leaved speedwell, Venus's looking glass, common mouse-ear chickweed, and German ivy. Several diminutive native ferns such as the 'oali'i, lau kahi, and'iwa'iwa are quite common on the moist gulch walls.

3.13.1.2.4 Mamane/Naio Forest

This forest is dominated by mamane and naio trees from 3 to 10 m tall, but typically around 5 m. The mamane/naio community may be an open parkland with the trees widely spaced or a closed canopy forest with the canopy of the trees interlocking or touching. Differences in tree spacing may be related to long term soil moisture conditions and to fog interception on the windward facing areas.

The proportion of mamane to naio varies with a number of environmental factors. On ash or ash/cinder soils at level sites in areas of somewhat higher rainfall, mamane predominates. On pu'u, mamane is common near the base of the pu'u, while naio is more common on the upper slopes. While best developed on ash or ash/cinder loam soils, the forest is also found on older, weathered pahoehoe and 'a'a lava flows.

Other tree species found occasionally in this forest type include pilo, sandalwood, and 'akoko. In some areas with blocky lava and shallow soils, 'akoko may form large stands and become codominant. Arborescent forms of 'a'ali'i are occasional on cinder cones. Shrubs include 'aweoweo on ash soils, and 'ulei, pukiawe, and kukaenene on lava substrates.

A number of native and introduced grasses are more common in areas where the canopy is open. Native grasses include hard-stemmed lovegrass, eragrostis, deschampsia, and mountain pili. Introduced grasses which tend to occur in larger numbers in these open areas include needlegrass, ripgut grass, cocksfoot, and perennial veldtgrass. Commonly encountered forbs include mostly introduced species such as telegraph plant, woolly mullein, lepidium, stinkweed, pin clover, and common yarrow. The native 'ena'ena is frequently observed in this vegetation type.

3.13.1.2.5 Pioneer Vegetation on Lava Flows

Pioneer vegetation represents the earliest stages of plant succession on geologically young, generally unweathered lava flows. The rate of vegetation development depends on the age and type of lava substrate, moisture, and elevation. On the westside botany study area, pioneer vegetation is found on the Lava Flows of 1843 and 1935. Because of the drier conditions on the westside, these flows do not support a dense lichen and moss cover.

Jumbled heaps of clinkery 'a'a lava are found on the 1843 lava flow. The loose 'a'a clinkers drain quickly and the flow is largely devoid of vegetation. A few small, very scattered pockets

of vegetation are found in depressions where organic material, soil, and coarse gravel have accumulated. Native vegetation found on this flow in low numbers include 'ae, 'oali'i, the fuzzy-leaved form of 'ohi'a, tetramolopium, and 'ohelo. Where the flow borders the mamane/naio forest, a few components from this forest type appear along the edges of the flow (edge transition zone or ecotone).

Pahoehoe lava is found on the 1935 flow, which originated from Mauna Loa. The dense, dark black pahoehoe lava is smooth and undulating with a ropy surface in many places. Fissures, cracks, and collapsed lava tubes provide a moist and protected microhabitat for plants of na'ena'e, ka'ape'ape, and 'ae. The 1935 flow did not cover the entire site, but left a few small isolated kipuka. These pockets of older, weathered, reddish-brown colored lava are covered primarily by pukiawe shrubs and tussocks of deschampsia grasses. Other species found here include native plants such as 'ohelo, carex, pilo, 'ae, 'oali'i, luzula, kukaenene, and laukahi; and introduced species such as sheep sorrell, velvet grass, and willow herb.

3.13.1.2.6 Lowland Wet Forest

New lowland wet forest occurs on the 1881 pahoehoe flow from MP 8 to MP 6. Invasive alien species like swordfern, glorybush, bamboo orchid, and broomsedge are present, but are not replacing the native vegetation. This community is dominated by uluhe, 'ohi'a, and pukiawe 'uki. Other characteristic species include wawae'iole and 'uki.

Old lowland wet forest occurs in the eastern end of the project area, below 'Ola'a Flume Road. This community is heavily infested with strawberry guava and shows the effects of many years of cattle grazing, logging, and the presence of feral animals. In Segment E-3, these areas were formerly dominated by koa trees, which were logged many years ago. The present grazing and infestation with introduced alien species is inhibiting koa regeneration.

3.13.1.2.7 Lowland Wet Shrubland

New lowland wet shrubland occurs on the 1881 pahoehoe flow in a few scattered localities from MP 8 to MP 6. This community occurs on lava *tumuli* which serve as biological islands in surrounding mesic forest. Vegetation on these perched habitats is distinct, because the tumuli are drier than adjacent areas. This community is dominated by uluhe and 'uki. Other characteristic species include 'oleho 'ai and 'akia.

3.13.1.2.8 Montane Wet Forest

New montane wet forest occurs on the 1855 pahoehoe flow from MP 16 to 9.4 and on the 1881 pahoehoe flow from MP 9 to 8. Invasive alien species such as bamboo orchid, broomsedge, swordfern, and firebush are present, but currently are not displacing the native vegetation. This community is dominated by uluhe and 'ohi'a. Characteristic species also include wawae'iole, 'uki, 'ama'u, and 'ohelo la'au.

Old montane wet forest occurs in all the kipuka and old flow areas between MP 16 and MP 8, from 600 to 1,400 m in elevation. These stands of late successional stage forest are the Hawaiian native rainforest, usually with an overstory canopy dominated by koa, a middle canopy layer dominated by 'ohi'a, and a lower canopy dominated by tree ferns. Loulu palm is frequently present as a canopy emergent. Numerous other nondominant native tree species may be present. Under the canopy, the forest is open, with a well developed herb layer dominated by ferns. A high diversity of bryophytes (mosses and liverworts) and Hawaiian native fungi (mushrooms) are present in the understory. In low lying spots, patches of bog vegetation are found. Characteristic species include koa, adenophorus, mehamehame, spleenwort, pa'iniu, paco fern, kanawao, carex, hapu'u'i'i, 'oha kepau, 'olopa, kukae nene, 'aku, kikawaio, ha'iwale, uluhe, laukahi, dubautia, ekaha,'ie'ie, manono, kawa'u, kamakahala, wawae'iole, 'uki, pala, 'ahu'awa, filmy fern, 'ohi'a, kolea, oreobolis, Dallis grass, alani, 'ala'ala wai nui, ho'awa, 'ae, loulu palm, kopiko, 'akala, 'ama'u, stenogyne, pukiawe, and 'ohelo.

3.13.1.2.9 Montane Wet Shrubland

New montane wet shrubland occurs on the 1855 pahoehoe flow from MP 16 to 9.4 and on the 1881 pahoehoe flow from MP 9 to 8. It is found on lava tumuli which serve as biological islands or microhabitats within surrounding wet forest. The vegetation on these perched habitats is distinct because the tumuli are drier than adjacent areas. There are few alien species found in this community. New montane wet shrubland is dominated by uluhe and 'uki. Characteristic species also include na'ena'e and 'ohelo 'ai, which are uncommon in surrounding wet forest.

3.13.1.2.10 Montane Mesic Forest

New montane mesic forest occurs on the 1855 'a'a flow from MP 19 to 16. Invasive alien species bamboo orchid, sword fern, and thimbleberry are present, but currently are not displacing the native vegetation. This community is dominated by uluhe and 'ohi'a. Characteristic species also include manono, wawae'iole, 'uki, 'ama'u, pukiawe, and 'ohelo. Occasionally found species include 'olopa, hapu'u, na'ena'e, wawae'iole, and 'ohelo 'ai.

Old montane mesic forest occurs from MP 23 to 17, between 1,400 and 1,900 m in elevation. Rainfall is less than at lower elevations. The forest has less canopy cover in most places than wet forest. Tree ferns are lacking and characteristic dry forest trees and shrubs are present. Characteristic species in old montane mesic forest include koa, athyrium, kukae nene, laukahi, manono, kawa'u, naio, kolea, kopiko, 'akala, 'ama'u, pukiawe, and 'ohelo.

3.13.1.2.11 Montane Mesic Shrubland

New montane mesic shrubland occurs on the 1855 'a'a flow from MP 22 to 19. There are few alien species found in this community. This community is dominated by kukae nene, 'ohi'a,

'ama'u, pukiawe, and 'ohelo 'ai. Characteristic species also include uluhe, laukahi, manono, 'ae, and 'ama'uma'u. Occasionally found species include pa'iniu and 'akala.

3.13.1.2.12 Montane Dry Forest

Old montane dry forest occurs from MP 27.5 to 22, primarily above 1,800 m in elevation. On old pahoehoe this forest type often shows an understory dominated by pili 'uka. Characteristic species include koa, kolea, kukae nene, 'ulei, pili 'uka,'iliahi, 'a'ali'i, mamane, dubautia, pukiawe, naio, and 'ohelo.

3.13.1.2.13 Montane Dry Shrubland

New montane dry shrubland occurs on the 1855 'a'a and pahoehoe flows from MP 27 to 22. There are few alien species found in this community. New montane dry shrubland is dominated by kalamoho, 'ae, 'ama'u, pukiawe, and 'ohelo 'ai. Characteristic species also include spleenwort, kukae nene, na'ena'e, and 'ohi'a. Occasionally found species include 'a'ali'i, laukahi, and na'ena'e.

Old montane dry shrubland occurs from MP 28 to 24 in the kipuka of old pahoehoe surrounded by the 1935 flow. Extensive areas of this type occur south of the 1935 flow. Characteristic species include spleenwort, carex, kukae nene, 'a'ali'i, dubautia, gahnia, 'ulei, kalamoho, 'ae, silene, pukiawe, and 'ohelo.

3.13.1.2.14 Montane Dry Grassland

Old montane dry grassland occurs in a few patches outside the survey corridor between MP 25 and 23. These areas are mapped by the Hawai'i Natural Heritage Program. They are characteristically dominated by hard-stemmed lovegrass.

3.13.1.2.15 Subalpine Dry Shrubland

New subalpine dry shrubland occurs on the 1935 pahoehoe flow from MP 28 to MP 27. Vegetation is sparse and alien species are virtually absent from this community. This community is dominated by kukae nene, na'ena'e, and 'ohelo 'ai. Characteristic species also include spleenwort and 'ae.

Old subalpine dry shrubland occurs in Pu'u Huluhulu Natural Area Reserve. Characteristic species include spleenwort, kukae nene, 'a'ali'i, dubautia, cranesbill, cudweed, hairy cat's ear, 'ohi'a, kalamoho, and mamane.

3.13.1.3 Discussion of Vegetation Types By Section

Section I

The vegetation on the majority of this section is primarily pasture land vegetation dominated by kikuyu grass and other nonnative range grasses on deep, well-drained soils. The stonier soils located along the lower portion of the alignments support fountain grass/mixed shrubland. Most of the lands in Section I have been used for grazing for a long time. Parker Ranch, through which most of the W-2 and W-3 alignments cross, was established in the mid-1800s. As a result, areas covered by native plant communities are rare. The few remnant pockets of native mixed shrubland occur on pu'u and larger stony ridges and outcrops, inaccessible to cattle and other grazing animals.

In Section I at the western project terminus, about 800 m in elevation, the alignment corridors cross stony lands with thin soils covered by fountain grass/mixed shrubland. Average annual rainfall is about 500 mm. Continuing upslope, the corridors pass through pasture land vegetation dominated by kikuyu grass and smaller amounts of other range grasses. Soils are deep and fertile, and the terrain gently rolling. Average annual rainfall is about 500 mm along the lower limits of the pasture land at about 900 m in elevation, increasing to roughly 1,250 mm near the upper limits of the pasture land vegetation at about 1,700 m in elevation. Blocks of various pine and eucalyptus plantings are found in the pasture lands, most of them in the Waiki'i Ranch area.

W-2. From its beginning at Mamalahoa Highway (SR 190) (Station 100+000) and continuing upslope to just before Station 102+000, the alignment passes through fountain grass/mixed shrubland on Waikoloa series soils (ref: FEIS - Part I, 3.12.1.4). This variant of the fountain grass/mixed shrubland supports a greater number of weedy herbaceous species. Scattered low shrubs of koa haole, up to 0.5 m tall, are occasional with shrubs of 'akia and 'a'ali'i occurring in smaller numbers. From Station 102+000, near 'Auwaiakeakua Gulch, to where it meets the W-3 alignment at Station 112+582, the corridor passes through pasture land vegetation.

W-3. For the greater part of its length, from Mamalahoa Highway (SR 190) to Station 107+000, the W-3 alternative alignment follows along over Pu'u Pa series soils covered by fountain grass/mixed shrubland. The terrain is dissected by numerous stony ridges with thin soils. Low lying swales with deeper soils and somewhat moister soil conditions occur between the ridges. The areas with thin soils support fountain grass/mixed shrubland, while the smaller swale areas support kikuyu grass and buffel grass as well as many weedy species. The swales tend to be heavily browsed by the cattle and there is a complex network of cattle paths crossing over the larger rocky areas and down into each grassy swale.

Around Station 105+520, 'a'ali'i shrubs, 1 to 2 m tall, become very dense. Olive trees are found scattered throughout this vegetation type, especially in the area by Station 102+000 near Ke'amuku. The trees are spread by game birds which eat the fruit. At Station 106+000 the

alignment crosses a fenceline with a small planting of eucalyptus. Kikuyu grass-dominated pasture land interfaces the fountain grass/mixed shrubland around Station 107+000. The W-3 alignment corridor continues upslope through kikuyu pasture land, crosses under the HELCO powerlines, and connects with the W-2 alignment.

W-2 and W-3. Along the common alignment of W-2 and W-3 to the Parker Ranch/PTA fenceline, the corridor passes through pasture land vegetation. This long stretch of gently rolling pasture land is almost uniform in composition throughout its length. Kikuyu grass forms a low, dense, yellowish-green colored carpet which excludes most other species. As the corridor approaches PTA, the soils become stonier and there are scattered patches of 'a'ali'i shrubs and a few mamane trees on the rocky knolls. A few small 'akoko plants, about 0.5 m tall, are found at Station 113+840, just at the edge of the corridor where it abuts a rocky knoll. The 'akoko plants as well as the 'a'ali'i shrubs all show signs of damage from the cattle. From the fenceline and onto the PTA property, the vegetation consists of hard-stemmed lovegrass grassland. A portion of this grassland around Station 114+820 was recently burned. Near Station 115+780, the vegetation changes to 'aweoweo shrubland.

Section II

The PTA, which occupies most of Section II, is dominated by native vegetation types. Average annual rainfall at the western PTA boundary is about 380 mm. Rainfall steadily increases eastward from about the Mauna Kea State Park, with the easternmost portions of the installation receiving about 1,000 mm per year. Because the PTA has not been grazed and military development is restricted to certain areas, the majority of the installation remains in native natural plant communities with a large proportion of the installation containing rare plants. Hard-stemmed lovegrass grassland and 'aweoweo shrubland are found on the alluvial flats, while 'a'ali'i shrubland occurs on the lower Mauna Kea slopes on the western portion of the installation. Mamane/naio forest occupies the area from the cantonment area of the PTA eastward past Mauna Kea State Park, and ends at the DHHL boundary. Pasture land vegetation composed primarily of kikuyu grass and velvet grass is found on the DHHL parcel.

EX-2. On the alluvial flats, between the start of EX-2 at Station 119+100 to around MP 36 by the cantonment area of the PTA, the vegetation consists of a mosaic of 'aweoweo shrubland and hard-stemmed lovegrass grassland. The 'aweoweo shrubland is usually associated with areas of deeper soil (alluvial loess), while the grassland is associated with less developed cindery soils or somewhat stony soils. From the cantonment area of the PTA, past the Mauna Kea State Park, and up to Station 132+000, the EX-2 alignment crosses through mamane/naio forest. There is evidence of a past fire, i.e. burnt tree stumps, in portions of the forest around Station 129+000. The forest is much more open and grassy in this area. Across from the park, there are a few plantings of coffeeberry, sambucus, and other introduced plants tucked in among the mamane and naio trees. From Station 132+000 to 140+700, the alignment crosses the Lava Flows of 1843 and 1935, which support only a very sparse pioneer vegetation.

PTA-1 and PTA-3. These segments start at Station 10+000 where they leave the existing Saddle Road and cross a short, level section covered by 'aweoweo shrubland with scattered 'a'ali'i shrubs and mamane trees. The alignment continues up ash-covered slopes dominated by hard-stemmed lovegrass grassland. From around Station 11+000 to 14+000, the stony slopes behind the three cinder cones (unnamed cinder cone, Pu'u Koko, Pu'u Ma'au) are covered by 'a'ali'i shrubland; in places, the alignment crosses the transition zone where the 'a'ali'i shrubland and hard-stemmed lovegrass grassland interface. Seven 'akoko trees are found in a large gully.

A short distance from Station 14+000 the alignment drops onto the deep ash-covered flats and 'aweoweo shrubland. The 'aweoweo shrubland continues to Station 17+000.

At Station 17+000 until just before 19+000, the vegetation consists of hard-stemmed lovegrass grassland. At Station 18+820, along the south edge of the alignment corridor, is a small patch of mamane/naio forest which harbors a stand of 'akoko trees. 'A'ali'i shrubland and mamane/naio forest cover the alignment up to the cantonment area of the PTA. A small cluster of about 15 'akoko plants, most of them less than 1 m tall, is found near an existing road cut at the base of Pu'u Pohakuloa near Station 19+660; the trees are within the PTA-1 corridor. No inventory of plants was made for the cantonment area of the PTA, from Station 19+840 to 20+140, because it is landscaped.

From the end of the cantonment area of the PTA at Station 20+140 to Mauna Kea State Park, the alignment passes through open mamane/naio forest with scattered 'aweoweo shrubs and an under story of grasses and herbs. A small planting of nonnative plants is found within the corridor by the park. From the park to Station 24+520, the alignment continues through open to closed canopy mamane/naio forest on nearly level to gently sloping, grayish-brown loamy soils.

From Station 24+520 and continuing to 27+000, the substrate becomes very stony land, characterized by very shallow soil material and a high proportion of 'a'a lava outcrops and stony ridges. Within this area, there are several scattered stands of 'akoko trees among the mamane and naio. Other native species found associated with this stony area include ko'oko'olau, stenogyne, hesperocnide, sicyos, sandalwood, and mountain pili.

PTA-1. From Station 27+000 to the fenceline between PTA and the DHHL, there is a small section of the alignment covered by a ruderal community composed of introduced grasses and herbs, primarily telegraph plant and mullein. On the DHHL property, the vegetation consists of a mixed grass pasture land. After crossing over the pasture land, the alignment then proceeds onto the 1935 lava flow and terminates at Station 30+999.

PTA-3. This segment follows along the PTA boundary adjacent to the DHHL property by Pu'u 'Oma'oko'ili and Pu'u Nene. Open canopied mamane/naio forest is found at the beginning of the alignment at Station 10+000, but soon changes to an open, grassy field which supports a ruderal community. This disturbed area is where a number of roads converge and is subject to

vehicular disturbance and troop training activities. The PTA-1 alignment also crosses this disturbed area. A small planting of several species of eucalyptus and pine, and cork oak is found on the lower slopes of Pu'u 'Oma 'oko'ili. From about Station 11+000 to 11+800, the alignment passes through mamane/naio forest with a small stand of 'akoko trees. From Station 11+800 to its terminus at EX-2, the alignment crosses the 1843 lava flow with sparse pioneer vegetation.

Section III

This segment starts at an altitude of 2,000 m at Station 140+700 and proceeds east, terminating at Station 171+576 at an altitude of 600 m. It passes through several micro-climatic zones as well as a number of vegetation types. The small portion of Section III covered by the westside study area consists of the Lava Flow of 1935, which is sparsely vegetated with pioneer vegetation. From the beginning of the eastside study area and heading east to approximately Station 154+000, the habitat is defined as subalpine shrubland with one pocket of montane dry forest found between Stations 150+750 and 151+000. From Station 154+000 to approximately 156+000, the segment passes through a mosaic of montane mesic shrubland and montane mesic forest. From Station 156+000 to 161+000, montane mesic forest predominates and at approximately Station 161+00 the vegetation blends into montane wet forest which continues to EX-3's terminus at Station 171+576. The proposed route generally follows the edge between the new lava flows and the surrounding old flow late successional forest.

The most environmentally important areas along this segment are numerous kipuka (koa-'ohi'a forests on older lava substrates). Environmentally sensitive kipuka have been identified at Stations 145+500 to 146+500, 147+250 to 148+240, 155+450 to 157+500, 157+700 to 157+900, 159+500 to 160+000, 162+500 to 164+000, 165+500 to 166+240, 167+860, 168+460, and 170+500 to 171+000. A more detailed description of kipuka vegetation is provided within this FEIS - Part I under the heading of Koa -'Ohi'a Forest, 3.11.1, Sections III and IV).

Section IV

EX-4A and E-3. Both Segments EX-4A and E-3 pass through lowland wet forest for the majority of their lengths. Some of this habitat has been highly modified. The westernmost 500 m of both segments traverses montane wet forest.

3.13.2 Environmental Consequences

Section I

W-2. Segment W-2 would disturb 68.6 ha of habitat. This includes 58.4 ha of nonnative vegetation types (7.6 ha of fountain grass/mixed shrubland and 50.8 ha of pasture land) and 10.2 ha of native vegetation types (6.1 ha of hard-stemmed lovegrass grassland and 4.1 ha of

'aweoweo shrubland). No eucalyptus/pine plantings, ruderal community, 'a'ali'i shrubland, mamane/naio forest, or pioneer vegetation on lava flows occurs within this segment.

W-3. Segment W-3 would disturb 70.1 ha of habitat. This includes 59.9 ha of nonnative vegetation types (33.3 ha of fountain grass/mixed shrubland and 26.6 ha of pasture land) and 10.2 ha of native vegetation types (6.1 ha of hard-stemmed lovegrass grassland and 4.1 ha of 'aweoweo shrubland). No eucalyptus/pine plantings, ruderal community, 'a'ali'i shrubland, mamane/naio forest, or pioneer vegetation on lava flows occurs within this segment.

Section II

EX-2. Not including prior disturbance of the existing Saddle Road surface, total habitat disturbance would be 68.5 ha. The 68.5 ha of habitat disturbance include 0.9 ha of nonnative vegetation types (all ruderal community) and 67.6 ha of native vegetation types (14.1 ha of hard-stemmed lovegrass grassland, 16.2 ha of 'aweoweo shrubland, 10.8 ha of mamane/naio forest, and 26.5 ha of pioneer vegetation on lava flows). No fountain grass/mixed shrubland, pasture land, eucalyptus/pine plantings, or 'a'ali'i shrubland occurs within this segment. Potential impacts to vegetation due to increased risk of fire within Section II would be reduced by the adoption of a fire mitigation plan.

PTA-1. Segment PTA-1 would disturb 85.1 ha of habitat. This includes 12.3 ha of nonnative vegetation types (10.9 ha of pasture land and 1.4 ha of ruderal community) and 72.8 ha of native vegetation types (9.4 ha of hard-stemmed lovegrass grassland, 12.3 ha of 'aweoweo shrubland, 15.4 ha of 'a'ali'i shrubland, 29.7 ha of mamane/naio forest, and 6.0 ha of pioneer vegetation on lava flows). No fountain grass/mixed shrubland or eucalyptus/pine plantings occurs within this segment. Potential impacts to vegetation due to increased risk of fire within Section II would be reduced by the adoption of a fire mitigation plan.

PTA-3. While the total ROW for Segment PTA-3 would total 90.3 ha, total habitat disturbance for would be 88.2 ha, due to prior disturbance of the existing Saddle Road surface. The 88.2 ha of habitat disturbance include 3.3 ha of nonnative vegetation types (0.9 ha of eucalyptus/pine plantings and 2.4 ha of ruderal community) and 84.9 ha of native vegetation types (9.4 ha of hard-stemmed lovegrass grassland, 12.3 ha of 'aweoweo shrubland, 15.4 ha of 'a'ali'i shrubland, 34.3 ha of mamane/naio forest, 13.5 ha of pioneer vegetation on lava flows). No fountain grass/mixed shrubland or pasture land occurs within this segment. Potential impacts to vegetation due to increased risk of fire within Section II would be reduced by the adoption of a fire mitigation plan.

Section III

EX-3. Not including the prior disturbance of the existing Saddle Road surface, total habitat disturbance with Segment EX-3 would be 96.5 ha of habitat, all of which are native vegetation types. This includes 0.4 ha of montane dry grassland, 33.1 ha of montane wet forest, 18.3 ha of

montane mesic forest, 0.9 ha of montane dry forest, 6.9 ha of subalpine dry shrubland, 3.2 ha of montane mesic shrubland, and 33.7 ha of montane dry shrubland. No lowland wet forest, lowland wet herbland, lowland wet grassland, or lowland wet shrubland occurs within this segment. Some montane wet shrubland occurs within this segment, but impacts to this habitat type would be too small to measure.

Section IV

EX-4A. Segment EX-4A would disturb 10.7 ha of habitat, all of which are primarily native vegetation types, but which also have been exposed to varying degrees of modification by nonnative species. This includes 9.4 ha of lowland wet forest and 1.3 ha of montane wet forest. The flora of the 9.4 ha of lowland wet forest includes numerous nonnative species and lacks the integrity generally associated with native vegetation types. No montane dry grassland, lowland wet herbland, montane mesic forest, montane dry forest, subalpine dry shrubland, lowland wet grassland, montane mesic shrubland, or montane dry shrubland occurs within this segment. Some lowland wet shrubland and montane wet shrubland occurs within this segment, but impacts to these habitat types would be too small to measure.

E-3. Segment E-3 would disturb 22.4 ha of habitat. This includes 11.1 ha of nonnative vegetation types (4.6 ha of lowland wet herbland and 6.5 ha of lowland wet grassland) and 11.3 ha of primarily native vegetation types (9.3 ha of lowland wet forest and 2.0 ha of montane wet forest). The flora of the 9.3 ha of lowland wet forest includes numerous nonnative species and lacks the integrity generally associated with native vegetation types. No montane dry grassland, montane mesic forest, montane dry forest, subalpine dry shrubland, montane mesic shrubland, or montane dry shrubland occurs within this segment. Some lowland wet shrubland and montane wet shrubland occurs within this segment, but impacts to these habitat types would be too small to measure.

No Action Alternative. With the No Action Alternative, there would be no construction-related impact to vegetation within the project area. With an increase in the number of vehicles using Saddle Road and increased access to the project vicinity, the risk of wildfire and the likelihood of human disturbance would be expected to increase, although to a lesser extent than with the action alternatives.

3.13.3 Mitigation Measures

Additional mitigation measures pertaining to the reduction of impacts to biological resources are detailed in the section of this chapter on threatened and endangered species (ref: FEIS - Part I, 3.18.3).

Mitigation Measures Applicable to All Project Sections

- All equipment, material, and support structures will be stored and maintained within the ROW or in designated staging areas that have been approved as being areas where the storing, servicing, and staging of equipment and material will not adversely impact native species. These areas will be clearly demarcated and fenced prior to construction.

- All construction activity will be restricted to the clearly delineated ROW.

- A Project Engineer will be on site at all times during construction to ensure implementation and compliance with environmental mitigation requirements as stated in the contract documents.

- Contractors will be required to participate in an environmental quality control program similar to required safety programs contained in Contract Specifications.

Section I Mitigation Measures

- Immediately after construction in this Section I is completed, the margins of the roadway will be replanted with kikuyu grass, the dominate ground cover along both segments in this section.

Section II Mitigation Measures

- Mitigation addressing the increased fire hazard is outlined elsewhere in this document (ref: FEIS - Part I, 3.9.3).

- During construction in Section II, emergency spills treatment, storage, and disposal of all petroleums, oils, and lubricants, both within construction limits and at staging areas will be handled in strict accordance with the FHWA 1996 Specifications for Construction of Roads and Bridges on Federal Highway Projects, as well as Federal Acquisition Regulations and appropriate EPA regulations. HDOT will provide similar measures in Sections I, III, and IV.

- A comprehensive manual outlining and discussing the environmental issues, specific mitigation requirements, and procedures that will be required of the construction company(s) awarded the project will be prepared. This document will be prepared by the FHWA in accordance with their newly effected environmental team policy, which ensures that the environmental team closely follows the entire project to its completion. At the pre-construction meetings this document and the rationale behind specific requirements will be explained to project engineers and supervisors. Similar measures will be taken by HDOT during construction outside of the PTA.

- All construction personnel will be required to attend a project orientation meeting where specific environmental considerations and prohibitions will be explained.

Section III and IV Mitigation Measures

- The proposed alignment will be shifted during final design to avoid or minimize impacts to kipuka (ref: FEIS - Part I, 3.11.3 and 3.18.3).

3.14 WILDLIFE

3.14.1 Birds

An ornithological survey was conducted for the proposed project between April 1995 and September 1996 along the various alternative segments (Rana 1997, Tech. App. Vol. III). The primary purpose of this survey was to document what species occur (or are likely to occur given the type of habitat available), provide some baseline data on the relative abundance of the species found, determine the presence of any native or listed species, and identify and address potential conflicts between the proposed action and listed species. Figure 3.13.1 shows the location of Palila Critical Habitat and the Kipuka 'Ainahou Nene Sanctuary.

3.14.1.1 Affected Environment

Both the isolation of the Hawaiian Islands from continental land masses and their volcanic origin fosters a high degree of adaptive radiation and endemism. The adaptation and specialization displayed by many of Hawai'i's endemic avian species has contributed to their vulnerability in a rapidly changing world. To date more than 60 percent of Hawai'i's endemic avifauna has become extinct. Within historical times a total of 69 endemic avian species and sub-species have been described from Hawai'i. Of these, 23 have gone extinct. Of the remaining 46 a total of 32 are currently listed as endangered or threatened by the USFWS. Thirteen of these are critically endangered or may in fact have already become extinct. Of the 32 currently listed endangered avian species and sub-species found in Hawai'i, 13 are found on the Island of Hawai'i. Nine of these can be expected to at least occasionally utilize parts of the proposed corridors.

Migratory waterbirds and shorebirds make up a large part of the winter avian population of Hawai'i. These annual visitors are found throughout the Islands from August through May. Currently 82 separate migratory and extralimital waterbird and shorebird species have been documented from the Islands. Most of these species are generally associated with wetland habitat, however; three of them, Pacific Golden Plover, Ruddy Turnstone, and Sanderling are common winter migrants and are regularly found in open, grassy areas. These species were encountered on all segments, their densities varied in direct correlation to the increase in canopy density as the study moved eastward.

During the last hundred years more than a 160 species of alien birds have been introduced to the Hawaiian Islands. Many of these species were game birds introduced by a combination of private landowners, the Territorial Board of Agriculture and Forestry, and following statehood, by the State of Hawai'i DLNR Division of Forestry and Wildlife. These birds were introduced in the hope that they would become established and provide a recreational hunting resource which, in turn, would generate Federal funding through the Pittman Robinson Act for the maintenance of game bird hunting. Less than a quarter of these introductions have been successful. On the Island of Hawai'i more than 60 species of game birds have been introduced. Currently, 14 of these alien introductions have survived and are considered to be established on the Island. Little is known of the effect that these species have on Hawai'i's native bird populations. Many of these alien birds out compete Hawai'i's native species for food, cover, and nesting resources. They have been implicated in the spread of alien plant species which have proven to have a negative effect on Hawai'i's native ecosystems. Some of these species are thought to impact Hawai'i's endemic avifauna by spreading disease.

A combination of survey protocols were utilized during the course of the avian surveys. A total of 296 count stations were placed along the various proposed alternate routes. All stations were visited at least twice. Counts were concentrated during the early morning hours (between 6:00 am and 11:00 am), the peak bird activity time. The basic survey protocol used is based on the techniques utilized in Hawai'i by the USFWS Hawai'i Forest Bird Surveys (HFBS) initiated in 1972. These counts are the basis for the relative abundance estimates in this report.

Additional time was spent "prospecting" in pockets of vegetation away from the proposed centerlines in an attempt to locate any species not recorded during count periods. In Segments W-2 and W-3, count stations were placed 240 m apart. Count stations were placed at 200-m intervals along PTA-1 and PTA-3. Count stations were placed at 1.6-km intervals along EX-2 and EX-3, using the MP markers as reference points. Along Segments E-3 and EX-4A count stations were placed at 200-m intervals.

A total of 41 bird species representing 18 families were detected. Of these, 7 are *endemic* (native and unique to Hawai'i) at the species level, one is endemic at the sub-species level, and 3 are considered native migratory species. The remaining 31 species detected are *alien* (introduced by man). One species, the Palila, is both endemic and listed as an endangered species by both the USFWS and by the State of Hawai'i. An individual Palila was observed during the botanical surveys for this project. Previous surveys of the avifauna of Hawai'i were reviewed for this project. The findings of the studies were consistent with past studies undertaken in the same areas.

The avifauna of the Humu'ula Saddle is dominated by introduced species. Table 3.14.1, *Birds Detected or Expected to Occur Within the Vicinity of the Project Area*, lists birds detected during the course of this survey. In addition, federally listed endangered species which may occur occasionally within one or more of the proposed corridors but were not detected are also included.

TABLE 3.14.1
Birds Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name	Notes
Dark-rumped Petrel, Ua'u	*Pterodroma phaeopygia sandwichensis*	Endangered
Hawaiian Goose, Nene	*Branta sandvicensis*	Endangered
Hawaiian Hawk,'io	*Buteo solitarius*	Endangered
Palila	*Loxoides bailleui*	Endangered
'Akiapola'au	*Hemignathus munroi*	Endangered
Hawai'i Creeper, 'Alauahio	*Oreomystis mana*	Endangered
Hawai'i 'Akepa, 'Akakane	*Loxops coccineus coccineus*	Endangered
Newell's Shearwater,'A'o	*Puffinus newelli*	Threatened
Short-eared Owl, Pueo	*Asio flammeus sandwichensis*	Native, Endemic Subspecies
Hawai'i 'Elepaio	*Chasiempis sandwichensis ridgwayi*	Endemic
'Oma'o	*Myadestes obscurus*	Endemic
Hawai'i 'Amakihi	*Hemignathus virens virens*	Endemic
'I'iwi	*Vestiaria coccinea*	Endemic
'Apapane	*Himatione sanquinea sanquinea*	Endemic
Pacific Golden Plover	*Pluvialis fulva*	Migratory
Ruddy Turnstone	*Arenaria interpres*	Migratory
Sanderling	*Calidris alba*	Migratory
Grey Francolin	*Francolinus podicerianus*	Introduced, game
Black Francolin	*Francolinus francolinus*	Introduced, game
Chukar	*Alectoris chukar*	Introduced, game
Erckel's Francolin	*Francolinus erkelii*	Introduced, game
Japanese Quail	*Coturnix japonica*	Introduced, game
Kalij Pheasant	*Lophura (leucomelanos) leucomelana*	Introduced, game

TABLE 3.14.1
Birds Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name	Notes
Ring-necked Pheasant	*Phasianus colchicus*	Introduced, game
Wild Turkey	*Meleagris gallopavo*	Introduced, game
California Quail	*Callipepla californica*	Introduced, game
Chestnut-bellied Sandgrouse	*Pterocles exustus*	Introduced, game
Spotted Dove	*Streptopelia chinensis*	Introduced, game
Zebra Dove	*Geopelia striata*	Introduced, game
Rock Dove	*Columba livia*	Introduced
Barn Owl	*Tyto Alba*	Introduced
Northern Mockingbird	*Mimus polyglottos*	Introduced
Common Myna	*Acridotheres tristis*	Introduced
Japanese White-eye	*Zosterops japonica*	Introduced
Melodious Laughing-thrush	*Garulax canorus*	Introduced
Red-billed Leiothrix	*Leiothrix lutea*	Introduced
Sky Lark	*Alauda arvenis*	Introduced
House Sparrow	*Passser domesticus*	Introduced
Red Avadavat	*Amadava amadava*	Introduced
Warbling Silverbill or African Silverbill	*Lonchura cantans (malabarica)*	Introduced
Nutmeg Mannikin or Scaly-breasted Munia	*Lonchura punctulata*	Introduced
Yellow-Fronted Canary	*Serinus mozambicus*	Introduced
House Finch	*Carpodacus mexicanus*	Introduced
Saffron Finch	*Sicalis flaveola*	Introduced
Northern Cardinal	*Cardinalis cardinalis*	Introduced

Section I

The avifauna found within Section I is dominated by introduced species. This is not surprising given that almost all of this area has been heavily grazed for more than a hundred years. This has resulted in the almost total destruction of the formerly existing native forest that once covered this area. All of the birds detected along this section were alien species with the exception of 2 sightings of Pu'eo or Hawaiian Owl which is an endemic sub-species of the widely distributed Short-eared Owl and numbers of three species of indigenous migratory shorebirds. One endangered Nene was seen in the introduced fountain grass savannah south of the W-2 and W-3 alignments in this section.

Section II

Within Section II there are three major avian habitats. The open 'aweoweo shrubland and hard-stemmed lovegrass grasslands (ref: FEIS - Part I, 3.13.1.2) is dominated by introduced avian species including numerous species of gamebirds and large numbers of House Finches, Common Myna, and Sky Larks. Pioneer vegetation on lava flows does not support any resident birdlife. The mamane/naio forest is entirely within the federally designated Palila Critical Habitat Area (ref: FEIS - Part I, 3.18.1). The avifauna within the mamane/naio forest is dominated by alien species such as House Finch, Japanese White-eye, Sky Lark, and numerous gamebirds, but there are also large numbers of two endemic avian species present here as well. Large numbers of Hawai'i 'Amakihi and lesser numbers of 'Apapane were recorded in this section. During the course of the botanical study of this area, an individual Palila was observed. Although this sighting was not corroborated by an ornithologist, there have been several recently documented sightings of Palila from the general area.

Section III

Within Section III, the eastern portion which includes pioneering vegetation on recent lava flows and extends to around station 145+175 does not support any resident birdlife. It crosses open lava flows with scant widely separated stands of 'ohi'a. This habitat has little to offer birds, all but an extremely few pass over this area on their way elsewhere. From station 145+750 to station 155+500 the habitat is a mosaic of open and closed 'ohi'a/koa forest which is dominated by alien species such as House Finch, Japanese White-eye, Common Myna, and Red-billed Leiothrix, but also supports large numbers of endemic Hawai'i Amakihi, and lesser numbers of 'Apapane, 'Oma'o, and I'iwi. The bulk of the endemic birds are found in the various kipuka found along this section of the existing roadway. During the course of this survey three separate sightings of the endangered Hawaiian Hawk were recorded along Segment EX-3. The Kipuka 'Ainahou Nene Sanctuary is located south of the existing alignment between MP 27.5 to 22.0.

Section IV

Within Section IV, vegetation consists of lowland disturbed 'ohi'a forest which becomes almost totally dominated by introduced plant species as the road gets closer to Hilo. During the course of this survey no endemic avian species were recorded in this area.

3.14.1.2 Environmental Consequences

A project of this size and scope will potentially impact numerous avian habitats.

W-2 and W-3

The almost total lack of native habitat or native avian species along Segments W-2 and W-3 implies that it is unlikely that any negative impacts on native avian species would result from the construction of the roadway along any one of these proposed corridors.

EX-2. This segment passes through habitat that does not support any resident endemic avian species, with the exception of the section between station 128+750 and station 133+000 near Mauna Kea State Park. This area is vegetated in open mamane/naio parkland which supports a diversity of endemic avian species. There is also documented incidental usage of this immediate area by Palila.

PTA-1 and PTA-3. With the selection of PTA-1 and PTA-3, there would be potential impacts to native avian species. The location of this alternative within and adjacent to Palila Critical Habitat represents a potential fire threat to the extremely dry introduced grasses and 'a'ali'i shrubland found on the western end of this section and the mamane/naio forest that characterizes the eastern end of this section. The results of this survey, and those of the HFBS surveys and the past 17 years of DLNR Palila surveys indicate that there is very little current usage of this area by any of the 13 species of extant endangered avian species and subspecies currently found on the Island of Hawai'i. More specifically; it is probable that there are no resident Palila or 'Akiapola'au within the PTA-1 corridor; furthermore, any current usage of the areas by either species is best characterized as incidental. There is currently only minimal usage of this part of the Palila Critical Habitat by either Palila or 'Akiapola'au. However, construction of the roadway along either of these segments will have some impact on the habitat. The potential impacts will not be limited to the obvious removal of habitat, but would also involve a more complex combination of long term cumulative impacts.

Constructing a roadway in the middle of an extremely dry mamane forest which has an understory dominated by grasses will certainly increase the threat of fire. Dry, slow growing forest such as this one takes an inordinate amount of time to regenerate in the event of a catastrophic fire. Increased access into this forest will also hasten further dispersion and possible introduction of alien plants, mammals, and insects into the area. This will, in turn, put ever increasing pressure on the remaining native habitat.

EX-3. This segment is built almost totally on the 1855 lava flow. The habitat crossed from station 140+700, heading east to approximately station 145+000 is best described as open lava fields interspersed with kipuka of mixed 'ohi'a/koa forest. There are no kipuka close to the proposed alignment in this section, and very little usage of this area by endemic avian species. It is unlikely that construction through this area will have any impacts on endemic avian species.

From approximately station 145+750 through station 155+500 the vegetation consists of a mosaic of open and closed canopy 'ohi'a forest interspersed with 'ohi'a/koa kipuka. Between station 155+500 and 41+000 the vegetation changes from mesic to wet 'ohi'a forest. Throughout this section of EX-3 there is considerable usage of the area by endemic birds. The most environmentally fragile areas along this section are the numerous kipuka that dot the area. The construction of roadway through this section would displace individual endemic birds during construction. Providing that no further damage is done to the remaining kipuka along this route the impacts to avian species should be of a temporary nature.

The Kipuka 'Ainahou Nene Sanctuary is the only wildlife or waterfowl refuge located in or near the area potentially affected by the project. EX-3 would require encroachment along one border of the sanctuary immediately adjacent to the existing Saddle Road. This would either pave or isolate a strip of the sanctuary with a total area of approximately 9.85 ha. The 16,000-ha sanctuary was established in 1974 as part of recovery efforts for the endangered Nene (*Branta sandvicensis*). A total of 320 birds were released in the early 1970s, but none have been released in the past twenty years because of poor survival rates. It is estimated that there are 16 Nene present in the Saddle area and no more than 4 Nene in the vicinity of Kipuka 'Ainahou.

Michael Wilson, Chairperson of the Board of Land and Natural Resources of the DLNR, the agency with jurisdiction over the sanctuary, states in a 9 June 1997 letter, "No successful production has been recorded in the Sanctuary within at least the last seven years. Because of these conditions, the sanctuary plays only a minor role in the overall recovery objectives of the Nene....because of the small reduction in the overall size of the Sanctuary (0.006%) and the avoidance of those areas that are used by the Nene, the proposed realignment of the Saddle Road is not expected to adversely affect the function or overall value of the Sanctuary" (ref: FEIS - Part II, 1.4.4). Information pertaining to 49 U.S.C. Section 103, known as Section 4(f) is included in the portion of this chapter addressing impacts to Outdoor Recreation Resources (ref: FEIS - Part I, 3.3.4.2). Because the Kipuka 'Ainahou Nene Sanctuary is not a significant wildlife refuge, the FHWA does not consider it a Section 4(f) property.

EX-4A and E-3. The westernmost portion of these segments is built on the 1855 lava flow. The remainder of these segments is built on the 1881 flow. During the course of this survey no endemic avian species were recorded in these segments. No impacts on endemic avian species are expected from construction of any of these portions of proposed roadway.

No Action Alternative. No impacts to native or migratory birds or their habitat would result from the No Action Alternative.

3.14.1.3 Mitigation Measures

Mitigation measures pertaining to the reduction of impacts to birds are detailed in the sections of this chapter on threatened and endangered species and fire hazard (ref: FEIS - Part I, 3.18.3 and 3.9.3).

3.14.2 Mammals

A mammalian survey was conducted for the proposed project between April 1995 and September 1996 along the various alternate routes for the proposed project (ref: Rana 1996, Tech. App. Vol. II). Because Hawai'i has only one endemic terrestrial mammal, the endangered Hawaiian hoary bat, the primary purpose of this survey was to determine the extent to which the species inhabits the project area (ref: FEIS - Part I, 3.18). The survey of feral mammals was limited to visual and auditory detection, as well as observation of scat, tracks, and road kills. No trapping study was conducted to determine their relative abundance.

3.14.2.1 Affected Environment

During the course of this survey 15 mammalian species plus one hybrid were detected while on site. Hawai'i's only endemic terrestrial mammalian species, the Hawaiian hoary bat was detected in all sections of the project area (ref: FEIS - Part I, 3.18.1). The other 14 mammalian species detected were all introduced to Hawai'i by man and are considered alien species. Table 3.14.2, *Mammal Species Recorded in the Project Area*, shows the mammals known to occur within the vicinity of the project area.

TABLE 3.14.2
Mammals Species Recorded in the Project Area

Common Name	Scientific Name	Status
Hawaiian hoary bat	*Lasiurus cinereus semotus*	endemic - Endangered
Pig	*Sus scrofa*	introduced
Domestic dog	*Canis familiaris*	introduced
Polynesian rat	*Rattus exulans*	introduced
European rabbit	*Oryclolagus cuniculus*	introduced
Roof rat	*Rattus rattus*	introduced
Norway rat	*Rattus norvegicus*	introduced
European house mouse	*Mus domesticus*	introduced

TABLE 3.14.2
Mammals Species Recorded in the Project Area

Common Name	Scientific Name	Status
Small Indian mongoose	*Herpestes auropunctatus auropunctatus*	introduced
Domestic cat	*Felis catus*	introduced
Domestic horse	*Equus caballus*	introduced
Domestic cattle	*Bos tauras*	introduced
Goat	*Capra hircus*	introduced
Sheep	*Ovis aires*	introduced
Mouflon sheep	*Ovis musimon*	introduced

All the mammalian species besides the Hawaiian hoary bat were introduced to the Hawaiian Islands by man. This process started when the first aboriginal settlers landed in the Islands some 1,500 years ago. The aboriginal peoples brought numerous alien species such as pigs, dogs, and Polynesian rats, as well as non-native plants and insects of many kinds, with them. Many of Hawai'i's endemic birds, especially the flightless and ground nesting ones, were easy prey for the introduced dogs and hungry humans. Both the aboriginal people and their pigs proceeded to markedly alter the endemic ecosystems. The humans cleared and burned the lowlands for agricultural purposes and the pigs moved into the wet forests where they found abundant food in the myriad of endemic understory plants. The European rediscovery of the Islands in the late 1700s heralded another wave of introductions that included European rabbits, roof rats, Norway rats, European house mice, small Indian mongooses, cats, horses, cattle, goats, pigs, and sheep, as well as countless insect and plants species.

3.14.2.2 Environmental Consequences

All Action Alternatives. Given the current knowledge and understanding of the abundance, distribution, and biology of the Hawaiian hoary bat, it is unlikely that the construction of the roadway along any of the alternatives proposed will have an adverse impact on this endangered species. No adverse impacts to introduced mammals are anticipated.

No Action Alternative. No impacts to mammals or their habitat would result from the No Action Alternative.

3.14.2.3 Mitigation Measures

No mitigation is proposed for impacts to mammals.

3.14.3 Invertebrates

Surveys for invertebrates were conducted in August, September, and October 1996 (Hawai'i Biological Survey 1996). The surveys involved spot sampling of the fauna along the length of Saddle Road and along the alternative new alignments. A total of 80 sites were investigated, 57 for land snails and slugs and 73 for insects and other arthropods. These sites were located in all sections of the corridor and on all alternative segments. Over 3,000 specimens of snails, insects, and related arthropods were collected. In addition, previous work in the area was reviewed through literature and collections of Bishop Museum.

3.14.3.1 Affected Environment

Land snails, including slugs, were found at 28 of 57 sites sampled. Land snails were collected by visual search of leaf litter and vegetation at each site in microhabitats identified as most likely to harbor snail populations. Observations of above-ground vegetation were made in order to search for tree snails. A total of 1,482 specimens were collected, representing at least 13 species. Section I harbored low diversity, except at its upper end. Section II supported the greatest diversity of land snails, especially in the area on Segment PTA-1, and in particular in the area just to the east of Mauna Kea State Park. This endemic fauna is characteristic of the dry area of the Humu'ula Saddle, the slopes towards Mauna Loa, and Hualalai. The snail fauna of Sections III and IV was dominated by a few introduced species.

Arthropods were found at 55 of 73 sites sampled. Various field collecting methods were employed during the field work portion of the project in order to ensure as complete a survey of existing species of arthropods as possible given the time constraints. The major collecting methods employed were Malaise traps, water traps, beating sheets, sweep nets, and bait traps. The total number of specimens collected is estimated to be over 3,000. A total of 215 arthropod taxa have been identified, 67 (31 percent) of which are considered endemic species.

A survey of cave habitats was undertaken to investigate subsurface geological features that extend into the project area. Many rare and sensitive species are obligate cave species and restricted to *deep zone habitats*. Deep zone habitats are moist still-air passages beyond direct environmental effects of climatic events on the surface. Over 16 potential cave entrances at 6 sites were checked. Four separate cave locations were found and investigated. Baits were placed in suitable habitats in Strawberry Cave and checked on subsequent trips. Additional discussion regarding caves is contained in the geology and soils section of this chapter (ref: FEIS - Part I, 3.12.1.5).

3.14.3.1.1 Snails

A total of 1,482 land snail specimens, including 13 specimens of a slug tentatively identified as a species of *Deroceras*, were collected during the survey. This material included at least 13 species. The only common name available for many snail species refers to the genus to which

that species belongs. In this discussion of snails, scientific nomenclature, rather than common terminology, is used to facilitate better differentiation between species.

Table 3.14.3, *Land Snail and Slug Species Recorded in the Project Area*, shows the land snail (and slug) species recorded within the project area. Of these, 3 species (*Euglandina rosea*, *Oxychilus alliarius*, and the slug) have been introduced to the Hawaiian Islands; 2 are of unclear status (the species referred below to *Striatura* sp. cf. *meniscus* and ?*Striatura* sp.); the remainder occur naturally in the Hawaiian Islands. No tree snails were seen.

TABLE 3.14.3
Land Snail and Slug Species Recorded in the Project Area

Section	Species Found		
Section I	**W-2** *Succinea konaensis* ?*Striatura* sp. "tornatellinid" A "tornatellinid" B "tornatellinid" C *Leptachatina* sp. A	**W-3** *Succinea konaensis* ?*Striatura* sp. "tornatellinid" A "tornatellinid" B "tornatellinid" C *Leptachatina* sp. A	
Section II	**EX-2** *Succinea konaensis* *Striatura* sp. cf. *meniscus* ?*Striatura* sp. *Lamellidea* sp. *Leptachatina lepida*	**PTA-1** *Oxychilus alliarius* *Succinea konaensis* *Striatura* sp. cf. *meniscus* ?*Striatura* sp. *Vitrina tenella* *Nesopupa subcentralis* *Lamellidea* sp. "tornatellinid" A "tornatellinid" B "tornatellinid" C *Leptachatina lepida*	**PTA-3** *Oxychilus alliarius* *Succinea konaensis* *Striatura* sp. cf. *meniscus* ?*Striatura* sp. *Vitrina tenella* *Nesopupa subcentralis* *Lamellidea* sp. "tornatellinid" A "tornatellinid" B "tornatellinid" C *Leptachatina lepida*
Section III	**EX-3** *Oxychilus alliarius* *Euconulus thaanumi* "tornatellinid" D ?*Deroceras* sp. *Deroceras* sp.		

TABLE 3.14.3
Land Snail and Slug Species Recorded in the Project Area

Section	Species Found		
Section IV	**EX-4A** *Euglandina rosea* ?*Deroceras* sp.	**E-3** None found	

Notable was the finding in Section II of *Leptachatina lepida*, a rare, native species. This is one of only two localities at which this species is known to be extant.

Leptachatina lepida is an oviparous species and is a ground dweller. Almost nothing is known of the ecology of *L. lepida* specifically. The genus *Leptachatina* is endemic to the Hawaiian Islands and almost all of its species, including *L. lepida*, are single island endemics. The family Amastridae, to which *Leptachatina lepida* belongs, is endemic to the Hawaiian Islands. It was once extremely diverse with over 300 species and numerous infra-specific taxa. Most of these taxa are now considered extinct. The Heritage Database has post-1945 records of live snails for only 15 amastrids, with only 4 of those species being recorded live since 1971.

Section I

W-2 and W-3. On these segments, a relatively diverse assemblage of snails was found around rocky outcrops. This assemblage of snail species included *Leptachatina* sp. A and "tornatellinid" B. At other sites, only the two most common snails found throughout the Kona side of the survey area were found. In general, the heavily grazed areas along this segment are extremely poor snail habitat.

Section II

EX-2. This segment is the least diverse in Section II in terms of numbers of snail species. Six sites were investigated for snails. One site was bare pahoehoe lava and supported no snails. Four sites harbored only the two most common species. The sixth site, which was located in the area just to the east of the Mauna Kea State Park, supported these two most common species plus *Leptachatina lepida* (including live individuals), *Striatura* sp. cf. *meniscus*, and *Lamellidea* sp. These species were generally found in the area to the east of Mauna Kea State Park. Most frequently, *L. lepida* appeared to be associated with naio trees.

PTA-1 and PTA-3. These segments harbor the most diverse assemblage of land snails encountered during the survey: 11 species. Snails were recorded at 10 sites on the PTA-1 alignment and nine sites on PTA-3 alignment. Sites on virtually bare pahoehoe or 'a'a lava east of the junction of PTA-1 and PTA-3 were investigated but harbored no snails. The greatest

diversity was found in the area of mamane/naio forest to the east of the Mauna Kea State Park. This area was the only area in which live *Leptachatina lepida* were found.

Section III

EX-3. At three of the four sites investigated, only the introduced garlic snail *Oxychilus alliarius* and the introduced slug species (?*Deroceras* sp.) were found. At the fourth site, a single specimen of "tornatellinid" D, four specimens of *Euconulus thaanumi*, as well as these two introduced species, were collected.

Section IV

EX-4A. Only the introduced slug (?*Deroceras* sp.) and the introduced snail *Euglandina rosea* were found.

E-3. No snails or slugs were found at the one site investigated. The upper end of this segment was not investigated and probably supports some native habitat, possibly harboring native snails.

3.14.3.1.2 Insects and Related Arthropods

Over 3,000 specimens of insects and related arthropods were collected during the survey. These comprise 215 species in 88 families and 14 orders. The only common name available for many insect and related arthropod species refers to the genus to which that species belongs. In this discussion of insects and related arthropods, scientific nomenclature, rather than common terminology, is used to facilitate better differentiation between species. Table 3.14.4, *Insects and Related Arthropod Rare-Native Species Recorded in the Project Area*, shows those species recorded within the project area.

TABLE 3.14.4
Insect and Related Arthropod Rare-Native Species Recorded in the Project Area

Section	Species Found		
Section I	W-2 *Coleotichus blackburniae* *Trupanea* sp.	W-3 *Coleotichus blackburniae* *Trupanea* sp.	

TABLE 3.14.4
Insect and Related Arthropod Rare-Native Species Recorded in the Project Area

Section	Species Found		
Section II	**EX-2** *Holocobius* sp. *Hylaeus (Nesoprosopis)* sp. *Neomachilis heteropus* *Linepithema humile*	**PTA-1** *Holcobius* sp. *Plagithmysus looki* *Plagithmysus blackburni* *Plagithmysus filipes sophorae* *Hylaeus (Nesoprosopis)* sp. *Odynerus* sp. *Trupanea apicalis* *Trupanea arboreae*	**PTA-3** *Holcobius* sp. *Plagithmysus looki* *Plagithmysus blackburni* *Plagithmysus filipes sophorae* *Hylaeus (Nesoprosopis)* sp. *Odynerus* sp. *Trupanea apicalis* *Trupanea arboreae* *Neomachilis heteropus* *Linepithema humile*
Section III	**EX-3** *Proterhinus* sp. *Liophaena gracilipes* *Dyscritomyia* sp. *Megalagrion amaurodytum peles* *Hylaeus (Nesoprosopis)* sp. *Schrankia* sp. 1 *Schrankia* sp. 2 *Erigone* cf. *stygius* *Nannolene* sp. *Linepithema humile*		
Section IV	**EX-4A** No rare-native species identified	E-3 No rare-native species identified	

Due to the large number of insects and related arthropods collected and identified, the discussion in this EIS is limited to rare-native species. While these species are not afforded legal protection under the ESA, the list reflects endemic arthropods of note.

Section I

W-2. The koa bug, *Coleotichus blackburniae*, was collected at one site, in association with 'a'ali'i. An undetermined species of the flower-head breeding fly *Trupanea* was collected at another site.

W-3. The koa bug, *Coleotichus blackburniae*, was collected at one site, in association with 'a'ali'i. An undetermined species of the flower-head breeding fly *Trupanea* was collected at another site.

Section II

EX-2. The anobiid *Holcobius* sp. was collected at one site. Two undetermined species of the native colletid bee *Hylaeus* (*Nesoprosopis*) were collected at another site.

PTA-1 and PTA-3. A total of 29 sites were investigated along PTA-1. The anobiid *Holcobius* sp. was collected at one site. The endemic long-horned beetle, *Plagithmysus looki*, was collected at four sites, one solely within PTA-1. *Plagithmysus blackburni* and *P. filipes sophorae* were collected at one site. The endemic colletid bees of the genus *Hylaeus* (*Nesoprosopis*) were collected at two sites, one solely within PTA-1. The endemic vespid wasp, *Odynerus* sp., was found at four sites, one solely within PTA-1. The flower-head breeding flies *Trupanea apicalis* and *T. arboreae*, were found in association with dubautia at one site.

A total of 29 sites were investigated along PTA-3. The anobiid *Holcobius* sp. was collected at one site. The endemic long-horned beetle, *Plagithmysus looki*, was collected at three sites. *Plagithmysus blackburni* and *P. filipes sophorae* were collected at one site. The endemic colletid bees of the genus *Hylaeus* (*Nesoprosopis*) were collected at two sites, one solely within PTA-3. The endemic vespid wasp, *Odynerus* sp., was found at three sites. The flower-head breeding flies *Trupanea apicalis* and *T. arboreae*, were found in association with dubautia at one site.

Within PTA-1 and PTA-3, in Bradshaw Field Cave, no living arthropods were found, but numerous fragments of spiders, moths, beetles, and other arthropods were identified. Thin dry roots, probably from native dodonaea bushes on the surface, were growing in the soil, especially near the wall. When these roots flush during rains, they may support many cave and soil arthropods. Within EX-2 and PTA-3, in the 1935 Lava Flow Cave A, the first live specimen of an endemic jumping bristletail (*Neomachilis heteropus*) found in many decades was collected. The Argentine ant (*Linepithema humile*) was abundant on the flow.

Section III

EX-3. A total of 11 sites were investigated for insects along this segment. One site was found to harbor the beetles, *Proterhinus* sp., *Liophaena gracilipes*, and the endemic calliphorid fly, *Dyscritomyia* sp. Though no specimens were collected during this survey, immatures of the damselfly *Megalagrion amaurodytum peles* have been collected previously from this site. Adults of this damselfly were observed at another site. The colletid bee *Hylaeus* (*Nesoprosopis*) sp. was found at one site. One site harbored the following sensitive species: the noctuid *Schrankia* sp. 1, the spider *Erigone* cf. *stygius*, and the millipede *Nannolene* sp. At Don's Cave, the noctuid *Schrankia* sp. 2 and the millipede *Nannolene* sp. were found.

Within EX-3, in the 1935 Lava Flow Cave B, the Argentine ant was common. Within EX-3, in Strawberry Cave, brown organic oozes support various arthropods. Fifteen species of arthropods were found in the cave. Eleven of these are native, and seven are obligate cave

species and known only from underground environments. The presence of the linyphiid spider, lithobiid centipede, and cambalid millipede indicates that the cave supports diverse endemic cave fauna. Within EX-3, in Don's Cave, eight species of arthropods, six of which are native and three of which are obligate cave species were found. Species such as *Oliarus* planthoppers and *Caconemobius* crickets would also be expected to occur. Within EX-3, in the 1881 Lava Flow, the large Kaumana Cave has a diverse range of endemic biological resources.

Section IV

EX-4A. No rare-native arthropod species were found along this segment.

E-3. Although no rare-native arthropod species have been identified, there may be some such species in the unprocessed material collected from this segment. This area is composed of wet forest known to normally yield high numbers of endemic and native insects and related arthropods. The upslope portions of Kaumana Cave, though not surveyed in this study, may cross under parts of E-3, along the 1881 lava flow (ref: FEIS - Part I, 3.12.1.5). These cave portions could provide habitat for additional native and cave-adapted species of arthropods.

3.14.3.2 Environmental Consequences

Direct impacts of construction, especially on sedentary species including snails and non-volant insects, are likely. Populations of individual species may be highly localized. Road construction will impact the habitat and the animals associated with it. Road construction on the new, alternative routes will generate a corridor along which introduced species, both plant and animal, will be able more readily to gain access to native habitat.

Habitat types of particular value for invertebrates include caves, lava tubes, kipuka, and mamane/naio forest (ref: 3.12.1.5 Speleological Resources, 3.13.1.3 Discussion of Vegetation Types by Section, and 3.13.1.2.4 Mamane/Naio Forest). Many cave animals on the Island of Hawai'i have differentiated within each cave, so that each cave may harbor a distinct and unique fauna found nowhere else. Caves identified within the project area include Bradshaw Field Cave, 1935 Lava Flow Cave A, 1935 Lava Flow Cave B, Strawberry Cave, Don's Cave, and 1881 Lava Flow (Kaumana Cave).

In one of the kipuka, flightless flies of the genus *Campsicnemus* were collected in the 1970s. They have not been collected since, despite repeated collecting efforts for almost 20 years. Feral ungulate damage as well as possible other perturbations that have led to the demise of the flightless flies and possibly other unique organisms found only in Hawaiian kipuka. Argentine ants have been found near kipuka by the stations EX-3 140+860 and EX-3 141+880. These ants are particularly dangerous to the continued welfare of native invertebrate faunas.

The land snails recorded in the mamane/naio forest around the PTA are characteristic of the saddle area from the PTA to Mauna Loa and Hualalai, based on previous sampling in the PTA

and elsewhere. This fauna is essentially endemic to the area. In particular, the present survey sites along Segments PTA-1 and PTA-3 in the area of mamane/naio forest east of Mauna Kea State Park represent one of only two localities at which *Leptachatina lepida* is known to survive. This area supported the greatest diversity of land snails encountered during the survey. For insects and related arthropods, the highest diversity in the dry area of the Humu'ula Saddle occurred in mamane/naio forest.

Snails are sedentary. Populations of individual species may be highly localized. Road construction will involve destruction of snail habitat and hence snails. The survey prepared for the proposed project has been used to obtain a general assessment of the relative importance of the various alternative segments from the perspective of snail diversity.

Insects are generally mobile and can occupy diverse habitats, ranges of altitudes, and ecosystems. However, the general faunal constituency of Saddle Road contains a large number of species of insects that are known to be habitat or host specific. The survey of the fauna of insects and related arthropods has shown that there are a few "sensitive" species that may be impacted by construction through a specific habitat.

Numerous species of alien wasps and alien ants (including Argentine ants) exist along portions of the existing Saddle Road.

Section I

W-2 and W-3. Populations of two relatively common snail species, *Succinea konaensis* and ?*Striatura* sp. might be impacted by construction, but they are widely distributed, so these impacts would not be notable. In the portion of W-2 common to both W-2 and W-3 (within the PTA), a relatively diverse assemblage of native snail species was found, including *Leptachatina* sp. A. These species were found in highly localized rocky outcrops. There are a small number of these outcrops in the area, and some others of them may also harbor these and perhaps other species. If road construction destroys these outcrops it will also destroy these snail populations.

These segments generally do not harbor many sensitive insect species. The site where the koa bug *Coleotichus blackburniae* was collected is a few hundred meters from the centerline of the proposed alignment. It would not be directly impacted by construction of either alternative segment. Indirect impacts could include providing corridors for further infestation by alien species.

Section II

EX-2. This segment is the least diverse of the alternative routes in Section II in terms of numbers of snail species. Construction impacts on widespread species *Succinea konaensis* and ?*Striatura* sp. are not notable. Construction could impact populations of *Leptachatina lepida* in the area just to the east of the Mauna Kea State Park.

Only the anobiid, *Holcobius*, the native colletid bees of the genus *Hylaeus* (*Nesoprosopis*), and the cave machilid (*Neomachilis heteropus*) were found long this segment. Construction through this segment would have a negligible impact on endemic arthropods, assuming implementation of mitigation measures regarding the avoidance of impacts to caves (ref: FEIS - Part I, 3.12.1.5).

PTA-1. This segment, especially the part to the east of Mauna Kea State Park, harbors the most diverse assemblage of land snails encountered during the survey, including living populations of *Leptachatina lepida*. Construction would impact a variety of snail populations.

A number of rare-native arthropod species were collected along this segment, most commonly associated with mamane/naio forest. Construction along this segment would impact individuals and populations of these species. This is especially true for species of the endemic colletid bee *Hylaeus* (*Nesoprosopis*) as well as the species of the long-horned beetle, *Plagithmysus*. Impacts to arthropods associated with cave habitats are possible in the vicinity of Bradshaw Field Cave and 1935 Lava Flow Cave A.

PTA-3. This segment harbored the second most diverse assemblage encountered during the survey. In terms of the habitat, this segment is similar to the part of PTA-1 between Mauna Kea State Park and the junction of PTA-1 and PTA-3. Impacts on land snails, including *Leptachatina lepida*, would be similar to PTA-1.

Construction along this segment may impact the endemic colletid bee, *Hylaeus* (*Nesoprosopis*). Impacts to arthropods associated with cave habitats are possible in the vicinity of Bradshaw Field Cave and 1935 Lava Flow Cave A.

Section III

EX-3. Impacts to introduced snails (*Oxychilus alliarius* and the slug species, ?*Deroceras* sp.), are of no concern. Direct or indirect impacts to native habitats, especially kipuka, could also impact endemic snails by creating a corridor for the introduction of non-native species. The distribution on the Island of Hawai'i of the two native species of snails recorded on this section ("tornatellinid" D and *Euconulus thaanumi*) is unknown.

Construction impacting kipuka could impact the beetles *Proterhinus* and *Liophaena* and the damselfly *Megalagrion amaurodytum peles*. Construction impacting caves could impact *Nannolene* sp., *Schrankia* spp., and *Erigone* cf. *stygius*.

Section IV

EX-4A and E-3. Only the slug (?*Deroceras* sp.) and the introduced carnivorous snail, *Euglandina rosea* were found in this section. Much of the habitat is disturbed. Even in

relatively undisturbed habitat, no native snails were found. The impact of road construction would likely be minor along E-3 and is probably negligible along EX-4A.

The Hilo rainforest side of the Humu'ula Saddle harbors a diverse fauna of native arthropods. Kipuka habitats are particularly sensitive to disturbance. New entrances to the system may be discovered to the Kaumana Cave during road construction.

No Action Alternative. With the No Action Alternative, there would be no construction-related impact to endemic land snails, arthropods, or their habitat. With an increase in the number of vehicles using Saddle Road and increased access to the project vicinity, the likelihood of human disturbance of sensitive habitat would be expected to increase, although to a lesser extent than with the action alternatives. Alien insects will continue to disperse and increase in numbers along the corridor.

3.14.3.3 *Mitigation Measures*

Mitigation measures pertaining to the reduction of impacts to biological resources, including kipuka, are detailed in the section of this chapter on threatened and endangered species (ref: FEIS - Part I, 3.18.3). Mitigation measures pertaining to the reduction of impacts to caves are detailed in the section of this chapter addressing geology and soils (ref: FEIS - Part I, 3.12.3).

3.15 FLOODPLAINS

The following information on floodplains is based on a preliminary hydrology/hydraulics report completed for the Saddle Road EIS (Okahara 1996). The preliminary hydrology/hydraulics report presents detailed results of the work completed. It documents a review and assessment of aerial photographs and mapping to determine floodplains, flow patterns, major drainages, and potential hydraulic concerns. The report performs preliminary hydrology and hydraulics computations (50-year storm) for all major drainages (watersheds larger than 10 km^2). It defines storm frequency, delineates and measures major drainage areas, calculates discharges, proposes tentative structure types/sizes, and identifies other notable drainage requirements.

The County of Hawai'i Department of Public Works Maintenance Department and the HDOT Highways Division were consulted as a part of this hydrology/hydraulics investigation.

3.15.1 Affected Environment

The alternative segments for the proposed project are mostly located in uninhabited areas. The exceptions are the Waiki'i Ranch subdivision (Section I), the PTA (Section II, Segments EX-2, PTA-1, and PTA-3), and the Kaumana settlements (Section IV, EX-4A and E-3). Because the study area is mostly rural or vacant, much of the study area has not been studied for floodplain determination by the Federal Emergency Management Agency (FEMA), the County, or the

State. The only floodplains mapped by FEMA within the project corridor are located on the eastern end of the project in the Kaumana area (Segment E-3). These floodplains are designated *Zone A*. Zone A represents areas inundated by a 100-year flood, where no base flood elevations have been determined.

The Saddle Road alternatives cross several major ephemeral drainages (Figure 3.15.1, *Major Drainages*). The peak discharges for all major ephemeral drainages along the study corridor were calculated for the EIS using the regression equations for the 50- and 100-year storms (FEMA n.d.).

All of the proposed segments cross deep drainages along the western portion of the project corridor, from the Mamalahoa Highway (SR 190) to the Mauna Kea access road. Along with several unnamed drainages, the drainages crossed by the project segments in Section I or II are listed as follows.

- 'Auwaiakeakua Gulch
- Waiki'i Gulch
- Popo'o Gulch
- Pohakuloa Gulch
- Waikahalulu Gulch

The drainages on the west side of the alternative alignments originate on the steep slopes of Mauna Kea and cross the existing Saddle Road at a number of bridges, culverts, and dips in the road. Although they are normally dry, they fill up rapidly during periods of high rainfall which sometimes result in flash floods. The climate on the western portion of the study area is semi-arid. Consequently, there are areas where vegetation is sparse and flash floods cause moderate to severe erosion within the watersheds. The cantonment area of the PTA has been subjected to flooding and sedimentation problems during heavy rainfalls. The existing roadway in the EX-2 segment is very flat and water currently flows over the road in several locations during heavy rainfall. A dip in the road has been constructed at one of the larger stream crossings.

East of the Mauna Kea access road, drainage generally flows unchannelized parallel to the roadway. One drainageway is crossed by Saddle Road in the Kaumana area, at approximately MP 6.7.

The existing drainage structures along Saddle Road are undersized and drainage currently overtops the road in several locations. The County of Hawai'i Department of Public Works Maintenance Department and personnel at the PTA, identified the following known locations where stormwater currently crosses the existing alignment during heavy precipitation events.

- At 'Auwaikeakua Gulch where it crosses Saddle Road within the Waiki'i Ranch, at an existing culvert, MP 47.25.

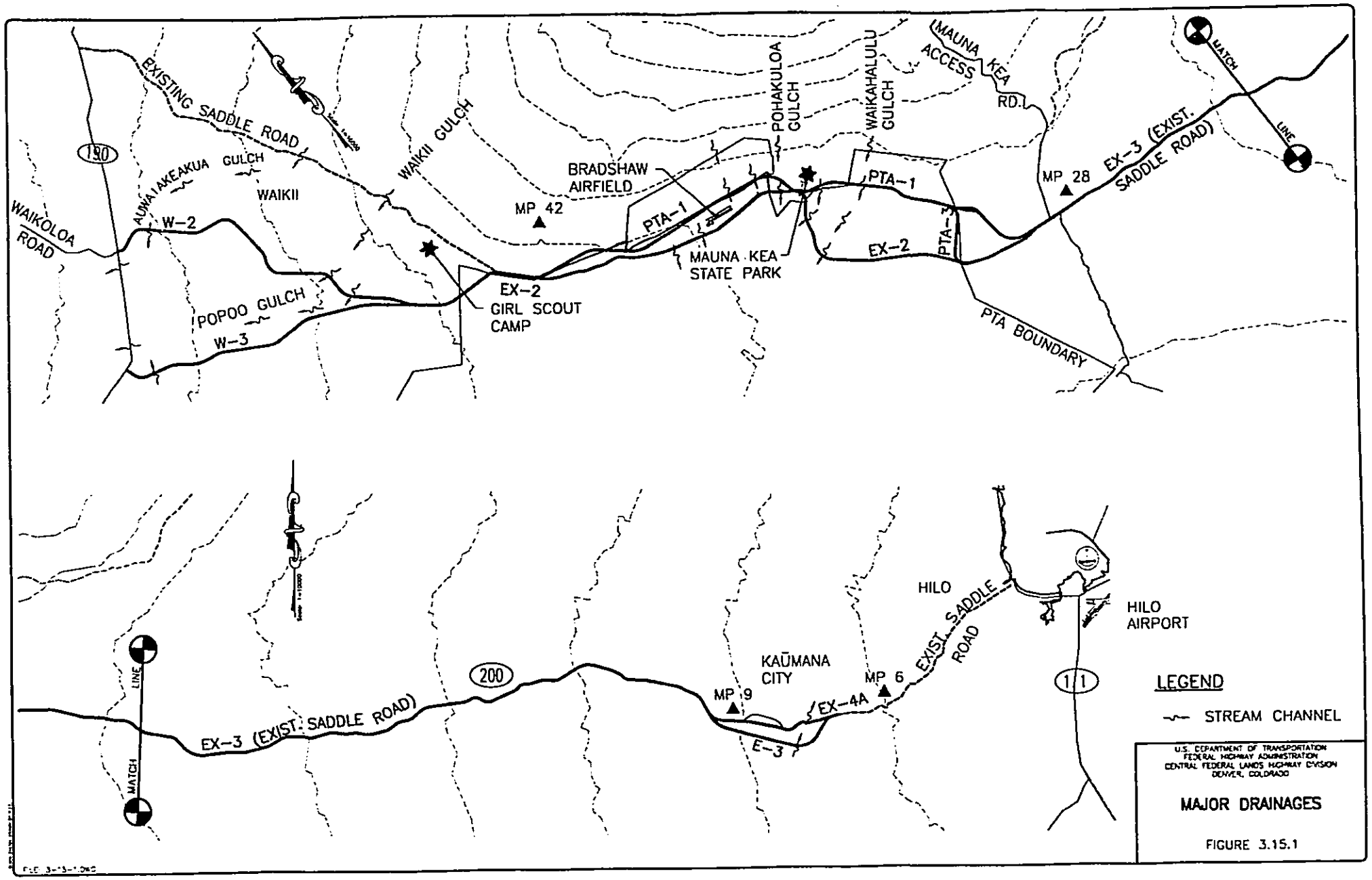

EXISTING SADDLE ROAD
190
WAIKOLOA ROAD
AUWAIAKEAKUA GULCH
WAIKII
W-2
POPOO GULCH
W-3
WAIKII GULCH
MP 42
BRADSHAW AIRFIELD
PTA-1
EX-2
GIRL SCOUT CAMP
MAUNA KEA STATE PARK
POHAKULOA GULCH
WAIKAHALULU GULCH
MAUNA KEA ACCESS RD.
PTA-1
EX-2
PTA-1
PTA BOUNDARY
MP 28
EX-3 (EXIST. SADDLE ROAD)
MATCH LINE
MATCH LINE
EX-3 (EXIST. SADDLE ROAD)
200
KAŪMANA CITY
MP 9
E-3
EX-4A
MP 6
HILO
EXIST. SADDLE ROAD
11
HILO AIRPORT
LEGEND
STREAM CHANNEL
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
MAJOR DRAINAGES

FIGURE 3.15.1

- Several locations, from MP 41.92 to 38.6.
- At the concrete dip in the road located downstream of existing culverts beneath the Bradshaw Airfield access road, MP 37.4.
- At the culverts on the west side of Mauna Kea State Park, near MP 35.3.
- At the culverts on the east side of Mauna Kea State Park, near MP 34.7.
- Near Mauna Kea Access Road, in the vicinity of MP 27.
- Along Kaumana Drive, in the vicinity of newly paved areas, near MP 13, 12, and 11.

Flooding of Saddle Road may occur in other locations. Saddle Road is often closed during major storm events due to flooding and the hazardous conditions of the road.

3.15.2 Environmental Consequences

All Action Alternatives. 23 CFR 650 states that is the policy of FHWA to encourage a broad and unified effort to prevent uneconomic, hazardous, and incompatible use and development of the nation's floodplains by avoiding significant encroachments on floodplains where applicable. An encroachment is any action within the limits of the base floodplain. A "significant encroachment is defined as a highway encroachment and any direct support of likely base floodplain development that would involve one or more of the following construction or flood-related impacts after encroachment.

- A significant potential for interruption or termination of a transportation facility which is needed for emergency vehicles or provides a community's only evacuation route.
- A significant risk.
- A significant adverse impact on natural or beneficial floodplain values.

All of the alternatives considered cross numerous drainage channels. For the design of the improved Saddle Road, the 50-year design storm will be used for culvert design, and the 100-year design storm will be used for bridge design, in accordance with the HDOTs *Design Criteria for Highway Drainage*. Drainage structures will be provided at all stream crossings to prevent water from flowing over the roadway during major storm events. The structures will be designed to accommodate the drainage without increasing existing flood elevations or altering existing drainage patterns. No floodplain map revisions are anticipated. The design improvements proposed would serve to better protect the road base and surface from flood drainage and associated damage, and would decrease the likelihood that flood waters would inundate the roadway in the future. The crossing of any 100-year floodplains will require

coordination with FEMA through the County of Hawai'i to ensure that there will be no increase in floodplain elevations (ref: Figure 3.15.2, *FEMA Floodplains*).

Wetlands are present in Sections III and IV and would be impacted by all alternatives to some degree (ref: FEIS - Part I, 3.11). These wetlands are described as being mosaic in nature with pockets of wetland soil interspersed with upland areas. The wetland areas are small microsites located on impermeable pohoehoe lava and do not serve to attenuate flooding. There are no existing homes or businesses in the vicinity of the proposed crossings.

The installation of culverts and bridges could result in the temporary loss of riparian and terrestrial vegetation associated with drainageways within the project corridor. There are no perennial streams within the project corridor, therefore, aquatic wildlife are not sustained. No impacts to aquatic wildlife are anticipated as a result of the action alternatives.

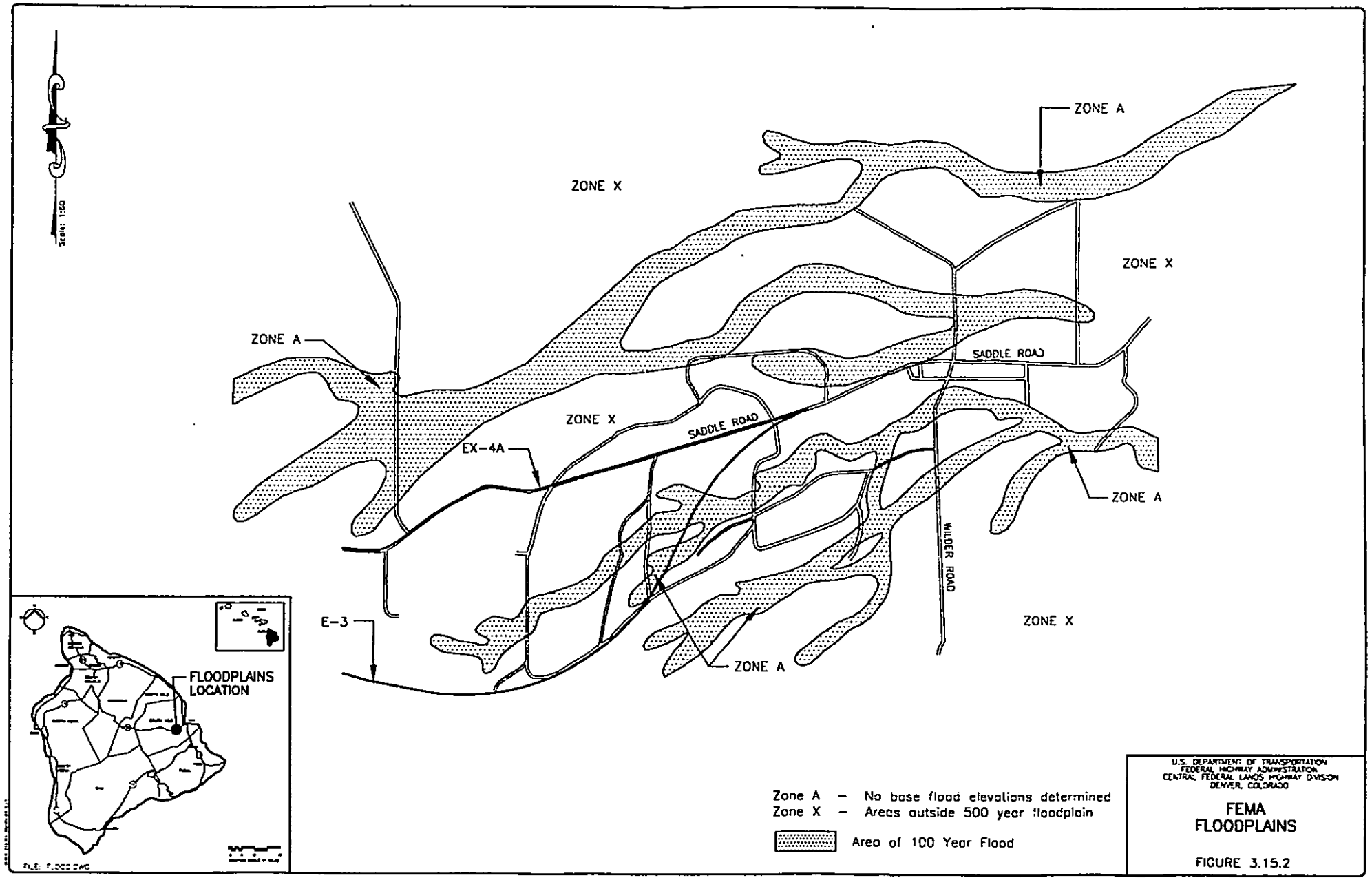
W-2 and W-3. Segments W-2 and W-3 each cross three major drainages. The peak flows for these channels range from 22 to 80 m^3 per second. The construction of Saddle Road on W-2 or W-3 would potentially open up new lands for development. The development of incompatible land uses within the 100-year floodplain is not anticipated as a result of the proposed project, since no encroachment of the 100-year floodplain is permitted by the County of Hawai'i and because lands within the vicinity of W-2 and W-3 are currently reserved for grazing.

EX-2, PTA-1, and PTA-3. Each of the segments within Section II crosses several large drainageways. The design discharges for these channels range from 24 to 111 m^3 per second. PTA-1 and PTA-3 run parallel to and upstream of the EX-2 alignment and therefore their flows are somewhat smaller than those for the EX-2 crossings. With the rebuild of Saddle Road on EX-2, the grade along portions of the existing alignment will need to be raised by approximately 2 to 3 m in some locations to provide clearance for larger culverts.

EX-3. Existing drainage within Section III, runs parallel to Saddle Road. No crossings of waterways are anticipated.

EX-4A and E-3. EX-4A and E-3 each cross one large intermittent drainage. The design storm peak discharges calculated for these crossings range from 42 to 50 m^3 per second. With the construction of Saddle Road on EX-4A, the grade along portions of the existing alignment will need to be raised to provide clearance for larger culverts. According to available FEMA maps, Segment E-3 would cross two minor drainageways identified as Flood Zone A (Figure 3.15.2). No development exists upstream from these proposed floodplain crossings.

The construction of Saddle Road on the new alignment of E-3 could potentially open up new lands for development by providing access. The development of land uses incompatible within the 100-year floodplain will not occur within the floodplain as a result of the project because no encroachment of the 100-year floodplain is permitted by the County of Hawai'i. The installation of properly sized culverts will minimize potential risk of flooding. Because of the


ZONE A
ZONE X
ZONE X
ZONE A
SADDLE ROAD
ZONE X
SADDLE ROAD
EX-4A
ZONE A
WILDER ROAD
E-3
ZONE X
ZONE A
FLOODPLAINS LOCATION
Zone A – No base flood elevations determined
Zone X – Areas outside 500 year floodplain
Area of 100 Year Flood
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
FEMA
FLOODPLAINS
FIGURE 3.15.2

intermittent nature of the streams, and the absence of significant floodplain habitats, no significant adverse impact on natural or beneficial floodplain values is anticipated.

No Action Alternative. The existing drainage structures along Saddle Road are undersized and drainage currently overtops the road in several locations. Without proposed improvements in grade, culvert, and bridge design, existing conditions related to drainage would continue within the project corridor. No loss of terrestrial or riparian vegetation or loss of other floodplain values would be anticipated with the No Action Alternative.

3.15.3 Mitigation Measures

Saddle Road will be designed as an all-weather facility, with new drainage structures designed to handle the minimum 50-year design storm in accordance with existing State requirements. No mitigation measures are recommended for floodplains (ref: FEIS - Part I, 1.9)

3.16 WILD AND SCENIC RIVERS

No Wild and Scenic Rivers are located within the project corridor or its vicinity. No impacts to Wild and Scenic Rivers are anticipated from implementation of any of the action alternatives or the No Action Alternative.

3.17 COASTAL BARRIERS/COASTAL ZONES

3.17.1 Affected Environment

The Hawai'i Coastal Zone Management (CZM) Program was established in 1977 through the adoption of the Coastal Zone Management Act, incorporated in Chapter 205A HRS. Under the CZM program, Federal projects must conform with objectives and polices related to seven areas: recreation resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, and managing development. The CZM objectives are outlined as follows.

- Recreational Resources. Provide coastal recreational opportunities accessible to the public.
- Historic Resources. Protect, preserve, and, where desirable, restore those natural, man-made historic, and pre-historic resources in the CZM area that are significant in Hawaiian and American history and culture.
- Scenic and Open Space Resources. Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

- Coastal Ecosystems. Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

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

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

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

Chapter 205A also established the *Special Management Areas* (SMAs) which are areas of particular concern that require a higher level of management to ensure the coastal resources are appropriately protected and managed. Accordingly, any development proposed with an SMA requires the approval of a minor or major use permit, dependent on the cost and impact of the proposed activity. No portion of the project area is within an SMA.

3.17.2 Environmental Consequences

All Action Alternatives. All Federal projects require a determination to ensure that the proposed project is consistent with the objectives and polices of the CZM Program. With implementation of the project mitigation measures, the project has been determined to be consistent with the objectives and polices of the CZM Program. The formal determination has been made by the CZM agency based on submittal of the required CZM assessment form (ref: FEIS - Part II, 1.4.6). Because the entire project area is outside of established SMAs, no review under the SMA Use Permit provisions is required for the project.

Recreational Resources. The proposed improvements to Saddle Road would not directly impact existing or potential future coastal recreational opportunities accessible to the public, but would indirectly improve accessibility of these opportunities through a safer and more efficient cross-island route.

Historic Resources. Existing historic features within the study corridor will be impacted by the proposed improvements to Saddle Road. An adverse effect would result from some sites, but effects can be mitigated (3.19.2.2 Environmental Consequences). Some mitigation will include the construction of vehicle pullouts and installation of interpretive signage for these features. Impacts to indigenous Hawaiian cultural values include the loss of some older trees/forests.

Scenic and Open Space Resources. The proposed improvements will affect the visual character and visual quality of the road corridor, but would allow improved access to the

center of the island. With the road improvements, people in rental cars would be allowed to travel Saddle Road and enjoy the open space and scenic quality of Mauna Kea and Mauna Loa, forested vegetation, open grasslands, varying terrain, and distant views of the ocean.

Coastal Ecosystems. No direct impacts to coastal ecosystems would be anticipated with the proposed project.

Economic Use. The proposed improvements to Saddle Road would result in a notable, positive economic benefit to the island in employment and income, tourism, time savings for cross-island travel, and safety (ref: FEIS - Part I, 3.4).

Coastal Hazards. During natural disasters (tsunami, storm waves, stream flooding, lava flows, erosion, and subsidence), other key roads on the island (e.g. SR 19 and SR 11) may be blocked or portions destroyed. The improvement of Saddle Road will provide a safe and efficient alternative route to these roadways. In addition, improvements to Saddle Road and its drainage structures would minimize the risk of flooding and flood damage to the road base and surface.

No Action Alternative. No impacts to coastal barriers or coastal zones would result from the No Action Alternative.

3.17.3 Mitigation Measures

The key mitigation measures related to the objectives and policies of the CZM program are listed in several sections of this EIS: Section 3.19.3 relating to archaeological, historic, and traditional cultural properties; Section 3.21.3 relating to visual resources, Section 3.10.3 relating to water quality, Section 3.23.3 relating to construction impacts, Section 3.15.3 relating to floodplains, and Section 3.18.3 relating to threatened and endangered species.

3.18 THREATENED AND ENDANGERED SPECIES

A Biological Assessment (BA) was prepared for the proposed project to address species afforded legal protection by the USFWS as either *endangered, threatened, proposed endangered, and proposed threatened*, also known as *listed species* (ref: Rana 1997, Tech. App. Vol. III). The BA was based on the information provided by floral and faunal surveys prepared for this project (ref: Char 1996 and Palmer 1997, Tech. App. Vol. I, and Rana 1997, Tech. App. Vol. II). The biological surveys inventoried listed species and rare, native species known or expected to occur in the project area and vicinity. The USFWS indicated that the species listed in the Final BO (ref: FEIS - Part III, BO) represent the current listed species for purposes of this project (Rosa, November 12, 1998, verbal communication). Species inventories were conducted by means of 100-percent pedestrian surveys within the 60-m wide corridor. Disturbance

resulting from the proposed project would be limited to construction limits within a 40- to 50-m ROW width based on the actual roadway footprint and within the 60-m survey limits.

3.18.1 Affected Environment

Prior to the initiation of the technical studies for this project, one endangered mammalian species, seven endangered and one threatened avian species, and three endangered and one threatened plant species were identified as potentially being within the project area. No listed species of invertebrates were detected during the surveys conducted.

During the course of mammalian surveys, the endangered Hawaiian hoary bat was detected in all sections of the project area. A total of 10 ultra-sonic bat stations were established in the vicinity of the project area. The use of voice-activated tape recorders and remote timing devices allowed the usage of multiple units simultaneously at separate locations. In addition visual scans were made for bats during twilight hours. Count stations were all sampled twice. The tapes were reviewed and the number of bat passes were counted.

Section I

Hawaiian hoary bat was detected in low numbers during the course of the biological surveys along both Segments W-2 and W-3.

No listed avian species were detected along either Segments W-2 or W-3 during the course of the biological surveys. One Nene was seen south of W-3. It is likely that there is occasional, incidental usage of habitat along both W-2 and W-3 by this species. It is probable that the endangered Dark-rumped Petrel overflies both W-2 and W-3 during the breeding season on their way to and from nesting colonies on Mauna Loa.

No listed species of land snails, insects, or other arthropods were detected during the course of the biological surveys on either W-2 or W-3.

No listed species of plants were detected within the limits of W-2 or W-3 during the course of the biological surveys. One endangered plant species, *Portulaca sclerocarpa* (po'e or'ihi), was recorded on EX-1, in the vicinity of the existing alignment of Saddle Road. Four plants of po'e are found roughly 15 m west of the survey limits, well outside of the existing ROW. The plants are growing in a soil-filled depression on top of one of the larger boulders in a rock outcropping located in kikuyu grass pasture land. The outcropping may also attract pedestrian traffic, as it offers a panoramic view of the surroundings.

Section II

Hawaiian hoary bat were detected in moderate numbers along PTA-1, PTA-3, and EX-2. Bats were concentrated in heavily vegetated areas, especially those with dense stands of trees; particularly mamane and naio. They were also found in numbers in close proximity to areas with external night lighting, such as the basketball court within the cantonment area of the PTA.

PTA-1 and PTA-3 traverse Palila Critical Habitat from Station 10+950 (PTA-1) just west of Pu'u Koko to Station 13+440 (PTA-1) just east of Pu'u Ma'au. This portion of Palila Critical Habitat is vegetated with a mix of 'aweoweo shrubland and 'a'ali'i shrubland and does not currently support either mamane/naio vegetation or Palila (ref: FEIS, Part I, Figure 3.13.1).

PTA-1 and PTA-3 again cross Palila Critical Habitat from Station 22+000 (PTA-1) just east of Mauna Kea State Park to just east of the point where PTA-3 diverges from PTA-1, Station 27+000. PTA-3, from the point it diverges from PTA-1 at Station 10+000 to approximately Station 11+800, is also within the Palila Critical Habitat. This portion of Palila Critical Habitat is vegetated with a mixed mamane/naio forest . The current usage of this habitat by Palila is best described as incidental. EX-2 is not within the Palila Critical Habitat.

One Palila was observed by a botanist close to the eastern boundary of PTA-1 during the course of the biological studies for this project. There have been at least three other documented sightings of Palila within the general area of the PTA-1 in the past five years. Past studies have identified obligate components in the Palila life cycle. Palila are highly dependent on mamane as both a food source and as nesting substrate. The larvae of mamane coddling moth (*Cydia* spp.) are a key source of protein for feeding young Palila. One of the principle limiting factors for Palila expansion is the fragmented nature of much of the remaining forest. Browsing of mamane seedlings by feral and domestic ungulates has reduced tree density, which in turn require Palila to expend greater energy in the pursuit of food resources. Following the efforts to reduce feral ungulates, especially sheep, from the upper slopes of Mauna Kea in the 1980s, fire has replaced sheep as the single greatest threat to the continued survival of Palila. Not only is the habitat in which Palila persevere extremely dry and fire prone, but the bulk of the population is concentrated in an area around Pu'u La'au, approximately 4 to 6 km uphill of the project area, near the western boundary of the PTA. The concentration of the population within one area increases the likelihood of a single catastrophic event extirpating the species.

There have been at least two documented records of 'Akiapola'au close to the eastern limit of PTA-1 over the past ten years. Although no Nene were encountered during the biological studies, they have occasionally been recorded from the flats along the eastern end of PTA-1. It is probable that the endangered Dark-rumped Petrel overflies PTA-1, PTA-3, and EX-2 during the breeding season on its way to and from their nesting colonies on Mauna Loa.

No listed species of land snails, insects, or other arthropods were detected during the course of the biological surveys for PTA-1, PTA-3, or EX-2.

Two populations of *Silene hawaiiensis*, an endangered plant, were found within and close to the portion of the PTA-1 corridor common to PTA-1 and PTA-3. The first population of about 70 plants is located within the corridor on a rocky knoll within hard-stemmed lovegrass grassland. The majority of the plants occur on the north side of the centerline at Station 16+720. The second population is located outside of the survey limits on the south side of the corridor on the southwest slope of Pu'u Ma'au at approximately Station 13+200. No listed plants were identified along the EX-2 corridor.

Section III

Hawaiian hoary bats were detected in moderate numbers along Segment EX-3. Bats were concentrated in heavily vegetated areas, especially those with dense stands of trees. The highest numbers were detected near the eastern terminus of the segment.

Three separate sightings of the endangered Hawaiian Hawk were recorded between Stations 156+000 and 165+000 during the biological studies along this segment. The mosaic of montane mesic/dry forest found along the existing roadway between Hilo and approximately MP 21 is within the breeding range of this species. Hawaiian Hawks nest between May and October. It is probable that this species nests in low numbers in a few of the kipuka found along the proposed route within this section.

It is probable that both the endangered Dark-rumped Petrel and the threatened Newell's Shearwater overfly parts of Segment EX-3 during the breeding season. Several Dark-rumped Petrel and numerous Newell's Shearwater have been observed or collected close to the existing roadway within this section. Although no Nene were encountered during the technical studies for this section, they have occasionally been recorded close to the existing roadway from approximately Station 140+700 to about 150+000.

The northern boundary of the Kipuka 'Ainahou Nene Sanctuary is adjacent to the existing Saddle Road between Station 141+400 and 149+000. In addition, the area between Station 147+000 and 159+500 is habitat for three species of endangered Honeycreepers; 'Akiapola'au, Hawai'i Creeper, and Hawai'i 'Akepa.

Hawaiian Duck are resident in some of the small ponds found in the pasture lands north of the existing highway in EX-3, but there is no habitat within or close to the proposed corridor that is suitable for this species. The 'O'u, an endangered honeycreeper, was known historically to occur in the area between Station 147+000 and 159+500. There has been no substantiated sighting of 'O'u on the Island of Hawai'i since the 1980s.

No listed species of native land snails, insects or other arthropods were detected during the course of the biological surveys for EX-3.

Ten rare, native plant species were identified as potentially occurring within Section III, but none were detected within the 60-m study corridor during the course of the 100-percent pedestrian botanical surveys. Three endangered plant species were detected at various distances outside the survey limits: *Plantago hawaiiensis* at 18 m north of the survey corridor, *Cyanea platyphylla* at 250 m south of existing roadway, and *Clermontia peleana* at 237 m north of proposed ROW.

Section IV

Hawaiian hoary bat were detected in low numbers along both Segments E-3 and EX-4A during the course of the technical surveys. As in other sections, bats were concentrated in areas with heavy vegetation.

During the course of technical studies, no listed avian species were detected on either E-3 or EX-4A. It is probable that both the endangered Dark-rumped Petrel and the threatened Newell's Shearwater overfly parts of both E-3 and EX-4A during the breeding season. Numerous Newell's Shearwater have been observed or collected close to the existing roadway within this section. At least one specimen was collected from Kaumana Drive in 1978. Hawaiian Hawk have also been seen along the existing Saddle Road within the vicinity of both E-3 and EX-4A.

No listed species of native land snails, insects or other arthropods were detected during the course of the technical surveys on either E-3 or EX-4A.

No listed species were detected on either Segment E-3 or EX-4A. There is one 1933 record of an endangered plant, *Cyrtandra giffardii*, in the Heritage Database from the general area of the west end of E-3. The area has since been disturbed and no individuals of this species were found during the course of the biological surveys.

3.18.2 Environmental Consequences

All Action Alternatives. Given the current knowledge and understanding of the abundance, distribution, and biology of the Hawaiian hoary bat, it is unlikely that the proposed project would have an adverse impact on this endangered species.

It is probable that Dark-rumped Petrel will overfly most portions of the project area, at least occasionally, between May and October each year during the breeding season. This seabird returns to its nesting colony after dark. A major threat to these birds, especially to fledging birds, is being disoriented by lights on their way to sea. When disoriented, they may collide with man-made structures and be killed or injured. Since no street lights are planned for the improved Saddle Road, potential impacts to this species will be negligible following the completion of construction efforts.

The potential exists that Nene will occasionally forage within most of the project area, except Section IV. Any such usage is incidental in nature. It is unlikely that any of the action alternatives would have an adverse impact on this endangered species.

Construction equipment and material pose several other potential impacts to sensitive biological resources. Indiscriminate parking of heavy equipment can destroy biologically sensitive areas, as can the storing of construction material, especially fill, petroleum, oil and other lubricants. Heavy equipment can also collapse or damage caves and lava tubes which often support site-specific endemic fauna. The servicing and maintenance of heavy construction equipment will generate quantities of used oils and lubricants, which if improperly disposed of on site, pose grave threats to endemic flora and fauna.

Section I

No concerns related to listed species were identified within Section I of the study corridor.

Section II

PTA-1 would directly modify 41.5 ha of Palila Critical Habitat, while PTA-3 would directly modify 46.1 ha of Palila Critical Habitat. This may have long-term implications on the recovery efforts for this species. EX-2 would not directly impact Palila Critical Habitat. No direct impacts to 'Akiapola'au are anticipated to result from any of the action alternatives in this section.

Implementation of either PTA-1 or PTA-3 on the original alignment would have directly impacted one colony (70-plant) of *Silene hawaiiensis*, however; the alignment has been adjusted to avoid this colony. Additionally, another population of silene in the vicinity of PTA-1 is in close proximity to an attractive vantage point currently used by the military. Implementation of PTA-1 may increase the potential for inadvertent destruction of this second population. Implementation of EX-2 would not directly impact either of two additional populations of *Silene hawaiiensis* located in its vicinity, but may increase the likelihood of inadvertent destruction of these populations. Increased fire hazard associated with each of the action alternatives would increase the likelihood of indirect impacts to *Silene hawaiiensis*.

Because of anticipated increases in traffic volumes, all action alternatives within this segment would increase the risk of fire, particularly within the west half of the PTA (ref: FEIS - Part I, 3.9). Wildfire has the potential for impacting listed and rare-native animal and plant species within this section. 'Aweoweo shrubland, hard-stemmed lovegrass grassland, 'a'ali'i shrubland, and mamane/naio forest are all extremely dry habitats. During construction, there would be an increased risk of fire ignition. After completion of the construction phase of this project, there would be a permanently heightened risk of the ignition of wildfires in the area. Fires would be especially destructive in the native plant communities found on PTA. Native plant species are poorly adapted to wildfires. Native woody plants may recover from fire to some degree, but

alien species are more successful in disturbed areas than native species. In species such as fountain grass, fire actually stimulates growth from the base of clumps and encourages seed production. Fires accelerate the conversion of native-dominated communities to alien-dominated communities.

Of the action alternatives, PTA-1 would entail the greatest risk for wildfire impacts to listed and rare-native plants. The PTA-1 alignment is particularly sensitive as it is close to or right at the slope of Mauna Kea. The rugged topography and lack of access roads increases the difficulty of fire suppression in this area. In the event of wildfire spreading up the slopes of Mauna Kea, several rare native plants species would likely be impacted.

Section III

It is probable that Newell's Shearwaters will overfly Section III, at least occasionally, between May and October each year during the breeding season. This seabird returns to its nesting colony after dark. A major threat to these birds, especially to fledging birds, is being disoriented by lights on their way to sea. When disoriented, they may collide with man-made structures and be killed or injured. Implementation of the proposed project would likely impact individuals of this species. Since no street lights are planned for the improved Saddle Road, potential impacts to this species will be negligible following the completion of construction efforts.

Implementation of EX-3 would not impact Hawaiian Duck. These species are not expected to occur within the project area in Section III. No impacts to Hawaiian Hawk are anticipated, unless a nest is located within, or close to, the construction corridor during the construction phase of this project. In that case individuals of this species may be impacted. Implementation of EX-3 may displace individual 'Akiapola'au, Hawai'i Creeper, and Hawai'i 'Akepa during construction. Due to mitigation measures designed to minimize impacts to kipuka, any impacts to these species will be of a temporary nature.

No direct impacts to *Plantago hawaiiensis*, *Cyanea platyphylla*, or *Clermontia peleana* are anticipated to result from EX-3. Potential impacts to rare-native plants would result from the increased risk of incursion into kipuka. Kipuka have already suffered extensive damage from pigs and other alien species. Additional mechanical incursions into the remaining kipuka could further impact the integrity of these natural areas of refuge. Bulldozing of vegetation and ground cover from lower elevations upslope towards the more undisturbed areas found in the native-dominated forest has the potential for serious impacts on these areas. Construction equipment has the potential for being the major vector for alien species dispersal and possible introduction during construction.

Section IV

It is probable that Newell's Shearwaters will overfly Section IV, at least occasionally, between May and October each year during the breeding season. This seabird returns to its nesting

colony after dark. A major threat to these birds, especially to fledging birds, is being disoriented by lights on their way to sea. When disoriented, they may collide with man made structures and be killed or injured. Implementation of the proposed project may impact individuals of this species.

No impacts to Hawaiian Hawk are anticipated for either E-3 or EX-4A, unless a nest is located within or close to the construction corridor during the construction phase of this project. In that case, individuals of this species may be impacted.

No impacts to rare native plants are anticipated to result from implementation of either E-3 or EX-4A.

No Action Alternative. With the No Action Alternative, there would be no construction-related impact to listed or rare native species or their habitats. With an increase in the number of vehicles using Saddle Road and increased access to the project vicinity, the likelihood of wildfire and human disturbance of sensitive habitat would be expected to increase, although to a lesser extent than with the action alternatives.

3.18.3 Mitigation Measures

Additional mitigation measures pertaining to the reduction of impacts to biological resources are detailed in the section of this chapter addressing fire hazard, waters of the U.S./wetlands, and speleological resources (ref: 3.9.3, 3.11.3, and 3.12.3).

Mitigation Measures Applicable to All Project Sections

- To avoid the potential downing of Dark-rumped Petrels and Newell's Shearwaters by their interaction with external construction lighting, no construction or unshielded equipment maintenance lighting will be permitted after dark between the months of April and October. This prohibition will be one of the Special Contract Requirements which will be incorporated in the construction contract documents.

- In an effort to avoid impacting any nesting Hawaiian Hawks in Sections III and IV, a nest search of the ROW and surrounding environs shall be conducted by a qualified ornithologist prior to the onset of construction for all portions of Section III and IV for which construction is to occur between May and October. If an active nest is detected during construction, construction activity shall be halted within 1 km of the nest until a consultation with the USFWS can take place, and appropriate mitigation measures implemented.

- To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction

personnel and equipment shall be at previously identified and marked non-sensitive areas.

- During construction in Section II, emergency spills treatment, storage, and disposal of all petroleums, oils, and lubricants, both within construction limits and at staging areas will be handled in strict accordance with the FHWA 1996 *Specifications for Construction of Roads and Bridges on Federal Highway Projects*, as well as Federal Acquisition Regulations and the appropriate EPA regulations. HDOT will provide similar measures in Sections I, III, and IV.

- To assist in mitigation of the potential spread of alien organisms, the possible infusion of additional feral mammalian predators and the possibility of wildfire ignition informational signs will be designed with messages relevant to the specific native ecosystem and installed where appropriate in conjunction with planned pullouts or parking areas.

- To mitigate the potential spread and introduction of noxious plants and other alien organisms into the Palila Critical Habitat and the other native species dominated areas, all construction equipment shall be thoroughly steamed cleaned and fumigated off-site before being transported to the construction site. Once equipment has been moved away from the site, it shall be steam cleaned and fumigated before being allowed back onto the job site.

- During the final design phase a concerted effort will be made to design the Recommended Alternative within Sections II, III, and IV (Segments PTA-1, EX-3, and E-3) to balance earthwork quantities so that no borrow/fill will need to be imported from outside the immediate area. Should the need arise for fill to be imported from off site, a local borrow site will be used so as not to introduce nonnative species. If a local, non-contaminated site cannot be found, the material will be sterilized by an appropriate method(s) if required after consultation with a qualified biologist. Construction in Sections III and IV shall begin on the western end of the section and proceed east so as not to introduce nonnative species.

- In a further effort to minimize the spread of alien plant species in Sections II, III, and IV, care shall be taken to avoid bulldozing from ruderal plant communities and pasture lands into more native-dominated communities. In Section II, this primarily refers to the ruderal areas adjacent to PTA-1 from Station 27+000 to 30+998.930 and to ruderal areas adjacent to PTA-3 from Station 10+000 to 10+500.

- To prevent the spread of fountain grass into disturbed areas along PTA-1 and EX-3, the ROW shall be inspected every three months during the course of construction. Any emerging fountain grass shall be controlled by spraying with a suitable herbicide, in consultation with a qualified biologist. Following the completion of construction the

roadway will fall under the maintenance jurisdiction of HDOT. HDOT will maintain the roadway and will use mowing, and, when necessary, herbicides to control roadside weed and grass growth in consultation with a qualified biologist. This measure is not to be applied in Section IV within native ecosystem areas where wetland restoration is underway.

- A baseline survey, which gathered information on the distribution of land snails, insects, and other arthropod species along the entire roadway corridor, has been conducted by scientists from the Bishop Museum. The survey was funded at $90,000 by this project even though there were no threatened or endangered invertebrate species known to exist within the project area. The study provides complimentary baseline information in Section II relative to Palila insect food sources and alien species.

- All equipment, material, and support structures shall be stored and maintained either within the ROW or in designated staging areas. Siting of staging areas will be coordinated with biologists to ensure that these be located where native species would not be adversely impacted by construction. Staging areas identified within Section II are located at MP 33 on the south side of the existing roadway, and at PTA-3 Station 11+500 to 12+000 west of Pu'u Nene in a highly disturbed lava field. Staging areas currently identified within Section III are located north of the roadway at MP 18.7, adjacent to MP 17.5 on the south side of the existing roadway, and MP 13.5 and MP 11.75. Staging areas have not yet been identified for Section I and IV. Staging areas will be clearly demarcated and fenced with temporary construction fencing.

- A comprehensive manual outlining and discussing the environmental commitments contained in the Special Contract Requirements will be prepared. This document will be prepared by the FHWA in accordance with their environmental team policy, which ensures that the environmental team closely follows the entire project to its completion. At the pre-construction meetings for Section II projects, this document will be distributed and the rationale behind specific requirements will be reviewed with project engineers, supervisors, and contractors. This document will be furnished to HDOT for their use in future contracts in Sections I, III, and IV.

- Special Contract Requirements will be incorporated into the construction documents directing the contractor's work consistent with specific mitigation commitments. Prior to construction in Section II, all construction personnel will be required to attend a project orientation meeting where Special Contract Requirements will be reviewed. During construction in Section II, a project engineer with FHWA's Central Federal Lands Highway Division (CFLHD) will be on site at all times to ensure implementation and compliance with the Special Contract Requirements. The project engineer will have the authority to shut down construction should violations of Special Contract Requirements be detected; furthermore, the project engineer will be responsible for

ensuring compliance with all environmental restrictions and mitigation measures. Similar measures will be implemented by HDOT in Sections I, III, and IV.

- Prior to and during construction in Section II, participation in the CFLHD's Construction Partnership Program, which provides a process for ensuring delivery of Contractor and FHWA responsibilities, will be solicited. This program provides for the involvement of all stakeholders, including regulatory agencies, in the construction process should they desire to participate.

Section I Mitigation Measures

- As soon as feasible after construction of the roadway, all disturbed areas will be replanted with kikuyu grass, the dominate ground cover along this section.

Section II Mitigation Measures

Because of the biological significance and sensitivity of much of the area through which PTA-1 traverses, there is a significant amount of mitigation proposed to offset the actual and potential impacts that construction of this alignment will have on the Palila Critical Habitat. The Palila Mitigation Plan is the major component in the total proposed mitigation for the Recommended Alternative and proposes specific actions to enhance Palila recovery as mitigation for the modification of Critical Habitat with the construction of PTA-1.

The history of consultation with the USFWS under Section 7 of the ESA for this project dates back to December 27, 1990. A detailed history of the consultation is provided in the USFWS BO, July 27, 1998 (ref: FEIS-Part III, BO). A summary of this consultation process is provided as follows.

In 1994, the scope of the proposed action was significantly expanded. At that time, the FHWA advised the USFWS that a new alternative for the project within the PTA area would traverse a portion of the federally designated Palila Critical Habitat. FHWA requested assistance from the USFWS to identify measures to offset the modification of Palila Critical Habitat.

A series of meetings ensued between the FHWA, USFWS, BRD/USGS, DOFAW, and the Army to examine the potential impacts of the project on the long-term survival of the Palila. Additionally, a group of scientists and resource managers developed a series of mitigation components designed to offset the potential impacts to Palila with the modification of Palila Critical Habitat. The following four main components of this plan were presented at an interagency meeting held in Honolulu on March 1, 1996: 1) Minimize impacts to existing Palila habitat at PTA and further explore the potential of Palila restoration at Kipuka 'Alala; 2) Minimize fire risk and increase ability to suppress fire; 3) Protect and enhance the existing core population of Palila; and 4) Acquire and manage additional Palila habitat on Mauna Kea's northern slope (ref: FEIS - Part III, Supplemental Documentation).

The FHWA Consultant team met with USFWS representatives on September 5, 1996 to discuss the scope and cost of the proposed Palila mitigation. At that meeting, FHWA requested detailed documentation and justification for securing and managing lands in the Pu'u Mali and Pu'u La'au areas of Mauna Kea as well as a written estimate of the cost of the proposed mitigation. The USFWS responded to Okahara & Associates in a letter dated October 9, 1996, in which the USFWS outlined the key components that they felt were necessary to adequately mitigate the modification of the federally designated Palila Critical Habitat. This document served as the foundation for the mitigation proposed in the BA prepared for this project (ref: 1997, Tech. App. Vol. III, Appendix A).

Numerous one-on-one meetings and phone calls were held between September 1996 and February 1997 with agency representatives and research scientists to gather input on biological issues, concerns, and potential mitigation measures. The result of these consultations was presented in a preliminary BA, which was circulated to all of the stakeholder agencies on March 11, 1997, for review and comment. Following the internal interagency review of the document a series of interagency meetings were held to resolve conflicting jurisdictional mandates, differing resource management approaches, and natural resource multi-use considerations.

The BA was revised to incorporate the results of these interagency meetings and comments received from agencies on the preliminary BA. The BA was formally submitted to the USFWS on November 12, 1997, and at that time a formal request for consultation was made under Section 7 of the ESA.

A meeting was held in the USFWS office in Honolulu on December 4, 1997, to clarify a number of issues in the BA. The USFWS agreed to accept the BA and to initiate formal consultation provided that FHWA respond to several areas of concern raised by the USFWS biologists. The USFWS further agreed to help develop a mitigation plan to offset potential impacts to two listed plant species found outside of the Section III corridor. On December 29, 1997, the USFWS responded in a letter to FHWA that the BO would be delivered on March 27, 1998 and stated that all information required was contained in the BA or was readily available. On February 25, 1998, the FHWA agreed to extend the issuance date of the BO to April 17, 1998 and accept a Draft BO to allow for further discussion on mitigation implementation issues. Mitigation issues regarding the two listed plant species in Section III were resolved on March 18, 1998, and finalized in a letter from the HDOT to the FHWA dated March 31, 1998 (ref: FEIS - Part II, 1.4.5 and Part III, BO).

Following the receipt of the Draft BO, it was necessary to convene a series of meetings between FHWA's technical consultants and each of the major stakeholder agencies in an attempt to resolve remaining jurisdictional and resource management disagreements. These meetings culminated in a Palila Mitigation Partnering Session hosted by FHWA at the Turtle Bay Hilton on June 30, 1998. The purpose of the meeting was to craft a Palila Mitigation Memorandum of Understanding (MOU) outlining the implementation elements and responsibilities of the proposed Palila Mitigation Plan. Consensus was reached among participating agencies and the

resulting document was signed by FHWA, HDOT, MTMC, USAG-HI, USFWS, DLNR, and BRD/USGS in July 1998 (ref: FEIS-Part III, MOU).

The USFWS delivered their final BO on July 27, 1998. It concluded that there will be no jeopardy to either Palila or *Silene hawaiiensis*, or adverse modification of Palila Critical Habitat resulting from the construction of this project based in large part on the conservation measures built into the project by the FHWA. The implementation MOU is referenced in the BO as the means for implementation of the Palila Mitigation Plan.

It should be noted that although the BO references the BA, there are several changes in the implementation of mitigation proposed in the BA as now embodied in the BO and stipulated in the MOU. The BA was used as a transitional document to solicit options and to develop a consensus of opinion between the various agencies who either control lands or resources and those that are proposed to implement the mitigation elements. Where there is discrepancy between the two documents, the BO supersedes the BA, which was modified by interim consultation and the MOU.

The three principle differences between the Palila mitigation as proposed in the BA and that in the MOU and BO are: 1) the agency with ultimate control over management actions on State lands, 2) the designation of an Oversight Committee, and 3) the agency(ies) seeking, receiving, and obligating the mitigation funds. In the BA, the Oversight Committee was presented as being a multi-agency entity that would plan and coordinate mitigation tasks and procedures. The State of Hawai'i is uncomfortable not having the final say on what is done on their lands, consequently, the DLNR will retain responsibility for implementing specific items on state replacement lands as guided by the MOU. Specific items of the implementation plan which will be implemented by DLNR forces or contract labor are shown in Table 3.18.3.1. The role of the Oversight Committee, as newly proposed in the MOU, is replaced by the FHWA. The FHWA has agreed to monitor agency implementation and be responsible for ensuring that mitigation tasks are carried out within the framework and guiding principles of the MOU in coordination with BRD, USFWS, USAG-HI, and DOFAW. Coordination mechanisms will be outlined in the ROD and various MOA between FHWA and each agency.

As originally proposed in the BA, the funding for mitigation performed offsite would funnel through the USFWS and be distributed by them to implementing sub-contractors and agencies. Following the MOU deliberations, it was determined that the monies for offsite mitigation would, in most cases, more logically be sought and administered by the BRD, and the PTA through their EMP (ref: FEIS - Part I, Table 3.18.3.1, and FEIS-Part III, MOU). Subsequent investigations by BRD of their budgetary requirements for Fiscal Year 2000, indicated that their organizational and program responsibilities would not allow Palila mitigation program support. Consequently, items previously believed eligible for BRD funding are now shown as "To Be Determined" (TBD) in Table 3.18.3.1; these items will be funded either by the DAR Program or EMP, as determined by project appropriations. As stipulated by MTMC based on funding appropriations, construciton monies allocated to the project through the DAR Program will first

be used to implement the mitigation for that fiscal year as specified in Table 3.18.3.1 with the remainder used for construction of the roadway (ref: FEIS - Part II, 1.4.6, FHWA Memorandum dated March 11, 1999, and MTMC letter dated April 1, 1999).

Mitigation measures stipulated in the BO, which will be implemented for the Saddle Road project are as follows.

- A fire prevention cross-section will be constructed within the PTA to prevent burning objects tossed from vehicles from easily leaving the road surface, to prohibit vehicles from driving off of the road surface, and to discourage parking for pedestrian excursions (Figure 2.1.1, Sheet 2, *Typical Sections B and C*).

- Emergency call boxes will be installed at 2-km intervals along one shoulder within the PTA to afford immediate reporting and, consequently, early suppression of fire events.

- A portion of the PTA-1 construction corridor in the vicinity of Bradshaw Airfield has been moved south of a population of 70 *Silene hawaiiensis*. This mitigated alignment will avoid any taking of *Silene hawaiiensis*. To ensure protection from construction related activities, both this population and one other are located well outside the survey corridor at Stations 16+720 and 13+200, respectively, will be fenced off at the ROW line with temporary construction fencing. All features contained within fenced exclosures shall be declared off limits to construction personnel.

- The USAG-HI will provide an exclosure around the large population of *Silene hawaiiensis* within Training Area 3 near Deadman's Curve north of the existing roadway.

- Increased fire suppression resources (six 302.800-L dip tanks, two Humvee pumper trucks, and one new 7,570-L tank truck) have been added to the PTA Fire Department and the PTA Fire Management Plan has agreed to stockpile and maintain sufficient fire fighting equipment for an 86-man fire fighting detail. (ref: FEIS - Part I, 3.9.3).

- A fire ecologist will be hired through BRD on a temporary basis to create a fire model(s) consistent with current methodology for high altitude xeric plant communities. The fire ecologist will also develop a comprehensive fire management plan consistent with Palila habitat recovery goals for use by the PTA and other fire-fighting entities. The fire management plan is to focus on Palila population protection and fuels management as described in the FEIS - Part I, 3.9.3).

- The implementation of the PTA Fire Management Plan by PTA command and the integration of the fire ecologist's modeling and comprehensive Palila and native ecosystems fire management plan will further ensure that the Palila Critical Habitat

within the PTA and rare biological communities is not rendered unsuitable for future potential Palila restoration efforts or receive serious impacts from unplanned wildfires.

- Strict adherence to training restrictions applicable to the PTA within the Palila Critical Habitat designed to protect sensitive habitats in the mamane/naio forests resulting from the USFWS, 1983 Section 7 consultation and detailed in the current USARG-HI PTA External Standing Operating Procedures document will continue to be implemented by the PTA command (USAG-HI, 1996).

- In the Pu'u Mali area on the north slope of Mauna Kea, approximately 1864 ha of State land below Mauna Kea Forest Reserve plus adjacent lands within the forest reserve, immediately upslope were identified by BRD/USGS as having the requisite vegetation, food resources, rainfall gradient, and real potential for timely restoration and translocation of Palila (ref: Figure 3.18.1, *Palila Mitigation Sites and Critical Habitat*). These lands are currently in State pasture leases to three separate lessees; Botellho Hawai'i Enterprises, K.K. Ranch, and S.C. Ranch. Transfer and management of this area for Palila translocation will be implemented to allow a population of Palila to be reestablished over a range of recovering habitat situated along suitably broad elevation and moisture gradients (ref: Rana 1997, Tech. App. Vol. III).

- In order to enhance the primary population and habitat located on the west slope of Mauna Kea, additional habitat needs to be secured and managed for Palila. The most important land to rehabilitate and make available for Palila on the west slope are those found in the Ka'ohe Lease Lands located immediately northwest of the core Palila population. This 704-ha parcel of State land is located within the Palila Critical Habitat and is presently leased to Parker Ranch for cattle grazing. Acquisition and management of this area for Palila translocation will be implemented to allow the core population of Palila to expand (ref: Rana 1997, Tech. App. Vol. III).

- For habitat restoration to succeed within the areas identified above (State replacement lands), they will be fenced and both domestic and feral ungulates removed. To ensure that ungulate control is both effective and cost efficient, it is imperative that the removal of ungulates be initiated concurrently with the above fencing efforts. If it is cost effective and manageable, public hunting will be allowed in initial ungulate control efforts. To ensure that all ungulates have been removed from the exclosures it will be necessary to monitor and continue control efforts for a period of three years. Maintenance of ungulates at inconsequential levels where not being used as management tool is an option within specific exclosures to be guided by the scientific principles and participatory commitments of the Palila Mitigation MOU.

- Management of state replacement lands will remain flexible under the principles and commitments of the Palila Mitigation MOU to allow for compatible uses such as recreation, game bird hunting, and other uses identical to adjacent forest reserve.

- To ensure success of the introduced Palila on the State replacement lands, alien species, pests and predators will also have to be monitored and controlled for a period of ten years.

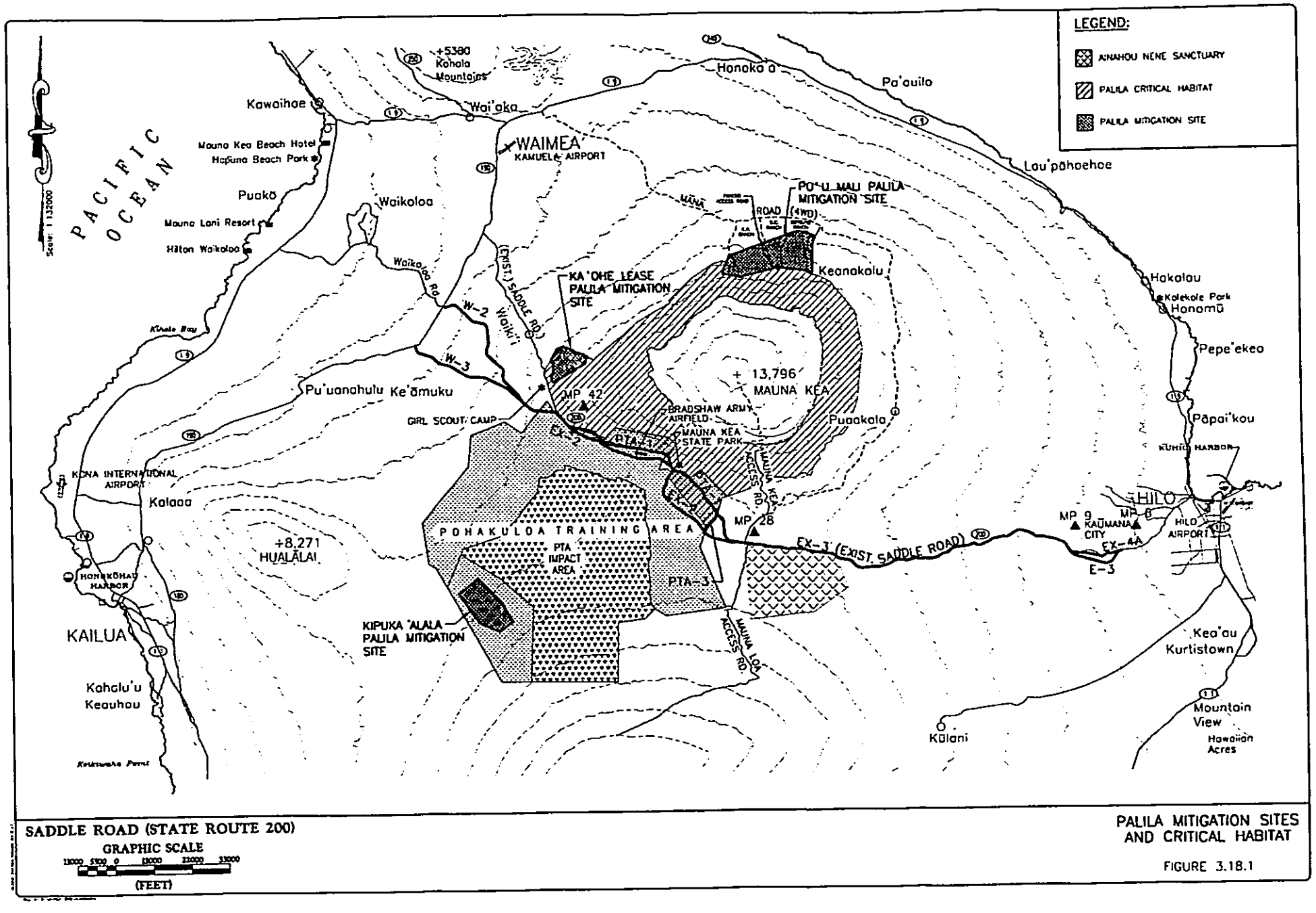
- In an effort to determine the impacts of ants, yellowjackets, parasitic wasps and flies on insect foods of Palila, work initiated by the US Army and conducted by BRD/USGS into limiting factors affecting Palila will be continued. A study will be implemented that will identify what impacts alien insects and other arthropods have on the insect foods necessary for Palila survival. Control methods will be explored for species that are deemed a threat to these essential resources. The basic outline, objectives, and methods of such a study are presented in the BA (ref: Rana 1997, Tech. App. Vol. III).

- Within the PTA the only location outside of the Palila Critical Habitat with any potential for long term restoration and Palila translocation is in the Kipuka 'Alala area. Approximately 1214 ha of mixed naio/mamane shrubland has been identified as suitable for long term habitat restoration. This area will be fenced and ungulates removed to promote restoration of mamane (ref: Rana 1997, Tech. App. Vol. III).

Palila Mitigation Implementation Plan

The proposed mitigation is to be funded over a ten-year period with implementation coupled with the initiation of construction on the Saddle Road project. Table 3.18.3.1, *Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule*, outlines the estimated costs and proposed implementation schedule for the specific mitigation tasks. Approximately 85 percent of the proposed mitigation funds are proposed to be secured and expended in the first three years. The estimated cost of the land transferral task is very preliminary until appraisals, surveying, transfer fees, etc., are complete. Other plan elements, or tasks, represent more accurate estimates; however, actual costs will not be known until specific contracts are let for bid. The agency and or programs responsible for each major mitigation task were proposed following the Palila Mitigation MOU discussions and represent the most logical routing for the funds at the time. The fiscal year of actual implementation may change, depending on the completion date of the environmental documentation process and eventual start of construction. Currently, an initial construction project is anticipated for late fiscal year 2000, at which time, at a minimum, the mitigation lands will be in place.

The Palila Mitigation MOU is the working agreement between the FHWA, HDOT, MTMC, USAG-HI, USFWS, DLNR and BRD for implementation of the proposed Palila Mitigation Plan because it stipulates the commitments of each of the signatory agencies with respect to individual mitigation plan elements within the context of a schedule for implementation and conservation principles designed to guide specific management decisions and actions. Memorandums of Agreement (MOA) will need to be executed between some signatory agencies so that specific management tasks can be performed consistent with monies received and



SADDLE ROAD (STATE ROUTE 200)

GRAPHIC SCALE

(FEET)

PALILA MITIGATION SITES AND CRITICAL HABITAT

FIGURE 3.18.1

obligated for mitigation plan elements as required by the commitments and principles of the MOU.

The FHWA will facilitate the development of MOA as required between signatory agencies to the MOU to ensure that monies received are allocated as guided by the implementation principles and commitments specified in the MOU. These MOA will be executed as funds are appropriated and will serve as legally binding documents for implementation of specific mitigation elements. As a result of the Palila mitigation partnering meeting, the following possible MOA have been identified.

USAG-HI and BRD/USGS - Since funding may originate with the Army (PTA EMP) for hiring of the fire ecologist to begin work in fiscal year 2000 and the alien insect study to begin in fiscal year 2001, an agreement will be needed to carry out this work within the framework of the MOU stipulations. Current agreements between these agencies may suffice for this implementation mechanism; however, these agreements may need to be modified to incorporate FHWA as the oversight agency.

USAG-HI and DLNR - Since funding may originate with the Army (PTA EMP) for fencing, ungulate control, or other activities off of Army lands, these activities will need to be performed or contracted out by DLNR utilizing these funds with FHWA as the oversight agency under the MOU.

FHWA and BRD and/or DLNR - In order to implement the Palila land management, and monitoring elements (predator and alien species control, ungulate control, mowing operations, etc.), the FHWA will need ground services provided by DLNR and research services of BRD. Since funding for these operations may originate with the DAR program, a mechanism for pass-through of these monies for specific services will be required.

Over time, the MOA identified above may need to be modified if monies become available through unforseen appropriations, specific tasks are refined, or additional tasks identified to implement the mitigation plan elements given in Table 3.18.3.1. The above MOA represent the minimum documents presently identified to initiate the mitigation implementation elements proposed for fiscal year 2000 as depicted in Table 3.18.3.1. Should some of the research and land management mitigation elements not receive funding in FY 2000, it is proposed that the initial phase of Saddle Road construction proceed with those mitigation tasks moved to FY 2001 for implementation. In the unlikely event that funding for any of the elements originates with the USFWS for pass-through to other agencies, it is anticipated that Section 6 procedures will suffice for the implementation mechanism.

TABLE 3.18.3.1
Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule

Fiscal Year	Item	Unit Cost (thousands)	Responsibility		Comments
			Program	Agency	
2000	Land Transferral	$2,000,000	DAR	FHWA	Includes lessee relocation and subdivision, Land Board application, and administrative costs.
	Biologically sensitive contract requirements	$250,000	DAR	FHWA	Assumes clearing and grubbing contract with contractor restrictions (included in construction costs).
	Fire ecologist (year 1 of 3)	$50,000	TBD[1]	USAG/ BRD	Does not include other agency costs for coordination efforts.
	Ungulate Fencing at Pu'u Mali	$500,000	TBD	DLNR	
	Ungulate Fencing at Kipuka 'Alala	$291,000	EMP	USAG	
	Ungulate control at Kipuka 'Alala (year 1 of 3)	$83,000	EMP	USAG	
	Palila relocation and monitoring (year 1 of 5)	$450,000	TBD	BRD	
	Predator and alien species control (year 1 of 5)	$150,000	TBD	DLNR	
	Contract administration (variable)	$222,000	TBD		24 % BRD plus 10 % all others except construction items.
	Total for 2000	**$3,996,000**			DAR=$2,250,000; EMP=$374,000; TBD=$1,372,000
2001	Additional excavation for fire shoulders	$300,000	DAR	FHWA	Assumes grading project for all of PTA-1 (included in construction costs).
	Biologically sensitive contract requirements	$250,000	DAR	FHWA	Restricted contractor operations, special equipment handling, etc. (included in construction costs).

TABLE 3.18.3.1
Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule

Fiscal Year	Item	Unit Cost (thousands)	Responsibility		Comments
			Program	Agency	
	Cattle fence at Pu'u Mali and Ka'ohe lands	$237,000	TBD	DLNR	
	Fire ecologist (year 2 of 3)	$50,000	TBD	USAG/ BRD	
	Ungulate control at Kipuka 'Alala (year 2 of 3)	$83,000	EMP	USAG	
	Palila relocation and monitoring (year 2 of 5)	$450,000	TBD	BRD	
	Predator and alien species control (year 2 of 5)	$150,000	TBD	DLNR	
	Alien insect study	$250,000	EMP	BRD	Continued funding of ongoing study by BRD/USGS.
	Mower for Ka'ohe lease lands	$30,000	TBD	DLNR	
	Mower operator labor (year 1 of 5)	$15,000	TBD	DLNR	
	Contract administration (variable)	$232,000	TBD		24% BRD plus 10% all others except construction items.
	Total for 2001	**$2,047,000**			DAR=$550,000; EMP=$333,000; TBD=$1,164,000
2002	Additional excavation for fire shoulders	$240,000	DAR	FHWA	
	Paved fire break shoulder and appurtenances	$4,335,000	DAR	FHWA	Assumes fiscal year 2002 project will install paving and other final work (included in construction costs).

TABLE 3.18.3.1
Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule

Fiscal Year	Item	Unit Cost (thousands)	Responsibility		Comments
			Program	Agency	
	Emergency telephone installation	$125,000	DAR	FHWA	To be maintained by HDOT.
	Fire ecologist (year 3 of 3)	$50,000	EMP	USAG/ BRD	
	Ungulate control at Kipuka 'Alala (year 3 of 3)	$83,000	EMP	USAG	
	Palila relocation and monitoring (year 3 of 5)	$450,000	TBD	BRD	
	Predator and alien species control (year 3 of 5)	$150,000	TBD	DLNR	
	Mower operator labor (year 2 of 5)	$15,000	TBD	DLNR	
	Contract administration (variable)	$145,000	TBD		24% BRD plus 10% all others except construction items.
	Total for 2002	**$5,523,000**			DAR=$4,700,000; EMP=83,000; TBD=$810,000.
2003-2004 (each year)	Palila relocation and monitoring (year 4 of 5)	$450,000	TBD	BRD	
	Predator and alien species control (year 4 and 5)	$150,000	TBD	DLNR	
	Mower operator labor (year 3 of 4)	$15,000	TBD	DLNR	
	Contract administration (variable)	$249,000	TBD		24% BRD plus 10% all others except construction items.
	Total each for 2003 and 2004	**$864,000**			TBD=864,000 per year; $1,728,000 total.

TABLE 3.18.3.1
Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule

Fiscal Year	Item	Unit Cost (thousands)	Responsibility		Comments
			Program	Agency	
2005-2009 (each year)	Palila relocation and monitoring (year 6-10)	$100,000	TBD	BRD	
	Predator and alien species control (year 6-10)	$75,000	TBD	DLNR	
	Mower operator labor (year 6 only)	$15,000	TBD	DLNR	Required only in fiscal year 2005.
	Contract administration (variable)	$159,000	TBD		24% BRD plus 10% all others except construction items.
	Total each for 2005-2009	**$334,000**			TBD=334,000 per year; $1,685,000 total (including fiscal year 2005 mower operator).
	GRAND TOTAL Fiscal Year 2000 - 2009	**$15,049,000**			

TBD = To be determined.
[1] = TBD funding may be EMP or DAR or combination, depending on appropriations.
MOAs will be executed with responsible agency when funds are allocated to the project.
Note: Table 3.18.3.1 does not include the $90,000 previously expended on EIS baseline invertebrate study. Total in Table 3.18.3.1 does not match Table 7 in BA due to refined Contract Administration percentages. Fiscal year of item implementation may vary depending on funding appropriations.
Estimates rounded to nearest $1000.

In fiscal year 2000, approximately $3,996,000 is currently estimated to be needed for eight specific mitigation task elements. The DAR Program will fund the transfer of portions of four parcels of State lands currently leased for pasture on Mauna Kea from agriculture use to conservation use. This transfer will be guided by provisions of the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970*, as amended. The purpose of this law is to provide uniform treatment of all parties impacted by a federal action so that no one suffers disproportionate injuries as a result of a project designed for the benefit of the whole public. In the case of the Saddle Road Project, this means that FHWA would offer to compensate the state for the cost of terminating the leases and any costs incurred in facilitating the transfer as well as relocation assistance to the property tenants.

With respect to any payments to the state for the cost of terminating the leases to use the properties for mitigation purposes, it would be necessary for FHWA to secure an interest in the state lands through a conservation easement, or other such document, for a period not to exceed 10 years (project mitigation period). This interest would be only to guarantee use of the lands as guided by the interagency Palila MOU for this time period. Payment for the easement would be based upon a fair market appraisal of each of the leases.

If the state does not wish to execute a conservation easement type document, FHWA would have no mechanism to compensate the state for the cost of terminating the leases; however, compensation could still be made to the state and the lessees for relocation expenses through an interagency agreement. In either case, this compensation would include; 1) administrative costs incurred by the state in transferring the lands, 2) replacement costs of permanent improvements, if any, made to the properties (buildings, wells, new fences, stock ponds, etc.), 3) moving expenses for personal property located on the lands (equipment, portable structures, animals, etc.), 4) cost of searching for a replacement site for that portion of the operation displaced (up to $1,000 each lessee), and 5) cost of re-establishing ranching operations at another location for that portion displaced (up to $10,000 each lessee).

In fiscal year 2000, the DAR Program will also incur additional costs for special environmental contract provisions required to complete clearing and grubbing within Section II of the roadway. A fire ecologist is to be staffed by BRD through the EMP at PTA to initiate a three-year study, which will culminate in a comprehensive fire management plan that will dovetail with PTA's existing fire plan and provide fire prevention and supression strategies for the main Palila population and all replacement lands. Ungulate exclosure fencing is to be installed at Pu'u Mali and Palila relocation and habitat monitoring and enhancement at Pu'u Mali will be started by BRD, as well as predator and alien species control by DLNR. It is possible that these elements may have to be postponed until fiscal year 2001 pending receipt of funding. On PTA, using EMP funds, the Army will undertake the ungulate exclosure fencing at Kipuka 'Alala as well as the concurrent ungulate control at this location.

In fiscal year 2001, approximately $2,047,000 is currently proposed to be spent on ten specific mitigation elements (Table 3.18.3.1). DAR will fund the additional excavation needed for the fire shoulders and incur additional costs for special environmental contract provisions required of the contractor to minimize the spread of alien insects and plants and avoid disturbance to sensitive habitat outside of the ROW. On PTA, using EMP funds, the Army will continue ungulate control of Kupuka 'Alala and initiate studies of insect related limiting factors to Palila habitat and essential resources through BRD. BRD is to continue its fire monitoring and modeling. DLNR will complete the cattle fencing on the Pu'u Mali lands and the Ka'ohe Lease lands through state forces or contracting. BRD is to continue the Palila relocation and the habitat monitoring and enhancement program at Pu'u Mali as well as assist DLNR with predator and alien species control. With the exception of relocation, similar work is to be initiated on the western Ka'ohe Lease parcel near Pu'u La'au. Monies are proposed to be allocated to DLNR to

purchase a mower and pay for a part time mower operator for the first of five years. Selected mowing will be undertaken at the Ka'ohe Lease parcel in coordination with BRD.

In fiscal 2002, approximately $5,523,000 is currently proposed to be spent on eight mitigation elements. DAR will fund additional excavation needed for the fire shoulders as well as paving of the fire break shoulder and appurtenances. They will also fund the purchase and installation of the emergency telephones along Section II of the roadway and special environmental contract provisions required of the contractor to minimize the spread of alien insects and plants and avoid disturbance to sensitive habitat outside of the ROW. On PTA, using EMP funds, the Army will complete ungulate control at Kipuka 'Alala. BRD is to complete its fire monitoring and modeling program and deliver an integrated fire management plan for the Palila Mitigation lands and adjoining sensitive habitat. BRD is to continue with their Palila relocation at Pu'u Mali along with habitat monitoring and enhancement program and DLNR will continue predator and alien species control and monitoring at Pu'u Mali and the Ka'ohe Lease parcel. Selected mowing will continue at the Ka'ohe Lease parcel.

In fiscal year 2003 and 2004, approximately $864,000 a year is currently proposed for three mitigation elements. BRD is to continue with their Palila relocation and habitat monitoring and enhancement program and DLNR with predator and alien species control and monitoring at Pu'u Mali and the Ka'ohe Lease parcel. If habitat restoration has progressed sufficiently on the Pu'Mali lands, efforts will be initiated to translocate Palila onto this parcel. Selected mowing will continue at the Ka'ohe Lease parcel.

In fiscal year 2005, approximately $209,000 is currently proposed for three mitigation elements. BRD is to continue with their Palila relocation and habitat monitoring and enhancement program, and DLNR with predator and alien species control and monitoring at Pu'u Mali and the Ka'ohe Lease parcel. If habitat restoration has progressed sufficiently on the Pu'u Mali lands, efforts will be initiated to translocate Palila onto this parcel. Selected mowing will continue at the Ka'ohe Lease parcel.

In fiscal year 2006 through 2009, approximately $334,000 a year is proposed for two mitigation elements. BRD is to continue with their Palila relocation and habitat monitoring and enhancement program, and DLNR with predator and alien species control and monitoring at Pu'u Mali and the Ka'ohe Lease parcel. Efforts will be initiated to translocate Palila onto the Pu'u Mali parcels as conditions warrant.

These implementation plan elements, or tasks, are expected to be initiated as scheduled by the agencies indicated. However, should funding appropriations or agencies change from that proposed, appropriate modifications will be made, facilitated by the FHWA, to the guiding MOU and required MOA.

Scientific Basis For Palila Mitigation

Palila is the lone surviving Finch-billed Honeycreeper found on Hawai'i. They are currently restricted to the upper elevation slopes of Mauna Kea above 6000 feet; however, they were formerly known from Mauna Loa, Hualalai, and areas in South Kona. Sub-fossil remains have also been recovered from O'ahu, suggesting that Palila may formerly have been found on other islands which supported mamane forests. Currently, 90 percent of the total Palila population is located on approximately 41 square km of forest on the western slope of Mauna Kea above the western boundary of the PTA.

Palila have evolved into an extremely specialized bird, which is dependent on mamane trees and attendant invertebrate organisms for their survival. Few other birds in the world are so highly specialized in their diet and therefore, their habitat requirements. Mamane seeds and flowers must be available throughout most of the year in order to sustain Palila populations. Only about 63 percent of adult Palila survive annually in the best portion of their existing range, and many birds that die probably cannot find sufficient food. Palila require supplemental insect foods in addition to mamane seeds and flowers.

Insects provide additional protein for growth and survival of the young. Caterpillars are the chief insect prey items of Palila. These are relatively easy to catch, even with a bill that has evolved for ripping open mamane pods. Breeding effort (number of pairs attempting to nest) and success (number of fledglings produced) depend heavily on the availability of mamane seeds and supplemental insect foods.

Large mamane trees can produce many more resources (seeds, flowers, insects, nest sites) than small trees and are preferred by Palila. Elevational and rainfall gradients result in food resources (especially mamane seeds and flowers) being available to Palila in relatively large quantities throughout the year. Where elevation and rainfall gradients are substantial, mamane flowers (and the seeds that follow) are produced in large quantities at higher elevations first (where rainfall is higher) and at lower elevations later (where rainfall is lower). Palila respond to this changing availability of food by moving up and down the mountain, following the available food resources. They do not; however, travel to distant parts of the mountain, even though these resources may be abundant there. Where elevation and rainfall gradients are insignificant, mamane seeds and flowers are produced in large quantities usually only once a year and are relatively scarce the rest of the year. Therefore, habitats best able to sustain Palila in the long-term are large areas of forest which contain dense stands of large mamane trees and incorporate significant elevational or rainfall gradients.

There are very few areas on the Island of Hawai'i where relatively dense stands of large mamane occur along a substantial elevational or rainfall gradient. The most prominent area currently exhibiting these criteria is located on the western slope of Mauna Kea near Pu'u La'au above the western boundary of PTA. This area is within the designated Palila Critical Habitat and presently

supports the core population of Palila (approximately 90 percent of the total population of the species).

Areas other than the western slope of Mauna Kea (Pu'u La'au) that have potential to sustain long-term Palila populations are limited. The southern slope of Mauna Kea, in the Pohakuloa Flats area, is the second largest area of mature mamane forest occurring along gradients of elevation and rainfall sufficient to support Palila year-round. However, because of historical and ongoing human activities as well as the magnitude of the existing alien pest and predator problem in this area, the realignment of the Saddle Road through this portion of the federally designated Palila Critical Habitat would further challenge future opportunities for successful Palila relocation actions in this area.

Given the complexity and interrelationships of the scientific criteria necessary to support long-term Palila populations and in order to ensure a relatively successful attempt to offset the further degredation of the Pohakuloa Flats area as a viable relocation site, a three-area, multi-year mitigation proposal was developed. The mitigation plan provides for immediate, near-term, and long-term relocation areas and management of these lands for mamane reforestation and Palila relocation over a 10 year period.

For immediate mitigation assurances, it is necessary to enhance the survivability of the primary population of Palila located on the west slope of Mauna Kea. Additional habitat needs to be secured and managed for Palila in the Pu'u La'au area. The most important land to rehabilitate and make available for Palila in this area, from a scientific perspective, are those found in the Ka'ohe Lease Lands (TMK 4-4-15:2) located immediately northwest of and down-slope from the core Palila population. This part of the mitigation plan increases the elevational and rainfall gradient available for resource habitat to the core population of Palila and assists in ensuring this population's continued success. This 704-ha parcel of State land is located within the Palila Critical Habitat and is presently leased to Parker Ranch for cattle grazing.

Intermediate future opportunities for rehabilitating Palila populations anywhere within their historical ranges are limited because of prolonged habitat degradation. In focusing site selection on areas with the requisite scientific criteria, only two sites were identified by biologists from the BRD/USGS as being suitable: 1) the Pu'u Mali area on the north slope of Mauna Kea, and 2) the Kipuka 'Alala in western PTA. In the Pu'u Mali area, approximately 1,864-ha of State land below the Mauna Kea Forest Reserve (MKFR) plus the adjacent MKFR immediately upslope, were identified by BRD/USGS as having the requisite vegetation, food resources, rainfall gradient, and minimal alien pest and predator populations for a timely restoration of the mamane forest and relocation of Palila in the near future (FEIS - Part III, Supplemental Documentation). These lands are currently in state pasture leases to three separate lessees; Botellho Hawai'i Enterprises (Portion of - TMK 4-3-10: 2), K.K. Ranch (Portion of - TMK 4-4-14:2 and all of 4-4-14:3), and S.C. Ranch (Portion of - TMK 4-3-10:8). One reason this area was selected is because it extends the existing rainfall gradient below MKFR. In addition to its locational benefits, existing conditions lend themselves to management of this area for maximization of the

scientific criteria required for Palila sustainability. The combination of location and management potential of this area would afford the best opportunity anywhere on the Island of Hawai'i to re-establish a population of Palila. A reintroduced population of birds in this area, while initially small, should expand with proper management and recovering habitat. With the exception of the Pohakuloa Flats area, no other site is better suited than the Pu'u Mali area for near-term reintroduction of Palila if requisite land management criteria are met.

For long-term future population expansion within lower elevations of the historical range of Palila, the only location outside of the Palila Critical Habitat with any potential for long-term mamane restoration and Palila relocation is in the Kipuka 'Alala area. Approximately 1,214-ha of mixed mamane-naio Shrubland has been identified as suitable for long-term habitat restoration. However, the relatively small size of the existing mamane forest and lack of large elevation and rainfall gradients make long-term sustainability of Palila more challenging. More intensive management of this area may be needed than for more suitable areas. Restoration in this parcel will be a long-term project, possibly several decades. Periodic release of captive-reared or surplus wild birds may be needed coupled with supplemental feeding. If successful, this new population could serve as the base population for Palila expansion into existing mamane forests in South Kona in attempts to further recover the historical range of the species.

For habitat restoration to succeed within the areas identified above, fencing exclosures for feral and domestic ungulates is required. Given the existing mamane growth and extensive seed bank present in the soils, it is likely that mamane would rebound with minimal additional management actions.

Although the scope and expense of the proposed Palila mitigation may appear to be ambitious, what is proposed is but a fraction of the length of time and physical requirements needed to totally recover the species from the brink of extinction and/or to de-list the species. The mitigation proposed addresses the impacts to recovery potential in the Palila Critical Habitat in the Pohakuloa Flats area by affording a beginning to recovery in other areas of similar potential. For Palila recovery to be successful it must ultimately go far beyond restoring populations on Mauna Kea, although that is where recovery would logically start. Palila must eventually be reintroduced and sustained within its former range on Hualalai and Mauna Loa as well as the eastern flank of Mauna Kea and South Kona before it can be said that "recovery" is well underway. Species recovery will require many decades of management because mamane trees grow slowly and reforestation may be difficult to achieve in many areas. It can take 20 to 30 years for a mamane tree to grow large enough to function as a resource for Palila. Because of the multi-faceted and intertwined scientific criteria necessary for the health of a given Palila population, neither habitat restoration nor Palila relocation can be guaranteed to work in any given area. This is the reasoning behind the three-area, multi-year approach in the proposed Saddle Road Palila Mitigation Plan which is designed to offset Saddle Road impacts to the Pohakuloa Flats area.

Section III Mitigation Measures

- Potential impacts to important native communities of flora and fauna will be minimized by avoiding further disturbance to kipuka found along the ROW.

- To ensure that construction of Segment EX-3 does not adversely impact a population of *Plantago hawaiensis* located north of the ROW in this section, the construction limits will be kept at least 3 m south of the Pahoehoe shelf on which this plant community is located. This population will be fenced off from construction related activities at the construction limits with temporary construction fencing and the area will be designated off-limits to construction personnel.

- The reconstructed road will be placed no closer than the existing road to the *Cyanea platyphylla*, located in a kipuka on private land approximately 200 m south of the existing centerline of Saddle Road at Station 168+460. Additional measures to restrict access in this area will be developed in consultation with the USFWS during design. These access restriction measures may include directional or regulatory signing, fences or berms, or siting of pullouts in less sensitive areas.

- The reconstructed road will be placed no closer than the existing road to the *Clermontia Peleana*, located approximately 200 m north of the existing centerline of Saddle Road at Station 163+030. Additional measures to restrict access in this area will be developed in consultation with the USFWS during design. These access restriction measures may include gating of the HELCO powerline road, directional or regulatory signing, fences or berms, or siting of pullouts in less sensitive areas.

- During the final design phase and after the Section 404 wetland consultation with the USACE and in keeping with FHWA policy of "laying the road lightly on the land," design plans will be modified as much as possible to avoid substantial impacts to all kipuka along this segment. When the construction limits are delineated, a concerted effort will be made to minimize disturbance within the ROW by optimizing the design parameters.

- To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction personnel and equipment shall be at previously identified and marked non-sensitive areas. Additionally, the following kipuka shall also be fenced off at the ROW with temporary construction fencing: 145+500 - 146+500, 147+250 - 148+240, 155+450 - 157+500, 157+700 - 157+900, 159+500 - 160+000, 162+500 - 164+000, 165+500 - 166+240, 167 + 860, 168 +460, and 170+500 - 171+000. All features outside of the ROW fencing shall be declared off limits to construction personnel.

Section IV Mitigation Measures

- During the final design phase the plans will be modified as much as possible to avoid substantial impacts to all the kipuka which still harbor native species along Section IV. When the construction limits are delineated, a concerted effort will be made to minimize disturbance within the ROW by optimizing the design parameters. To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction personnel and equipment shall be at previously identified and marked non-sensitive areas.

3.19 ARCHAEOLOGICAL, HISTORIC, AND TRADITIONAL CULTURAL RESOURCES

An Archaeological Inventory Survey and Traditional Cultural Study was prepared for the proposed project and was designed to meet applicable State and Federal requirements (ref: FEIS - Part III). The inventory survey was conducted by means of a 100-percent pedestrian survey of the existing roadway and alternative corridors in order to locate and evaluate all cultural resources for eligibility for listing on the National Register of Historic Places (NRHP), as outlined in 36 CFR 800.2(e). The field work was conducted by archaeologists between January and September 1996. Previous studies addressing the prehistoric use of the project area by native Hawaiians were reviewed.

3.19.1 Background

3.19.1.1 Prehistoric Background

The project area was used by Hawaiians long before Western contact. Prehistoric trails crossed the general area of the project, running west to east and south to north. The trails enabled travel between districts and access to interior resources. The portion of the project area on the west side of the island has been thought too dry to have been exploited by Hawaiians for agriculture. The dry upland forest was mainly exploited by birdcatchers hunting birds valued for their feathers.

The interior of the island was used by birdcatchers who sought the 'Ua'u (Dark-rumped Petrel), Nene (Hawaiian Goose) and Koloa (Hawaiian Duck) for meat, and various smaller birds for their feathers. This area also provided access to the adze quarry at the summit of Mauna Kea to the north. Adzes made from Mauna Kea basalt were distributed over the whole of the Island of Hawai'i and beyond. Shelter caves in the area were evidently used both by birdcatchers and by workers traveling to the quarry and back.

The forested portion of the project area on the east side of the island was used mainly by birdcatchers. At elevations up to 800 m (near MP 9), koa logs were obtained for use as canoes, and bananas were planted in forest clearings. Near the eastern end of the project area, yams were planted in forest clearings as well. The permanently cleared *kula* (open land), which was heavily used by Hawaiians for agriculture, was located just east of the project area at elevations of about 330 m and lower near MP 5.

3.19.1.2 Historic Background

During the nineteenth century, traditional Hawaiian use of interior resources gave way to Western-inspired exploitation. Herds of wild cattle, sheep, and goats flourished on grasslands of West Hawai'i and the interior of the island. White settlers and Hawaiians began to hunt these wild herds, and later they established ranches. The whole area eventually came under the control of Parker Ranch, centered at Waimea. By the late nineteenth century, a wagon trail connected Waimea to Humu'ula. In the twentieth century automobiles used this trail to reach the interior of the island from Waimea, until it was replaced by Saddle Road during World War II.

The forested East Side was less valuable to Westerners, although there was some lumber milling of koa and 'ohi'a. The middle elevation forest (from around 450 to 1,800 m) was little used in the nineteenth century and was turned into a forest reserve in the twentieth century. The trail which had passed through the forest and connected Hilo with Saddle fell into disuse. The upper elevation forest (generally above 1,650 m) was cleared for ranching, and became Pu'u 'O'o Ranch, owned by the Shipman family of Kea'au. The lower elevation forest (generally below 500 m), including the lower parts of Kaumana and Ponahawai, was cleared for growing sugar cane, which was carried by a flume system to Hilo for milling.

Ranching played a major role in shaping the historic landscape of West Hawai'i and the interior (Parker Ranch) and the elevated areas of East Hawai'i (Shipman's Pu'u 'O'o Ranch). Pasture lands were demarcated with barrier walls made of stone. The historic southern boundaries of the Humu'ula Sheep Station occur within the project corridor. New trails and existing trails facilitated the movement of cowboys and stock across the island, from pasture to market and between pastures. The old wagon road between Waimea and Humu'ula was created to carry wool from the Humu'ula Sheep Station to the harbor at Kawaihae west of Waimea. Once automobiles were brought to the island, the wagon road was used by tourists.

Transportation across interior of the island has taken a variety of forms over the past. During prehistory, foot travel took place over unmodified pahoehoe, grassland, and on stepping stones over rough 'a'a flows. Trails were modified and/or built with basalt cobbles in thin, meandering pathways during historic times, to facilitate the movement of horses, mules, and cattle. Carts and wagons required different paths. The portion of the old wagon road to Humu'ula, investigated during this archaeological survey, is notably different in morphology than the prehistoric or historic stone trails. The deep and wide path in the soil at the base of Mauna Kea was likely created as the result of the passage of wagons, rather than created prior to their passage. Multiple

parallel tracks are common, probably created as the result of expeditious maneuvering around temporary obstacles.

Further development of roads in the area was stimulated by World War II. Since a Japanese attack could have hindered travel along the coast, there was a need to develop alternative routes through the interior. Roads capable of carrying cars, trucks, and tanks were created by bulldozing. The path chosen for the World War II-era Saddle Road included portions of the old wagon road to the west, some previously unmodified areas in the Saddle, and portions of the Hilo-Pu'u 'O'o trail on the east. Historic walls associated with earlier ranching activities were breached. Later on, maintenance and upgrades of Saddle Road resulted in some deviation from the original World War II route.

Remains of the sugar industry are found at the eastern end of the project area. The 18-km 'Ola'a Flume traverses the project area at about 600 m in elevation and continues south through forest land to 'Ola'a, Puna. In 'Ola'a, Puna, it fed the flume system that carried harvested cane down to Kea'au for milling. The flume systems were part of a large complex of sugar fields, mills, transportation routes, and camps that formed the dominant economic force in East Hawai'i from the 1860s up to the 1970s.

The primary World War II military headquarters on the island of Hawai'i were located at Camp Tarawa in Waimea, beyond the project area. Tank training maneuvers and artillery practice took place at Camp Pohakuloa, located in the same area as the present cantonment area of the PTA. Structures associated with this war training include tents, a few Quonset huts, and the Civilian Conservation Corps (CCC) camp house located east of the PTA (at the site of the current Mauna Kea State Park). The current airfield and cantonment were built during the early and mid 1950s.

Structures used in field training are located within and beyond the limits of the PTA. These include walls of various shapes (C-shaped, L-shaped, linear), low enclosures, refuse disposal, and filled excavations (foxholes). Field training structures occur most commonly to the east of Mauna Kea State Park. The greatest number occur on Parker Ranch lands at Humu'ula, to the east of PTA, as far as the intersection of PTA-1 and the 1935 lava flow. Some training structures are also located west of Mauna Kea State Park, most of them occurring in Waikoloa, beyond the western boundary of PTA.

3.19.2 Archaeological Sites

3.19.2.1 Affected Environment

The *area of potential effect* (APE) for the project was defined in consultation with the Hawai'i State Historic Preservation Office (SHPO). Consultation with the SHPO is included elsewhere in this document (ref: letter from PHRI to SHPD dated August 5, 1996, FEIS -Part II, 1.4.4). Because several different types of sites were encountered, it was decided to define the area of potential effect according to the type of site. The area of potential effect for archaeological sites

was defined as the staked roadway corridor (60 m in width along the existing alignment and 100 m to 120 m in width along proposed new alignments). The actual area of disturbance of the proposed project will be limited to the proposed ROW, which averages approximately 45 m in width within the staked roadway corridor. Not all portions of a site within the defined area of potential effect will necessarily be impacted by the proposed project.

The area of potential effect for burials was 60 m from the proposed centerline in order to provide for a buffer between the burials and the potential project impacts. The area of potential effect for ritual sites was extended to 150 m from the proposed centerline in forested areas and to 800 m from the proposed centerline in open terrain in order to provide for a buffer between the sites and any audiovisual impacts of the proposed project.

A total of 19 archaeological sites were observed and recorded within the APE of all alternatives. Of these, 16 sites are within the APE of the Recommended Alternative; 13 of which are newly identified and 3 had been previously identified. All 19 sites are eligible for listing on the National Register of Historic Places (NRHP). The 16 sites within the Recommended Alternative APE include Old Waimea-Kona Belt Road (50-10-33-20855), a historic habitation / animal enclosure (50-10-21-20854), Ka'ohe Wall (50-10-31-5002), Humu'ula Sheep Station Perimeter Wall (50-10-32-7119), Old Waimea-Humu'ula Wagon Road (50-10-32-21150), a historic fence (50-10-32-20865), Pu'u 'O'o-Volcano Trail (50-10-33-10309), Hilo-Pu'u 'O'o Trail (50-10-33-20878), Saddle Road (50-10-34-20864), two historic linear walls (50-10-32-20862 and 50-10-32-20877), a historic paving (50-10-33-20856), a historic cairn (50-10-34-20869), 'Ola'a Flume (50-10-34-20870), Hilo Country Club (50-10-34-20872), and Senator Kimi's House (50-10-34-20873), as shown in Figure 3.19.1, *NRHP Eligible Archaeological Sites*, and Table 3.19.2, *NRHP Eligible Archaeological Sites within the APE of the Recommended Alternative.*

Significance assessments have been made in consultation with the Hawai'i SHPO. Many of the sites that will be impacted by the Saddle Road undertaking are long and linear with a relatively small width. Only small portions of the long sites are within the APE. Consequently, identification, assessment of site integrity, and significance evaluation efforts are confined to those portions of the sites that are within and adjacent to the APE. Other criteria of signficance may apply to these sites beyond the APE. All 19 archaeological sites are eligible under Criterion D only; they contain important information pertaining to prehistory or history.

Two prehistoric sites and one burial site occur beyond, but near, the area of potential effect for the Recommended Alternative and are also eligible for listing on the NRHP: a prehistoric lava tube shelter cave (50-10-31-5003), a prehistoric surface lithic scatter (50-10-31-14638), and two historic stone enclosures with an associated burial (50-10-21-20852). The prehistoric lava tube shelter cave and the prehistoric surface lithic scatter have previously been recommended as eligible for listing on the NRHP. The location of the burial near the stone enclosures was identified during field inspection by the primary informant for Traditional Cultural Properties, Mr. Henry Auwae. Based on the procedures developed in consultation with the Hawai'i SHPO

office, the exact location of the burial was not divulged, and no archaeological tests were conducted in the area, because the burial was determined to be situated beyond the area of potential effect for burials.

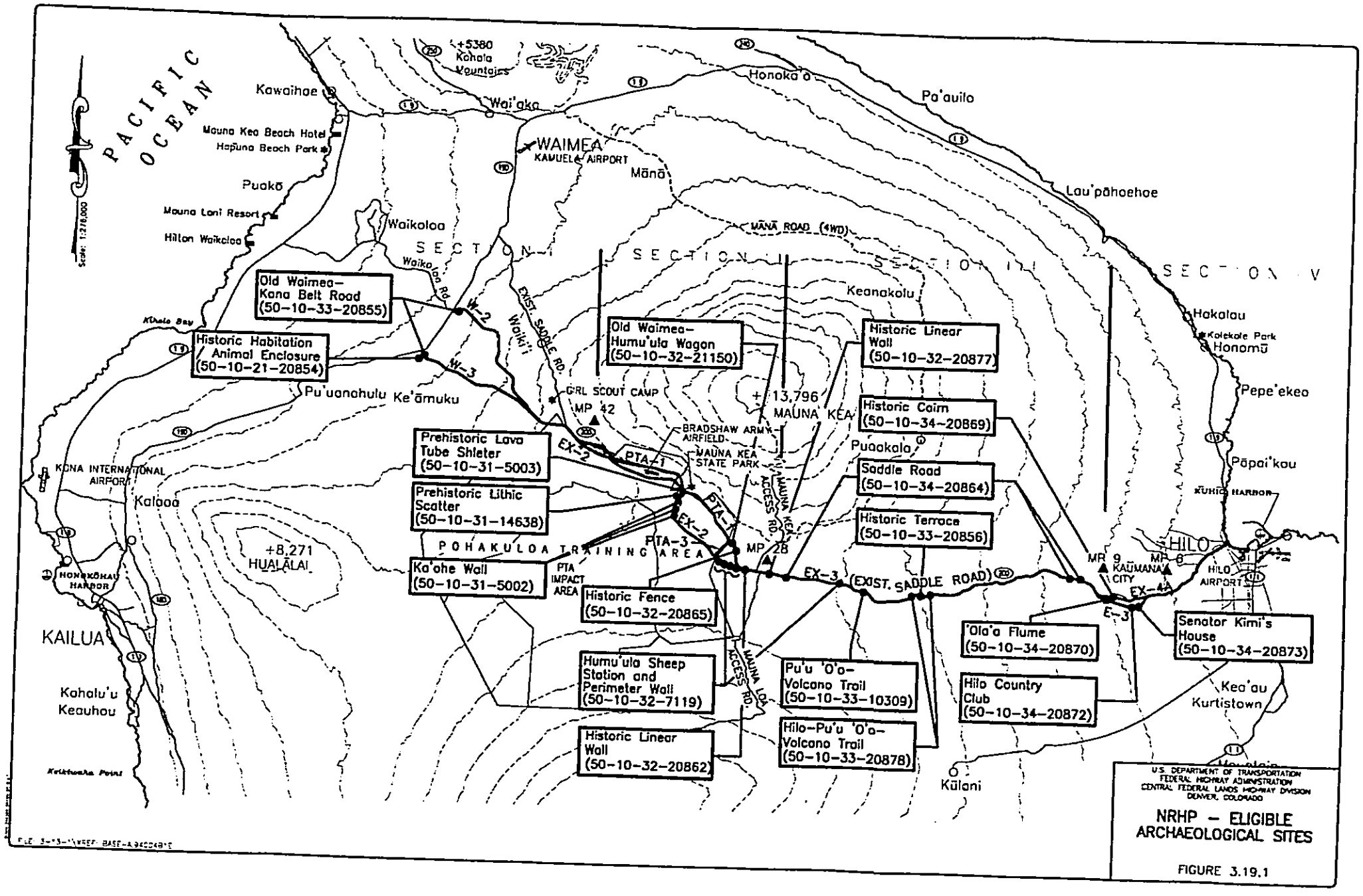
No military sites or structures dating to World War II-era activities, other than historic Saddle Road, were encountered within the area of potential effect. The buildings now found in the cantonment area of the PTA were erected in the early 1950s when the PTA was officially established. No specific activity areas, structures, or features dating to World War II activities were identified. This is a reflection of the expedient and temporary use of the areas within the vicinity of the proposed project; i.e., soldiers were housed in the main camp facilities at Tarawa, and mostly used tents during maneuvers in PTA. None of the military sites are eligible for listing on the NRHP.

W-2. There is one site eligible for listing on the NRHP within this segment, the Old Waimea-Kona Belt Road (50-10-33-20855). The road was built in 1916 by prison laborers. The old roadway is paved with concrete through the W-2 corridor, and does not exhibit the original characteristics of the cobble-paved road.

In the vicinity of this segment, but beyond the area of potential effect, are the two historic stone enclosures with an associated burial (50-10-21-20852). Although the burial and archaeological features were not fully examined due to their location beyond the area of potential effect, the burial is recognized as a burial site under the State of Hawai'i Rules of Practice and Procedure Relating to Burial Sites and Human Remains. The burial is located on private property.

W-3. There are two sites eligible for listing on the NRHP within this segment, the Old Waimea-Kona Belt Road (50-10-33-20855) and a historic habitation/animal enclosure (50-10-21-20854). The old roadway is a two-track, unpaved pathway on pahoehoe, built at grade within the W-3 corridor. The roadway has been used for access to ranching operations since its abandonment. There is a hand-built stone causeway culvert along this site within the APE. Eight culverts similar in architecture and varying in size, and one bridge, were observed along the roadway within a 1.5-km sample of the road in the vicinity of the project area. The causeway will not be impacted by construction. The historic enclosures (50-10-21-20854) are the remains of a ranch habitation and animal pen located near the Old Waimea-Kona Belt Road.

EX-2. There are four sites eligible for listing on the NRHP within this segment, the Ka'ohe Wall (50-10-31-5002) and the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119). Site 50-10-31-5002 is the remains of a property boundary wall built around 1892 to contain animals within the ranches in the Saddle area. The stone wall has been heavily disturbed, and there are three discontinuous segments totalling 1.2 km of stone wall within EX-2. In some places,the wall is 1.5 m high, but generally, it is less than 1.0 m.


PACIFIC OCEAN
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
Waikoloa
Waikoloa Rd.
Kiholo Bay
Kawaihae
Wai'aka
+5380 Kohala Mountains
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka'a
Pa'auilo
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
SECTION I
SECTION II
SECTION III
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KUHIO HARBOR
HILO
HILO AIRPORT
Old Waimea–Kona Belt Road (50–10–33–20855)
Historic Habitation / Animal Enclosure (50–10–21–20854)
W-2
W-3
Waiki'i
EXIST. SADDLE RD.
Old Waimea–Humu'ula Wagon (50–10–32–21150)
Historic Linear Wall (50–10–32–20877)
Historic Cairn (50–10–34–20869)
Saddle Road (50–10–34–20864)
Historic Terrace (50–10–33–20856)
Pu'uanahulu
Ke'āmuku
GIRL SCOUT CAMP
MP 42
+13,796 MAUNA KEA
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Prehistoric Lava Tube Shleter (50–10–31–5003)
Prehistoric Lithic Scatter (50–10–31–14638)
EX-2
PTA-1
PTA-3
MAUNA KEA ACCESS RD.
MP 28
EX-3 (EXIST. SADDLE ROAD)
MP 9
MP 6
KAŪMANA CITY
EX-4A
E-3
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271 HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
Ka'ohe Wall (50–10–31–5002)
Historic Fence (50–10–32–20865)
HONOKŌHAU HARBOR
KAILUA
Kahalu'u
Keauhou
Keikiwaha Point
Humu'ula Sheep Station and Perimeter Wall (50–10–32–7119)
Historic Linear Wall (50–10–32–20862)
MAUNA LOA ACCESS RD.
Pu'u 'O'o–Volcano Trail (50–10–33–10309)
Hilo–Pu'u 'O'o–Volcano Trail (50–10–33–20878)
'Ola'a Flume (50–10–34–20870)
Hilo Country Club (50–10–34–20872)
Senator Kimi's House (50–10–34–20873)
Kea'au
Kurtistown
Kūlani
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
NRHP – ELIGIBLE ARCHAEOLOGICAL SITES
FIGURE 3.19.1

The Humu'ula Sheep Station was the locus of early Western exploitation of the interior of the island. Sheep raising was the most important and lucrative economic activity in the area from the 1860s, after the early bullock-hunting period.

A network of stone walls (50-10-32-7119) is associated with the southern boundary of the Humu'ula Sheep Station. The southern boundary wall is generally parallel to and near the Saddle Road. The wall is faced and is core-filled. The exterior stones are 10 to 50 cm long, and are subrounded to nearly tabular. The core stones are 4 to 20 cm in diameter. The wall is 1.6 to 2.3 m high (five to twelve courses high) and 0.9 to 1.2 m wide, and is wider at the base. The top of the wall is often flat and parallels the surface of the lava flow. There are wooden posts on top of the wall, about 1.5 to 2.0 m apart. Most of the posts are saw cut and some have staples, which once held barbed wire.

The southern perimeter wall crosses the Saddle Road at several locations along the EX-2 and EX-3 corridors. Near Station 148+000, the wall angles northward as an eastern boundary for the sheep station, continuing well beyond the project area for two km (+/-) toward Pu'u 'O'o. The western wall terminus is just west of Pu'u Nene at the boundary of the 1843 Mauna Loa flow. The older Mauna Kea flow to the north is covered in soil, and could have supported wooden fences like that observed with Site 20865. The intact portions of the wall are in good condition. The wall was built on the 1843 Mauna Loa flow. The 1935 flow has fully covered portions of the wall, and partially covered some parts.

There are two prehistoric sites in the EX-2 corridor: a prehistoric lava tube shelter cave (50-10-31-5003) and a prehistoric surface lithic scatter (50-10-31-14638). The lava tube shelter (50-10-31-5003) contains intact, stratified deposits containing cultural debris, lithic artifacts, and subsistence remains dating to the late prehistoric and historic periods. The prehistoric surface lithic scatter (50-10-31-14638) includes three shallow lava tubes covering an area of approximately 0.07 ha.

PTA-1. There are two sites eligible for listing on the NRHP within this segment, the old Waimea-Humu'ula Wagon Road (50-10-32-21150) and a wooden pole and wire fence (50-10-32-20865). The Old Waimea-Humu'ula wagon road (50-10-32-21150) was established between Waimea and the Humu'ula Sheep Station by 1873. The portion of the old wagon road from Waimea to the State Park was apparently obliterated by the construction of the Saddle Road. An approximately 5.5 km segment of the Old Waimea-Humu'ula wagon road between the State Park and the eastern boundary of PTA has been used as a transportation route for military vehicles for over 40 years. Consequently, the path of the Old Waimea-Humu'ula wagon road within this part of PTA has been transformed into a deeply-rutted two-track. There are no vestiges of the morphology that identify this route as the Old Waimea-Humu'ula wagon road. The Old Waimea-Humu'ula wagon road has also been impacted for about 1.0 km east of the PTA's eastern boundary. This portion of the trail has been disturbed by military and powerline maintenance vehicles. The gate at the PTA boundary is situated over the Old Waimea-Humu'ula wagon road route, so all vehicles that cross the boundary must travel over the site. Consequently,

vehicular traffic has been and continues to be concentrated over the Old Waimea-Humu'ula wagon road for a kilometer east of the PTA boundary. The Old Waimea-Humu'ula wagon road at this location exhibits two-track morphology with deeper ruts (up to 50 cm deep) along the outer edges of the pathway, and a hump down the centerline.

At 1.0 km east of the PTA boundary, military activity decreases dramatically and modern transportation pathways diverge from the Old Waimea-Humu'ula wagon road. The fenceline associated with the Humu'ula Sheep Station (Site 50-10-32-20865), and two modern overhead utility lines converge with the Old Waimea-Humu'ula wagon road at this location. From here eastward 2.3 km to the Humu'ula Sheep Station, the Old Waimea-Humu'ula wagon road roughly parallels the fenceline. In contrast, the modern transportation paths follow along the utility corridors. Consequently, the Old Waimea-Humu'ula wagon road has had almost no impacts from this location eastward to the Humu'ula Sheep Station. The morphology of the intact Old Waimea-Humu'ula wagon road is more subtle than the two-track manifestations further to the west. The intact road is shallow (less than 15 cm maximum), and often barely recognizable on the surface. The intact Old Waimea-Humu'ula wagon road does not exhibit any two-track morphology. Instead, the path is flat across the entire route width. A wagon pulled by draft animals would account for a flat pathway. While the wooden wheels would create impressions along the outer edges of the path, hooved draft animals would trample down the center of the path.

PTA-3. There is one site eligible for listing on the NRHP within this segment, the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119), as described previously for Segment EX-2).

EX-3. There are seven sites eligible for listing on the NRHP within this segment, the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119), the Pu'u 'O'o-Volcano Trail (50-10-33-10309), the Hilo-Pu'u 'O'o Trail (50-10-33-20878), abandoned segments of Saddle Road (50-10-34-20864), two linear walls (50-10-32-20862 and 50-10-32-20877), and a lava paving site (50-10-33-20856).

Parts of the Humu'ula Sheep Station Perimeter Wall (as described previously for Segment EX-2) are within Segment EX-3. A 10-m portion of Part 4 of the wall is within the project area near Station 143+150, east of Pu'u Huluhulu. A short portion of Part 6 of the wall lies entirely within the project area near Station 148+000. Also near Station 148+000, Part 7 of the wall turns north. Its southern end extends into the corridor a short way.

The full extent of the Pu'u 'O'o-Volcano Trail (50-10-33-10309) is about 35 km from Pu'u 'O'o Ranch on the slopes of Mauna Kea, to the highway near Kilauea Volcano. South of the road, the trail path is most often manifest as unmodified pahoehoe lava from 0.8 to 1.5 m wide. Occasionally, low spots in the lava are filled with small 'a'a cobbles and gravel. North of the road, the rail is a low, trough-like indentation in the Mauna Kea soils. This archaeological site may have been created during the Prehistoric Period, but subsequent use during the Historic Period has modified or covered any evidence of earlier use. A lava flow covered a portion of the

site 10309 trail in 1935, and the Saddle Road was built on the 1935 flow. It is about 300 m from the Saddle Road project impact area to the northern edge of the 1935 flow and the non-covered portion of site 10309. There are 150 m between the Saddle Road project impact area and the intact trail at the southern edge of the 1935 flow. Consequently, there are no intact portions of the trail within the project impact area. An informal parking area has been created in the 1935 flow by bulldozing to provide access to the trail. There are signs in the lot identifying the trailhead. The trail is currently used for recreational hiking and for access to hunting areas.

The portion of the Hilo - Pu'u 'O'o Trail (50-10-33-20878) within the EX-3 APE is on lava flow dating to 1855. The eastern terminus of the trail is located near MP 18 south of the existing Saddle Road. The trail continued further east prior to being covered by the current Saddle Road. The trail continues west, paralleling Saddle Road for approximately 2.1 km, and crosses the road at Station 154+170, near MP 20. The morphology of the trail varies with the topography and type of lava flow present. Most of the trail near the project study area is on the 1855 flow. The trail through this flow is mostly unmodified pathway on the pahoehoe, so the exact width of the trail is not measurable. These portions are marked by small basalt cairns. Thirty eight cairns were observed along the trail. Only one, near the crossing at Station 154+170, is located within the APE. There are several areas near the eastern terminus of the trail that have been built up with small basalt cobbles (5 to 15 cm in diameter) to fill in low areas in the terrain. The 2.1 km portion of the trail located south of Saddle Road is used by hikers and hunters.

The portion of the trail north of the road consists of a winding "trough" through the 'a'a constructed by removing stones from the path and piling them along the margins. This section extends between the existing road and the HELCO alignment about 50 m to the north. The overgrowth of vegetation on the trail north of Saddle Road indicates that this portion is not currently used. About 30 to 40 m north of the HELCO ROW, the character of the substrate changes once more with the change to the forested pre-1000 B.C. Mauna Kea flow.

The portion of the Hilo - Pu'u 'O'o Trail (50-10-33-20878) within the EX-3 APE is on lava flow dating to 1855. The eastern terminus of the trail is located near MP 18 south of the existing Saddle Road. The trail continued farther east prior to being covered by the current Saddle Road. The trail continues west, paralleling Saddle Road for approximately 2.1 km, and crosses the road at Station 154+170, near MP 20. The morphology of the trail varies with the topography and type of lava flow present. Most of the trail near the project study area is on the 1855 flow. The trail through this flow is mostly unmodified pathway on the pahoehoe, so the exact width of the trail is not measurable. These portions are marked by small basalt cairns. Thirty eight cairns were observed along the trail. Only one, near the crossing at Station 154+170, is located within the APE. There are several areas near the eastern terminus of the trail that have been built up with small basalt cobbles (5 to 15 cm in diameter) to fill in low areas in the terrain. The 2.1 km portion of the trail located south of Saddle Road is used by hikers and hunters.

The portion of the trail north of the road consists of a winding "trough" through the 'a'a constructed by removing stones from the path and piling them along the margins. This section

extends between the existing road and the HELCO alignment about 50 m to the north. The overgrowth of vegetation on the trail north of Saddle Road indicates that this portion is not currently used. About 30 to 40 m north of the HELCO ROW, the character of the substrate changes once more with the change to the forested pre-1000 B.C. Mauna Kea flow.

Saddle Road (50-10-34-20864) was built in 1943 in order to provide a pan-island access route in case of Japanese invasion. For most of its length, the original construction materials of the road have already been modified by modern repaving and maintenance activities. Two portions of the non-paved Old Saddle Road exist within this Segment EX-3. Both exhibit signs of deterioration of the original grade because of use by modern day traffic since abandonment.

One linear wall (50-10-32-20862) is a short segment of a rock wall, without protruding wood pieces along the top, that has been partially buried by lava flow from 1935. The wall is part of the Humu'ula Sheep Station. Another wall (50-10-32-20877) is a short segment of a larger rock wall, without protruding wood pieces along the top, also associated with the Humu'ula Sheep Station. It has been almost completely buried by the 1935 lava flow.

The lava paving site (50-10-33-20856) is a 1.4 m by 0.8 m paving of small 'a'a cobbles situated on the 1855 lava flow. No cultural material was observed in test excavations and the function of this feature is unknown.

EX-4A. There is one site eligible for listing on the NRHP within this segment: an early surveyor's marker (50-10-34-20869) built of pahoehoe lava rock. It is approximately 1.8 m in diameter and 2.1 m tall.

E-3. There are three sites eligible for listing on the NRHP within this segment, the 'Ola'a Flume (50-10-34-20870), the Hilo Country Club (50-10-34-20872), and Senator Kimi's House (50-10-34-20873). The 'Ola'a Flume (50-10-34-20870) was originally a 23-km long flume used to carry water from 'Ola'a Flume Spring north of the Saddle Road to Shipman's 'Ola'a plantation in Puna. Numerous branch flumes were located at the downstream end of the system. A small segment of this lengthy flume crosses the E-3 corridor at about Station No. 41+660. At this location, the flume has collapsed and is in a deteriorated condition disturbed by vegetation growth. The flume was constructed of galvanized metal, and was semicircular in the cross section measuring 1.35 m by 0.95 m by 0.60 m deep. Sections of the flume were tied together with 3/8" metal rods threaded through small (10 by 7 cm, and 0.5 cm thick) steel plates. The flume was supported by a wooden substructure of planed 4 x 4's and 2 x 4's with the plates nailed to the substructure. The cross-pieces of the sub-structure supported the flume joints from below. The interior of the flume was tarred to aid in water retention. The trough rested on the ground on redwood runners in high spots, and was built up on a redwood frame in low spots.

The Hilo Country Club is the archaeological remains of a golf course and a lodge. Senator Kimi's House (50-10-34-20873) is the archaeological foundation remains of a home where Senator Kimi lived as early as 1945.

3.19.2.2 Environmental Consequences

W-2. Segment W-2 would have an effect on the Old Waimea-Kona Belt Road (50-10-33-20855). The information that has made the Old Waimea-Kona Belt Road significant has been collected. Consequently, the effect to this site can be considered as not adverse pursuant to 36 CFR 800.9(c)(1) in W-2.

The general location of the burial associated with two historic stone enclosures (50-10-21-20852) was determined to be over the 75 m beyond the area of potential effect designated for burials. Consequently, Segment W-2 will not affect the burial or the other features of the site.

W-3. Segment W-3 would have an effect on the Old Waimea-Kona Belt Road (50-10-33-20855) and the historic enclosures (50-10-21-20854). It has been determined that the effects to the Old Waimea-Kona Belt Road (50-10-33-20855) in W-3 and the historic enclosures (50-10-21-20854) are adverse but can be mitigated.

EX-2. Segment EX-2 would have an effect on the Ka'ohe Wall (50-10-31-5002) and Part 1 of the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119). Since these two sites are extensive linear features and project-related impacts to the sites would occur where they have been previously disturbed, project activities would constitute a minor impact such that no substantial impairment of the sites would occur. It has been determined that effects to these sites are adverse, but can be mitigated.

Segment EX-2 will have no effect on the prehistoric lava tube shelter cave (50-10-31-5003) and the prehistoric surface lithic scatter (50-10-31-14638). Both sites are beyond the area of potential effect. The data that makes the lava tube shelter significant is contained within the cave. Surface deposits have been disturbed by the construction and use of a dirt road near the cave entrance. In the case of the prehistoric surface lithic scatter, higher terrain separates the site remains from the project area. This creates a clear delineation between the site and the project area and provides a deterrent to access those remains. These two sites will not be disturbed because they are outside of the APE; therefore, the project will have no effect on them.

PTA-1. Segment PTA-1 would have an effect on the Old Waimea-Humu'ula Wagon Road (50-10-32-21150). Since this is an extensive linear feature, breaching it would constitute a minor impact such that no substantial impairment of the site would occur. As a result, it has been determined that there is no need for preservation in place for the portion of the historic site to be impacted. It has been determined that effects to this site are adverse, but can be mitigated.

The information that has made the wood pole and wire fence (50-10-32-20865) significant has been collected. Consequently, the effect to this site can be considered as not adverse pursuant to 36 CFR 800.9(c)(1).

PTA-3. Segment PTA-3 would have an effect on Part 1 of the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119). This effect is determined to be adverse, but can be mitigated. The effect determination would be as described previously for Segment EX-2.

EX-3. Segment EX-3 would have an effect on Parts 4, 6, and 7 of the Humu'ula Sheep Station Perimeter Wall (50-10-32-7119), the Pu'u 'O'o-Volcano Trail (50-10-33-10309), the Hilo-Pu'u 'O'o Trail (50-10-33-20878), and abandoned segments of Saddle Road (50-10-34-20864). Since these four sites are extensive linear features and project-related impacts to these sites would occur where they have been previously disturbed, project activities would constitute a minor impact such that no substantial impairment of the sites would occur. It has been determined that there is no need for preservation in place for the portion of the sites to be impacted. It has been determined that the effects to these sites are adverse but can be mitigated.

Segment EX-3 would also have an effect on the two historic linear walls (50-10-32-20862 and 50-10-32-20877), and the lava paving site (50-10-33-20856). The information that has made these sites significant has been collected. Consequently, the effect to these sites can be considered as not adverse pursuant to 36 CFR 800.9(c)(1).

EX-4A. The information that has made the early surveyor's marker (50-10-34-20869) significant has been collected. Consequently, the effect to this site can be considered as not adverse pursuant to 36 CFR 800.9(c)(1). Because of previous disturbance and eradication of site features, there is no impact to the 'Ola'a Flume (50-10-34-20870) in the existing corridor of EX-4A, and therefore, the proposed construction would have no effect.

E-3. Segment E-3 would impact the 'Ola'a Flume (50-10-34-20870), the Hilo Country Club (50-10-34-20872), and Senator Kimi's House (50-10-34-20873). Since the 'Ola'a Flume is an extensive linear feature and in a very deteriorated condition within the APE, breaching it would constitute a minor impact such that no substantial impairment of the site would occur. As a result, it has been determined that there is no need for preservation in place for the portion of the site within the APE. It has been determined that the effects to these sites are adverse, but can be mitigated.

The information that has made the Hilo Country Club and Senator Kimi's House significant has been collected. Consequently, the effect to these sites can be considered as not adverse pursuant to 36 CFR 800.9(c)(1).

No Action Alternative. With the No Action Alternative, there would be no impact anticipated to archaeological sites.

3.19.2.3 Mitigation Measures

The draft report of the cultural resources survey entitled *Archaeological Inventory Survey and Traditional Cultural Study for the Hawai'i Defense Access Road A-AD-6(I) and Saddle Road (SR*

200) Project (Archaeological Report) was delivered to the Hawai'i SHPO on April 8, 1997 and a subsequent letter requesting concurrence with the eligibility determinations therein transmitted on April 10, 1997 (ref: FEIS - Part II, 1.4.4). Mr. Michael Wilson, SHPO, responded in a letter of July 31, 1997 to the request for concurrence and offered observations on effect determinations for the various sites.

Subsequent to this correspondence, the FHWA transmitted, by letter of September 23, 1997 (ref: FEIS - Part II, 1.4.4), an initial evaluation of effect determinations and proposed mitigation efforts for the various sites in order to initiate discussion on the disposition of the sites and propose mitigation.

A meeting between FHWA and the SHPO was conducted on October 28, 1997 to consult on and settle the disposition and mitigation of the archaeological sites. The SHPO was not prepared to discuss site disposition, but instead, suggested that there may be more traditional cultural properties (TCP) that could be directly or indirectly affected by the undertaking. The SHPO followed up with a letter dated November 14, 1997 expressing that position and requesting supplemental ethnographic studies (ref: FEIS - Part II, 1.4.4).

The SHPO commented on the DEIS in a letter dated December 22, 1997, reserving comment on effects and mitigation until receipt of a revised inventory report. The FHWA met with SHPO on March 13, 1998 to discuss the appropriate procedures for developing an MOA (ref: FEIS - Part II, 1.4.5). The SHPO responded with comments on the revised inventory report in a letter dated June 16, 1998 (ref: FEIS - Part II, 1.4.5), concurring with significance evaluations for all 19 archaeological sites, and suggesting alternative mitigation measures for several sites. This letter also acknowledged the SHPO's plan to review the supplemental report on the potential TCPs separately from the final inventory report. The June 15, 1998 SHPO letter raised accuracy questions, which prompted FHWA to fax a request for clarification to the SHPO (ref: FEIS - Part II, 1.4.5). Although a written response was requested, the SHPO declined and responded verbally that the June 15, 1998 letter was in error on the points indicated in the fax and that PHRI should proceed as suggested by the fax.

The supplemental report on the potential TCPs and a draft MOA were submitted to the SHPO with a transmittal letter from FHWA dated September 17, 1998 (ref: FEIS - Part II, 1.4.5). The results of that investigation are summarized in the FEIS - Part I, 3.19.3 (see also FEIS - Part III, Supplemental TCP Assessment). This letter also transmitted a letter from University of Hawai'i Regent Stanley Roehrig dated August 14, 1998, stating their responsibility for the Mauna Kea summit area (ref: FEIS - Part II, 1.4.5). FHWA met with the SHPO on October 6, 1998 to discuss the SHPO review of the supplemental TCP report and MOA. The SHPO verbally stated that they concurred with the evaluations and recommendations of the TCP report. FHWA requested that the SHPO supply a letter with their determinations, but the SHPO indicated that the determinations could be given within the body of the MOA; i.e. the SHPO signage of the MOA would constitute the formal notification of concurrence with the TCP report. Subsequent

discussions with the SHPO in January and February, 1999, resulted in revisions to the Archaeological Report and an acceptable MOA.

An MOA has been executed among the FHWA, SHPO, Advisory Council on Historic Preservation (ACHP), HDOT, and Office of Hawaiian Affairs (OHA), agreeing upon mitigation treatments and Data Recovery and Treatment Plan procedures. OHA suggested revisions to the MOA which were subsequently acceptable to SHPO. The OHA formally concurred in the MOA on April 27, 1999. The SHPO has indicated by letter that their acceptance of the MOA constitutes their agreement with final conclusions and recommendations in the Final Archaeological Report and supplemental TCP report (ref: FEIS - Part II, 1.4.6). A history of the Section 106 Consultation process is presented in Table 3.19.1, *History of Section 106 Consultation,* for easy reference.

TABLE 3.19.1
History of Section 106 Consultation

Date	Action	From	To	Regarding	Enclosures
9/5/96	Letter	PHRI	SHPO	APE	
10/9/96	Letter	SHPO	PHRI	APE	
4/10/97	Letter	FHWA	SHPO	Request for comments on Inventory Survey	Inventory Survey
7/31/97	Letter	SHPO	FHWA	Comments on Inventory Survey	
9/23/97	Letter	FHWA	SHPO	Agree with SHPO recommendations	
10/28/97	Meeting	FHWA	SHPO	Eligibility and effect issues: TCP	
11/11/97	Newspaper	FHWA	Public	Announce public hearing in Waikoloa	
11/14/97	Letter	SHPO	FHWA	Requests additional TCP study	
12/3/97	Newspaper	FHWA	Public	Announce public hearing in Hilo	
12/11/97	Meeting	FHWA	Public	Public hearing in Waikoloa	
12/13/97	Letter	FHWA	Public	Public hearing in Hilo	
12/22/97	Letter	SHPO	FHWA	Comments on DEIS	
3/12/98	Meeting	FHWA	SHPO	MOA procedures	
4/29/98	Letter	FHWA	SHPO	Submitted revised Inventory Survey	Revised Inventory Survey

TABLE 3.19.1
History of Section 106 Consultation

Date	Action	From	To	Regarding	Enclosures
6/15/98	Letter	SHPO	FHWA	Signed off revised Inventory Survey pending changes	
8/14/98	Letter	Roehrig	FHWA	University of Hawai'i has responsibility for Mauna Kea	
8/21/98	Fax	PHRI	SHPO	Corrections to 6/98 SHPO ltr.	1 page
9/17/98	Letter	FHWA	SHPO	Submittal of TCP w/ University of Hawai'i letter	TCP, Roehrig letter
9/22/98	Meeting	PHRI	SHPO	Delivered MOA	MOA
9/22/98	Meeting	PHRI	SHPO	Delivered TCP, MOA	TCP, MOA
9/22/98	Meeting	PHRI	OHA	Delivered TCP, MOA	TCP, MOA, Inventory Survey
10/6/98	Meeting	FHWA	SHPO	Signed off TCP w/ changes, comments on MOA	
10/26/98	Field Trip	PHRI	OHA	Inspection of sites in project	
1/14/99	Meeting	FHWA	SHPO	Discussion of Report revisions	
2/3/99	Letter	SHPO	FHWA	TCP review: concurrence with action on Mauna Kea	
2/18/99	Meeting	FHWA	SHPO	Discussion of Report revisions	
2/23/99	Letter	SHPO	PHRI	Portions of sites within APE are Criterion D only	
3/3/99	Letter	SHPO	PHRI	Corrections to list of sites within APE that are Criterion D only	
5/99	Letter	SHPO	FHWA	Submission of signed MOA and concurrence with report findings	Executed MOA

Mitigation Measures Applicable to All Project Sections

Recommended treatments for the 19 sites eligible for listing on the NRHP vary. Table 3.19.2, *NRHP Eligible Archaeological Sites within the APE of the Recommended Alternative,* summarizes recommended treatments. Four sites will be avoided. In some instances, data has already been retrieved through appropriate data collection and documentation. In other instances,

where the linear sites are eligible under Criteria D only within the APE, appropriate mitigation has been determined in cooperation with the SHPO; the SHPO has determined that the entire linear feature from beginning to end (including obliterated segments) defines the historic property.

The MOA stipulates how each archaeological site will be treated and provides a schedule for plan development and review procedures in the mitigation process. In the MOA, all parties agree that the effects of the undertaking on the summit region of Mauna Kea are indirect, and mitigation of any potential effects can best be addressed as part of the University of Hawai'i's new management plan for Mauna Kea. Mitigation, as outlined in the MOA, is summarized in Table 3.19.2.

Data recovery will be conducted following the Secretary of the Interior's Standards and Guidelines for Archaeological and Historic Preservation. For each site and pursuant to the MOA, a data recovery plan and/or a site treatment plan detailing procedures and methods to be used will be completed, reviewed, and approved by SHPO before initiating data recovery field work or completing design accommodations for access and interpretive features. Field work will be conducted prior to beginning construction for the proposed Saddle Road project.

TABLE 3.19.2
NRHP Eligible Archaeological Sites within the APE of the Recommended Alternative

SIHP #	DESCRIPTION	CRITERIA	IMPACT	MITIGATION
20852	Burial[1]	D	no	Avoid
20854	Ranching - Habitation & Animal Enclosures	D	yes	Data Recovery Only
20855	Transportation- Old Waimea-Kona Rd.	D[3]	yes	Data Recovery, Interpretation
5002	Ranching-Ka'ohe Wall[1]	D	no	Avoid
5003	Temporary Habitation[1]	D	no	Avoid
14638	Temporary Habitation[1]	D	no	Avoid
20862	Ranching- Linear Wall	D	yes	None[2]
20865	Ranching- Linear Post Fence	D	yes	None[2]
20877	Ranching- Linear Wall	D	yes	None[2]
21150	Transportation- Humu'ula Wagon Trail	D[3]	yes	Data Recovery, Interpretation
7119	Ranching-Humu'ula Sheep Station Walls	D[3]	yes	Data Recovery, Interpretation

TABLE 3.19.2
NRHP Eligible Archaeological Sites within the APE of the Recommended Alternative

10309	Transportation- Pu'u 'O'o Volcano Trail	D[3]	yes	Data Recovery, Interpretation
20856	Paving	D	yes	None[1]
20878	Transportation- Hilo Pu'u 'O'o Trail	D[3]	yes	Data Recovery, Interpretation, Consult with Na Ala Hele
20864	Transportation- Old Saddle Road	D[3]	yes	Interpretation[2]
20869	Survey Marker	D	no	None[2]
20870	Agriculture- 'Ola'a Flume	D[3]	yes	Interpretation[2]
20872	Recreation- Hilo Country Club	D	no	None[2]
20873	Habitation- Senator Kimi's House	D	no	None[2]
TCP	Mauna Kea[1]	TCP	indirect	Avoid: defer to Univ.of Hawai'i Management Plan study

SIHP = State Inventory Historic Property Number
1. Not within the Recommended Alternative APE but identified as eligible during alternate alignment investigations.
2. Data Recovery has been completed, either as part of this project or other independent surveys.
3. Additional Significance Criteria may apply outside of the APE.

- W-3 (Old Waimea-Kona Belt Road). The site in this area is a two-track, unpaved pathway on pahoehoe containing a hand-built, stone causeway. Data recovery will include surface examination and documentation of the road morphology and causeways within the affected area and in the immediate project vicinity at nearby locations where data that makes the site important to history can be examined. Mitigation will also include interpretive signage as appropriate.

- W-3 (Historic Enclosures). Construction of the W-3 alignment will affect about half of this site, including both of the features. Data recovery of the archaeological remains will include excavation of portions of the enclosures, and within the area between the enclosures to recover the data that makes the site significant.

- PTA-1 (Old Waimea-Humu'ula Wagon Road). Data recovery will include thorough and complete measurements and photo documentation of the morphology of the road as impacted by modern travel within the APE. Measurements and recordation of a small portion of the intact wagon road approximately 1.0 km beyond the APE will be taken to compare with the information retrieved from the portion within the APE. No excavations are proposed. If feasible, treatment of the property may also include interpretative

signage and construction of a pullout where the trail meets the north side of the proposed corridor. The content of the signage may include a description of the road, dates of use, and how it was used for transportation of goods and people across the interior of the island.

- EX-3 (Humu'ula Sheep Station and Perimeter Wall). If feasible, the proposed alignment will be modified to minimize impacts to the wall. Data on wall construction technology has already been recovered during previous investigations. Data recovery will include documentation of construction, schematic mapping, and recording of the network of walls comprising site 7119 as well as the wall's function and relationship to the sheep station buildings. If warranted, construction activities may be periodically monitored to ensure that impacts to the walls are restricted to the absolute minimum under the provisions of a written Archaeological Monitoring Plan (Monitoring Plan) pursuant to SHPO draft regulations 13-146, 13-150, and 13-154 (DLNR 1994). The Monitoring Plan will be reviewed and approved by the SHPO prior to beginning construction and the monitoring project. If feasible, treatment of the property will also include interpretative signage with a place for motorists to pull off Saddle Road. The content of the signage may include a description of the Humu'ula Sheep Station, its role in the history of the area, and a discussion of the function and construction of the walls.

- EX-3 (Pu'u 'O'o-Volcano Trail). The proposed alignment will be modified to minimize the impacted segment. A lava flow covered a portion of the trail in 1935, and the Saddle Road was built on the 1935 flow. Consequently, there are no intact portions of the trail within the project impact area, and there will be no direct impacts to Site 10309. The indirect effects of constructing Saddle Road over the buried trail path can be mitigated with data recovery that documents trail morphology and adaptations to the varying terrain outside of the construction impact area. This documentation will take place at nearby locations along the trail where data that makes the site important to history can be examined. If feasible, treatment of the property will also include interpretative signage and construction of a pullout.

- EX-3 (Hilo-Pu'u 'O'o Trail). The proposed alignment will be modified to minimize the impacted segment. Data recovery will include examination of the modes of construction of the trail as they apply to chronological, functional, and maintenance activities. Some areas of the trail within the APE will be disassembled to aid in the assessment of the trail technology. If feasible, treatment of the property will also include interpretative signage and construction of a pullout.

- EX-3 (Old Saddle Road). Data collection has been completed on this site and no further data recovery efforts are necessary. If feasible, mitigation will also include the provision of a motorist pullout and interpretive signage at the site. Additional research may be provided to complement signage accuracy. The signage may contain information on the location of the original road, and its historical use.

- E-3 ('Ola'a Flume). Data collection has been completed on this site and no further data recovery efforts are necessary. If necessary, mitigation will also include the provision of a motorist pullout and interpretive signage at the site. Additional research may be provided to complement signage accuracy. The signage may contain information on the location of the flume system, its historical use, and an artist's sketch of a segment of the flume.

3.19.3 Traditional Hawaiian Cultural Sites

Twenty-four individuals were contacted who provided information about the project area and its history. Information provided was used to determine the broad historical patterns of land ownership, settlement, and land use in the project area. This effort was designed to provide the historical context and to gain information about specific historic sites within the project area. The oral history research was started by initiating consultation with native Hawaiian organizations and by networking to find knowledgeable informants.

Initial consultation with native Hawaiian organizations is mandated by the 1992 amendment to the NHPA, Sect. 301. The amendment requires that the project investigator notify native Hawaiian organizations at the start of the project and ask for their advice on finding expert informants. The Office of Hawaiian Affairs (OHA) and Hui Malama i Na Kupuna O Hawai'i Nei were notified by letter at the start. Hui Malama recommended that Mr. Henry Auwae be interviewed regarding the project. Other organizations including the Waimea Hawaiian Civic Club, Waimea Homesteaders Association, Kona-Hawaiian Civic Club, Hilo Hawaiian Civic Club, Prince David Kawananakoa Hawaiian Civic Club [of Hilo], and Ka Lahui Hawai'i were consulted. None of these other organizations responded with the names of additional Hawaiian *kupuna* (elders) who had knowledge of traditional native Hawaiian sites in the project area. Consultation with native Hawaiian organizations is included elsewhere in this document (PHRI 1997, Tech. App. Vol. IV).

3.19.3.1 Affected Environment

The cultural sites known to occur in the general vicinity of the project area include a native Hawaiian burial and native Hawaiian ritual sites of several kinds. Generally such sites are considered eligible for either the Hawai'i or National Register of Historic Places. It was not possible to definitively locate the ritual sites, although efforts were made. All of the sites fall outside the APE of the proposed project.

Mr. Henry Auwae was interviewed on five occasions for this project, and two helicopter trips were made to attempt to locate the sites. Mr. Auwae's knowledge of these sites may be unique. He was the only informant recommended through contact and coordination with native Hawaiian organizations. Mr. Auwae attained his knowledge about ritual sites and burials from his great-grandparents, who adopted him, and imparted their knowledge to him.

Early in this century when Mr. Auwae was a boy, he journeyed several times through the Saddle together with his great-grandparents. His great-grandmother was an expert healer (*kahuna la'au lapa'au*) and his great-grandfather a prophet (*kula*), who came from a line of prophets. In her role as a healer, his great-grandmother traveled to see people who were sick and to collect medicinal plants. His great-grandparents had specialist knowledge of ritual sites. When the three of them traveled together, they shared this knowledge. Mr. Auwae has not revisited the sites since that time.

Today Mr. Auwae believes he is the only individual who still has knowledge of either the burials or the ritual sites. Attempts were made to locate additional informants with knowledge of native Hawaiian sites in the project area, without success. Older Hawaiians in Waimea and Hilo and native Hawaiian Organizations in both areas were asked if they knew of any individuals who might have such knowledge. Surviving relatives of Hawaiian cowboys who had worked at Parker Ranch or Pu'u 'O'o Ranch were contacted, but no knowledge of cultural sites had been passed down to them.

3.19.3.1.1 Burials and Homesteads

For native Hawaiian burials, it was decided to define a wider APE than that used for archaeological sites. Native Hawaiian burial sites over 50 years old are protected under the Hawai'i State historic preservation law, Chapter 6(E), Sect. 43. Under that law, decisions on the treatment of native burials are made by an island-level burial council. Any burial located within the project area would have to be removed for reinterment, or the road be rerouted. Burials outside the project area might be left in place, but there still would be some potential for disturbance of any burial located adjacent to the road corridor. Because of that potential, a buffer is generally established between construction and known burials. For this project, the APE effect for burials was established as a 120-m corridor, extending 60 m on each side of the centerline.

Mr. Auwae knew of two areas where people used to live and where there were Hawaiian burials, one on the west side and one in the Saddle. Mr. Auwae said there were Hawaiian graves in the area near the west side of alternative routes W-2 and W-3. In the Saddle, Mr. Auwae said there once were "villages" north of the present Saddle Road on the lower slopes of Mauna Kea, at an elevation where several springs existed. He knows of Hawaiian burials in that area. He said there had also been many Hawaiian burials in the area of Bradshaw Army Airfield in the PTA, and to the southeast of Mauna Kea State Park in the PTA. Both areas were heavily bulldozed by the DOA after World War II and he thinks nothing is left of the graves.

Attempts were made to determine the relationship of the proposed road corridors to any burial or ritual sites in the vicinity of the project area by means of two helicopter trips.

The alternate corridors were flown to determine whether any of the burials known to Mr. Auwae lay within or close to the corridors. One burial was identified as being in the vicinity of the project area, near Segment W-2. The distance of the burial site from the corridor boundary was

measured to be more than 100 m. Mr. Auwae was confident that there were no burials near the PTA-1 corridor, although he said that he did know of burials farther up on the Mauna Kea slope.

3.19.3.1.2 Ritual Sites

For native Hawaiian ritual sites, a variable APE was defined. Such ritual sites would generally be considered "traditional cultural properties," as described in National Register Bulletin 38 of the National Park Service. A ritual site used by native Hawaiians could be adversely affected by a nearby road even if it was outside the road corridor. Ritual activity could be compromised by the sight and sound of a nearby road, or by passing motorists. It was reasoned that such adverse effects would extend much farther in the area of open terrain of the West Side than in the forested terrain of the East Side. For these reasons, the APE for ritual sites was defined as a 300-m corridor (150 m on each side of the centerline) in forested terrain, and 1.6-km corridor (800 m on each side of the centerline) in open terrain.

None of the ritual sites could be definitely located because no stone remains of the sites were found. Mr. Auwae designated approximate locations for the sites. The designated locations are all well outside of the APE.

Approximate locations for three of the sites were identified by sighting a line between two hills as landmarks. The first site was located about 1 km south of the Saddle Road corridor in Section III. The second site was located more than 1.5 km north of the Saddle Road corridor in Section III, but it was discovered that the site had been covered by the 1935 lava flow. The third site was located about 400 m southwest of the Saddle Road corridor in Section IV. The location of the fourth site was less well known, but was associated with a trail that ran south of Saddle Road. Since it was close to the trail, it is probably well south of Saddle Road. A fifth ritual site was not located, but is reportedly well north of the existing Saddle Road corridor in Section I.

Four of the ritual sites identified are potentially eligible for the NRHP as traditional cultural properties; the other two are not. Of the two ineligible sites, one has been covered by lava. The other is too diffuse to be easily considered a traditional cultural property, and Mr. Auwae did not wish to claim that sort of status for it. Of the four potentially eligible sites, none are presently being used by Hawaiian religious practitioners. In general, however, Hawaiians believe that such ritual sites still have *mana* (religious power) because of their previous use. These former ritual sites still have religious importance to native Hawaiians, even if they are not being actively used for religious rituals. Since none of the four sites in question has been definitely located and inspected to determine physical integrity, none of them can be evaluated as eligible for the register. All four sites lie outside the APE established for the proposed project for native Hawaiian ritual sites.

3.19.3.1.3 Mauna Kea

In a letter dated November 14, 1997, the SHPO requested further ethnographic research for the project. Specifically, the SHPO asked for research on two areas that might be considered traditional cultural properties (TCP) under the NHPA: the mamane-naio forest, which lies east of the cantonment and airfield in PTA, and Mauna Kea, the mountain.

Research with informants and consultation with Native Hawaiian organizations was undertaken from January to May 1998, designed (1) to evaluate the two areas with regard to their potential eligibility for the NRHP, and (2) if eligible, to determine the effect of the project and how to mitigate any adverse effect.

Based on the guidelines published in National Register Bulletin 38 (Parker and King 1992), it was concluded that the mamane-naio forest in question is not eligible for the NRHP as a TCP.

The evidence and the issues involved in considering Mauna Kea as a TCP and the effects of the Saddle Road improvement project on Mauna Kea are very complex. This is partly because there are many specific Hawaiian cultural sites on Mauna Kea to be considered and evaluated and partly because Mauna Kea is already being managed by various state entities--the Institute for Astronomy, an arm of the University of Hawai'i, and several divisions of the DLNR.

It is difficult to separate the current adverse effects on Mauna Kea sites that result from inadequate state management, from those potential adverse effects that would result from the implementation of improvements to Saddle Road, as articulated in the recent State Auditor report on this matter and summarized below.

> *The University's control over public access was weak and its efforts to protect natural resources were piecemeal. The university neglected historic preservation, and the cultural value of Mauna Kea was largely unrecognized.* (Hawai'i State Auditor 1998).

Interviews were carried out with several Native Hawaiians knowledgeable about Hawaiian cultural sites on Mauna Kea, including Kupuna X (*kupuna* means elder), Edward and Pualani Kanahele, Kupuna Y and Kealoha Pisciotta. Both Kupuna X and Kupuna Y gave important information about cultural sites on Mauna Kea, but decided not to allow their names and interviews to be made public.

Kupuna X learned about Mauna Kea from his great-grandparents. They taught him that there were two sites of ritual importance on Mauna Kea, the summit peak and Lake Wai'au, together with Pu'u Wai'au which surrounds it. The summit peak was used "in the early days" as a place to go and pray to the gods for *mana*, to cleanse the person and give him health. It was used especially for first-born children. Lake Wai'au was used as a place to deposit the navel cords of

newborn children to ensure them a long life. Its water has *mana*, so it was used to purify people and to cure sickness.

The interviews held with the Kanahele's reiterated and sometimes amplified the points made about Mauna Kea in their report for the Saddle Road project (ref: Kanalele 1997, Tech. App. Vol. V).

In two interviews, the Kanahele's made further points. First, the *whole* of Mauna Kae is sacred, a place of *mana,* from the summit down to the zone frequented by man--not just specific ritual sites. As described previously, in pre-contact times the upper zones of the island (mountain summits and upper forests) were inhabited by the gods, while the lower zones (lower forests and open country near the sea) were used by Hawaiians. In their view, that means that everything above the lower forest zone is sacred. Of course, much of the upper forest has been eliminated from Mauna Kea today. When pressed to say how much of the mountain deserved protection as a sacred area, Pualani Kanahele said it should at least include all of the forest reserve area. Second, Mrs. Kanahele said that all three pu'u, Poli'ahu, Lilinoe, and Wai'au, are important religious sites. The pu'u are named for three sister goddesses who are female forms of water, Poli'ahu embodied in snow, Lilinoe in mist, Wai'au in the lake. She said that the pu'u is a place where the goddess manifests herself, just as the gods manifested themselves in *heiau* images. So the *pu'u* is a good place to pray to, or make requests of the goddess.

Kupuna Y said that she learned about the family traditions regarding Poli'ahu and Mauna Kea from her mother and her great-grandmother. She said that her family traditionally deposited *piko* of their children in Lake Wai'au and buried their dead on Mauna Kea. She herself has never gone up Mauna Kea, but she said that others of her family do. She said further that although her own family is connected particularly to Poli'ahu, Mauna Kea is not only a place for Poli'ahu but for all the Hawaiian gods.

Both Kupuna Y and Ms. Pisciotta said that the whole mountain is sacred. There are traditional shrines (found during archaeological surveys) and traditional ritual areas, including the summit, Pu'u Poli'ahu, Pu'u Lilinoe, and Lake Wai'au.

As a result of this ethnographic research, it was recommended that the summit area of Mauna Kea is eligible for the NRHP as a TCP. It is also recommended that the boundary of this upper zone be defined by further consultation between Native Hawaiian organizations and ritual practitioners, and the University of Hawai'i and DLNR.

3.19.3.2 Environmental Consequences

No direct impacts to identified Hawaiian TCP are anticipated as a result of any of the proposed action alternatives or the No Action Alternative. No such properties were identified within the APE for any of the action alternatives. The burial site in the vicinity of Segment W-2 lies outside the area of potential effect and will be avoided and preserved in place.

In a MOA among the SHPO, ACHP, and FHWA (ref: FEIS - Part III, MOA), the SHPO has concurred with the evaluation that Mauna Kea Summit area as described in the Supplemental Traditional Cultural Properties Assessment (ref: FEIS - Part III) is eligible for the NRHP as a TCP. As indicated in the MOA, all parties further agree that the effects of the Saddle Road project on this property are indirect and mitigation of any potential effects should be addressed as part of the University of Hawai'iUH's new management plan for Mauna Kea. The University of Hawai'i is responsible for management of the Mauna Kea Scientific Reserve, which includes the Summit area. The University of Hawai'i is in the process of updating the management plan for this area. Therefore, effects upon and related mitigation of the Mauna Kea Summit area are more properly considered within the APE of actions being planned by the University of Hawai'i concerning the development and management of, and access to, facilities on Mauna Kea.

3.19.3.3 Mitigation Measures

Mitigation Measures Applicable to All Project Sections

- In order to protect the burial site in the vicinity of W-2, it is thought best to avoid flagging of the burial site. Mitigation measures developed for the protection of biological resources will prohibit any construction activity outside of the staked ROW corridor or established staging areas (ref: FEIS - Part I, 3.18.3).

- For all alternatives, upon discovery of native Hawaiian burials or ritual sites, construction activities will cease in the vicinity of the site until appropriate regulatory and resource personnel are contacted and a determination has been made. All requirements of Chapter 6E, HRS and the administrative rules relating to burials will be satisfied.

- In order to ensure the protection of archaeological and paleontological remains during construction, Section 107.02, "Protection of Property and Landscape," *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FPJ-96, 1996, FHWA* will be followed.

- The FHWA and HDOT shall cooperate with University of Hawai'i in planning for access restriction facilities or signage at the intersection of Mauna Kea Access Road and Saddle Road by considering the inclusion of design or ROW accommodations as might be reasonably required in the Saddle Road project at the time the project is advanced.

3.20 HAZARDOUS WASTE SITES

3.20.1 Affected Environment

A Phase I Site Assessment was performed for the project area to identify possible hazardous material sites, petroleum hydrocarbon sites, and underground storage tank (UST) locations (Rust

1996). The survey area included a 120-m corridor (60 m on either side of the roadway) along Saddle Road and each of the alternative segments. Site reconnaissance and interviews were conducted in March and April of 1996. Follow up phone interviews were conducted in April and May of 1996.

The survey consisted of a records search, visual site reconnaissance, and interviews with Federal, State, and County officials, industry representatives, and DOA representatives. The conclusions contained in this report are based on conditions observed during the site reconnaissance at the time of the survey, available historical information, Hawai'i Department of Health records search, and personal and phone interviews with knowledgeable local personnel. This investigation did not evaluate the presence of any unexploded ordnance.

Current and past uses include limited private property use and minimal to no usage of public lands, with the exception of the PTA. The PTA has been used as a military training area since the 1940s. The current re-alignment has the north side of EX-2 running immediately adjacent to the Fuel Storage Yard fence.

3.20.1.1 Records Search

Records and databases were reviewed directly by project personnel or through a computerized search of zip codes within the vicinity of the project corridor. Records reviewed at the Hawai'i Department of Health, Environmental Management Division, include the Hawai'i Spill Reports Database, the Hawai'i Solid and Hazardous Waste Database, and the Underground Storage Tank Database. The Hawai'i Spill Reports Database files list all reported spills, releases, and unauthorized dumpings between 1988 and 1996. Files indicate that only 1 spill, which occurred when 2,000 L of jet fuel was spilled on Saddle Road at the PTA in January 1991, was within the project corridor. The spill was cleaned up to the Department of Health's satisfaction. The Hawai'i Solid and Hazardous Waste Database lists all solid and hazardous waste facilities in Hawai'i. There were no such facilities listed along the project corridor, but the DOA applied for a Small Quantity Hazardous Waste Generator Permit with the EPA for the PTA in April 1996.

The Underground Storage Tank Database lists all registered USTs in the State. The only USTs listed in the corridor were those present at the PTA. Six tanks are present at the Fuel Storage Yard, and two tanks are present at the gas station. There have been no reports of leaks or overfills from these tanks. A UST was removed in 1994 from a building outside of the project corridor.

Federal American Society of Testing and Materials (ASTM) records reviewed include the Comprehensive Environmental Response, Compensation, and Liability Information System, the Emergency Response and Notification System, and the National Priority List (NPL). No sites were recorded in the project corridor or immediate vicinity. The Resource Conservation and Recovery Information System (RCRIS) records were reviewed and no sites were listed in project

corridor or vicinity. Since the PTA recently applied for small quantity generator status, it was yet not listed on the RCRIS database.

Federal Non-ASTM records including Corrective Action Reports, Facility Index System, Hazardous Materials Information Reporting System, Material Licensing Tracking System, NPL Liens, PCB (polychlorinated biphenyl) Activity Database System, RCRA (Resource Conservation Recovery Act) Administrative Action Tracking System, Records of Decision, Toxic Chemical Release Inventory System, and Toxic Substances Control Act were reviewed. No sites were recorded in the project corridor or immediate vicinity.

State of Hawai'i ASTM records including Active Leaking Underground Storage Tank Log Listing, State Hazardous Waste Sites, Solid Waste Facilities/Landfill Sites, and Listing of Underground Storage Tanks were reviewed. Historical and other databases including Delisted NPL Sites and No Further Remedial Action Planned were reviewed. No sites were recorded in the project corridor or immediate vicinity.

The EPA (Honolulu), the U.S. Department of Agriculture Forest Service (Honolulu), the State of Hawai'i Department of Health, the County of Hawai'i Land and Natural Resources Department, the County of Hawai'i Public Works Administration, the County of Hawai'i Fire Department, Hawaiian Electric (Hilo and Kona) utility company, PTA, and the USARG-HI (Honolulu/Scofield) were contacted either personally or by phone and questioned regarding environmental problems or hazardous materials along Saddle Road. Hawaiian Electric runs two transmission lines over Saddle Road pass. According to Hawaiian Electric, there are three substations with transformers over the route. There are no PCBs associated with the transformers and there are no USTs operated by Hawaiian Electric located on or near Saddle Road. According to the PTA and the USARG-HI, all USTs in the PTA were recently inspected and passed tank tightness tests and inventory checks as of May 24, 1996. No hazardous waste issues were identified through contacts with these parties.

3.20.1.2 Site Reconnaissance

Site reconnaissance was conducted by means of a visual survey. Some portions of the project area were inaccessible and were not physically surveyed. Visibility in some areas was obstructed by heavy vegetation. There was no evidence of dumping of any kind observed. A number of pullouts where dumping could likely occur were investigated. Two quarrying operations and one former quarry site were in the vicinity of the corridor but none are located in the ROW. Three Hawaiian Electric substations occur in the project vicinity. Two substations were located at MP 48 and MP 7.5. The third substation was located on the PTA. No environmental concerns were identified during the inspection of any of the substations. Transformers were evident at the substations, but none were observed to be leaking or showed evidence of prior leaking. According to Hawaiian Electric personnel, the transformers do not contain PCBs.

Personnel at ranch buildings operated by Waiki'i Ranch, located at MP 47.25, confirmed that no USTs or environmental problems are associated with their lands adjacent to Saddle Road. Inspections of the Kilohana Girl Scout Camp, located at MP 44, and of Mauna Kea State Park, located just to the east of the PTA, showed no evidence of hazardous waste concerns.

The only other facility or operation along the Saddle Road corridor is the PTA. Military bases commonly use large volumes of petroleum products and solvents. Because of the great depth of ground water in this region and the dependence on surface water, ground water investigations have not been conducted at this facility. Surface reconnaissance revealed no areas of stained soils, stressed vegetation or trash piles that would indicate dumping within the project corridor. Vacant storage areas, which essentially consist of 3.7-m-high bermed soil in the shape of a rectangle, located north of the airfield were examined as potential landfill sites, but there was no visible evidence that this site had been a past landfill. A current landfill for the PTA is located south of Saddle Road, well beyond the project corridor.

The Fuel Storage Yard for the PTA and Bradshaw Army Airfield is located immediately adjacent to the existing Saddle Road. Because EX-2 would require major grade and alignment improvements, it would run closer to the Fuel Storage Yard than the existing roadway. The storage yard contains 8 USTs (6 40,000-L tanks and 2 20,000-L tanks). Personnel onsite did not recall the tanks having ever leaked, as is consistent with the UST records previously summarized (ref: FEIS - Part I, 3.20.1.1). Numerous 200-L drums were observed in the northern part of the Fuel Storage Yard. According to personnel these drums either were empty or contained hydraulic fluid or used oil. No other hazardous materials were observed onsite. Other USTs on the PTA are not within the project corridor.

3.20.2 Environmental Consequences

There was no indication in the records search or during the site reconnaissance of hazardous waste. As there are very few homes or facilities located along Saddle Road, the only area of concern with regard to future impacts would be at the PTA. The PTA is the only known waste generator along the Saddle Road corridor.

Since there is no active solvent or used oil recycling program on the PTA and many field training activities take place at the PTA, it is likely that chemicals and petroleum products have been dumped on the ground resulting in minor localized soil contamination throughout the PTA and Bradshaw Army Airfield.

All Action Alternatives. Site reconnaissance did not reveal any specific areas of soil contamination along EX-2, PTA-1, or PTA-3. Table 3.20.1, *Hazardous Material Issues*, indicates hazardous material issues identified for each segment. Five current sites on the PTA, three of which are old landfills, are currently being investigated by DOA personnel for possible environmental impacts. According to DOA, preliminary results show no areas of concern. None

of these sites are within the project corridor, but the Vehicle Staging Area is located adjacent to the project corridor.

The area most prone to soil contamination would be the area around the Fuel Storage Yard and its gas station. Since these are the only USTs along the entire project corridor and these USTs are located very close to EX-2, this would be the area at greatest risk to soil contamination from leaks or spills. Spills are very common at all gas stations and tend to accumulate over time. The only spill recorded was cleaned up to the Hawai'i Department of Health's satisfaction. These USTs may provide environmental impacts in the future. They are 10 years old and are scheduled to be replaced in the near future.

No Action Alternative. With the No Action Alternative, there would be no construction-related impact to hazardous waste. Existing USTs or other unidentified hazardous waste may result in future environmental impacts.

TABLE 3.20.1
Hazardous Material Issues

Section and Segment	Existing Hazardous Material Issues	Potential Future Hazardous Material Issues
Section I		
W-2	None identified	None identified
W-3	None identified	None identified
Section II		
EX-2	Possible accumulation of spills in vicinity of PTA Fuel Storage Area; possible minor localized soil contamination.	Potential future leaks or spills at PTA Fuel Storage Yard; possible minor localized soil contamination
PTA-1	Possible minor localized soil contamination	Possible minor localized soil contamination
PTA-3	Possible minor localized soil contamination	Possible minor localized soil contamination
Section III		
EX-3	None identified	None identified
Section IV		
EX-4A	None identified	None identified

TABLE 3.20.1
Hazardous Material Issues

Section and Segment	Existing Hazardous Material Issues	Potential Future Hazardous Material Issues
E-3	None identified	None identified

3.20.3 Mitigation Measures

Mitigation Measures Applicable to All Project Sections

- If previously unidentified hazardous substances or petroleum products are found within the project corridor which indicate an existing release, a past release, or a material threat of a release of any hazardous substance or petroleum products into the project corridor, further investigation will be pursued, as warranted. If previously unidentified hazardous waste is discovered during project construction, work will cease at that location and appropriate regulatory or resource personnel will be contacted.

- Final documents regarding the DOA investigations of five sites on the PTA for possible environmental impacts will be reviewed once investigations are complete. The DOA will pursue additional investigation, if warranted, after review of the final documents and provide ROW clear of all hazardous waste.

- In areas where ROW is needed outside of that already surveyed, the project area will be further investigated prior to land acquisition or construction to confirm the absence of hazardous waste.

- Prior to construction, an unexploded ordnance survey will be conducted within the PTA and, if unexploded ordnance are found, the ordnance will be removed from the project area in accordance with DOA regulations by USAG-HI.

3.21 VISUAL

A visual resource impact assessment was prepared for the project (LS&D 1996). The methodology used was based on the FHWA's *Visual Impact Assessment for Highway Projects* procedures. Because the U.S.D.A. Forest Service has developed a landscape modification evaluation process specifically to assess the visual impacts of roads, its *National Forest Landscape Management-Roads* was also used.

3.21.1 Affected Environment

3.21.1.1 Existing Visual Character

Elevational differences ranging from 450 to 2,000 m and open vegetation provide panoramic views of distant vistas and interesting geologic features. Rolling hills, cone shaped pu'u, broad valleys, and mountains are examples of the diverse landforms found within the corridor.

Notable landforms include Mauna Kea, Mauna Loa, Mount Hualalai, Kohala Mountains, Pu'u Nene, Pu'u Huluhulu, Pu'u Waawaa, Pu'u Nohonaohae, Pu'u Ke'eke'e, 'Auwaiakeakua Gulch, Waiki'i Gulch, Pohakuloa Gulch, and Waikahalulu Gulch. Rock outcrops of cooled basaltic lava are visible along a large portion of the existing roadway in the project area. Notable water features are Kawaihae Bay to the west and Hilo Bay to the east. Several biotic communities are found in the project area (ref: FEIS - Part I, 3.13).

Within the project area there are distinct cultural modifications of the natural landscapes. These include both commercial and residential development associated with the community of Hilo, the PTA, Mauna Kea State Park, Kilohana Girl Scout Camp, homes of Waiki'i Ranch, and various ranch buildings and corrals associated with Parker Ranch.

Visual resources are defined in terms of two primary elements, visual character and quality. The landscape components of landforms, water features, vegetation types, and cultural modifications, and the patterns they create provide the basis for defining the project area's visual character. The quality of the visual resources in the project area varies because of changes in the landscape components and their patterns. The visual quality of an area is rated in terms of such criteria as the landscape's distinctiveness, its visual integrity, and the compatibility of its components. Visual quality is expressed as *very high*, *high*, *moderately high*, *moderate*, *moderately low*, *low*, and *very low*.

The visual features viewed from the roadway vary depending on travel direction and existing weather conditions. Each of the project segments are portrayed below in terms of their existing visual character and visual quality. Unless otherwise noted, the visual character is described from west to east.

<u>Section I</u>

<u>W-2</u>. The landscape consists of a predominantly pastoral setting with few built features. The segment is characterized by a broad, open grassland used for grazing. Tufts of fountain grass are dispersed across the fields, contrasting with the smoother appearing texture of other pasture grasses. The corridor gradually gains elevation. The landforms are smooth and rounded in appearance. There are numerous features of ranching and grazing activities visible, such as fences with wooden posts, water troughs, ranch roads, and corrals. The visual pattern of this area

of the project corridor is characterized by expansive views with Mount Hualalai, Kohala Mountains, and the coastline as the backdrop.

Near Station 104+500, the terrain begins to display more relief, crossing numerous drainages. One of the largest drainages in the area is the deeply incised Waiki'i Gulch (Station 109+150). Further east, the terrain transitions to a more undulating, hilly landform.

Around Station 112+000, the corridor is notably more arid. There are scattered grasses and shrubs. Pu'u Ke'eke'e, Mauna Kea, and Mauna Loa are prominent. Near Station 114+00, the land is dotted with outcrops of black lava rocks.

The combination of landscape elements in this area of the project corridor forms a moderately memorable pattern. The built elements are noticeable and attract some attention, but the natural setting remains dominant. An overhead transmission line and ranch roads contrast with the landscape, but do not spatially dominate the setting.

The existing visual quality of Segment W-2 was identified as moderate for its entire length (Station 100+000 to 116+000, and Station 118+087 to 119+100).

W-3. The western portion of this segment can be characterized as a broad, open valley. The visual pattern of this area of the project corridor is characterized by the expansive views with Mount Hualalai, Kohala Mountains, and the coastline as the backdrop, and the grassy rolling hills dotted with mature trees. The landscape consists of a predominantly pastoral setting with few built features. Fencing visible in the area blends with the natural setting.

From approximately Station 106+000 to 108+200, the low-growing 'a'ali'i shrub becomes as common as fountain grass. The transition from shrubland to grassland gives the landscape a darker color and more irregular texture. The terrain remains distinctly hilly. Also, from Station 108+200 to 111+078, the character of the setting changes to a landscape with broad expansive views outward, gently rolling terrain, short green grasses, and a scattering of shrubs and rock outcrops.

At Station 111+078, W-3 intersects W-2. As previously noted, the portion of W-2 common to W-2 and W-3, near Station 112+000 (W-2), is notably more arid. There are more *bunch grasses* (grasses that grow in bunches or clumps) and shrubs scattered throughout the landscape. To the north and east, Pu'u Ke'eke'e, Mauna Kea, and Mauna Loa are prominent features. Near Station 114+00, the land is dotted with outcrops of black lava rocks with individual boulders scattered across the corridor. The overhead transmission line and the dirt ranch roads notably contrast with the landscape in terms of line, texture, and form, but do not spatially dominate the setting.

The existing visual quality of Segment W-3 was identified as moderate from Station 100+000 to 108+200, moderately low from Station 108+200 to 111+078, and moderate from Station 118+087 to 119+100 (W-2).

Section II

EX-2. Segment EX-2 traverses the relatively flat valley between Mauna Kea and Mauna Loa. Much of the landscape is dotted with pu'u. The roadway crosses into the PTA. Pu'u Koko in the foreground area to the north of the roadway has been mined so that its form is not intact. At MP 39, Pu'u Ma'au is the prominent feature in the foreground to the north. The roadway is crossed in numerous locations by concrete slabs designed to support heavy vehicular traffic crossing the highway. Dual strands of transmission lines parallel the roadway to the south. In this portion of EX-2, the vegetation community has changed notably to a native mosaic of hard-stemmed lovegrass grassland and 'aweoweo shrubland, creating a mottled texture in the landscape.

Near MP 39.8, the facilities associated with the PTA become discernible. The airport facilities associated with Bradshaw Army Airfield are visible, with the control tower and tower lights creating strong vertical elements in the foreground. These facilities are painted white and contrast in terms of color and form with the surrounding landscape. The buildings at the cantonment area of the PTA consist primarily of small one story quonset huts painted light green or beige. The buildings are clustered together. The built elements of this area attract attention. Overhead transmission lines and military facilities contrast substantially with the natural setting in line, color, and form, and spatially dominate the setting. Native vegetation in this area provides landscape features unique to the Island of Hawai'i and in the State.

Just east of the cantonment area of the PTA is Mauna Kea State Park. Many of the facilities of the park are nestled amongst non-native pines and eucalyptus trees and screened from the roadway. The natural vegetation has transitioned to a mamane-naio forest. This forest is densely canopied, with very little understory.

At MP 33.2, the 1843 lava flow is visible. The military is modifying the area by leveling the existing surface of the lava flow. Several water tanks associated with the PTA are visible at the base of the mountain.

Lava flows through the central portion of the corridor are void of vegetation. Adjacent to the roadway, there are non-native grasses that create a linear strip of green. The edge of the flow to the north is marked by the dense green canopy of the mamane forest. Two types of lava flows are present in the project area: the irregular design and sharp edges of the 'a'a lava, and the smooth, pancake batter-like appearance of the pahoehoe lava. The observatory structures on Mauna Loa are visible and easily noticed from the roadway. The lava flows, pu'u, grasslands, and rising form of Mauna Kea and Mauna Loa create vivid patterns.

At MP 31.1, a single-lane road adjacent to Saddle Road has been etched on the lava rocks, creating a subtle change in the surface of the flow. The smooth regular pattern of the road follows the terrain and is intermittently visible from Saddle Road. On the horizon, the top of Kohala Mountains is visible. Near MP 30.0, Pu'u Nene is a prominent feature adjacent to and north of the roadway. It has been mined for cinder and has dark brown soils exposed along its

west slope. Beginning near Pu'u Nene, lava rock walls are present and visible from the roadway. These walls are almost imperceptible linear features in the landscape because of their material and color.

The eastern end of EX-2 is characterized by the striking presence of the lava flows against the vegetation of the forest at the base of Mauna Kea, and the rounded forms of pu'u, which create a distinct landscape. Unrestricted views to both Mauna Kea and Mauna Loa simultaneously are unique. Built elements in this area do not attract attention and the natural setting remains dominant. The landscape features in this area are unique to the Island of Hawai'i and in the State.

The existing visual quality of Segment EX-2 was identified as moderate from Station 119+100 to 125+000, moderately low from Station 125+000 to 132+200, and moderately high from Station 132+200 to 140+700.

PTA-1. This segment traverses the gently rolling terrain near the base of Mauna Kea. Mauna Loa to the south is a dominant feature. The vegetation community is primarily a mosaic of 'a'ali'i shrubland and hard-stemmed lovegrass grassland. Evidence of dirt roads used for training exercises can be seen across the valley. From Station 11+000 to 13+500, the corridor runs between several pu'u including Pu'u Koko, Pu'u Ma'au, and the base of Mauna Kea, creating a sense of enclosure by the landforms. Past the pu'u, the segment crosses a single-pole overhead transmission line.

The facilities associated with Bradshaw Army Airfield become notably visible at approximately Station 16+900. The control tower and tower lights create strong vertical elements. These facilities are painted white and contrast with the surrounding landscape in color and form. PTA-1 provides a close view of the runway and associated buildings. The corridor traverses along the back of Pu'u Pohakuloa, skirting the edge of the military facilities at the Pohakuloa Camp. The light-colored quonset huts, arranged in a regimented pattern, contrast sharply in color, texture, and pattern with the natural surroundings.

East of the Camp, the corridor curves toward Mauna Kea State Park, paralleling the previously referenced transmission line. In this area, the vegetation transitions to mamane-naio forest. For the next 7 km, views away from the corridor are screened by the trees. The forest creates a consistent vegetation pattern through this portion of the corridor. The corridor crosses rolling, somewhat rocky, terrain of the ridges at the base on Mauna Kea and gains 90 m elevation. Dirt roads cross the corridor intermittently. Openings in the dense tree stands provide opportunities for brief views to Mauna Kea and in the distance, Mauna Loa. In this area of the segment, built elements in the landscape do not attract attention and the natural setting remains dominant. The landscape features in this area are notable to the Island of Hawai'i and in the State.

Near Station 27+000, the vegetation notably transitions from the mamane-naio forest to open grassland. It is in this area that the corridor cuts between Pu'u Omaokoili and an unnamed pu'u.

At Station 28+000, the segment curves south around two other unnamed pu'u. The pu'u become the dominant feature in the landscape with their rounded, conical forms and mottled colors of browns, reds, and greens. Some of the pu'u are void of visible vegetation, others have scatterings of dark green shrubs across their slopes.

Near Station 27+270, the corridor exits the PTA and crosses into grazing land. Just past Station 28+000, numerous dark patches of lava rock outcrops break the ground surface. These irregular forms create an interesting pattern in the grassland. Pasture land transitions to lava fields. From Station 29+700 to 30+999, the landscape consists of a combination of 'a'a and pahoehoe lava.

The existing visual quality of PTA-1 was determined to be moderately low from Station 10+000 to 21+640, and moderate from Station 17+200 to 30+999.

PTA-3. For the majority of its length, starting on the west end, PTA-3 follows Segment PTA-1 (ref: FEIS - Part I, 3.21.1.1). PTA-3 diverges from PTA-1 at Station 10+000 (Station 26+900 on the PTA-1 segment). The portion of PTA-3 that is different from PTA-1 is described in the following paragraph.

With PTA-3, the road would cross between Pu'u Omaokoili and an unnamed pu'u before intersecting Saddle Road. From Station 10+000 to Station 11+800, the landscape is characterized by an open mamane-naio forest, where pu'u are dominant landforms. The corridor crosses gently rolling terrain that offers occasional views outward to Mauna Loa and Mauna Kea. Just past Station 11+800, the lava flows encroach upon the forest landscape and change the character of the corridor substantially. The corridor swings around Pu'u Nene, providing a direct view of the mining operations that have taken place on it.

The eastern end of PTA-3 follows EX-2 (Station 137+800 to 140+700), which in this area is characterized by the striking presence of the lava flows against the green vegetation of the forest at the base of Mauna Kea, and the rounded forms of pu'u, which create a distinct landscape. Unrestricted views to both Mauna Kea and Mauna Loa simultaneously are unique. Built elements in this area do not attract attention and the natural setting remains dominant. The landscape features in this area are unique to the Island of Hawai'i and in the State.

The existing visual quality of Segment PTA-3 was identified as moderately low from Station 10+000 to 21+640 (PTA-1), moderate from Station 21+640 to 26+900 (PTA-1), moderate from Station 10+000 to 12+881 (PTA-3), and moderately high from Station 137+800 to 140+700 (EX-2).

Section III

EX-3. EX-3 begins near the Mauna Kea access road, where the forested Pu'u Huluhulu is located just to the south of the highway. From here, the corridor begins its gradual descent toward Hilo. Near MP 25.0, the lava flows are older and vegetation becomes more pronounced.

'Ohi'a and koa trees are intermittently visible. As the roadway descends, the vegetation becomes more dense. Stands of koa trees are distinguishable from the 'ohi'a trees by their greater height, oval form, light colored bark, and denser canopy.

At MP 19.0, the roadway surface has recently been repaved and paved shoulders have been added, creating a more developed rural character. The vegetation is characterized by a mixture of 'ohi'a and koa trees as well as a dense understory of ferns and shrubs. The views are confined to the direction of travel by the narrow created by 'ohi'a trees, and views outward are intermittent. Overhead transmission lines cross back and forth over the highway. Near MP 16.0, the stark white tree forms of the 'ohi'a dieback are visible. The roadway weaves though the forest, following the terrain with only short segments of the road visible at any one time. Intermittent views to Hilo Bay are visible between MP 15.0 and MP 11.0. Near MP 10.4, there is a dense stand of both koa and 'ohi'a trees. Various ferns provide rich contrast to the overhead trees. At MP 9.0, the roadway is lined with koa trees whose canopies extend over the roadway, creating a park-like setting. The koa trees spatially enclose the views and shade the roadway, creating dark and light shadow patterns on the roadway.

The dense vegetation, various hues of color, spatial enclosure, and rolling terrain create a memorable pattern in the landscape. Built elements do not notably contrast with the color, scale, line, or form of the setting. The EX-3 corridor ends near Saddle Road MP 9. The existing visual quality of Segment EX-3 was identified as moderately high from Station 140+700 to 145+500, moderate from Station 145+500 to 155+400, and moderately high from Station 155+400 to 171+576.

Section IV

EX-4A. Single family residences are located along both sides of the roadway beginning at MP 8.0. The residences are one and two stories, varying in color and architectural style. The landscape associated with the homes consists primarily of introduced ornamental plant material with turfed lawn areas. Walls are made of lava. Numerous driveways access the road. The setting of the roadway has notably changed from a predominately natural landscape to a more urban area. The landscape features in this area do not form a distinct visual pattern, and residential development substantially lowers the level of naturalness. The structures, overhead transmission lines, and utility facilities spatially dominate the landscape and contrast notably with the natural setting in terms of color, form, texture, and line.

EX-4A diverges from the existing Saddle Road at MP 7.9, to parallel an overhead transmission line and rejoins Saddle Road at MP 6.5. The length of EX-4A that parallels the transmission line is dominated by a mixture of 'ohi'a and koa trees as well as a lush understory of ferns, shrubs, and ground covers. The views are restricted by vegetation. Near Station 21+400, two single-family homes are visible intermittently through the dense vegetation. In this section of EX-4A, the dense vegetation, various hues of color, spatial enclosure, and rolling terrain create a memorable pattern in the landscape. The forest setting remains dominant.

The existing visual quality of Segment EX-4A was identified as moderately high from Station 171+576 to 172+837 and Station 20+000 to 21+970, and moderately low from Station 175+005 to 175+750.

E-3. The entire length of E-3 lies within mixed 'ohi'a and koa trees and a lush understory of ferns and shrubs. The views are restricted by the vegetation. Only the once-cleared area of the abandoned country club golf course near Station 43+800 provides an opportunity for uninterrupted views outward. The rolling terrain drops 270 m, which provides intermittent views of Hilo Bay.

The dense vegetation, various hues of color, spatial enclosure, and rolling terrain create a memorable pattern in the landscape. The forest setting remains dominant. The few built features present blend with the natural setting. The existing visual quality of E-3 was identified as moderately high for its entire length, Station 40+000 to 45+503.

3.21.1.2 Characteristics of the Viewer

Visual assessment also considers the level of sensitivity or attitude that the viewer will have in response to the change in appearance of the existing landscape. Identification of viewer groups, duration of viewer exposure, and type of viewer activity provide an indication of the level of viewer response. The majority of the viewers in the project study corridor are traveling the highway and viewing the landscape from the road. These highway users are traveling at speeds of 65 kph. Other viewers are those from residences located along the roadway corridor and from military facilities. These groups view the landscape (including the roadway) from different viewpoints, and have a stationary view rather than a changing one, such as that from a moving vehicle.

3.21.2 Environmental Consequences

Impacts to visual quality from the proposed project range from moderate to severe. Changes in visual character range from subtle to severe. Cut and fill slopes associated with the new highway would create areas of primary visual concern, but treatment of these slope faces would minimize the change in visual quality and character. Table 3.21.1, *Visual Quality*, and Table 3.21.2, *Visual Character*, summarize the anticipated change in visual quality and character that would result from the proposed improvements.

W-2. The addition of a two-lane highway on the W-2 alignment would severely lower the existing visual quality of the foreground area. Over its length, cut slopes would range from 3 to 7 m, and fill slopes would range from 3 to 9 m. In general, however, the expansive views outward to the pastoral setting and distant views to the prominent landforms would remain dominant. Construction of the proposed highway would result in a substantial change in visual character due to the introduction of a paved road to the existing pastoral setting.

W-3. The addition of a two-lane highway would severely lower the existing visual quality of the foreground area. Over its length, fill slopes would range from 2 to 12 m, cut slopes would range from 2 to 11 m. Construction of the proposed roadway would result in a substantial change in visual character due to the introduction of a paved road to the existing pastoral setting.

EX-2. From Station 119+100 to 123+000, fire protection warrants the construction of Typical Section B (ref: FEIS - Part I, 2.1 and Figure 2.2.1), which includes the construction of a wider roadway footprint, the installation of fencing, and the construction of an extruded curb. With the application of Typical Section B, a notable change in visual quality and character would occur, due to the increase in the level of contrast in terms of form, line, and color. From Station 129+000 to 132+500, fire protection warrants the construction of Typical Section C, which includes the construction of an even wider roadway footprint than Typical Section B. With the application of Typical Section C, a severe change in visual quality and character would result. This portion of the corridor is within the mamane/naio forest. In this forested area, the application of Typical Section C would result in an urban rather than rural character, and would appear to be oversized or out of scale with the surrounding setting. From Station 132+500 to 140+700, a substantial change in visual quality would occur with the construction of the proposed improvements, principally due to the marked difference that would be created between the graded edge of the roadway shoulder and adjacent undisturbed lava. One portion of this segment would have cut slopes on both sides of the highway at Station 132+500, ranging from 3.5 to 5.5 m. Along the EX-2 segment, the change in visual character would range from notable to severe.

PTA-1. The addition of a two-lane highway would severely lower the existing visual quality of the segment from Station 10+000 to 17+200. Along the alignment at the base of Pu'u Ma'au, 7 to 12.5 m cut slopes would occur. Between Station 17+200 and 21+640, no perceived change in visual quality would be anticipated as a result of the project. Between Station 21+640 and 27+000, the addition of the highway would notably lower the existing visual quality of the foreground area. Cut slopes of 6 and 7 m would occur at several locations along the alignment. From Station 27+000 to the east end of Segment PTA-1, the addition of a two-lane highway would lower the existing visual quality of the foreground area because of the presence of the paved highway and associated landscape modifications. In general, the prominent landforms would remain dominant along the length of this segment. With the implementation of Typical Section B construction of the highway would result in a severe change in visual character from Station 10+000 to 17+200. With Typical Section C, a substantial change in visual character would result from Station 21+640 to 29+671.

PTA-3. The addition of a two-lane highway would severely lower the existing visual quality of the segment from Station 10+000 to 17+200 (PTA-1). Along the alignment at the base of Pu'u Ma'au, 7 to 12.5 m cut slopes would occur. Between Station 17+200 and 21+640 (PTA-1), no perceived change in visual quality would be anticipated as a result of the project. Between Station 21+640 and 26+900, the addition of the highway would notably lower the existing visual quality of the foreground area. Cut slopes of 6 and 7 m would occur at several locations along

the alignment. From Station 10+000 to 12+881, the proposed improvements would severely lower the existing visual quality of the foreground area. From Station 137+800 to 140+700 (EX-2), the proposed improvements would moderately lower visual quality. Along much of the alignment, the landscape modifications are greater than 3 m for either cut or fill slopes. Several areas of severe cut slope heights occur along the alignment as well. With the implementation of Typical Section B, a severe change in visual character would result from Station 10+000 to 12+500. With Typical Section C, a substantial change in visual character would result from Station 12+500 to 12+881.

EX-3. The proposed improvements would substantially change the visual quality of Segment EX-3, from Station 132+200 to 145+500, principally due to the marked difference that will be created between the graded edge of the roadway shoulder and adjacent undisturbed lava. One area would result in cut slopes on both sides of the highway ranging from 3.5 to 5.5 m.

From Station 145+500 to 155+400, modifications to the landscape would occur in areas of cut and fill slopes, reaching as much as 6 m fill and 7.5 m cut. The proposed improvements in this area would create changes in the landscape that would attract attention in the foreground.

From Station 155+400 to 171+576, the highway would become a more dominant feature in the landscape because of the spatial enclosure created by the natural forest vegetation and the wider road footprint created by the new wider road section. In this area, landscape modifications would reach 9.5 m of fill and 7.5 m of cut. The overall visual quality of EX-3 from Station 145+500 to its eastern limit would not be substantially lower than that of existing conditions. The straightening of vertical and horizontal alignments and removal of trees would result in a severe change in visual character.

EX-4A. On its western end, Station 171+576 to 172+837, the highway would become a more dominant feature in the landscape because of the spatial enclosure created by the forest vegetation and the wider roadway footprint. From Station 20+000 to 21+970, where the alignment diverges from the existing Saddle Road and follows the transmission line corridor, the addition of a new two-lane highway would substantially lower the existing visual quality of the foreground area because of the amount of landscape modification that would occur. Four and 5m cut slopes would occur on several locations along the alignment. From Station 175+005 to 175+750, minimal change to visual quality would be anticipated. In this area, however, local residences would have a direct view of some of the landscape modifications associated with the proposed construction. Construction of the highway would result in a substantial change in character.

E-3. The addition of a two-lane highway on E-3 would substantially lower the existing visual quality of the foreground area because of the amount of landscape modification that would occur. Several locations along this alignment would have 7- and 8-m cut slopes. Construction of the highway would result in a substantial change in character.

TABLE 3.21.1
Visual Quality

Segment	Stations	Existing Visual Quality	Visual Quality with Project
W-2	Station 100+000 - 116+000	Moderately High	Moderate
	Station 118+087 - 119+100	Moderately High	Moderate
W-3	Station 100+000 - 106+000	High	Moderate
	Station 106+000 - 108+200	Moderately High	Moderate
	Station 108+200 - 111+078	Moderately High	Moderately Low
	Station 112+582 - 116+002 (W-2)	Moderately High	Moderate
	Station 118+087 - 119+100 (W-2)	Moderately High	Moderate
EX-2	Station 119+100 - 123+000	Moderate	Moderately Low
	Station 123+000 - 125+000	Moderate	Moderate
	Station 125+000 - 129+000	Moderately Low	Moderately Low
	Station 129+000 - 132+500	High	Moderate
	Station 132+500 - 140+700	High	Moderately High
PTA-1	Station 10+000 - 17+200	Moderately High	Moderately Low
	Station 17+200 - 21+640	Moderately Low	Moderately Low
	Station 21+640 - 26+900	Moderately High	Moderate
	Station 26+900 - 30+999	Moderate	Moderate
PTA-3	Station 10+000 - 17+200 (PTA-1)	Moderately High	Moderately Low
	Station 17+200 - 21+640 (PTA-1)	Moderately Low	Moderately Low
	Station 21+640 - 26+900 (PTA-1)	Moderately High	Moderate
	Station 10+000 - 12+881	High	Moderate
	Station 137+800 - 140+700 (EX-2)	High	Moderately High
EX-3	Station 140+700 - 145+500	High	Moderately High
	Station 145+500 - 155+400	Moderate	Moderate
	Station 155+400 - 171+576	Moderately High	Moderately High
EX-4A	Station 171+576 - 172+837	Moderately High	Moderately High
	Station 20+000 - 21+970	High	Moderately High
	Station 175+005 - 175+750	Moderately Low	Moderately Low
E-3	Station 40+000 - 45+503	High	Moderately High

TABLE 3.21.2
Visual Character

Segment	Stations	Change in Visual Character
W-2	Entire Segment	Substantial
W-3	Entire Segment	Substantial
EX-2	Station 119+100 - 123+000 Station 123+000 - 129+000 Station 129+000 - 132+500 Station 132+000 - 140+700	Notable Substantial Severe Substantial
PTA-1	Station 10+000 - 17+200 Station 21+640 - 29+671	Severe Substantial
PTA-3	Station 10+000 - 17+200 (PTA-1) Station 21+640 - 26+900 (PTA-1) Station 10+000 - 12+500 Station 12+500 - 12+881 Station 137+800 - 140+700 (EX-2)	Severe Substantial Severe Substantial Substantial
EX-3	Entire Segment	Severe
EX-4A	Entire Segment	Substantial
E-3	Entire Segment	Substantial

No Action Alternative. With the No Action Alternative, the road would not be improved and, therefore, no changes to visual quality or visual character would result. No scenic pullouts would be developed along the Saddle Road corridor.

3.21.3 Mitigation Measures

The degree of visual impact is generally lessened by minimization of the amount of cut and fill slopes, revegetation of disturbed areas, and by blending any proposed improvements into the surrounding landscape. The intent of visual impact mitigation measures is to reduce the contrast between the proposed improvements and the existing landscape. Mitigation measures applicable to all action alternatives are listed first, followed by measures applicable to one specific alternative segment.

Mitigation Measures Applicable to All Project Sections

- Cut and Fill Slopes. Final cut and fill slope faces will be made to blend with the surrounding landscape. The natural appearance of the slopes will be improved by rounding the toe and top of slopes, warping, blending the ends of slopes, varying the slope ratios, utilizing staggered ledges, and roughening the face of cut slopes, either by ripping or blasting, where appropriate. (Warping results in a slope face that is not parallel to the roadway. Slope rounding refers to blending the slope into the natural terrain by excavating additional area at the top of the cut slope. Laying back the ends of slopes or blending provides a smooth transition to adjacent cut, fill, or drainage area by flattening the slope ratio at the ends of slopes. Varying slope ratios leaves an irregular, undulating or roughened appearance with staggered ledges rather than a uniform grade. Staggered ledges are benches with varying dimensions and heights on the cut face which do not cross the entire face.) The slope ratios will vary from the top to the bottom of the slope face as well as horizontally along the face, if practicable and feasible.

- Rock Slope Surface Treatment. Rock slope surface treatment will be applied to cut slopes in competent rock areas as identified in the geotechnical testing results. These treatments include roughening of the cut face to incorporate short, staggered ledges, minor warping, and other irregularities in the rock that take on a natural appearance.

- Lava Rock Areas. In areas not recommended for revegetation, the top 1 m of lava material in disturbed areas will be stockpiled prior to construction. After construction, the stockpiled material will be used as plating material. The plating material will be placed over slope faces to resemble the adjacent, undisturbed ground surface conditions or used as rip rap material along ledges and outside of ditch backslopes.

- Erosion Control. Intercepted drainages on cut slopes will be cut at the angle to existing joints, planes or rock features, and drainage patterns. These features will be incorporated into the NPDES SWPPP (ref: FEIS - Part I, 3.10 and 1.9).

- Guardrails. Where guardrails are needed, natural-appearing guardrail material, such as naturally weathered steel or a material approved by HDOT, will be used to blend more effectively with the surrounding landscape.

- Fencing. To reduce contrast and blend more effectively with the surrounding landscape, aesthetic fencing materials will be used, such as naturally weathered metal or steel, painted or wood posts, to be approved by HDOT.

- Clearing. Clearing of trees and large shrubs along an irregular edge adjacent to the recovery zone will be done to create a gradual transition or feathered edge.

- Abandoned Roadway Segments. Where the abandoned roadway is not to be used for local access and is not considered a historic resource, asphalt surfacing on the abandoned roadway segments will be removed from the site, and the road bed will be ripped and regraded to match surrounding terrain. The regraded area will be reclaimed as appropriate, consistent with recommendations contained in the section of this chapter addressing geology and soils (ref: FEIS - Part I, 3.12.3) or restoration measures as described for wetlands (FEIS - Part I, 3.11.3). Plant material such as trees will be planted or large rock material placed at the interface of the new highway with the old roadway to screen views of the abandoned section.

- For Segments W-2 and W-3, any small remnant pieces of landform left by cut slopes will be eliminated except between W-2 Station 112+420 to 114+500. In this area, boulders will be stockpiled to create rock outcrops on remnant fins of landform which match existing rock outcroppings.

- For Segment EX-2 (Station 109+150), if a structure Waiki'i Gulch is constructed, it will incorporate materials with color and texture qualities that blend with the existing landscape.

- For Segment EX-2 (Station 130+875 Rt. to 130+950 Rt), all of remnant landform will be removed flush to the road.

- For Segment PTA-1, Station 28+570 to 29+371, boulders will be stockpiled to create artificial rock outcrops on remant fins of landform. Cut slopes will not be rounded, but left angular and irregular in form to match existing rock outcrop.

- Reseeding of disturbed areas will be undertaken only in Section I (Segments W-2 and W-3), as is consistent with the section of this chapter addressing geology and soils (ref: FEIS - Part I, 3.12.3).

- For Segment EX-4A, Station 172+550 to 172+750, aesthetic rock retaining walls will be constructed where feasible to reduce cut slope face adjacent to residences.

3.22 ENERGY

3.22.1 Affected Environment

There are two primary energy demands associated with the proposed project: energy will be consumed in the construction activities, and in the operation of vehicles using the facility after completion of construction. Since there are no data available on the current levels of fuel consumption in passenger vehicles or trucks on Saddle Road, estimates were made based on estimated ADT, average length of Saddle Road (73 km), and motor fuel consumption data for the

County of Hawai'i as a whole. For the existing condition, or 900 ADT, the total vehicle kilometers driven per day on Saddle Road is approximately 65,700, resulting in the consumption of roughly 9,200 L of motor fuel per day.

3.22.2 Environmental Consequences

All Action Alternatives. Construction of the proposed improvements will entail consumption of fuel for the operation of construction equipment. Engineering data from 1996 were used to estimate the total earthwork, aggregate base course, and pavement area for each segment. Based on the generalized working efficiency of various pieces of construction equipment (e.g., grader, roller, D-9 bulldozer, scraper), the estimated fuel consumption for construction of the proposed Saddle Road would be approximately 2.5 million to 3.0 million L of fuel.

The proposed project would conserve fuel in individual vehicles by improving the LOS and travel time, reducing curves and grades, providing safe opportunities for passing, and for some destinations, reducing the length of the commute. Vehicles traveling at steady highway speeds use less fuel than those traveling at variable speeds due to excessive curves and steep grades. With the increase in total vehicle kilometers forecasted for future traffic on Saddle Road with the proposed improvements; however, overall fuel consumption by vehicles using the road would increase dramatically. For year 2014 with the proposed project, or 14,000 ADT, total kilometers driven would be approximately 1 million, resulting in the consumption of roughly 143,000 L of motor fuel per day.

No Action Alternative. With the No Action Alternative, no construction will take place and no construction-related energy would be consumed. Total fuel consumption by vehicles using Saddle Road will increase in the future as vehicle kilometers increase. This increase would be notably less than that of the action alternatives. For year 2014 with the No Action Alternative, or 4,400 ADT, total kilometers driven would be 321,200, resulting in consumption of roughly 45,000 L of motor fuel per day. Without improvements to Saddle Road, congestion on SR19 would be expected to result in fuel use increases.

3.22.3 Mitigation Measures

Mitigation measures associated with use of construction equipment are presented in the Construction impact section of this chapter (ref: FEIS - Part I, 3.23.2). No other mitigation measures related to fuel consumption are recommended.

3.23 CONSTRUCTION IMPACTS

3.23.1 Environmental Consequences

All Action Alternatives. Environmental impacts associated with the construction phase of a project are generally localized and temporary in nature. Construction impacts anticipated include noise from heavy construction equipment, fugitive dust from earthmoving activities, air pollutant emissions from internal combustion engines, and soil erosion and sedimentation. Construction activities would include mobilization, clearing and grubbing, excavating and filling of earth, foundation construction, drainage structure construction or installation, preparation of highway base, paving, and cleaning up.

Due to the length of Saddle Road, it would not be feasible to construct the entire length at one time. Construction projects will be identified during the final design phase of the project. Each construction project would improve a 9- to 12-km portion of the road. Plans call for the construction of the entire project to be completed over a nine-year period pending adeqwuate funding appropriations. With implementation of mitigation, construction-related impacts are not expected to be significant with any of the action alternatives.

No Action Alternative. No construction-related impacts would occur with the No Action Alternative.

3.23.2 Mitigation Measures

Mitigation Measures Applicable to All Project Sections

The following mitigation measures have been identified to minimize potential impacts. These activities will be noted as mandatory in Special Contract Requirements.

- The total amount of land disturbance will be minimized. The construction contractor will be limited to the delineated construction work areas within the ROW or clearly marked staging areas.

- Construction traffic will be limited to military roads and the construction area within the PTA-1 ROW as much as possible to minimize interaction with vehicular traffic on the existing Saddle Road. Traffic control will assure a safe and timely flow of traffic along all sections of the Saddle Road project during construction. Traffic control plans will be an integral part of the construction documents and enforced by the Project Engineer.

- Construction activities and traffic control will be coordinated with representatives of the Mauna Kea Science Reserve to avoid potential conflicts with their observatory construction projects. Plans for the transport of oversized loads for these projects from Kawaihae to the Mauna Kea summit are presented in a letter from the University of

Hawai'i at Manoa, Institute for Astronomy, to the FHWA, dated October 11, 1996 (ref: FEIS -Part II, 1.4.3).

- Environmental awareness materials will be provided to all persons, agency personnel, construction workers, subcontractors, inspectors, and others on the project. These materials will be prepared in a checklist format and will address issues related to caves, sensitive species, cultural resources, spill management, delineation of authorized work area, pollution prevention through recycling and other efforts required by the Pollution Control Act of 1990, and other relevant factors (ref: FEIS - Part I, 3.18.3). Contract specifications addressing environmental mitigation and procedural requirements will also be included in the contract documents and will be enforced by the on-site project engineer throughout the duration of the construction contract.

- Trucks will be covered when hauling loose material on public roads.

- Unused materials and excess fill will be removed and disposed of at an authorized waste disposal site.

- Dust control measures will be implemented. These will include, but are not limited to, the use of water trucks, the stabilization of the surfaces of stockpiled materials, and the treatment of unpaved routes with dust suppressants. Possible contractor furnished water sources are described in this FEIS (Part I, 3.10.2).

- Clearing and grubbing of construction work areas will be conducted in such a manner as to minimize the amount of exposed soil at any one time.

- Stationary equipment will be placed as far away from sensitive noise receptors as practical.

- All exhaust systems will be maintained in good working order. Properly designed engine enclosures and intake silencers will be used. Equipment will be maintained on a regular schedule.

Mitigation measures related to construction impacts are also provided in other mitigation sections of this chapter (ref: FEIS - Part I, 3.1.1.3, 3.3.3.3, 3.3.4.3, 3.6.3, 3.7.3, 3.12.3, 3.13.3, and 3.18.3).

3.24 SECTION 4(F) DETERMINATION

The purpose of 49 U.S.C. Section 103, generally known as Section 4(f), is to ensure that the U.S. DOT makes special efforts to protect public parks and recreation lands, wildlife and waterfowl refuges, and historic properties. The law states that the Secretary of Transportation shall approve a project which requires the use of publicly owned land from a public park, recreation area,

wildlife or waterfowl refuge, or from an historic property of significance only if; (1) there is no prudent and feasible alternative to such use, and (2) the project includes all possible planning to minimize harm to the resource being affected by use. It is the responsibility of the FHWA to determine whether any potential 4(f) properties are present and will be used by a highway project. This determination is made through thorough examination of the resources and consultation with agencies that have jurisdiction over potential 4(f) properties.

In the case of the Saddle Road project, 19 NRHP eligible archaeological sites, one public park, and one wildlife refuge are present in the general project area. The FHWA has consulted with the appropriate jurisdictional entities in determining whether and how these properties will be affected. The FHWA has concluded that no use of 4(f) properties will occur as a result of the project. The analysis supporting this conclusion is contained below.

3.24.1 Archaeological Sites

None of the 19 archaeological sites are 4(f) properties. Based on consultation with the Hawai'i SHPO, those portions of the archaeological sites that are within the APE are eligible for the NRHP under Criterion D only. It has also been determined that none of the sites require preservation in place. It has been agreed in consultation with the Hawai'i SHPO and consummated in a MOA that data recovery is the appropriate and sufficient mitigation for all of the 19 archaeological sites within the APE where avoidance is not possible. In several instances, interpretive signage and periodic monitoring will be conducted as part of the mitigation process. These procedures are outlined below in detail.

Three of the 19 archaeological sites are beyond the APE, and will not be impacted by the undertaking. Sufficient data recovery efforts already have been conducted for another eight sites during the identification and evaluation procedures for this project. Data recovery efforts will be conducted for the remaining eight sites prior to project construction. With the completion of the data recovery activity, there will be no adverse effect to any of the archaeological sites within the project area. Documentation on the characteristics and planned mitigation for each of the eight sites that require further mitigation is provided below. The consultation history is the same for all of the sites and provided in detail in Table 3.19.1.

3.24.1.1 Section 106 Coordination Summary

Original significance assessments and recommendations for mitigation were presented in the archaeological inventory report (PHRI, 1997, FEIS - Part III). In reply to this submittal, the Hawai'i SHPO concurred with some site assessments and provided revised significance evaluations for other sites. Subsequently, the FHWA concurred with the SHPO recommendations; however, additional consultation regarding significance and treatment was conducted in 1998 and 1999 in meetings between the FHWA and Hawai'i SHPO. As a result of this extensive consultation, the Hawai'i SHPO concluded that the portions of seven long, linear archaeological sites impacted by the project are eligible for the NRHP under Criterion D only

within the APE (FEIS - Part II, 1.4.6). A more detailed description of consultation is provided in this FEIS (Part I, 3.19). The mitigation treatments detailed below were also agreed to in the consultation documented above and are consummated in the MOA.

3.24.1.2 Archaeological Site Location, Characteristics, and Mitigation

The proposed mitigation efforts for the sites presented below have been agreed to by the Hawai'i SHPO. Details, including the need for and extent of excavation and/or monitoring, the extent of data collection and research, the location of pullouts where appropriate, and the text of the interpretive signage when appropriate, will be presented in a Data Recovery Plan to be reviewed and approved by the Hawai'i SHPO prior to initiating any archaeological field work which will precede project construction. Complete site descriptions and photographs are contained in the Archaeological Inventory Survey report in Part III of this FEIS.

Ranch Enclosures (Site 20854). Site 20854 is the archaeological remains of a ranching habitation and associated animal enclosure within the W-3 corridor (Figure 3.24.1, *Site 20854 and Site 20855*). The site is roughly 70 m in diameter (345 m^2). There are two features (remains of the habitation and enclosure) and a trash midden. The site is on property owned by Parker Ranch. There are no planned facilities for this site. Access to the site is limited, and must be obtained by the landowner. The site is located near the Old Waimea-Kona Road site (Site 20855).

Construction of the W-3 alignment will affect about half of the site area, including both of the features. Data recovery of the archaeological remains will include excavation of portions of the enclosures, and within the area between the enclosures to recover the data that makes the site significant.

Old Waimea-Kona Belt Road (Site 20855). The Old Waimea-Kona Belt Road is the archaeological remains of a long road built from Waimea to Kona during the Historic Period (Figure 3.24.1). The road was built by Hawai'i County over a wagon track through the pasture beginning in 1916, mostly using prison labor. The northern portion of the 63-km long by 2.5-m wide road was paved. Paving ends north of the W-3 corridor. Many stone causeways and culverts were built along the old road. One of these, a 3-m high causeway spans a shallow gully within the W-3 corridor. There is a stone-lined culvert 80 by 50 cm at the base of the causeway.

The portion of the Site 20855 that is within the Saddle Road project area is owned by Parker Ranch. This is private property, and access is regulated by Parker Ranch. This archaeology site is no longer used as a public road; however, the site has been used for access to ranching operations since abandonment. The Old Waimea-Kona road was rebuilt and straightened circa 1939, and is now referred to as the Mamalahoa Highway (SR 190). Many segments of the old road were covered by improvements or abandoned. The cut-off segments are often short, and there is no ingress to the modern highway. There are no planned facilities for the archaeology site. There are no similar archaeology sites nearby.

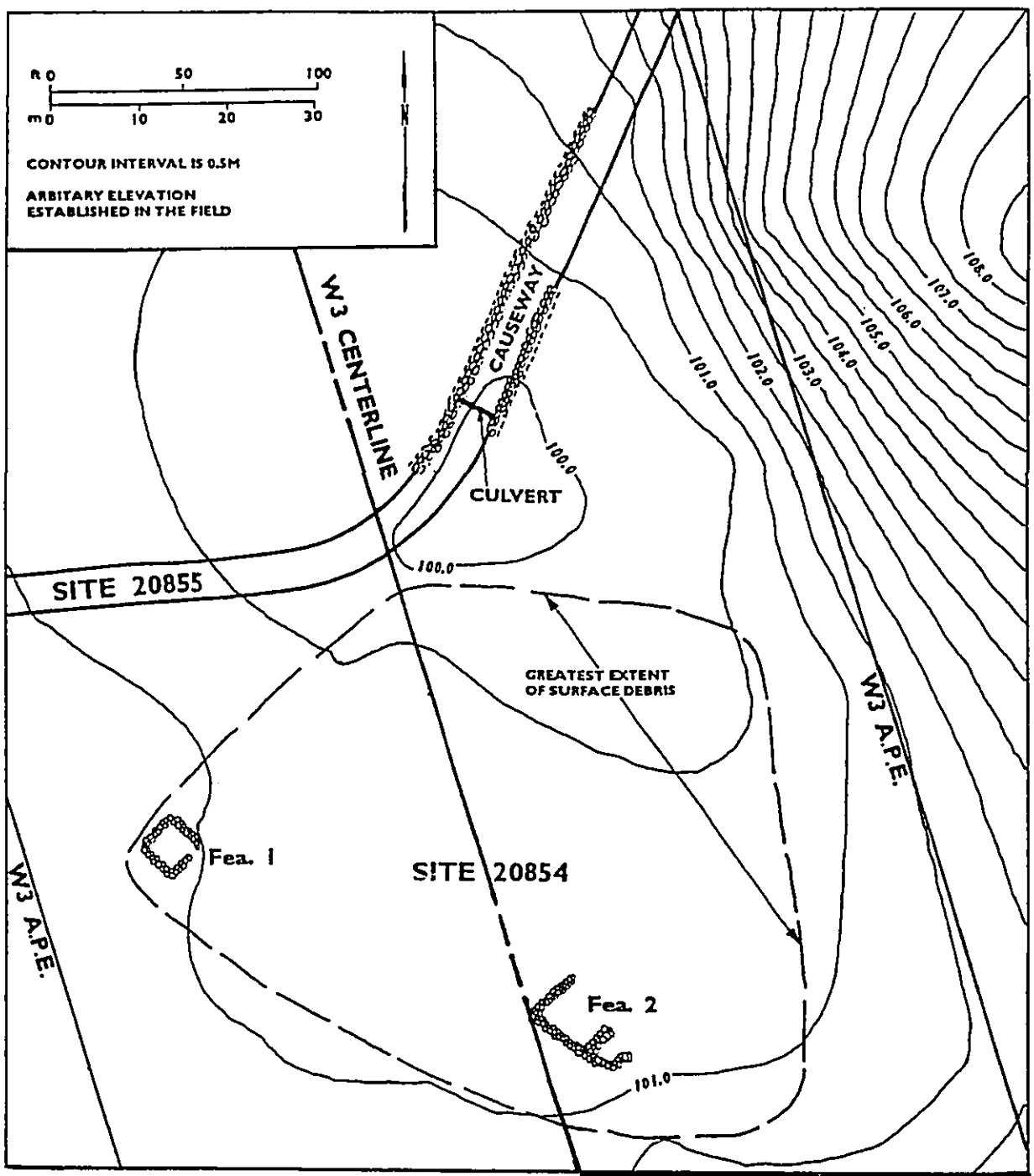
An approximately 40-m long segment of the 63-km long Site 20855 will be impacted by the preferred corridor. The new Saddle Road will be built over an unpaved segment that is level to grade and that has been reduced to a two track trail by ranch use. The mitigation effort will include surface examination and documentation of the road morphology and causeways within the affected area and in the immediate project vicinity at nearby locations where data that makes the site important to history can be examined. If feasible, mitigation will also include interpretative signage as appropriate.

Old Waimea-Humu'ula Wagon Road (Site 21150). The archaeological remains of a portion of the Old Waimea-Humu'ula wagon road are in Humu'ula, North Hilo (Figure 3.24.2, *Site 21150*). The wagon road covered about 42 km between Waimea and Humu'ula Sheep Station in 1873. The old wagon road has been destroyed by the construction of the Saddle Road between Pu'u Ke'eke'e and Mauna Kea State Park, and by military activity within the PTA and for another kilometer east of the PTA boundary. The land to the east of the PTA boundary is owned by the Hawaiian Homes Commission and leased to Parker Ranch. Access to this area is controlled by Parker Ranch.

At 1.0 km east of the PTA boundary, military activity decreases dramatically and modern transportation pathways diverge from the Old Waimea-Humu'ula wagon road. The fenceline (Site 20865) associated with the Humu'ula Sheep Station, and two modern overhead utility lines, converge with the Old Waimea-Humu'ula wagon road at this location. From here eastward 2.3 km to the Humu'ula Sheep Station, the Old Waimea-Humu'ula wagon road roughly parallels the fenceline. In contrast, the modern transportation paths follow along the utility corridors. Consequently, the Old Waimea-Humu'ula wagon road has had almost no impacts from this location eastward to the Humu'ula Sheep Station. There are no planned facilities at Site 21150.

The PTA-1 corridor will impact less than a 50-m long segment of the Old Waimea-Humu'ula wagon road. The impacted segment has been highly disturbed by military, ranching, and maintenance vehicle transportation. This segment does not display the intact morphology that is present about 0.8 km to the east. Data recovery of the archaeological remains will be conducted to mitigate the impacts to the site. The mitigation effort will include detailed documentation of the morphology of the trail as impacted by modern travel within the APE and a documentation of the undisturbed portion of the trail 0.8 km to 1.0 km east of the APE. No excavations are proposed. If feasible, mitigation will also include interpretative signage as appropriate.

Pu'u 'Ô'ô-Volcano Trail (Site 10309). The Pu'u 'Ô'ô-Volcano Trail (Site 10309) is oriented roughly perpendicular to Saddle Road between MP 22 and MP 23 at an elevation around 1,750 m above sea level (Figure 3.24.3, *Site 10309*). The full extent of the trail is about 35 km from Pu'u 'Ô'ô Ranch on the slopes of Mauna Kea, to the highway near Kilauea Volcano. South of the road, the trail path is most often manifest as unmodified pahoehoe lava from 0.8 to 1.5 m wide. Occasionally, low spots in the lava are filled with small *'a'ā* cobbles and gravel. North of the road, the trail is a low trough-like indentation in the Mauna Kea soils. This archaeological site



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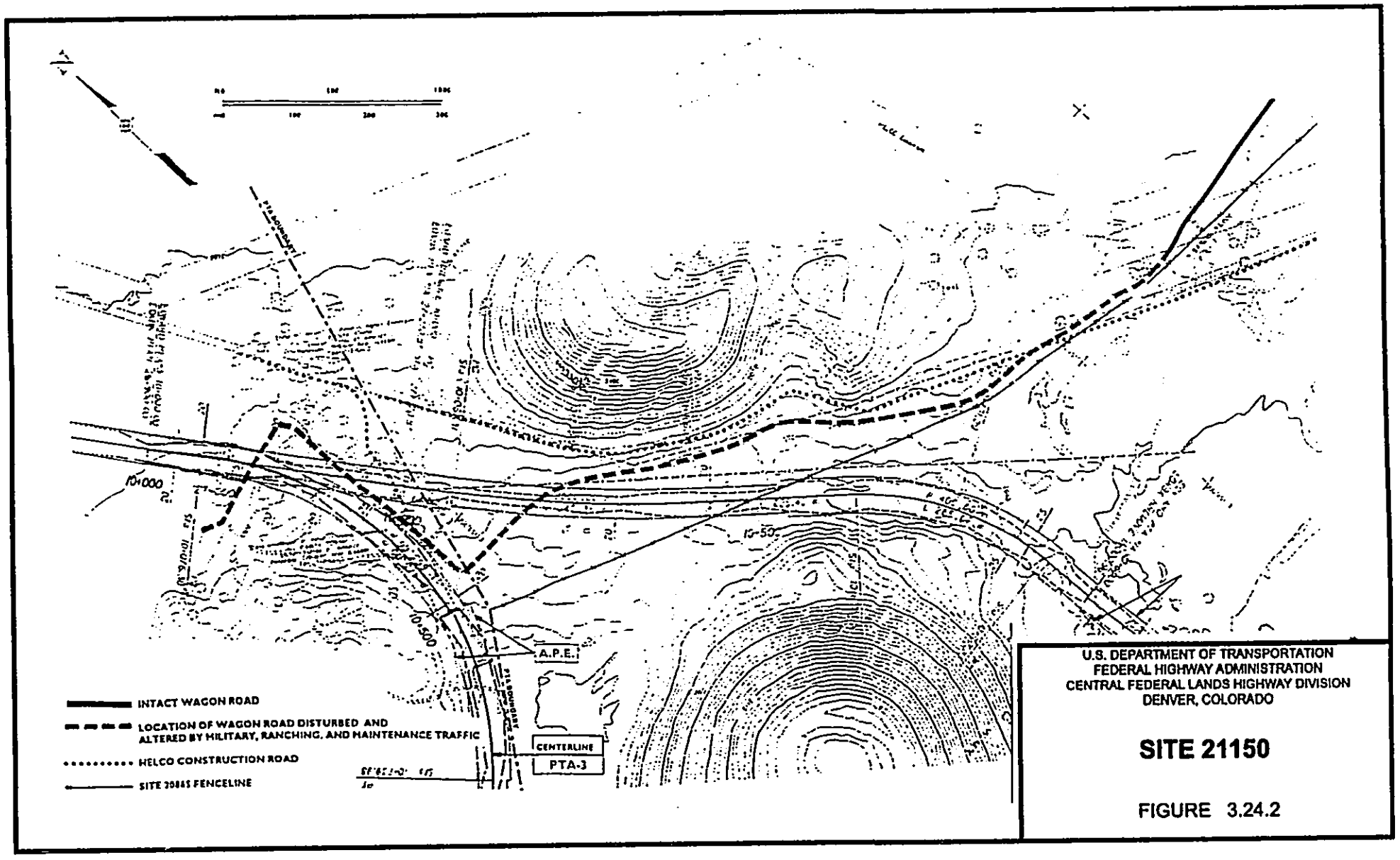
SITE 20854 AND SITE 20855

FIGURE 3.24.1



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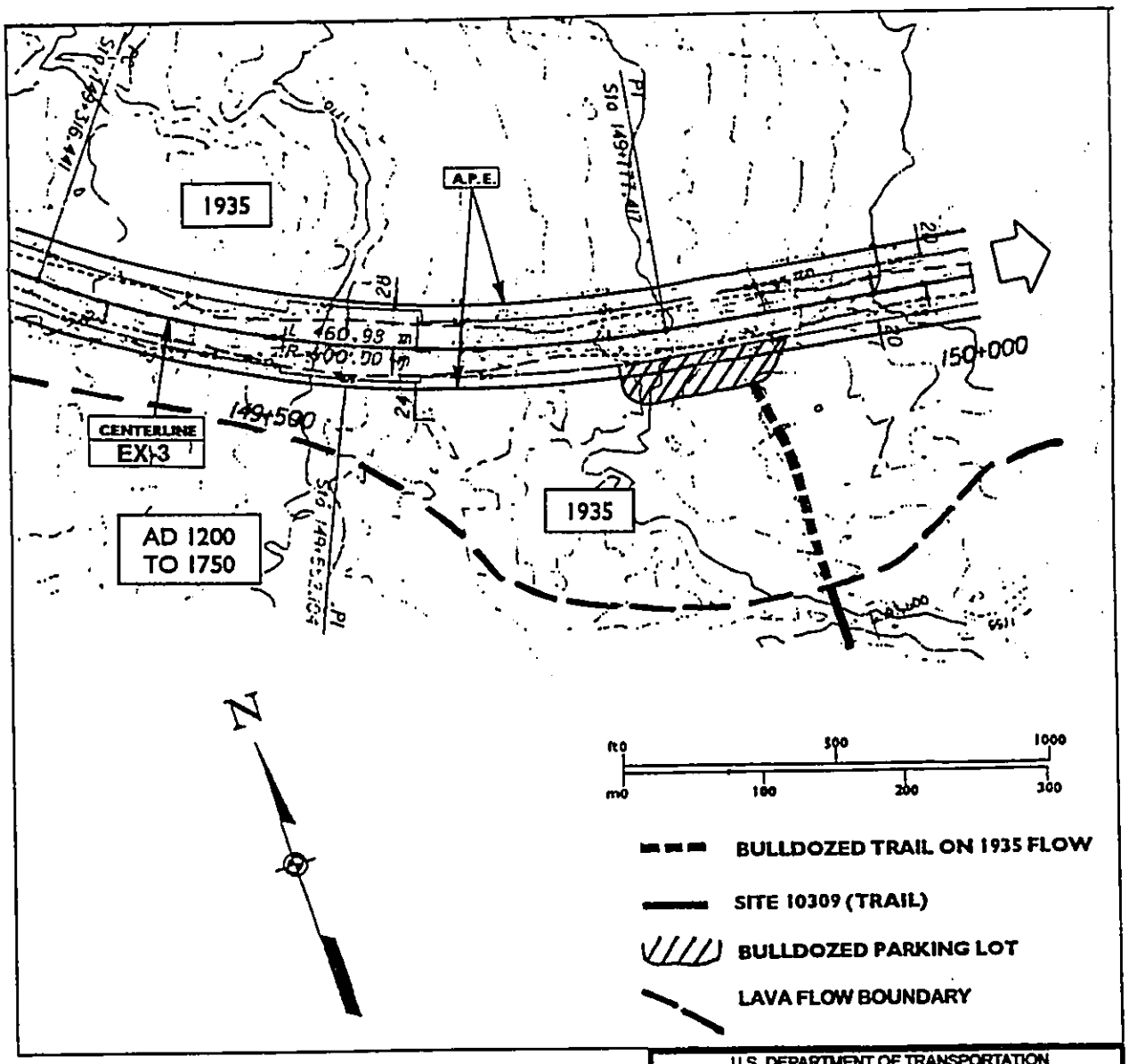
SITE 21150

FIGURE 3.24.2



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DENVER, COLORADO

SITE 10309

FIGURE 3.24.3

may have been created during the Prehistoric Period, but subsequent use during the Historic Period has modified or covered any evidence of earlier use.

A lava flow covered a portion of the Site 10309 trail in 1935, and the Saddle Road was built on the 1935 flow. Consequently, there are no intact portions of the trail within the project impact area. It is about 300 m from the Saddle Road project impact area to the northern edge of the 1935 flow and the non-covered portion of Site 10309. The property to the north of Saddle Road in this area is owned by the State of Hawaii and leased to Donn W. Carlsmith. There are 150 m between the Saddle Road project impact area and the intact trail at the southern edge of the 1935 flow. The portion adjacent to the project on the south is also owned by the State of Hawaii and leased to Donn W. Carlsmith.

An informal parking area has been created in the 1935 flow by bulldozing to provide access to the trail. There are signs in the lot identifying the trailhead. The trail is currently used for recreational hiking and for access to hunting areas. No additional improvements or facilities are planned. Site 10309 is similar to the nearby trail Site 20878, the Pu'u 'Ô'ô-Hilo Trail. Site 10309 is oriented north and south to facilitate transportation of people and cattle from Pu'u 'Ô'ô to pastures and slaughter elsewhere. In contrast, Site 20878 was used by people only to travel between the ranch and Hilo. The two trails converge south and east of the Pu'u 'Ô'ô Ranch.

There will be no direct impacts to the archaeology Site 10309. The proposed Saddle Road will be built over the 1935 flow that covers Site 10309. The indirect effects of constructing the proposedSaddle Road over the buried trail path will be mitigated by surface only documentation of trail morphology and adaptations to the varying terrain outside of the affected areas at nearby locations where data that makes the site important to prehistory or history can be examined. If feasible, mitigation will also include interpretative signage as appropriate.

Humu'ula Sheep Station Wall (Site 7119). The Humu'ula Sheep Station Wall (Site 7119) is a complex of walls complementing the function of the sheep station ranch buildings in Humu'ula, North Hilo. Portions of the southern boundary wall will be impacted by the proposed Saddle Road in places between MP 23 and MP 31 (Figure 3.24.4, *Site 7119*). Portions of the site are located on lands owned by the State of Hawaii and the Hawaiian Homes Commission. Lessees include Parker Ranch and the PTA and they control access to the site. There are no planned facilities at the site. The wall is faced and core-filled. The exterior stones are 10 to 50 cm long, and are subrounded to nearly tabular. The core stones are 4 to 20 cm in diameter. The wall is 1.6 to 2.3 m high (five to twelve courses high) and 0.9 to 1.2 m wide, and is wider at the base. The top of the wall is often flat and parallels the surface of the lava flow. There are wooden posts on top of the wall, about 1.5 to 2.0 m apart. Most of the posts are saw cut and some have staples, which once held barbed wire.

The southern boundary wall is over 11 km long. The 1935 lava flow covers the wall in several locations, creating discontinuous segments of wall within and near the Saddle Road project area. There are several other wall segments that are perpendicular to the main boundary wall. These

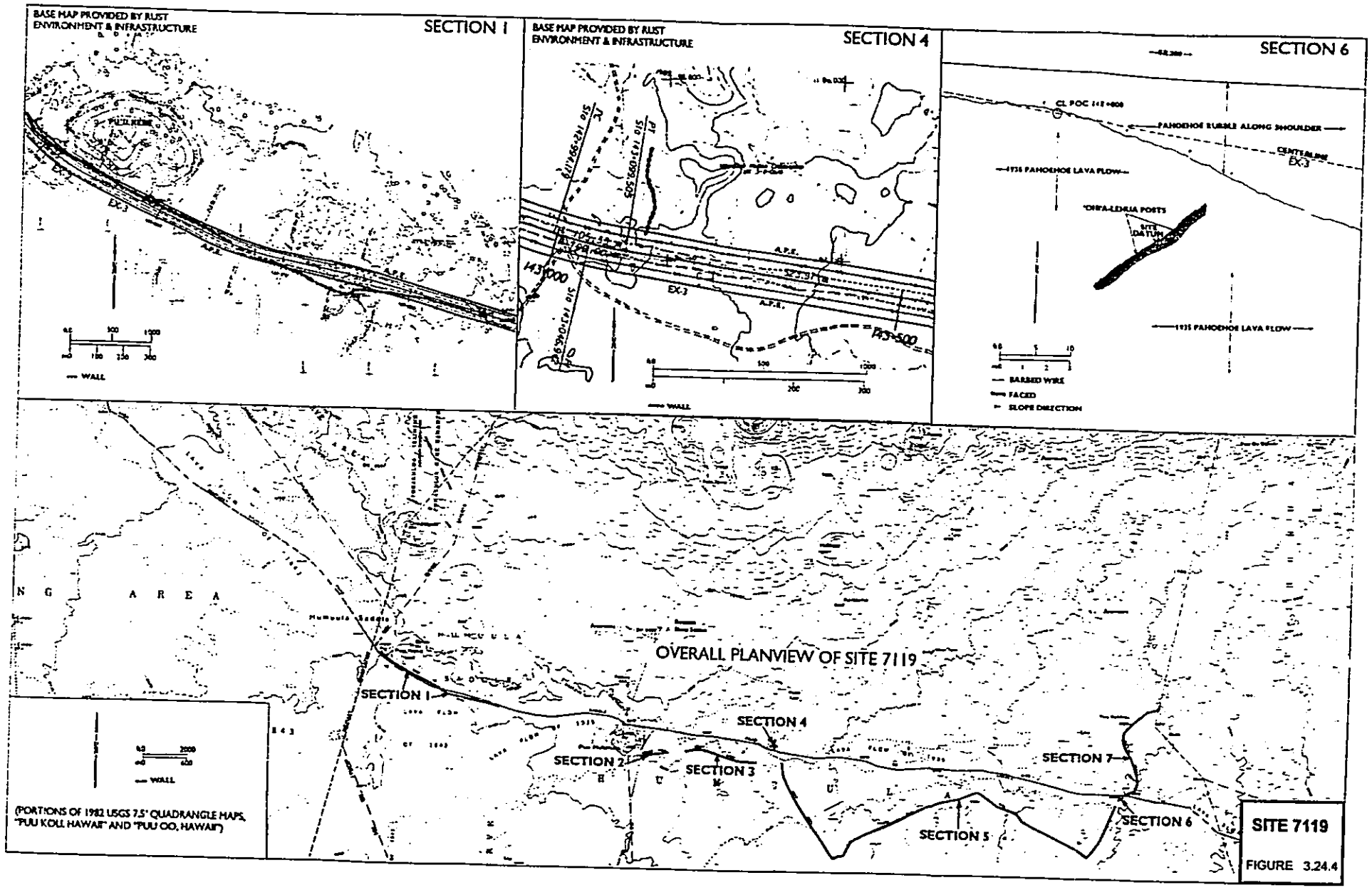
mark pasture areas within the larger sheep station property. Two of these wall segments have been assigned separate site numbers (Sites 20862 and 20877), because they lack the characteristic wooden post projections. Data recovery will include documentation of construction, schematic mapping, and recording of the network of walls comprising site 7119. Documentation will also include the walls' function and relationship to the sheep station buildings. If warranted, construction activities may be periodically monitored to ensure that impacts to the walls are restricted to the absolute minimum under the provisions of a written Archaeological Monitoring Plan. If feasible, mitigation may also include interpretative signage and one or more pullouts as appropriate.

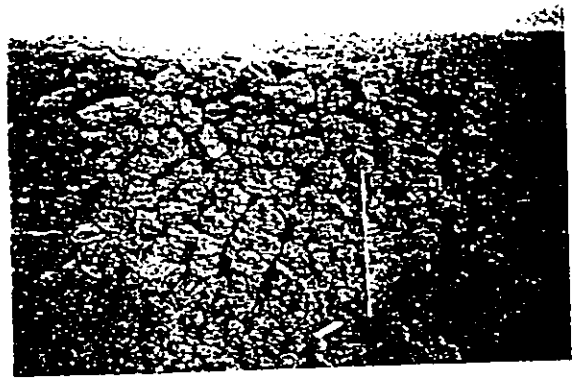
Pu'u 'Ô'ô-Hilo trail (Site 20878). The Hilo-Pu'u 'Ô'ô Trail (Site 20878) crosses the proposed Saddle Road at two places along the EX-3 corridor (Figure 3.24.5, *Site 20878*). The eastern (downslope) terminus of the trail is located within the EX-3 APE at Station 156+300, near MP 18, south of the existing Saddle Road. The trail continued further east prior to being covered by the current Saddle Road. The trail continues west, paralleling Saddle Road for approximately 2.1 km, and crosses the road near MP 20. The morphology of the trail varies with the topography and type of lava flow present. Most of the trail near the project study area is on the 1855 flow. The trail through this flow is mostly unmodified pathway on the *pahoehoe*, so the exact width of the trail is not measurable. These portions are marked by small basalt cairns. Thirty-eight (38) cairns were observed along the trail. Only one, near the crossing at Station 154+170, is located within the APE. There are several areas near the eastern terminus of the trail that have been built up with small basalt cobbles (5 to 15 cm in diameter) to fill in low areas in the terrain.

The portion of the trail north of the road consists of a winding trough through the *'a'â* constructed by removing stones from the path and piling them along the margins. This section extends between the existing road and the HELCO alignment about 50 m to the north. About 30 to 40 m north of the HELCO ROW, the character of the substrate changes once more with the change to the forested pre-1000 B.C. Mauna Kea flow. Further to the north, the trail connects to the Pu'u 'Ô'ô-Volcano Trail (Site 10309).

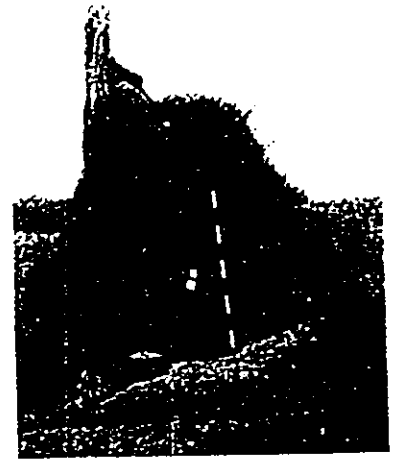
The archaeological remains of the trail are not prehistoric, because it was built on the 1855 lava flow. The trail was used beginning as early as 1883 by the Hitchcock family and continued to be used for moving cattle until the building of Saddle Road in 1943. After Saddle Road was built, the trail was used less often, mainly to check the telephone line when it had problems. The 2.1 km portion of the trail located south of Saddle Road is now used by hikers and hunters. The trial is on land owned by the State of Hawaii and is leased to the DOFAW for forest reserve purposes. There are no planned facilities for the trail.

Approximately 190 m of the eastern end of the trail will be impacted by construction, and about 5 m of the western crossing will be impacted. Data recovery will include examination of the modes of construction of the trail as they apply to chronological, functional, and maintenance activities. Some areas of the trail within the APE will be disassembled to aid in the assessment of the trail technology.

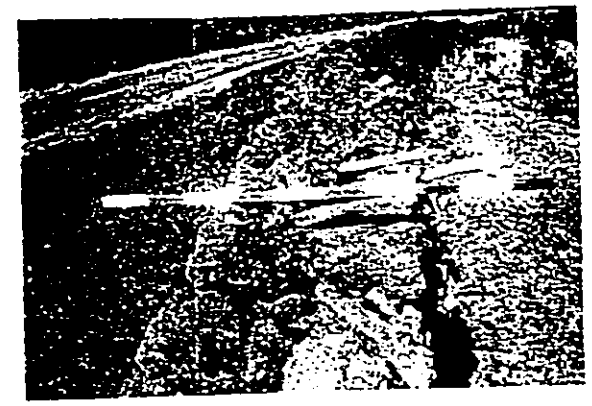

BASE MAP PROVIDED BY RUST ENVIRONMENT & INFRASTRUCTURE
SECTION 1
BASE MAP PROVIDED BY RUST ENVIRONMENT & INFRASTRUCTURE
SECTION 4
SECTION 6
PAHOEHOE RUBBLE ALONG SHOULDER
CENTERLINE
1935 PAHOEHOE LAVA FLOW
BARBED WIRE
FACED
SLOPE DIRECTION
OVERALL PLANVIEW OF SITE 7119
SECTION 1
SECTION 2
SECTION 3
SECTION 4
SECTION 5
SECTION 6
SECTION 7
(PORTIONS OF 1982 USGS 7.5' QUADRANGLE MAPS, "PUU KOLI HAWAII" AND "PUU OO, HAWAII")
SITE 7119
FIGURE 3.24.4



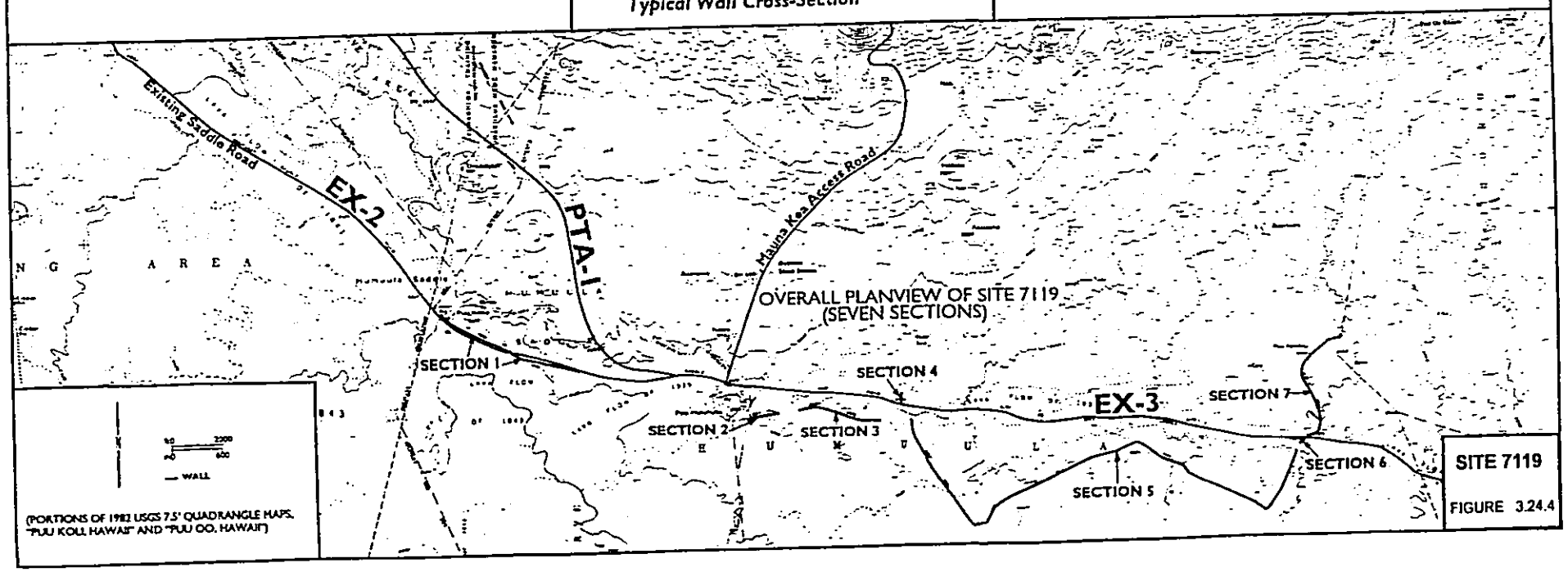
Typical Wall Construction

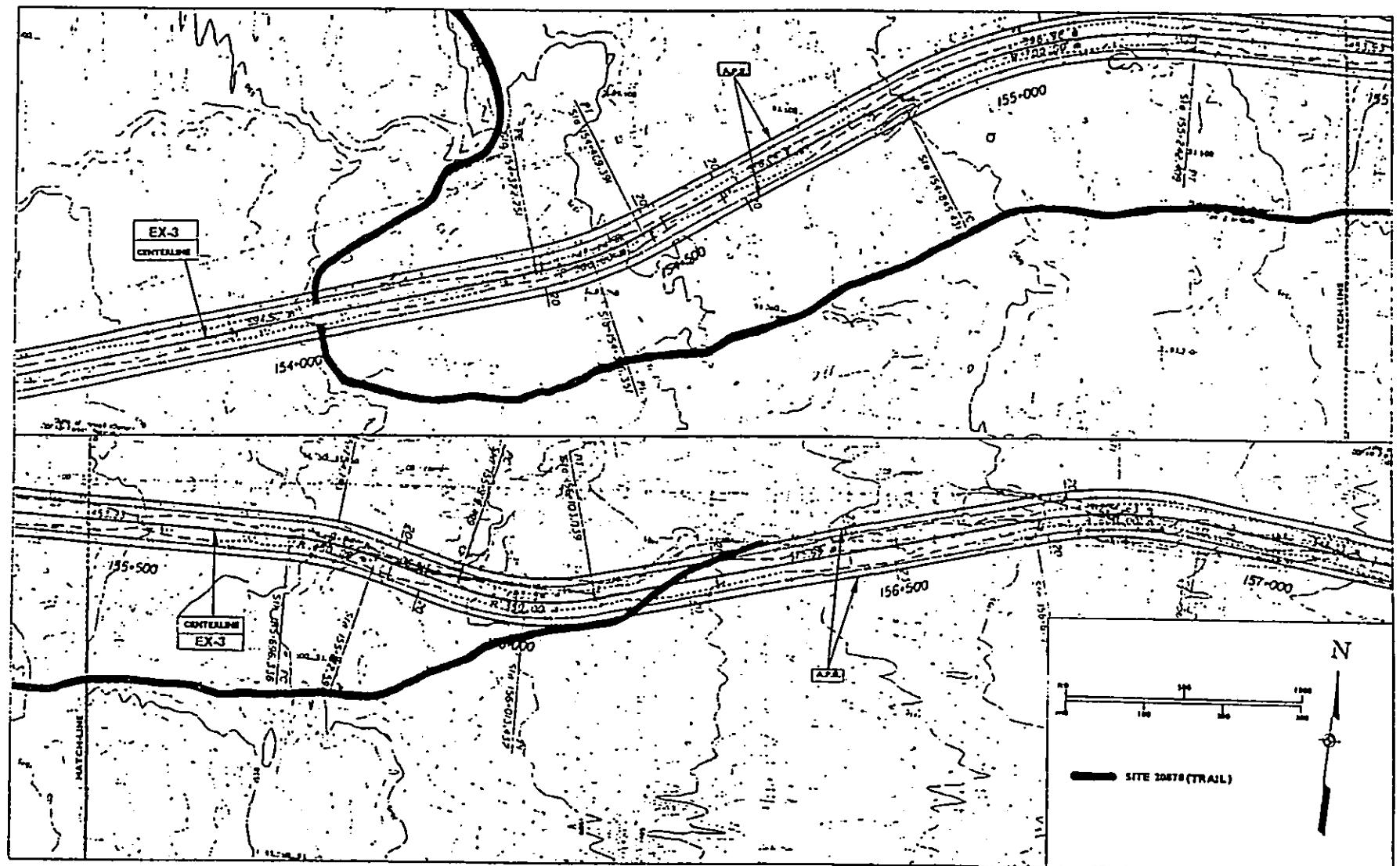


Typical Wall Cross-Section



Typical Wall Construction





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SITE 20878

FIGURE 3.24.5

Old Saddle Road (20864). The Saddle Road site (Site 20864) is the archaeological remains of the 86-km long road built by the Civilian Conservation Corps and the USACE during World War II in order to provide an access route in case of Japanese invasion. The roadway between Kaûmana and PTA was cleared by bulldozer in 1943. The road west of PTA (previously the Old Waimea-Humu'ula Wagon Road, Site 21150) was paved soon after 1945, and the road east of PTA was paved circa 1949. The route east of PTA was modified during the 1949 paving, with the result that two non-paved portions of the post-World War II road exist east of PTA along EX-3 corridor (Figure 3.24.5). The easternmost loop connects to corridor EX-3 near Station 170+300 and Station 168+640, and is on Hawaii Conference Foundation owned-land. The westernmost loop of old road connects to corridor EX-3 near Station 143+000 and Station 143+750, and is on Hawaiian Homes Commission owned-land. The site is made of these two non-paved loops. There are no planned facilities for these loops.

Small portions of the old Saddle Road (less than 10 m total) will be impacted by construction. The data contained within the site has already been recovered and no further data recovery efforts are necessary. If feasible, mitigation will include interpretive signage and a pull-out for motorists as appropriate.

'Ôla'a Flume (20870) The 'Ôla'a Flume (Site 20870) is the archaeological remains of a long flume (over 23 km) crossing the E-3 corridor at about Station No. 41+660 (Figure 3.24.6, *Site 20870*). The portion within the APE has collapsed and is disturbed by vegetation growth. The pieces left at the site indicate that the flume was constructed of galvanized metal. It was semicircular in cross section and measured 1.3 by 0.9 m and was 0.6 m. Sections of the flume were tied together with 3/8" metal rods threaded through small (10 by 7 cm, and 0.5 cm thick) steel plates. The flume was supported by a wooden substructure of planed 4 x 4's and 2 x 4's with the plates nailed to the substructure. The cross-pieces of the sub-structure support the flume joints from below. The interior of the flume was tarred to aid in water retention. The trough rested on the ground on redwood runners in high spots, and was built up on a redwood frame in low spots. Olaa Sugar Company constructed the flume between 1900 and 1903. Eventually the flume was replaced by trucks for transporting cane. The last year when cane was flumed was 1945.

The portion of the flume within the APE is on land owned by Wallace Young, the Liliy Wong Trust, Henry Young, Gladys Chun, Alan Young, Michael Young, Robert Young, and Kenneth Young, who control access to the site. There are no planned facilities at the site, and no other sites nearby. Construction will impact a portion of the flume archaeological remains (less then 40 m). The data contained within the site has already been collected. If feasible, mitigation may also include interpretive signage and a pull-out for motorists as appropriate.

3.24.2 Public Parks and Recreation Areas

Mauna Kea State Park. Mauna Kea State Park is the only public park in or near the area potentially affected by the project. The park property is designated as Tax Map Key (3rd) 4-4-16

Portion of 3, Parcels A and B. As shown in Figure 3.24.7, *Mauna Kea State Park, Parcel A and Parcel B,* the no Action Alternative encroaches on park lands (Source: Hawai'i State Department of Accounting and General Services files). Charles K. Supe, Hawai'i District Park Superintendent for the Hawai'i State DLNR, the agency with jurisdiction over the park, stated by letter of April 21, 1997, that none of the Action Alternatives encroach upon the park's lands or will adversely affect its operations (FEIS - Part II, 1.4.4).

Based on this information, no use of a public park as defined in Section 4(f), either through a direct take or constructive use, will occur.

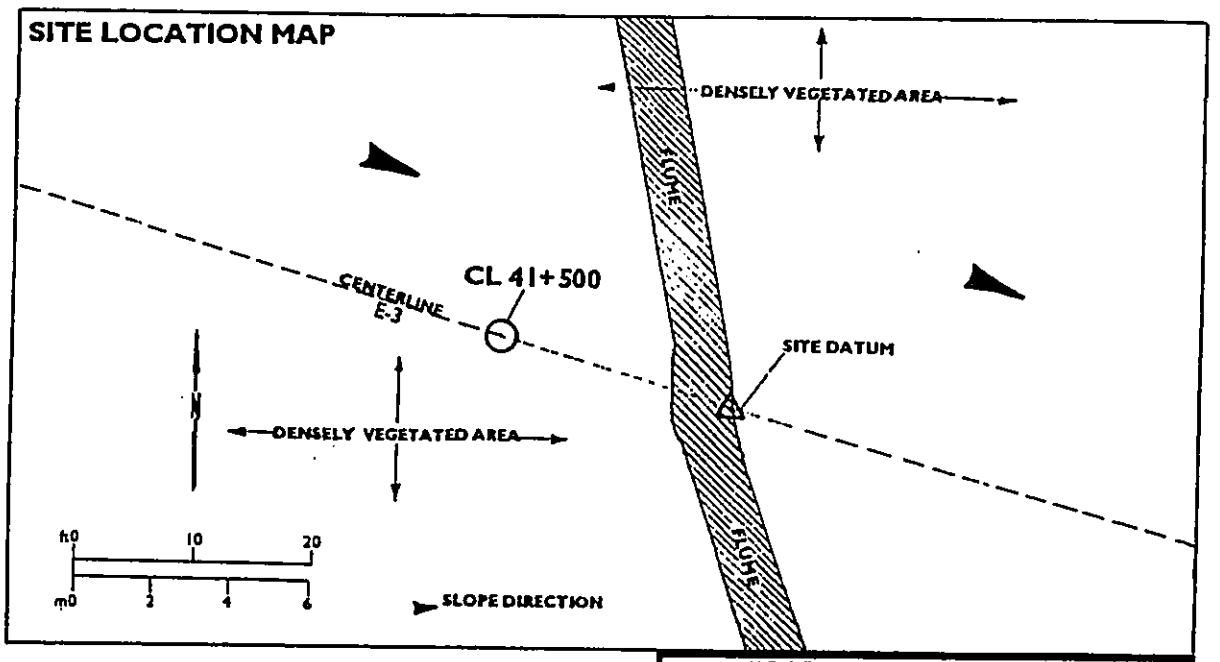
Kipuka 'Ainahou Nene Sanctuary. The Kipuka 'Ainahou Nene Sanctuary (KANS) is the only wildlife refuge located in or near the area potentially affected by the project (Figure 3.13.1). The 16,000 ha sanctuary was established in 1974 as part of recovery efforts for the endangered Nene (Nesochen sandvicensis). A total of 320 birds were released in the early 1970s, but none have been released in the past twenty years because of poor survival rates. Approximately 16 Nene are present in the general area, mostly concentrated outside the sanctuary.

The sanctuary is bounded on the north side by the existing Saddle Road between Stations 141+400 and 149+000. The Recommended Alternative in this location will remain within the existing roadway corridor to the extent possible. During final design of Alternative EX-3, there may be some encroachment of ROW within the KANS; however, in consultation with the USFWS and the DOFAW of DLNR, no adverse proximity effects or environmental impacts to Nene will occur.

During preliminary design, the amount of the potential encroachment was estimated as a 5 to 19-m wide strip of ROW along the 7.6-km boundary of the sanctuary with a total area of 9.8 ha. In response to a May 6, 1997 letter from FHWA transmitting this potential impact information and inquiring concerning the significance of this sanctuary to overall state refuge objectives, Michael Wilson, Director of the DLNR, the agency with jurisdiction over the sanctuary, responded in a June 9, 1997 letter (FEIS - Part II, 1.4.4):

"No successful production has been recorded in the Sanctuary within at least the last seven years. Because of these conditions, the sanctuary plays only a minor role in the overall recovery objectives of the Nene....because of the small reduction in the overall size of the Sanctuary (0.006%) and the avoidance of those areas that are used by the Nene, the proposed realignment of the Saddle Road is not expected to adversely affect the function or overall value of the Sanctuary."

Subsequent re-design of EX-3 will attempt to avoid any encroachment upon the sanctuary property by moving the alignment to the north. Based on the jurisdictional authorities' determination that the sanctuary does not contribute significantly to the overall Nene recovery objectives, it appears clear that no 4(f) take will occur even if there are minor unavoidable encroachments.



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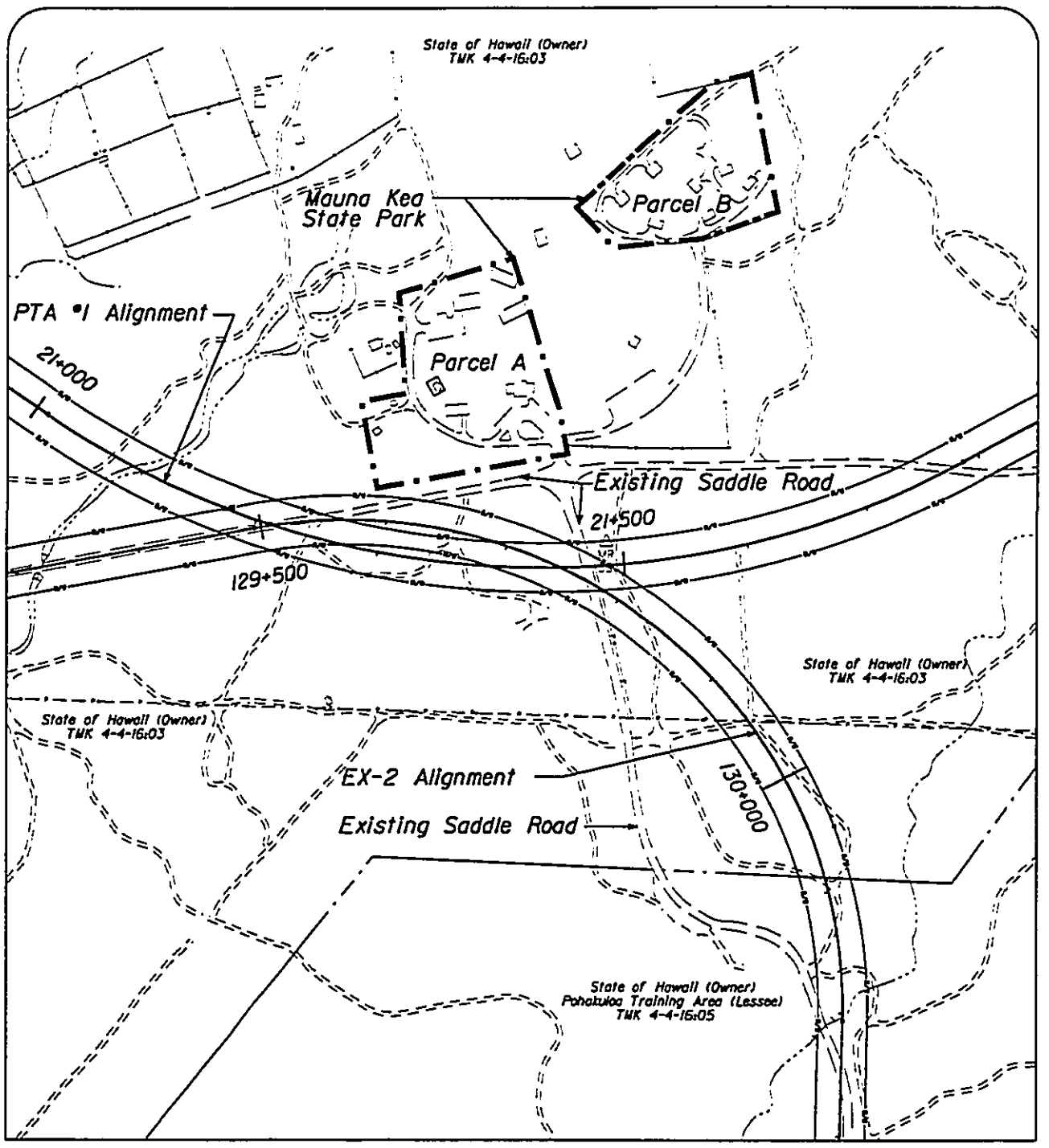
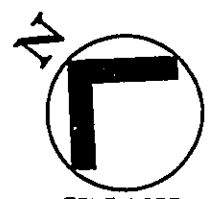
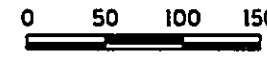
SITE 20870

FIGURE 3.24.6





TRUE NORTH



SCALE IN METERS

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DENVER, COLORADO

MAUNA KEA STATE PARK
PARCEL A & PARCEL B

FIGURE 3.24.7

CHAPTER 4
RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

CHAPTER 4 - RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A comparison of short-term use versus long-term productivity considers the commitments of resources that would directly or indirectly result from the project. For example, typical mining operations might significantly contribute to local short-term productivity of a land resource, but generally do not contribute to the maintenance and enhancement of its long-term productivity. For the purpose of this discussion, short term refers to the construction phase and the first 5 to 10 years of the project. Long term refers to the estimated life cycle of the project, or 20 years.

The proposed project would improve Saddle Road from the Mamalohoa Highway to MP 6. The work would include the rebuild of the existing road with major grade and alignment improvements and the realignment of portions of the road. Because it takes advantage of an existing road corridor for much of its length, the proposed project is considered an efficient means to achieve state and county transportation goals.

The project would require the direct taking or conversion of existing land uses into this transportation corridor use and the commitment of resources for road construction and regular maintenance. It would be expected to increase the number of cross-island vehicle trips, resulting in substantial changes in roadway use and traffic levels. It would strengthen economic conditions and increase access to public lands within the area. The improvement of Saddle Road is not expected to foster new development along Saddle Road.

Approval and implementation of the proposed project would begin the process of ROW acquisition and construction of the road in phases over a period of nine years. Over the life of the project, the construction phase would likely represent the period of most concentrated impact to the natural, biological, and social environment. Construction-related impacts such as soil erosion and sedimentation, the generation of air pollutants and dust, traffic congestion due to detours and delays, and noise from construction equipment, would be considered temporary and would not be expected to affect the area's long-term productivity.

The conversion of existing land use, the direct loss or displacement of sensitive native plants and wildlife, the degradation of historic resources and native Hawaiian cultural resources, and the modification of the visual environment would occur immediately; these impacts would not be retrievable for the long-term productivity of the area. Any inadvertent introduction or spread of aggressive alien species would be expected to result in a long-term impact to the region's biological resources.

Economic benefits associated with the construction efforts would occur immediately upon initiation of the project. Those economic benefits associated with increased cross-island traffic and time savings would begin following the construction period and would be expected to increase over time contributing to the long-term productivity of the area.

Mitigation measures committed for the project would be initiated and maintained over time as appropriate. The mitigation measures designed to contribute to the establishment of a second population of the endangered Palila and to provide a higher degree of fire protection to existing Palila habitat would contribute to the maintenance and enhancement of the region's long term productivity. No plant or wildlife species are expected to become extinct as a direct result of project activities.

Proposed improvements would enhance safety and reduce travel time for many cross-island commuters. While taking advantage of an existing road facility, the short-term use of project resources represents an efficient means to achieve a primary transportation goal.

CHAPTER 5
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CHAPTER 5 - IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Resources committed to the project would be material and nonmaterial, including financial. An irreversible commitment of resources refers to resources, once committed to the proposed project, that could not be restored to their pre-project condition. An irretrievable commitment of resources refers to resources used, consumed, destroyed, or degraded by implementation of the proposed project such that the resource cannot be retrieved or replaced in any form. As an example, while the crushing of stone to create an aggregate base is irreversible, the commitment of the resource is only irretrievable for the life of the project. Although the crushed stone cannot be un-crushed, it could be put to another use after the life of the project.

The proposed Saddle Road project is planned for completion in roughly nine years. The life cycle of a completed roadway segment spans a period of 20 years. Irreversible and irretrievable commitment of resources for the proposed project are summarized in Table 5.1, *Irreversible and Irretrievable Commitment of Resources.*

TABLE 5.1
Irreversible and Irretrievable Commitment of Resources

Resource	Type of Commitment	Irreversible	Irretrievable
Land Use	exclusion of residential, commercial and institutional uses in corridor	project life only	project life only
Farmland	property acquisition and loss of use	project life only	project life only
ROW/Relocation	property acquisition and relocation	yes	project life only
Air Quality	degradation of air quality	construction phase only	construction phase only
Noise	noise level exceeding ambient	yes	project life only
Fire Hazard	increase during life of project	yes	project life only
Water Resources	sedimentation	yes	construction phase only
Wetlands, Waters of U.S. and Floodplain	loss from construction	yes	yes
Geology and Soils	loss from construction	yes	yes
Biological Resources	modification of habitat, loss of flora and fauna	yes	yes

TABLE 5.1
Irreversible and Irretrievable Commitment of Resources

Resource	Type of Commitment	Irreversible	Irretrievable
Cultural Resources	disturbance or modification of sites	yes	yes
Native Hawaiian Resources	modification or loss	yes	yes
Visual	degradation of natural scenic quality and viewshed intrusion	project life only	project life only
Construction Materials, Fuels and Energy	use of: aggregate water steel concrete wood fossil fuels	yes yes yes yes yes yes	no yes no no no yes

CHAPTER 6
CUMULATIVE IMPACTS

CHAPTER 6 - CUMULATIVE IMPACTS

6.1 Overview

Cumulative impacts are the result of incremental impacts of an action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7).

Construction and implementation of the proposed Saddle Road when considered in conjunction with other past, present, and future actions on the Island of Hawai'i, would likely contribute somewhat to existing trends that impact environmental resources. Past military, agricultural, scientific, and residential development within the saddle area and the island as a whole has resulted in the loss or degradation of resources unique to the island. These resources include native plants, endemic wildlife, wetlands, sensitive habitats such as kipuka and mamane/naio forest, caves and lava tubes, historic and archaeological resources, native Hawaiian cultural and traditional resources, and visual resources.

The introduction and distribution of alien species to the Hawaiian Islands and the subsequent natural and human disturbance of native habitats has resulted in their conversion to alien-dominated communities. This conversion has contributed to the ongoing threat of extinction or extirpation for a number of endemic species and has substantially increased the risk of fire. These cumulative impacts are considered in more detail in Section 6.2. Development and land use conversion across the island has also caused soil erosion and sedimentation, water quality degradation, the destruction of lava tubes and caves, and the alteration of topographical features.

Within the vicinity of the project, activities that would be expected to continue include ranching operations, recreational facilities and public use areas, mining operations, bird and mammal hunting, Mauna Kea Science Reserve expansion, residential development and PTA training. Current trends also reflect increasing tourism, incidence of cross-island commuting, and the conversion of fallow sugar plantation lands to small-scale, specialized farming operations (ref: FEIS - Part I, 3.1.2). These activities and trends would be expected to contribute to the anticipated growth of traffic along Saddle Road, to indirectly expand the use of the area by residents and tourists, and to continue without the proposed project, albeit at a slower rate.

Further impacts to physical, biological, and cultural resources in the project vicinity may result from current plans and potential projects under consideration independent of the Saddle Road project. These include the expansion of Mauna Kea Science Reserve, the extension of the runway at Bradshaw Army Airfield, the construction of an additional HELCO transmission line, the installation of a GTE fiber optic transmission line, the extension of Puainako Street, and the development of an improved connection between Mamalahoa and Queen Ka'ahumanu Highways

(ref: FEIS - Part I, 3.1.4). These project are expected to proceed regardless of the implementation of the Saddle Road project; hence, these projects do not have a direct relationship to generating cumulative impacts.

Because of efforts to preserve and protect threatened and endangered species and habitats of special value, notable losses of public hunting lands have occurred since 1970. Past trends are expected to continue.

The development of Saddle Road would add to the cumulative impacts on the physical, biological, and cultural resources of the island. It would require acquisition of land, the conversion of native habitat and existing land uses, and it would result in the partial loss of some cultural resources. It would improve access, result in an increase in traffic volumes, and be expected to increase public use of the area.

Mitigation measures recommended for this project attempt to minimize the project's role in these overall cumulative impacts. The Palila and fire mitigation plans are designed to assist in the protection and recovery of native biological resources, including the endangered Palila, and involves the rehabilitation of suitable habitat (ref: FEIS - Part I, 3.18.3). The project should also enhance public access to and appreciation of cultural resources along the route.

6.2 Ecosystem Considerations

This section examines potential impacts to ecosystem components and functions that include interactions of the various environmental and biological resources present.

6.2.1 Affected Environment

Definition and Locations of Native Ecosystems

All ecosystems have general resource value providing services that may include erosion control, climate moderation, biomass production, aesthetic qualities and others. All parts of the project area that are vegetated support ecosystems providing these services whether or not the ecosystem is made-up predominantly of native or alien plants and animals. Native ecosystems have conservation resource values in addition to these general values. Alien-dominated ecosystems do not possess conservation value. Native ecosystems have these conservation values because they are made up of organisms and combinations of organisms unique to the State of Hawai'i and the Island of Hawai'i. These unique species and their ecosystems are valued for their special contribution to biodiversity in the Pacific ecoregion and elsewhere. The State of Hawai'i has recognized this unique biological character and established Conservation Districts (CDs) to protect it. Land use changes within CDs require application to the State of Hawai'i. Conservation Districts may be further subdivided into subzones defined by multiple conservation objectives and/or allowable uses (FEIS - Part I, 3.1.3.8).

Native ecosystems are those areas with native vegetation types described in the EIS (ref: FEIS - Part I, 3.13.1). They occur within all four roadway sections (Table 6.2.1 *Conservation Status of Native Ecosystems Adjacent to Proposed Project*). Some of the physical and biological aspects of the native ecosystems are summarized in Table 6.2.2, *Ecosystem Resource Summary*.

TABLE 6.2.1
Conservation Status of Native Ecosystems
Adjacent to Proposed Project

Saddle Road Station Numbers	Adjacent Vegetation Type [1]	Landowner	Land Use	Adjacent Conservation District to North Side/to South Side
Section I - W-3				
115+000-119+000	HLG AWS	State	Military	Protected Subzone/ Resource Subzone
Section II - PTA-1				
10+000-27+000	HLG, AWS, AS, MNF, PVLF	State	Military	Protected Subzone/ Resource Subzone
29+500-31+000	PVLF	DHHL	Open	Not in CD/ Protected Subzone
Section III - EX-3				
140+700-146+000	SDS, MDS, MDF	DHHL	Pasture/ Nene Sanctuary	Not in CD/ Protected Subzone
146+000-168+000	MDS, MMF, MWF	State	Forest Reserve	Resource Subzone/ Protected Subzone
168+000-170+000	MWF	Private	Forest Reserve	Protected Subzone/ Resource Subzone
170+000-156+000	MWF	State	Forest Reserve	Resource Subzone/ Resource Subzone

TABLE 6.2.1
Conservation Status of Native Ecosystems Adjacent to Proposed Project

Saddle Road Station Numbers	Adjacent Vegetation Type [1]	Landowner	Land Use	Adjacent Conservation District to North Side/to South Side
Section IV - E3				
40+000-41+400	MWF	State	Forest Reserve	Resource Subzone/ Resource Subzone
41+400-42+500	LWF	Private	Pasture	Not in CD

[1]Vegetation Types Referenced:

AS-'A'alii Shrubland	AWS-'Aweoweo Shrubland	HLG-Hard-stemmed Lovegrass Grassland
LWF-Lowland Wet Forest	MDF-Montane Dry Forest	MDS-Montane Dry Shrubland
MNF-Mamane/Naio Forest	MMF-Montane Mesic Forest	MWF-Montane Wet Forest
PVLF-Pioneer Vegetation on Lava Flows	SDS-Subalpine Dry Shrubland	

TABLE 6.2.2
Ecosystem Resource Summary

Resources	Section (Segment)			
	I (W-3)	II (PTA-1)	III (EX-3)	IV (E-3)
Native Ecosystem Extent (km) **Potential Clearing (ha)	3.2 10	16.9 73	30.7 97	2.5 11
Rare Communities	Sighted(1)	Sighted(1)	Sighted(1)	Not Known(2)
Native Wetlands (ha)	0.0	0.0	2.4	0.5
Caves	Not Known(2)	Sighted(1)	Sighted(1)	Sighted(1)

TABLE 6.2.2
Ecosystem Resource Summary

Resources	Section (Segment)			
	I (W-3)	II (PTA-1)	III (EX-3)	IV (E-3)
Threatened and Endangered Plants (# of species)	None found [2]	Sighted in Vicinity[3] (1 species)	Sighted in Vicinity[3] (3 species)	None found [2]
Endangered Bat	Sighted[1]	Sighted[1]	Sighted[1]	Sighted[1]
Endangered Birds				
Nene	Not Sighted[4]	Not Sighted[4]	Not Sighted[4]	None found [2]
'I'o	None Found [2]	None Found [2]	Not Sighted[4]	Not Sighted[4]
Palila	None Found [2]	Sighted[1]	None found [2]	None found [2]
Newell's Shearwater	Transits Area[5]	Transits Area[5]	Transits Area[5]	Transits Area[5]
Dark-Rumped Petrel	Transits Area[5]	Transits Area[5]	Transits Area[5]	Transits Area[5]
Other Native Birds	Not Sighted[4]	Sighted[1]	Sighted[1]	None found [2]
Native Snails	Sighted[1]	Sighted[1]	Sighted[1]	None found [2]
Rare Insect Species	Sighted[1]	Sighted[1]	Sighted[1]	None found [2]

[1] - sighted during EIS survey within the survey corridor*.
[2] - not found during survey, nor known from area.
[3] - sighted in vicinity, outside of ROW**.
[4] - recorded as habitat for species, but not sighted during EIS survey.
[5] - known to transit the area; no suitable habitat within ROW.
**ROW width = 30m-50m variable, construction limits are less than ROW width.
*Survey Corridor = 60m width.

6.2.2 Environmental Consequences

6.2.2.1 Analysis of Direct, Indirect, and Cumulative Impacts

Actions that may have impacts are grouped according to the conservation biology concepts of *habitat loss*, *habitat degradation*, or *habitat fragmentation*.

Short-Term Direct Impacts

Short-term direct impacts are those that occur only *during* the construction phase.

Habitat Loss. Since the construction-related impact of clearing habitat for the roadway is a permanent impact, this form of habitat loss is treated in the next section on long-term impacts.

Habitat Degradation. Temporary construction disturbances, including noise, dust, and exhaust emissions, will result in temporary habitat degradation. Noise may frighten animals away temporarily. Dust may cover the leaves of plants, reducing light absorption, or may cover the flowers, interfering with pollination and seed production until rainfall cleanses them. Uncontrolled runoff during rainfall may cover small plants and soil-living animals. These adverse impacts are expected to be of short duration and, moreover, occur only very near the construction areas (ref: Section 3.23.1). The NPDES Permit, Best Management Practices, and Contract Specifications will substantially limit and/or prevent most of these impacts.

Operation of construction equipment and use of fire (e.g. smoking) increase the potential risk of fire. Fire may spread from near the roadway into more distant parts of the native ecosystems, especially in the dry portions of Sections I and II. Fires would have catastrophic effects on plant communities in these sections. Wildfire promotes the spread of fountain grass, a noxious alien bunch grass that competes with the native plants and readily catches fire to repeat the cycle. Construction contract specifications governing contractor operations will prevent this possibility. These specifications will be enforced by an on-site project engineer.

Long-term Direct Impacts

Long-term direct impacts are those direct impacts associated with the presence of the road feature and its use. These impacts are compared to the level of impact of the existing road with future traffic levels. The No Action Alternative would have direct long-term impacts since it has been shown that the existing Saddle Road will carry more traffic in the future whether or not it is improved.

Habitat Loss. Areas of native habitat to be destroyed by roadway construction are described by community type in the FEIS, Section 3.13 and summarized in Table 6.2.2.

These include losses within three plant communities mapped by the Hawai'i Natural Heritage Program and are sometimes described as "rare communities." These three, Mamane/Naio Forest (MNF), Aweoweo Shrubland (AWS), and the Hard-stemmed Lovegrass Grassland (HLG) occur only on Mauna Kea. The latter two occur primarily in the Saddle Area on or near the Pohakuloa Training Area. Table 6.2.3, *Impact to Rare Communities as a Result of Project Construction (ha)*, outlines the hectares of rare communities that would be impacted by the proposed project.

TABLE 6.2.3
Impact to Rare Communities as a Result of Project Construction (ha)

Habitat	W-3	PTA-1	EX-3	E-3
Mamane/Naio Forest	0.0	29.7	0.0	0.0
'Aweoweo Shrubland	4.1	12.3	0.0	0.0
Hard-stemmed Lovegrass grassland	6.1	9.4	0.4	0.0

Jurisdictional wetlands occur in Sections III and IV (ref: FEIS - Part I, 3.11). The wetlands occur within a mosaic of upland vegetation. The wetlands are usually small depressions, one to several meters in diameter, formed in impervious lava basins or in cracks between lava slabs that have become plugged. No plant or animal species were found within the wetlands that did not occur in the surrounding upland vegetation. These wetlands are recognized as an integral part of their ecosystems but were not found to have a biological function different from the surrounding vegetation and were not found to provide habitat or any unique resources to organisms outside their neighboring community. Such wetland mosaics are widespread within the region. The Recommended Alternative within Sections III and IV would fill jurisdictional wetlands within the proposed ROWs.

Habitat Fragmentation. Habitat fragmentation occurs when large natural areas are divided into smaller segments. Fragmentation may cause two types of impacts. First, the roadway could provide new corridors into the ecosystems for degrading factors including fire, alien species, and off-road human uses. As stated in the Final BO, however, these possibilities exist now and will increase with the increased traffic and local motorists' off-road use irrespective of the proposed project. These are discussed below as habitat degradation. Second, the roadway may present a barrier to the movement of some organisms, isolating formerly interacting populations into smaller sub-populations. Some fragments may be too small to be viable, self-sustaining ecosystems. The area of native ecosystem that could be degraded due to fragmentation is potentially greater than the area lost directly during construction.

The existing Saddle Road fragments native ecosystems and, in some locations, the proposed realignment would further fragment some of them. In some locations, narrow strips of habitat would be isolated between the existing alignment and the proposed alignments. However, the existing alignment, in most cases, will be rehabilitated.

It is not likely that the road would interrupt the pollination or establishment of plants. While native birds and flying insects could easily cross the roadway, the noise and activity along the roadway may create a wider corridor that might alter use of the habitat and possibly mating

patterns. It is reasonable to assume that the roadway would present some obstacle to the movement of invertebrates such as snails or non-flying insects.

The potential of the road to act as a barrier, leading to deterioration of ecosystem function, is related to the effective width of the roadway and its influence on the roadside vegetation. The influence of the roadway will be essentially limited to the pavement and mowed shoulders and therefore, the effect will probably not be important. If a wide corridor is degraded, the native ecosystems on the north or south sides could become isolated. This effective widening would occur if the roadway: 1) promotes establishment of vigorous alien plants that further invade nearby areas; 2) promotes excessive off-road human use with trampling, harvesting, and other degradation of the vegetation; and 3) promotes further development of infrastructure projects along the alignment. However, mitigation measures have been developed to limit or prevent the first two impacts. The limited potential for future adjacent development is discussed in the FEIS - Part I, 3.1.1. This consequence is further discussed below.

Fragmentation of the three rare communities of Sections I and II, described above, could potentially be serious. The Recommended Alternative in Section II creates two large fragments. These fragments are subject to degradation, as described above, should the recommended mitigations not be implemented. Mitigation measures in place in this section limit this potential substantially.

Habitat Degradation. In addition to habitat fragmentation, the combined potential of wildfire and the introduction and spread of alien species are serious threats to the native ecosystem. In the dry Sections I and II the existing Saddle Road has been identified as a source of wildfire. Fires can be ignited by passing motorists or accidents. Fire is not a threat in the much wetter parts of Sections III and IV. Substantial mitigation investment is being made in road features, fire fighting capabilities and early warning and prevention planning to prevent fire and aid in early suppression in these two sections.

It is more difficult to determine the role of the existing road in the spread of alien species because of the simultaneous use of the area for many other activities, including military training, nearby ranching, hunting, and gathering activities. Although there are no known, documented cases of Saddle Road being the primary route of invasion by an alien species, as the major access into the region, the existence of the road furthers the spread of alien species that are dependent upon human activity, and the degradation caused by the combination of all human uses in the region is cumulative.

In Section III, above milepost 12, the roadside vegetation beyond the shoulders has not been invaded by alien plants. Below that marker, invasion by the noxious tree wai awi (*Paidium cattleienum*) is widespread within the communities on the old lava flows, both near and far from the existing road. Wai awi does not grow on the new lava flows where the Recommended Alternative is proposed. Therefore, this placement will reduce the threat that construction would spread this noxious species.

In Section IV, alien plants are widespread and abundant. Construction of E-3 could be expected to enhance the establishment of some alien species, even on the new lava flow; however, all disturbed areas will be restored and maintained to enhance native vegetation re-establishment. Undisturbed areas will be preserved and maintained to sustain native biological communities. At lower elevations, the vegetation is already heavily degraded by alien plants and grazing animals; the proposed alignment would not add noticeably to the degradation here.

Noise, lights and air pollution from automobile traffic would affect areas near the road. Traffic accidents and other spills of industrial materials may also degrade the roadsides. These impacts are expected to quickly dissipate with distance from the road and to be of minor importance.

Indirect Impacts

Indirect impacts are not caused by the primary function of Saddle Road but may occur because of its existence. These are mostly impacts that may occur away from the roadway due to increased usage and improved access. Impacts are compared to the existing road with future traffic levels.

Habitat Loss. Further loss of native habitat could occur if the proposed action increases development within native ecosystems. Development is generally constrained by land ownership and zoning regulations. Areas that have potential for development or change of land use are summarized below. The proposed improvements to the Saddle Road could make new development more likely outside of Conservation Districts.

Land use, ownership and conservation zoning are summarized in Table 3.24.1 (ref: FEIS 3.1.1, 3.1.3.8 and 3.15). Conservation zoning refers to the State of Hawai'i Land Use Classification. Conservation Districts are further subdivided into subzones that permit varying levels of use. The Protective Subzone gives priority to protection of the existing natural resources; in the Resource subzone, permits for a broader range of activities can be granted, e.g. residential, commercial, forestry, and extraction of natural resources (Hawai'i Administrative Rules 13-5-24).

In Sections I and II, the state-owned land leased to the military is not subject to private development but use may be altered by the military. Such changes in use are subject to NEPA and other federal and state environmental regulation.

In Section II and III, lands owned by DHHL are in the State's Agricultural District, not the Conservation District. DHHL has developed a master plan for use of their lands along the Saddle Road (Piihonua and Humu'ula). The master plan includes commercial facilities, homestead residences, plantation forestry and continued ranching. DHHL does not always recognize jurisdiction of County and State regulation.

Most of the rest of Section III is State-owned Forest Reserve, partly designated watershed. Between approximately mileposts 9 and 11, the land is privately-owned. This parcel includes

ecologically sensitive and diverse kipuka near the Saddle Road. Outside the proposed ROW, by more than 200 m, is the habitat of a population of an endangered plant species, *Cyanea platyphylla* (ref: 3.13.1.2.8 and 3.18.1). This parcel was formerly leased by the County of Hawai'i Department of Water Supply. Development of this privately owned land would be constrained by the Conservation District classification; most of the parcel is in the Resource Subzone, making some use or development possible.

In Section IV, privately-owned Agricultural land is currently used for grazing. Although considered a native ecosystem, these areas on the outskirts of Hilo are already degraded due to past use. Neither ownership nor land use classification would constrain more intensive development in this area.

Habitat Degradation. Native ecosystems can be degraded by off-road use. These uses range from those very near the roadway, such as parking on the roadside vegetation and dumping trash, to the more distant impacts of hunters and hikers. The adverse impacts result from direct impacts of trampling, trail making, and cutting plants; but more importantly, include the potential to spread noxious alien plants or to ignite wildfire.

Without mitigation commitments for Section I, II, and IV, construction of the Recommended Alternative would impact new areas by allowing access to native habitat areas that are now not accessible by vehicle.

In Section III, off-road use could occur in the same location as before if access locations are not provided as planned; increased use by a larger number of people at these locations would lead to a higher degree of degradation. However, it is likely that the amount of off-road use would increase only slightly. Most of the traffic using the improved road would be commuters not stopping along the roadway. It is expected that the road would carry a greater number of visitors; it is assumed that only a few of these would hike any distance from the road. Most off-road use is by island residents who are not deterred by the present condition of the road (ref: FEIS - Part I, 3.3.4.2).

Habitat Fragmentation. As previously discussed, the severity of adverse habitat fragmentation would be dependent on the effective width of the Saddle Road corridor as a barrier to the movement of native organisms and to its importance as a source of invasion by alien organisms. If the possible impacts previously described are allowed to degrade the native vegetation near the road by allowing an alien-dominated community to become established, it is possible that these alien species would spread farther from the road resulting in severe fragmentation impacts.

Cumulative Impacts

General cumulative impacts of regional development are discussed elsewhere in this chapter. Several potential cumulative impacts with specific implications for the Saddle Road corridor are summarized below (ref: FEIS - Part I, 3.1.4).

Saddle Road is used as an infrastructure corridor, including two existing power transmission lines with a service road. A fiber optic transmission line is planned. A water transmission line with pumping stations has been proposed but is not currently under consideration. The strategic location of Saddle Road will always make it an attractive route for such projects. Construction and maintenance of existing, planned, and potential future infrastructure may result in disturbance of the native ecosystems near Saddle Road if these facilities are not carefully planned.

Continued use of the PTA for military training impacts the same native ecosystems in Sections I and II that would be affected by the Recommended Alternative for Saddle Road. These include the rare communities discussed previously.

DLNR has changed the designation of some of the forest reserves in Section III. Recognizing the increased demand for recreational areas and other uses, the designation of "closed watershed" has been changed to "protected watershed." This change allows a somewhat wider range of activities but still requires permits. This change may lead to greater use and possible degradation in some areas.

As discussed in the previous section, DHHL has developed a conceptual master plan for the development of lands adjacent to the Saddle Road in Section II and III.

6.2.2.2 Conclusion of Impact Analysis

The effects of short term impacts would not generally be considered serious.

The direct loss of habitat might not be serious, but the habitat fragmentation and possible degradation along alignments that do not follow the existing road could be, especially in the three rare plant communities of Section I and II, if recommended mitigation measures are not implemented.

The potential increase in risk of wildfire at new locations in Sections I and II is a serious concern; however, the mitigation measures proposed reduce this risk below that of the existing road with future traffic levels.

Some development and future loss of habitat may occur along Saddle Road. Such development might occur regardless of improvements of Saddle Road.

6.2.3 Mitigation Measures

Measures to mitigate potential adverse impacts are detailed in specific sections of Chapter 3 and Section 3.18.3.

In the future, further native habitat may be lost to development or other uses within the Saddle Road corridor. Most of the native ecosystems are within the State land use Conservation Districts. Prevention of habitat loss is the responsibility of the State Board of Land and Natural Resources, the permit issuing body, and is regulated very strictly from a resource conservation perspective.

Degradation by wildfire will be prevented by extensive measures presented in 3.9.3. These include the use of paved firebreaks in vulnerable areas and enhanced fire-fighting capabilities of the PTA fire department. In addition, a fire ecologist would be contracted to develop a comprehensive fire management plan complete with risk assessment protocols and guidelines for use by the PTA fire department and other fire-fighting entities.

Degradation by establishment of alien plants would be prevented by measures detailed in 3.18.3, including periodic surveys and control measures.

In areas where the Recommended Alternative does not follow the existing road, habitat fragmentation cannot be avoided. Adverse impact of fragmentation will be reduced by design efforts to minimize the width of the actual construction limits (cut/fill areas). Construction damage will be kept to a minimum by measures described in 3.23.2. Degradation along the roadway will be minimized by the prevention and rapid suppression of fire and by minimizing the potential for alien plant establishment through preventative maintenance procedures.

Increased off-road usage could also contribute to the fragmentation of habitat. In consultation with USFWS and DOFAW, pullouts will be sited and designed to encourage motorists to stop only in non-sensitive areas. Signage will be used to encourage use of the shoulder for emergency purposes only and to note designated parking areas.

CHAPTER 7
PREPARERS

CHAPTER 7 - PREPARERS

NAME	*EDUCATIONAL BACKGROUND*	*APPLICABLE EXPERIENCE (Years of Experience)*	*PROJECT RESPONSIBILITY*
Federal Highway Administration (Lead Agency)			
Dave Gedeon, P.E.	University of Colorado, M.B.A., 1981 Ohio University, B.S. (Civil Engr.), 1970	Transportation design and project management (25 yrs)	FHWA Project Manager - design, funding and resource scheduling
Bert McCauley, P.E	Penn State University, Bureau of Highway Traffic, 1973 Texas Tech University, B.S. (Civil Engr.), 1970	Traffic & transportation planning, design and management, NEPA coordination (25 yrs)	FHWA Environmental Project Manager
Glenn Yasui, P.E.	University of Southern California, M.P.A., 1985 University of Hawai'i, B.S. (Civil Engr.), 1964	Highway engineering and administration (33 yrs)	FHWA Local Project Coordinator
Rust Environment and Infrastructure (Project Management and Design; Traffic, Noise and Air Analysis)			
James Anderson, P.E. and L.S.	Colorado State University, B.S. (Civil Engr.), 1951	Road design, location and construction, NEPA documentation, Section 7 consultations (46 yrs)	Rust Contract Manager
Craig Chumbly	University of Iowa, Ph.D. (Botany), 1989 University of Iowa, M.S. (Botany), 1984 University of Northern Iowa, B.A. (Biol.), 1974	Stamina/Optima noise modeling, field noise measurements (10 yrs)	Noise Study Specialist
Don Griner, P.E.	University of Colorado, B.S. (Civil Engr.), 1981 Southern Illinois University, A.T. (Architecture), 1968	Bridge and roadway planning, design and project management (27 yrs)	Rust Project Manager - preliminary engineering and environmental studies
Christian Sherry	New Mexico State University, M.S. (Geology), 1990 Ohio Wesleyan University, B.A. (Geology), 1986	Environmental documentation, hazardous materials studies (7 yrs)	Hazardous Materials Study Specialist
Sharon Wavering	Pittsburgh Technical Institute, (Computer Tech), 1985	CADD technician, road design (10 yrs)	Roadway Designer

Randal Weyrauch, P.E.	North Dakota State University, B.S. (Civil Engr.), 1986	Rural highway design, coordination of NEPA documentation (11 yrs)	Project Engineer - design of preliminary plans, coordination of environmental documents
EcoPlan Associates, Inc. (EIS Preparation)			
Bruce Brown	Utah State University, M.S. (Agricultural Economics), 1974 Utah State University, B.S. (Economics), 1973	Resource economics, NEPA documentation, natural resource project development (23 yrs)	Economics analysis and NEPA documentation
William Davis	California State University, M.S. (Water Pollution Biology), 1966 California State University, B.S. (Fisheries), 1965	Water quality analysis, NEPA documentation (30 yrs)	NEPA documentation
Leslie Stafford	Arizona State University, Graduate coursework (Geomorphology), 1980 Arizona State University, B.S. (Physical Geography), 1979	Environmental analysis, NEPA documentation (21 yrs)	NEPA documentation, EIS preparation
Beth McMichael	Arizona State University, Graduate coursework (Botany), 1995 University of Arizona, B.A. (Arts and Sciences), 1993	Environmental analysis, NEPA documentation (7 yrs)	NEPA documentation, EIS preparation
George Ruffner	Arizona State University, Ph.D. (Botany), 1985 Texas A&M University, M.S. (Wildlife), 1975 Northern Arizona University, B.S. (Zoology), 1972	NEPA documentation, Section 7 consultations, 404 permitting (25 yrs)	EcoPlan Project Manager - NEPA documentation
Rana Productions, Ltd. (Vertebrates)			
Reginald David	University of Denver, 1972	Field Ornathology, Hawai'i and Tropical Pacific Terrestrial vertebrate surveys, Section 7 consultations (19 yrs)	Biologist - terrestrial vertebrate surveys, Biological Assessment, Section 7 consultation

Bishop Museum (Invertebrates)			
Robert Cowie	University of Liverpool, Ph.D. (Zoology), 1982 University of Cambridge, M.A. (Zoology), 1979 University of Cambridge, B.A. (Zoology), 1975	Malacological research and contract surveys (22 yrs)	Biologist - malacologist
Neil Evenhuis	University of Hawai'i, Ph.D. (Entomology), 1988 California State Polytechnic University, M.S. (Biology), 1977 California State Polytechnic University, B.S. (Zoology/ Entomology), 1974	Entomological research and contract surveys (26 yrs)	Biologist - entomologist, invertebrate survey
Francis Howarth	University of Hawai'i, Ph.D. (Medical Entomology and Systematics), 1974 Cornell University, M.S. (Medical Entomology and Systematics), 1966 University of Massachusetts, B.S. (Entomology and Chemistry), 1962	Entomological research and contract surveys (27 yrs)	Biologist - entomologist
Gordon Nishida	San Jose State University, M.A. (Entomology), 1975 University of California, B.A. (Biology), 1968	Entomological research and contract surveys (26 yrs)	Biologist - entomologist
Allan Samuelson	Purdue University, Ph.D. (Entomology), 1970 University of Arizona, M.S. (Entomology), 1961 San Jose State University, B.A. (Biology), 1959	Entomological research and contract surveys (37 yrs)	Biologist - entomologist
Char and Associates (West-side Botany)			
Winona Char	University of Hawai'i, M.S. (Botanical Sciences), 1983 University of Hawai'i, B.A. (Botanical Sciences), 1970	Botanical surveys & reports, natural resources management plans, Section 7 consultations, NEPA documentation, wetland delineations (20 yrs)	Botanical Assessment: West side

Palmer and Associates Consulting (East-side Botany)

Rexford Palmer	University of California, Ph.D. (Botany), 1982 University of California, M.S. (Botany), 1976 California State University, B.A. (Botany), 1972	Biological and botanical assessments (25 yrs)	Botanical Assessment: East side

PHRI (Cultural Resources)

Charles Langlas	University of Hawai'i, Ph.D. (Anthropology), 1974 Iowa State University, B.S. (Chemistry), 1964	Ethnography, oral history, cultural and social anthropology (20 yrs)	Ethnographer, ethnohistorical research, Traditional Cultural Properties
Thomas Wolforth	University of Wisconsin M.S. (Anthropology), 1989 Indiana University, B.S. (Anthropology), 1982	CRM archaeology reports, SHPO archaeologist, Section 106 process (15 yrs)	Cultural Resources Project Manager

Okahara and Associates, Inc. (Land Use, Hydrology, Hydraulics, Recreation, Small Studies)

Nancy Burns, P.E.	University of Lowell, B.S. (Civil Engr.), 1984	Civil Engineering, Permitting, project management (13 yrs)	Project Engineer and Civil Design
William Moore	York University (UK), Graduate Diploma (Economics), 1977 Beloit College, B.A. (Business/Economics), 1974	Planning, project management and development, NEPA documentation (21 yrs)	Project Planner
Masahiro Nishida, P.E.	California State Polytechnical University, B.S.C.E. (Civil Engr.), 1971	Roadway design, NEPA documentation (26 yrs)	Okahara Project Manager
Donald Okahara, P.E.	Oregon State University, B.S.M.E. (Mechanical Engr.), 1962	Water development and transmission, NEPA documentation, agriculture feasibility (38 yrs)	Principal-In-Charge
Jay Uyeda, P.E.	University of Hawai'i, B.A. (Mathematics), 1990	Civil engineering (8 yrs)	Project Engineer

Hahn and Associates (Social, Economics, Native Hawaiian Culture)			
Youngki Hahn	University of California, Ph.D. (Economics), 1971 Ohio State University, M.B.A. (Economics), 1963 Muskingum College, B.A. (Economics), 1961	Economic analysis (15 yrs)	Assessment of Economic Impacts
Ed Kanahele	University of Hawai'i, M.A. (Hawaiian History), 1982 University of Hawai'i, B.S. (Hawaiian Studies), 1975	Native Hawaiian cultural assessments, Hawaiian history (25 yrs)	Social Assessment: Native Hawaiian Culture
Pualani Kanahele	University of Hawai'i, B.A (Hawaiian Studies), 1982	Native Hawaiian cultural assessments, Hawaiian history (15 yrs)	Social Assessment: Native Hawaiian Culture
Ron Terry	Louisiana State University, Ph.D. (Geography), 1988 University of Hawai'i, B.A., (Geography) 1980	Social analysis (5 yrs)	Assessment of Social Impacts
Logan, Simpson and Dye (Visual)			
Diane Simpson-Colebank, R.L.A. and A.S.L.A.	University of Colorado, M.L.A. (Landscape Architecture), 1984 University of Georgia, B.S. (Biology), 1974	Visual resource impact analysis and documentation, scenic corridor management plan preparation, scenic resource evaluation (23 yrs)	Visual Resource Specialist
Geolabs Hawai'i (Geotechnical Analysis)			
Robin Lim	University of California, M.S. (Geotechnical Engr.), 1989 University of California, B.S. (Mining Engr.), 1987	Geotechnical engineering analysis and feasibility studies, earthwork monitoring, landslide and site soil studies (10 yrs)	Geotechnical Project Manager
Donaldson Enterprises, Inc. (Unexploded Ordnance)			
Byron Donaldson	U.S. Marine Corps training and certification	Explosive ordnance disposal (25 yrs)	Ordnance Disposal
Norman Garon	U.S. Navy training and certification	Explosive ordnance disposal (22 yrs)	Ordnance Disposal
Ronald Boyd	U.S. Navy training and certification	Explosive ordnance disposal (15 yrs)	Ordnance Disposal

R.M. Towill, Inc. (Aerial Survey and Mapping)

Robert Lee	University of Hawai'i, B.S. (Civil Engr.), 1973	Land surveying, GPS systems (25 yrs)	Photogrammetric Control and Mapping Project Manager

Island Survey, Inc. (Alignment Staking)

Robert Shirai, PLS	Hawai'i Community College, 1974	Land surveying (25 yrs)	Principal Surveyor

Grant Gerrish, Ph.D. (Wetlands)

Grant Gerrish, Ph.D.	University of Hawai'i-Manoa, Ph.D. 1988, M.S. 1974; Ball State, B.S. 1974	Hawaiian Ecosystem Research (23 years); Environmental Analysis (10 years)	Wetlands

CHAPTER 8
LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE FEIS WERE SENT

CHAPTER 8 - LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE FINAL EIS WERE SENT

Locations where FEIS is available for public review are designated with bold type.

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Mr. Wayne Tanaka
Field Representative
Office of Senator Inouye
P.O. Box 41
Kealakekua, HI

Mr. William Y. Kikuchi
Field Representative
Office of U.S. Senator Daniel K. Inouye
101 Aupuni Street, Suite 205
Hilo, HI 96720

Lt. Col. Wally Z. Walters, Commander
U.S. Army Corps of Engineers
Honolulu Engineering District
Building 230, Room 203
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Honolulu, HI 96858

Mr. Wayne Hamaguchi, Chief
Planning Branch
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Ms. Genevieve Salmonson, Director
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Mr. Denis R. Lau, Branch Chief
Clean Water Branch
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CHAPTER 9
MITIGATION SUMMARY

CHAPTER 9 - MITIGATION SUMMARY

Measures contained in FHWA's standard specifications to minimize environmental harm are incorporated into the construction contract documents as requirements of the contractor and subcontractors and are enforced by the Project Engineer. Some mitigation commitments will be included in the construction contract documents as Special Contract Requirements written in specification format for this project only. Similar measures will be provided by HDOT pursuant to their standard specifications for construction of those segments under their authority.

9.1 STANDARD SPECIFICATIONS FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS

- Control of work, including measures to avoid environmental harm and implementation of permit requirements and mitigation measures is the responsibility of FHWA's Contracting Officer or the Contracting Officer's Representative; i.e., Project Engineer.

- Operate construction equipment within all legal load restrictions when hauling material and equipment on public roads to and from the project. On the existing road, operate and schedule construction in a manner that does not conflict with traffic flow and minimizes delays to the public.

- For sources of material used in construction, determine existing sediment levels in adjacent bodies of water prior to construction. Control all erosion so that sediment levels do not increase. Reconfigure and revegetate all locations used as sources of material.

- Comply with applicable laws, ordinances, safety codes, regulations, orders, and decrees. All permits and agreements obtained by the government for performing the work are included in the construction contract documents.

- Preserve public and private property. Do not disturb the area beyond the construction limits. Do not excavate, remove, damage, alter, or deface any archaeological or paleontological remains of specimens. Ensure that protected sites are not damaged. Cooperate with utility providers to locate, move, or modify existing utilities while minimizing service disruptions.

- Do not operate mechanized equipment or discharge or otherwise place any material within the wetted perimeter of any waters of the U.S. Comply with the terms and conditions of any permits that are issued for the performance of work within the wetted perimeter of waters of the U.S. Separate work areas, including materials sources, from waters of the U.S., by the use of dike or other suitable barrier that prevents sediment, petroleum products, chemicals, or other liquid or solid material from entering the waters

of the U.S. Remove and properly dispose of the sediment or other material collected by the barrier.

- Comply with all regulations of the state fire marshall, conservation commission, U.S. Forest Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, or other authority having jurisdiction governing the protection of land, including or adjacent to the project.

- Provide permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction according to the contract erosion control plan and any permits issued. Controls and limitation on work include: Limitations on the size of graded areas; requirements for the method, timing, and effectiveness of temporary and permanent erosion control measures, and requirements for revegetation of graded and distrubed areas.

- The contractor shall control dust within the project limits and at materials sources by providing and applying adeauate water at all hours as necessary to control dust in those portions of the project open to the public.

- Perform work within designated limits. Do not damage vegetation scheduled to remain. If vegetation designated to remain is damaged or destroyed, repair or replace the vegetation in an acceptable manner. Where possible, preserve all vegetation adjacent to bodies of water. Within clearing limits, cut all trees so that they fall within clearing limits only.

- Where economically and practically feasible, the contractor is urged to recycle material. For materials to be burned, obtain necessary buring permits.

9.2 SADDLE ROAD PROJECT MITIGATION COMMITMENTS

The mitigation commitments included in the Saddle Road FEIS are listed as follows. Background information is provided in the corresponding sections of Chapter 3. The corresponding section numbers are provided in parentheses for cross referencing Chapter 3. Commitments may appear to be duplicative in some instances because specific mitigation measures may be applicable to more than one affected resource or concern. The ROD will provide commitments consolidated under like protection, operation, and application objectives.

9.2.1 Land Use (ref: 3.1)

Mitigation Measures Applicable to Multiple Project Sections

- Access to public use and recreation areas, ranching operations, residences, and the PTA will be maintained at all times during construction.

9.2.2 Social (ref: 3.3)

Community Identity and Cohesion (ref: 3.3.3)

Mitigation Meaures Applicable to Multiple Project Sections

- For all construction, and particularly work that will occur near Kaumana, a traffic control plan will be developed to outline the steps needed to minimize congestion and maintain access to adjacent properties at all times during construction.

Outdoor Recreation Resources and Hunting (ref: 3.3.4)

Mitigation Meaures Applicable to Multiple Project Sections

- To the extent feasible, construction work in the vicinity of the access roads to recreational areas including hunting units will be scheduled for periods of non-peak use. Special consideration will be given to minimizing disruption to hunting units and the access that serves these units for construction activities that occur during the bird hunting season (November through January). This will be detailed in the traffic control plan, part of the construction contract documents.

- The traffic control plan will specify that during construction, access will be maintained at all times to roads that serve recreational areas including hunting units.

- Vehicle pullouts, and interpretive signage will be incorporated where appropriate.

- Scenic pullouts will be constructed and maintained by HDOT along the improved Saddle Road corridor. It is anticipated that two will be developed: one mauka of W-3 and one along EX-3 in the eastern one-half of the study corridor.

- Hunting enhancement activities are being initiated as part of the Ecosystem Management Plan at PTA. These activities include game studies, access improvement, and hunting management elements.

Public Services, Community Centers and Local Business (ref: 3.3.5)

Mitigation Measures Applicable to Multiple Project Sections

- Emergency service providers, including the Hawai'i County Fire Department, the Hawai'i Police Department, and the PTA, will be kept informed on the location and schedule of construction along the length of the project.

- Traffic control plans prepared for construction of Saddle Road will include provisions for allowing emergency vehicles to pass through construction zones without delays.

Travel Patterns for Motorists, Pedestrians and Bicycles (ref: 3.3.6)

Mitigation Meaures Applicable to Multiple Project Sections

- Whenever feasible, construction activities will be scheduled to avoid construction-related delays on Saddle Road during those annual events known to generate significant cross-island traffic, including the Merrie Monarch Festival, the Ironman Triathlon, the Mauna Kea Relay road race, and the Waiki'i Ranch Music Festival.

- As feasible, construction-related delays will be minimized during the rush hours for commuters, business travelers, and observatory workers.

- Construction information will be publicized on a regular, on-going basis through signage, radio and newspaper bulletins, and road signs at each end of Saddle Road.

Native Hawaiian Culture and Values (ref: 3.3.8)

Mitigation Meaures Applicable to Multiple Project Sections

- Proper cultural protocol will be completed by a native Hawaiian who follows the ways of the old culture to release and sanctify the construction project.

- For Segments EX-2, PTA-1, PTA-3, EX-3, EX-4A, and E-3, impacts to native Hawaiian cultural values (associated with the mamane/naio forest and the kipuka) will be minimized in sensitive areas by limiting the area of impact and the width of ROW needed.

- During final design the alignment for Segments EX-3, EX-4A, and E-3 will be adjusted to avoid or minimize impacts to kipuka that harbor native species.

- BMPs will be used during construction to prevent runoff from damaging kipuka.

9.2.3 **Right-of-Way and Relocation** (ref: 3.5)

Mitigation Meaures Applicable to Multiple Project Sections

- Any relocation necessitated by the project would be completed in accordance with Federal Uniform Relocation and Real Property Acquisition Policies Act of 1970 (P.L. 91-646), as amended, and applicable State regulations.

9.2.4 **Pedestrian and Bicycle Facilities and Use** (ref: 3.6)

Mitigation Meaures Applicable to Multiple Project Sections

- Within Segment EX-4A, create provisions for pedestrian and bicycle crossings of Saddle Road during construction periods.

9.2.5 **Air Quality** (ref: 3.7)

Mitigation Meaures Applicable to Multiple Project Sections

- Standard dust control and construction equipment emission control measures will be implemented as necessary to reduce temporary impacts to air quality during construction activities. Water or a dust palliative will be applied as necessary to minimize particulate pollution. Areas to receive such treatment will include unpaved access roads, staging sites, and construction areas where the movement and operation of construction equipment produces airborne dust. No water will be used from on-site sources such as stockponds, streams or sinks. Construction equipment will meet all applicable emission standards.

9.2.6 **Fire Hazard** (ref: 3.9)

Mitigation Measures Applicable to All Project Sections

- The PTA Fire Department, with primary responsibility for responding to and fighting fire within the PTA, has upgraded their fire fighting capabilities. Key improvements include construction of six 302,800-L dip tanks, the purchase and deployment of 2 Humvee pumper trucks, and one new 7,570-L tank truck. In addition the USAG-HI in its PTA Fire Management Plan has agreed to stockpile and maintain the fire fighting equipment necessary to supply an 86-man fire fighting detail (USAG-HI 1997).

- In an effort to develop effective fire management regimes for the three Palila mitigation sites, a fire ecologist will be contracted on a temporary basis to create a fire model(s) consistent with current methodology for high altitude xeric plant communities.

- Following the fire modeling exercise, the fire ecologist will develop a comprehensive fire management plan complete with risk assessment protocols and guidelines to be consistent with Palila habitat recovery goals for use by the PTA and other fire-fighting entities (ref: Rana 1997, Tech. App. Vol. III). The plan will be designed to offset the increased risk of wildfire and associated threat to the existing viable Palila population on the west slope of Mauna Kea, as well as the three Palila mitigation sites. The plan will contain a fuels management plan, complete with fuels management goals, objectives, and methods.

Section II Mitigation Measures

- With the selection of Segment PTA-1, Typical Section B will be incorporated from Station 10+000 to 21+500. Typical Section C will be incorporated from Station 21+500 to 27+270.

- With the selection of Segment PTA-3, Typical Section B will be incorporated into one portion of PTA-3 that is common to PTA-1, from Station 10+000 to 21+500 (PTA-1). Typical Section C will be incorporated into one portion of PTA-3 that is common to PTA-1, from Station 21+500 to 26+900 (PTA-1), and one portion of PTA-3 that is distinct to PTA-3, from Station 10+000 to 12+500.

- With the selection of Segment EX-2, Typical Section B will be incorporated from Station 119+100 to 123+000. Typical Section C will be incorporated from Station 129+000 to 132+500.

- With the selection of Segment EX-2, PTA-1, or PTA-3, emergency call boxes will be installed on the north side of the road along the entire length of Section II. The emergency call box system will aid in rapid response to fires and rapid suppression of any such incident. Emergency call boxes will be spaced at approximately 2 km intervals.

- The PTA Fire Department will install and maintain two fire risk signs along Saddle Road, one each at the east and west boundary of PTA. Sign information will be based upon the National Fire Danger Rating System and will be updated daily.

9.2.7 **Water Resources** (ref: 3.10)

Mitigation Measures Applicable to All Project Sections

- Practices that prevent erosion, including the stabilization of cut and fill slopes by vegetative as well as non-vegetative means.

- Practices that trap pollutants before they can be discharged such as silt fences and sedimentation basins.

- Practices that prevent the mixing of pollutants from construction materials and storm water, such as providing protected storage for chemicals, paints solvents, and other toxic materials.

- During construction, erosion will be minimized by applying temporary measures that will reduce the velocity of the runoff and retain sediment on-site. Examples of these measures may include but are not limited to: silt fences, check dams, mulching, culvert outlet protection, and sedimentation basins. Construction materials will be stored in a protected area with measures in place to contain and clean-up spills.

- Permanent pollution control measures will be applied to minimize degradation of stormwater quality after construction of the road has been completed. These measures include but are not limited to the following examples: providing velocity reducers and/or settlement basins at culvert outlets, vegetating slopes, minimizing the steepness of slopes where possible, providing stream bank stabilization where required, and managing the use of chemicals for roadway maintenance.

- For Segments W-2 and W-3, cut slopes will be revegetated to reduce highway runoff pollution.

- If a major hazardous spill were to occur within the Saddle Road corridor, clean up efforts would be coordinated through both the County of Hawai'i Civil Defense agency and the State of Hawai'i Department of Health (DOH).

9.2.8 Waters of the U.S./Wetlands (ref: 3.11)

Section III and IV Mitigation Measures

- Restoration measures, consisting of enabling native vegetation to cover areas of disturbance in all areas not essential to the operation and maintenance of the roadway, will be implemented within the ROW. Restoration may also include acquisition and/or preservation of lands outside of the ROW to offset unavoidable impacts on wetland and aquatic areas disturbed by the roadway footprint*. Areas that may be considered for restoration include the following.

    1. Construction damage outside of the footprint of the completed roadway; e.g., staging areas.
    2. The cut/fill slopes, created by grading, up to the edge of the grassy shoulders.
    3. Any other distrubed areas, such as currently existing parking areas and service roads (completed in consultation with HELCO and DLNR to determine the minimum access required, applied within the ROW).
    4. Any abandoned segment of the existing Saddle Road.

5. Any uneconomic remnants of ROW requiring purchase in disturbed agricultural lands.
6. Lands that can be practicably transferred or acquired and preserved or restored for the purpose of offsetting impacts to values and functions of wetland and aquatic areas. Areas that are adjacent to or nearby the areas of impact and that include areas of similar habitat or function would be considered more appropriate for such transferral or acquisition than areas that are farther removed or dissimilar in nature. Such compensatory mitigation parcels may be transferred to resource agencies or non-profit groups whose long-term interest in habitat protection would make them more appropriate managers of the properties; however, the maintenance of these areas, once transferred, would not be the responsibility of the roadway project owner.

   * The roadway footprint is defined as all areas within the ROW that are regularly maintained for the safe and efficient operation of the roadway.

- Contamination of surrounding kipuka, wetlands, and watershed due to drainage, run-off, and pollutants will be minimized through the implementation of BMPs.

- The potential for increased runoff into kipuka or other sensitive areas will be mitigated as necessary by use of appropriate drainage structures.

- Specific design criteria will be utilized during final design of the selected alternative in Sections III and IV to afford avoidance or minimization of impacts to kipuka and the wetlands within them.

9.2.9 Climate, Geological Hazards, and Soils (ref: 3.12)

Mitigation Measures Applicable to All Project Sections

- Prior to construction, a field review with representatives of the BRD/USGS and the Hawai'i Speleological Society will be conducted to determine the probability of caves or lava tubes in the construction corridor. Final design and/or construction techniques will be developed to avoid or minimize impacts.

- In the case that a cave or lava tube is encountered during construction, all construction activity will cease immediately at the location in question and the Project Engineer will be notified. Consultation will be conducted with appropriate resource or regulatory personnel to ensure that unique biological, cultural, or geological resources associated with these features are adequately protected, or investigated and documented.

- During final design, significant caves will be identified in consultation with appropriate regulatory agencies, and where feasible, the overburden over significant caves will be reinforced; passages will not be crushed and filled.

- When current access to exceptional caves would be blocked by the project, bypass conduits will be installed to allow continued access.

- Construction specifications would be incorporated to minimize potential hazards of caves to construction workers.

Section I Mitigation Measures

- During the rainy season, following completion of construction, slopes and denuded areas within Section I (Segments W-2 and W-3) will be revegetated with a grass such as kikuyu to minimize soil erosion. Reseeding of disturbed areas within Sections II, III, and IV (Segments EX-2, PTA-1, PTA-3, EX-3, EX-4A, and E-3) is not recommended.

9.2.10 Vegetation (ref: 3.13)

Mitigation Measures Applicable to All Project Sections

- All equipment, material, and support structures will be stored and maintained within the ROW or in designated staging areas that have been approved as being areas where the storing, servicing, and staging of equipment and material will not adversely impact native species. These areas will be clearly demarcated and fenced prior to construction.

- All construction activity will be restricted to the clearly delineated ROW.

- A Project Engineer will be on site at all times during construction to ensure implementation and compliance with environmental mitigation requirements as stated in the contract documents.

- Contractors will be required to participate in an environmental quality control program.

Section I Mitigation Measures

- Immediately after construction in this Section I is completed, the margins of the roadway will be replanted with kikuyu grass, the dominate ground cover along both segments in this section.

Section II Mitigation Measures

- Mitigation addressing the increased fire hazard is outlined elsewhere in this document (ref: FEIS - Part I, 3.9.3).

- During construction in Section II, emergency spills treatment, storage, and disposal of all petroleums, oils, and lubricants, both within construction limits and at staging areas will be handled in strict accordance with the FHWA 1996 Specifications for Construction of Roads and Bridges on Federal Highway Projects, as well as Federal Acquisition Regulations and appropriate EPA regulations. HDOT will provide similar measures in Sections I, III, and IV.

- A comprehensive manual outlining and discussing the environmental issues, specific mitigation requirements, and procedures that will be required of the construction company(s) awarded the project will be prepared. This document will be prepared by the FHWA in accordance with their newly effected environmental team policy, which ensures that the environmental team closely follows the entire project to its completion. At the pre-construction meetings this document and the rationale behind specific requirements will be explained to project engineers and supervisors. Similar measures will be taken by HDOT during construction outside of the PTA.

- All construction personnel will be required to attend a project orientation meeting where specific environmental considerations and prohibitions will be explained.

Section III and IV Mitigation Measures

- The proposed alignment will be shifted during final design to avoid or minimize impacts to kipuka (ref: FEIS - Part I, 3.11.3 and 3.18.3).

9.2.11 Threatened and Endangered Species (ref: 3.18)

Mitigation Measures Applicable to All Project Sections

- To avoid the potential downing of Dark-rumped Petrels and Newell's Shearwaters by their interaction with external construction lighting, no construction or unshielded equipment maintenance lighting will be permitted after dark between the months of April and October. This prohibition will be one of the Special Contract Requirements which will be incorporated in the construction contract documents.

- In an effort to avoid impacting any nesting Hawaiian Hawks in Sections III and IV, a nest search of the ROW and surrounding environs shall be conducted by a qualified ornithologist prior to the onset of construction for all portions of Section III and IV for which construction is to occur between May and October. If an active nest is detected

during construction, construction activity shall be halted within 1 km of the nest until a consultation with the USFWS can take place, and appropriate mitigation measures implemented.

- To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction personnel and equipment shall be at previously identified and marked non-sensitive areas.

- During construction in Section II, emergency spills treatment, storage, and disposal of all petroleums, oils, and lubricants, both within construction limits and at staging areas will be handled in strict accordance with the FHWA 1996 *Specifications for Construction of Roads and Bridges on Federal Highway Projects*, as well as Federal Acquisition Regulations and the appropriate EPA regulations. HDOT will provide similar measures in Sections I, III, and IV.

- To assist in mitigation of the potential spread of alien organisms, the possible infusion of additional feral mammalian predators and the possibility of wildfire ignition informational signs will be designed with messages relevant to the specific native ecosystem and installed where appropriate in conjunction with planned pullouts or parking areas.

- To mitigate the potential spread and introduction of noxious plants and other alien organisms into the Palila Critical Habitat and the other native species dominated areas, all construction equipment shall be thoroughly steamed cleaned and fumigated off-site before being transported to the construction site. Once equipment has been moved away from the site, it shall be steam cleaned and fumigated before being allowed back onto the job site.

- During the final design phase a concerted effort will be made to design the Recommended Alternative within Sections II, III, and IV (Segments PTA-1, EX-3, and E-3) to balance earthwork quantities so that no borrow/fill will need to be imported from outside the immediate area. Should the need arise for fill to be imported from off site, a local borrow site will be used and the material sterilized by an appropriate method(s) as required. Construction in Sections III and IV shall begin on the western end of the section and proceed east.

- In a further effort to minimize the spread of alien plant species in Sections II, III, and IV, care shall be taken to avoid bulldozing from ruderal plant communities and pasture lands into more native-dominated communities. In Section II, this primarily refers to the ruderal areas adjacent to PTA-1 from Station 27+000 to 30+998.930 and to ruderal areas adjacent to PTA-3 from Station 10+000 to 10+500.

- To prevent the spread of fountain grass into disturbed areas along PTA-1 and EX-3, the ROW shall be inspected every three months during the course of construction. Any emerging fountain grass shall be controlled by spraying with a suitable herbicide, such as Roundup ©. Following the completion of construction the roadway will fall under the maintenance jurisdiction of HDOT. HDOT will maintain the roadway and will use mowing, and, when necessary, herbicides to control roadside weed and grass growth in consultation with a qualified biologist.

- A baseline survey, which gathered information on the distribution of land snails, insects, and other arthropod species along the entire roadway corridor, has been conducted by scientists from the Bishop Museum. The survey was funded by this project even though there were no threatened or endangered invertebrate species known to exist within the project area. The study cost $90,000.

- All equipment, material, and support structures shall be stored and maintained either within the ROW or in designated staging areas. Siting of staging areas will be coordinated with biologists to ensure that these be located where native species would not be adversely impacted by construction. Staging areas identified within Section II are located at MP 33 on the south side of the existing roadway, and at PTA-3 Station 11+500 to 12+000 west of Pu'u Nene in a highly disturbed lava field. Staging areas currently identified within Section III are located north of the roadway at MP 18.7, adjacent to MP 17.5 on the south side of the existing roadway, and MP 13.5 and MP 11.75. Staging areas have not yet been identified for Section I and IV. Staging areas will be clearly demarcated and fenced with temporary construction fencing.

- A comprehensive manual outlining and discussing the environmental issues and Special Contract Requirements for the construction company(s) awarded the project will be prepared. This document will be prepared by the FHWA in accordance with their environmental team policy, which ensures that the environmental team closely follows the entire project to its completion. At the pre-construction meetings for Section II projects, this document will be distributed and the rationale behind specific requirements will be reviewed with project engineers, supervisors, and contractors. This document will be furnished to HDOT for their use in future contracts in Sections I, III, and IV.

- Special Contract Requirements will be incorporated into the construction documents directing the contractor's work consistent with specific mitigation commitments. Prior to construction in Section II, all construction personnel will be required to attend a project orientation meeting where Special Contract Requirements will be reviewed. During construction in Section II, a project engineer with FHWA's Central Federal Lands Highway Division (CFLHD) will be on site at all times to ensure implementation and compliance with the Special Contract Requirements. The project engineer will have the authority to shut down construction should violations of Special Contract

Requirements be detected; furthermore, the project engineer will be responsible for ensuring compliance with all environmental restrictions and mitigation measures. Similar measures will be implemented by HDOT in Sections I, III, and IV.

- Prior to and during construction in Section II, the CFLHD's Construction Partnership Program, which provides a process for ensuring delivery of Contractor and FHWA responsibilities, will be implemented. This program provides for the involvement of all stakeholders, including regulatory agencies in the construction process.

Section I Mitigation Measures

- As soon as feasible after construction of the roadway, all disturbed areas will be replanted with kikuyu grass, the dominate ground cover along this section.

Section II Mitigation Measures

- A fire prevention cross-section will be constructed to prevent burning objects tossed from vehicles from easily leaving the road surface, to prohibit vehicles from driving off of the road surface, and to discourage parking for pedestrian excursions (Figure 2.1.1, Sheet 2, *Typical Sections B and C*).

- Emergency call boxes will be installed at 2-km intervals along one shoulder to afford immediate reporting and, consequently, early suppression of five events.

- A portion of the PTA-1 construction corridor in the vicinity of Bradshaw Airfield has been moved south of a population of 70 *Silene hawaiiensis*. This mitigated alignment will avoid any taking of *Silene hawaiiensis*. To ensure protection from construction related activities, both this population and one other are located well outside the survey corridor at Stations 16+720 and 13+200, respectively, will be fenced off at the ROW line with temporary construction fencing. All features contained within fenced exclosures shall be declared off limits to construction personnel.

- The USAG-HI will provide an exclosure around the large population of *Silene hawaiiensis* within Training Area 3 near Deadman's Curve north of the existing roadway.

- Increased fire suppression resources (six 302.800-L dip tanks, two Humvee pumper trucks, and one new 7,570-L tank truck) have been added to the PTA Fire Department and the PTA Fire Management Plan has agreed to stockpile and maintain sufficient fire fighting equipment for an 86-man fire fighting detail. (ref: FEIS - Part I, 3.9.3).

- A fire ecologist will be hired through BRD on a temporary basis to create a fire model(s) consistent with current methodology for high altitude xeric plant communities. The fire

ecologist will also develop a comprehensive fire management plan consistent with Palila habitat recovery goals for use by the PTA and other fire-fighting entities. The fire management plan is to focus on Palila population protection and fuels management as described in the FEIS - Part I, 3.9.3).

- The implementation of the PTA Fire Management Plan by PTA command and the integration of the fire ecologist's modeling and comprehensive Palila and native ecosystems fire management plan will further ensure that the Palila Critical Habitat within the PTA and rare biological communities is not rendered unsuitable for future potential Palila restoration efforts or receive serious impacts from unplanned wildfires.

- Strict adherence to training restrictions applicable to the PTA within the Palila Critical Habitat designed to protect sensitive habitats in the mamane/naio forests resulting from the USFWS, 1983 Section 7 consultation and detailed in the current USARG-HI PTA External Standing Operating Procedures document will continue to be implemented by the PTA command (USAG-HI, 1996).

- In the Pu'u Mali area on the north slope of Mauna Kea, approximately 1864 ha of State land below Mauna Kea Forest Reserve plus adjacent lands within the forest reserve, immediately upslope were identified by BRD/USGS as having the requisite vegetation, food resources, rainfall gradient, and real potential for timely restoration and translocation of Palila. These lands are currently in State pasture leases to three separate lessees; Botellho Hawai'i Enterprises, K.K. Ranch, and S.C. Ranch. Transfer and management of this area for Palila translocation will be implemented to allow a population of Palila to be reestablished over a range of recovering habitat situated along suitably broad elevation and moisture gradients (ref: Rana 1997, Tech. App. Vol. III).

- In order to enhance the primary population and habitat located on the west slope of Mauna Kea, additional habitat needs to be secured and managed for Palila. The most important land to rehabilitate and make available for Palila on the west slope are those found in the Ka'ohe Lease Lands located immediately northwest of the core Palila population. This 704-ha parcel of State land is located within the Palila Critical Habitat and is presently leased to Parker Ranch for cattle grazing. Acquisition and management of this area for Palila translocation will be implemented to allow the core population of Palila to expand (ref: Rana 1997, Tech. App. Vol. III).

- For habitat restoration to succeed within the areas identified above (State replacement lands), they will be fenced and both domestic and feral ungulates removed. To ensure that ungulate control is both effective and cost efficient, it is imperative that the removal of ungulates be initiated concurrently with the above fencing efforts. If it is cost effective and manageable, public hunting will be allowed in initial ungulate control efforts. To ensure that all ungulates have been removed from the exclosures it will be necessary to monitor and continue control efforts for a period of three years.

Maintenance of ungulates at inconsequential levels where not being used as management tool is an option within specific exclosures to be guided by the scientific principles and participatory commitments of the Palila Mitigation MOU.

- Management of state replacement lands will remain flexible under the principles and commitments of the Palila Mitigation MOU to allow for compatible uses such as recreation, game bird hunting, and other uses identical to adjacent forest reserve.

- To ensure success of the introduced Palila on the State replacement lands, alien species, pests and predators will also have to be monitored and controlled for a period of ten years.

- In an effort to determine the impacts of ants, yellowjackets, parasitic wasps and flies on insect foods of Palila, work initiated by the US Army and conducted by BRD/USGS into limiting factors affecting Palila will be continued. A study will be implemented that will identify what impacts alien insects and other arthropods have on the insect foods necessary for Palila survival. Control methods will be explored for species that are deemed a threat to these essential resources. The basic outline, objectives, and methods of such a study are presented in the BA (ref: Rana 1997, Tech. App. Vol. III).

- Within the PTA the only location outside of the Palila Critical Habitat with any potential for long term restoration and Palila translocation is in the Kipuka 'Alala area. Approximately 1214 ha of mixed naio/mamane shrubland has been identified as suitable for long term habitat restoration. This area will be fenced and ungulates removed to promote restoration of mamane (ref: Rana 1997, Tech. App. Vol. III).

Section III Mitigation Measures

- Potential impacts to important native communities of flora and fauna will be minimized by avoiding further disturbance to kipuka found along the ROW.

- To ensure that construction of Segment EX-3 does not adversely impact a population of *Plantago hawaiensis* located north of the ROW in this section, the construction limits will be kept at least 3 m south of the Pahoehoe shelf on which this plant community is located. This population will be fenced off from construction related activities at the construction limits with temporary construction fencing and the area will be designated off-limits to construction personnel.

- The reconstructed road will be placed no closer than the existing road to the *Cyanea platyphylla*, located in a kipuka on private land approximately 200 m south of the existing centerline of Saddle Road at Station 168+460. Additional measures to restrict access in this area will be developed in consultation with the USFWS during design.

These access restriction measures may include directional or regulatory signing, fences or berms, or siting of pullouts in less sensitive areas.

- The reconstructed road will be placed no closer than the existing road to the *Clermontia Peleana*, located approximately 200 m north of the existing centerline of Saddle Road at Station 163+030. Additional measures to restrict access in this area will be developed in consultation with the USFWS during design. These access restriction measures may include gating of the HELCO powerline road, directional or regulatory signing, fences or berms, or siting of pullouts in less sensitive areas.

- During the final design phase and after the Section 404 wetland consultation with the USACE and in keeping with FHWA policy of "laying the road lightly on the land," design plans will be modified as much as possible to avoid substantial impacts to all kipuka along this segment. When the construction limits are delineated, a concerted effort will be made to minimize disturbance within the ROW by optimizing the design parameters.

- To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction personnel and equipment shall be at previously identified and marked non-sensitive areas. Additionally, the following kipuka shall also be fenced off at the ROW with temporary construction fencing: 145+500 - 146+500, 147+250 - 148+240, 155+450 - 157+500, 157+700 - 157+900, 159+500 - 160+000, 162+500 - 164+000, 165+500 - 166+240, 167 + 860, 168 +460, and 170+500 - 171+000. All features outside of the ROW fencing shall be declared off limits to construction personnel.

Section IV Mitigation Measures

- During the final design phase the plans will be modified as much as possible to avoid substantial impacts to all the kipuka which still harbor native species along Section IV. When the construction limits are delineated, a concerted effort will be made to minimize disturbance within the ROW by optimizing the design parameters. To minimize collateral damage to areas outside of the ROW, the Special Contract Requirements will mandate that all construction activity shall be restricted to within the clearly delineated ROW and that entry and exit into the ROW by all construction personnel and equipment shall be at previously identified and marked non-sensitive areas.

9.2.12 Archaeological, Historic, and Traditional Cultural Resources (ref: 3.19)

Archaeological Sites (ref: 3.19.2)

Section I Mitigation Measures

- W-3 (Old Waimea-Kona Belt Road). The site in this area is a two-track, unpaved pathway on pahoehoe containing a hand-built, stone causeway. Data recovery will include surface examination and documentation of the road morphology and causeways within the affected area and in the immediate project vicinity at nearby locations where data that makes the site important to history can be examined. Mitigation will also include interpretive signage as appropriate.

- W-3 (Historic Enclosures). Construction of the W-3 alignment will affect about half of the site are, including both of the features. Data recovery of the archaeological remains will include excavation of portions of the enclosures, and within the area between the enclosures to recover the data that makes the site significant.

Section II Mitigation Measures

- PTA-1 (Old Waimea-Humu'ula Wagon Road). Data recovery will include thorough and complete measurements and photo documentation of the morphology of the road as impacted by modern travel within the APE. Measurements and recordation of a small portion of the intact wagon road approximately 1.0 km beyond the APE will be taken to compare with the information retrieved from the portion within the APE. No excavations are proposed. If feasible, treatment of the property may also include interpretative signage and construction of a pullout where the trail meets the north side of the proposed corridor. The content of the signage may include a description of the road, dates of use, and how it was used for transportation of goods and people across the interior of the island.

Section III Mitigation Measures

- EX-3 (Humu'ula Sheep Station and Perimeter Wall). If feasible, the proposed alignment will be modified to minimize impacts to the wall. Data on wall construction technology has already been recovered during previous investigations. Data recovery will include documentation of construction, schematic mapping, and recording of the network of walls comprising site 7119 as well as the wall's function and relationship to the sheep station buildings. If warranted, construction activities may be periodically monitored to ensure that impacts to the walls are restricted to the absolute minimum under the provisions of a written Archaeological Monitoring Plan (Monitoring Plan) pursuant to SHPO draft regulations 13-146, 13-150, and 13-154 (DLNR 1994). The Monitoring Plan will be reviewed and approved by the SHPO prior to beginning construction and

the monitoring project. If feasible, treatment of the property will also include interpretative signage with a place for motorists to pull off Saddle Road. The content of the signage may include a description of the Humu'ula Sheep Station, its role in the history of the area, and a discussion of the function and construction of the walls.

- EX-3 (Pu'u 'O'o-Volcano Trail). The proposed alignment will be modified to minimize the impacted segment. A lava flow covered a portion of the trail in 1935, and the Saddle Road was built on the 1935 flow. Consequently, there are no intact portions of the trail within the project impact area, and there will be no direct impacts to Site 10309. The indirect effects of constructing Saddle Road over the buried trail path can be mitigated with data recovery that documents trail morphology and adaptations to the varying terrain outside of the construction impact area. This documentation will take place at nearby locations along the trail where data that makes the site important to history can be examined. If feasible, treatment of the property will also include interpretative signage and construction of a pullout.

- EX-3 (Hilo-Pu'u 'O'o Trail). The proposed alignment will be modified to minimize the impacted segment. Data recovery will include examination of the modes of construction of the trail as they apply to chronological, functional, and maintenance activities. Some areas of the trail within the APE will be disassembled to aid in the assessment of the trail technology. If feasible, treatment of the property will also include interpretative signage and construction of a pullout.

- EX-3 (Old Saddle Road). Data collection has been completed on this site and no further data recovery efforts are necessary. If feasible, mitigation will also inlcude the provision of a motorist pullout and interpretive signage at the site. Additional research may be provided to complement signage accuracy. The signage may contain information on the location of the original road, and its historical use.

Section IV Mitigation Measures

- E-3 ('Ola'a Flume). Data collection has been completed on this site and no further data recovery efforts are necessary. If necessary, mitigation will also include the provision of a motorist pullout and interpretive signage at the site. Additional research may be provided to complement signage accuracy. The signage may contain information on the location of the flume system, its historical use, and an artist's sketch of a segment of the flume.

Traditional Hawaiian Cultural Sites (ref: 3.19.3)

Mitigation Measures Applicable to All Project Sections

- In order to protect the burial site in the vicinity of W-2, flagging of the burial site will be avoided. Mitigation measures developed for the protection of biological resources will prohibit any construction activity outside of the staked rROW corridor or established staging areas (ref: FEIS - Part I, 3.18.3).

- For all alternatives, upon discovery of native Hawaiian burials or ritual sites, construction activities will cease in the vicinity of the site until appropriate regulatory and resource personnel are contacted and a determination has been made. All requirements of Chapter 6E, HRS and the administrative rules relating to burials will be satisfied.

- In order to ensure the protection of archaeological and paleontological remains during construction, Section 107.02, "Protection of Property and Landscape," *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FPJ-96, 1996, FHWA* will be followed. HDOT will apply similar specifications.

- The FHWA and HDOT shall cooperate with University of Hawai'i in planning for access restriction facilities or signage at the intersection of Mauna Kea Access Road and Saddle Road by considering the inclusion of design or ROW accommodations as might be reasonably required in the Saddle Road project at the time the project is advanced.

9.2.13 Hazardous Waste Sites (ref: 3.20)

Mitigation Measures Applicable to All Project Sections

- If previously unidentified hazardous substances or petroleum products are found within the project corridor which indicate an existing release, a past release, or a material threat of a release of any hazardous substance or petroleum products into the project corridor, further investigation will be pursued, as warranted. If previously unidentified hazardous waste is discovered during project construction, work will cease at that location and appropriate regulatory or resource personnel will be contacted.

- Final documents regarding the DOA investigations of five sites on the PTA for possible environmental impacts will be reviewed once investigations are complete. The DOA will pursue additional investigation, if warranted, after review of the final documents and provide ROW clear of all hazardous waste.

- In areas where ROW is needed outside of that already surveyed, the project area will be further investigated prior to land acquisition or construction to confirm the absence of hazardous waste.

- Prior to construction, an unexploded ordnance survey will be conducted within the PTA and, if unexploded ordnance are found, the ordnance will be removed from the project area in accordance with DOA regulations by USAG-HI.

9.2.14 Visual (ref: 3.21)

Mitigation Measures Applicable to All Project Sections

- Cut and Fill Slopes. Final cut and fill slope faces will be made to blend with the surrounding landscape. The natural appearance of the slopes will be improved by rounding the toe and top of slopes, warping, blending the ends of slopes, varying the slope ratios, utilizing staggered ledges, and roughening the face of cut slopes, either by ripping or blasting, where appropriate. (Warping results in a slope face that is not parallel to the roadway. Slope rounding refers to blending the slope into the natural terrain by excavating additional area at the top of the cut slope. Laying back the ends of slopes or blending provides a smooth transition to adjacent cut, fill, or drainage area by flattening the slope ratio at the ends of slopes. Varying slope ratios leaves an irregular, undulating or roughened appearance with staggered ledges rather than a uniform grade. Staggered ledges are benches with varying dimensions and heights on the cut face which do not cross the entire face.) The slope ratios will vary from the top to the bottom of the slope face as well as horizontally along the face, where possible.

- Rock Slope Surface Treatment. Rock slope surface treatment will be applied to cut slopes in competent rock areas as identified in the geotechnical testing results. These treatments include roughening of the cut face to incorporate short, staggered ledges, minor warping, and other irregularities in the rock that take on a natural appearance.

- Lava Rock Areas. In areas not recommended for revegetation, the top 1 m of lava material in disturbed areas will be stockpiled prior to construction. After construction, the stockpiled material will be used as plating material. The plating material will be placed over slope faces to resemble the adjacent, undisturbed ground surface conditions or used as rip rap material along ledges and in ditches outside of roadside recovery zones.

- Erosion Control. Intercepted drainages on cut slopes will be cut at the angle to existing joints, planes or rock features, and drainage patterns. These features will be incorporated into the NPDES SWPPP (ref: FEIS - Part I, 3.10 and 1.9).

- Guardrails. Where guardrails are needed, natural-appearing guardrail material, such as naturally weathered steel or a material approved by HDOT, will be used to blend more effectively with the surrounding landscape.

- Fencing. To reduce contrast and blend more effectively with the surrounding landscape, aesthetic fencing materials will be used, such as naturally weathered metal or steel, painted or wood posts, to be approved by HDOT.

- Clearing. Clearing of trees and large shrubs along an irregular edge adjacent to the recovery zone will be done to create a gradual transition or feathered edge.

- Abandoned Roadway Segments. Where the abandoned roadway is not to be used for local access and is not considered a historic resource, asphalt surfacing on the abandoned roadway segments will be removed from the site, and the road bed will be ripped and regraded to match surrounding terrain. The regraded area will be reclaimed as appropriate, consistent with recommendations contained in the section of this chapter addressing geology and soils (ref: FEIS - Part I, 3.12.3) or restoration measures as described for wetlands (FEIS - Part I, 3.11.3). Plant material such as trees will be planted or large rock material placed at the interface of the new highway with the old roadway to screen views of the abandoned section.

- For Segments W-2 and W-3, any small remnant pieces of landform left by cut slopes will be eliminated except between W-2 Station 112+420 to 114+500. In this area, boulders will be stockpiled to create rock outcrops on remnant fins of landform which match existing rock outcroppings.

- For Segment EX-2 (Station 109+150), the bridge over Waiki'i Gulch will be constructed of materials with color and texture qualities that blend with the existing landscape.

- For Segment EX-2 (Station 130+875 Rt. to 130+950 Rt), all of remnant landform will be removed flush to the road.

- For Segment PTA-1, Station 28+570 to 29+371, boulders will be stockpiled to create artificial rock outcrops on remant fins of landform. Cut slopes will not be rounded, but left angular and irregular in form to match existing rock outcrop.

- Reseeding of disturbed areas will be undertaken only in Section I (Segments W-2 and W-3), as is consistent with the section of this chapter addressing geology and soils (ref: FEIS - Part I, 3.12.3).

- For Segment EX-4A, Station 172+550 to 172+750, aesthetic rock retaining walls will be constructed where feasible to reduce cut slope face adjacent to residences.

9.2.15 Construction Impacts (ref: 3.23)

Mitigation Measures Applicable to All Project Sections

- The total amount of land disturbance will be minimized. The construction contractor will be limited to the delineated construction work areas within the ROW or clearly marked staging areas.

- Construction traffic will be limited to approved routes to minimize interaction with vehicular traffic on the existing Saddle Road. Traffic control will assure a safe and timely flow of traffic along Saddle Road.

- Construction activities and traffic control will be coordinated with representatives of the Mauna Kea Science Reserve to avoid potential conflicts with their observatory construction projects. Plans for the transport of oversized loads for these projects from Kawaihae to the Mauna Kea summit are presented in a letter from the University of Hawai'i at Manoa, Institute for Astronomy, to the FHWA, dated October 11, 1996 (ref: FEIS -Part II, 1.4.3).

- Environmental awareness materials will be provided to all persons, agency personnel, construction workers, subcontractors, inspectors, and others on the project. These materials will be prepared in a checklist format and will address issues related to caves, sensitive species, cultural resources, spill management, delineation of authorized work area, pollution prevention through recycling and other efforts required by the Pollution Control Act of 1990, and other relevant factors (ref: FEIS - Part I, 3.18.3). Contract specifications addressing environmental mitigation and procedural requirements will also be included in the contract documents and will be enforced by the on-site project engineer throughout the duration of the construction contract.

- Trucks will be covered when hauling loose material on public roads.

- Unused materials and excess fill will be removed and disposed of at an authorized waste disposal site.

- Dust control measures will be implemented. These will include, but are not limited to, the use of water trucks, the stabilization of the surfaces of stockpiled materials, and the treatment of unpaved routes with dust suppressants.

- Clearing and grubbing of construction work areas will be conducted in such a manner as to minimize the amount of exposed soil at any one time.

- Stationary equipment will be placed as far away from sensitive noise receptors as practical.

- All exhaust systems will be maintained in good working order. Properly designed engine enclosures and intake silencers will be used. Equipment will be maintained on a regular schedule.

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APPENDICES

APPENDIX A

FARMLAND CONVERSION IMPACT RATING

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: August 2, 1996
Name Of Project: A-AD-6(1) SADDLE ROAD	Federal Agency Involved: USDOT FEDERAL HIGHWAY ADMINISTRATION
Proposed Land Use: HIGHWAY	County And State: HAWAII COUNTY, HAWAII
PART II *(To be completed by SCS)*	Date Request Received By SCS: 8/16/96

	Yes	No	Acres Irrigated	Average Farm Size
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*	☒	☐	12,899	358

Major Crop(s): MacNuts, Coffee, Beef	Farmable Land In Govt. Jurisdiction: Acres: 727,700 % 28	Amount Of Farmland As Defined in FPPA: Acres: 569,000 % 22
Name Of Land Evaluation System Used: State of HI LESA	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By SCS: 8/30/96

PART III *(To be completed by Federal Agency)*	Alternative Site Rating: Site A-1	Site A-2	Site A-3	Site A-4
A. Total Acres To Be Converted Directly	431.0	527.3	469.9	563.1
B. Total Acres To Be Converted Indirectly	Ø	Ø	Ø	Ø
C. Total Acres In Site	431.0	527.3	469.9	563.1
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0	0	21.7	21.7
B. Total Acres Statewide And Local Important Farmland	66.8	78.7	66.8	78.7
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.012	0.014	0.016	0.018
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	20.6	28.5	19.7	27.5
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	78	71	80	74

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15	15	15	15
2. Perimeter In Nonurban Use	10	10	10	10	10
3. Percent Of Site Being Farmed	20	Ø	Ø	Ø	Ø
4. Protection Provided By State And Local Government	20	Ø	Ø	Ø	Ø
5. Distance From Urban Builtup Area	–	–	–	–	–
6. Distance To Urban Support Services	–	–	–	–	–
7. Size Of Present Farm Unit Compared To Average	10	10	10	10	10
8. Creation Of Nonfarmable Farmland	25	Ø	Ø	4	4
9. Availability Of Farm Support Services	5	5	5	5	5
10. On-Farm Investments	20	20	20	20	20
11. Effects Of Conversion On Farm Support Services	25	Ø	Ø	Ø	Ø
12. Compatibility With Existing Agricultural Use	10	Ø	Ø	1	1
TOTAL SITE ASSESSMENT POINTS	160	60	60	65	65
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	78	71	80	74
Total Site Assessment *(From Part VI above or a local site assessment)*	160	60	60	65	65
TOTAL POINTS *(Total of above 2 lines)*	260	138	131	145	139

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

A-1

(See Instructions on reverse side)

Form AD-1006 (10-83)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: AUGUST 2, 1996
Name Of Project: A-AD-6(1) SADDLE ROAD	Federal Agency Involved: USDOT FEDERAL HIGHWAY ADMINISTRATION
Proposed Land Use: HIGHWAY	County And State: HAWAII COUNTY, HAWAII
PART II *(To be completed by SCS)*	Date Request Received By SCS: 8/16/96

	Yes	No	Acres Irrigated	Average Farm Size
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*	☒	☐	12,899	358

Major Crop(s): Mac Nuts, Coffee, Beef	Farmable Land In Govt. Jurisdiction: Acres: 727,700 % 28	Amount Of Farmland As Defined In FPPA: Acres: 569,000 % 22
Name Of Land Evaluation System Used: State of HI LESA	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By SCS: 8/30/96

	Alternative Site Rating			
PART III *(To be completed by Federal Agency)*	Site AB-1	Site AB-2	Site AB-3	Site AB-4
A. Total Acres To Be Converted Directly	450.0	543.3	485.8	579.1
B. Total Acres To Be Converted Indirectly	Ø	Ø	Ø	Ø
C. Total Acres In Site	450.0	543.3	485.8	579.1
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0	0	21.7	21.7
B. Total Acres Statewide And Local Important Farmland	122.1	134.0	122.1	134.0
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.021	0.024	0.025	0.02
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	54.3	57.0	43.1	45.0
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	60	58	64	61
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points			
1. Area In Nonurban Use	15	15	15	15	15
2. Perimeter In Nonurban Use	10	10	10	10	10
3. Percent Of Site Being Farmed	20	Ø	1	1	1
4. Protection Provided By State And Local Government	20	Ø	Ø	Ø	Ø
5. Distance From Urban Builtup Area	–	–	–	–	–
6. Distance To Urban Support Services	–	–	–	–	–
7. Size Of Present Farm Unit Compared To Average	10	10	10	10	10
8. Creation Of Nonfarmable Farmland	25	Ø	Ø	4	4
9. Availability Of Farm Support Services	5	5	5	5	5
10. On-Farm Investments	20	20	20	20	20
11. Effects Of Conversion On Farm Support Services	25	Ø	Ø	Ø	Ø
12. Compatibility With Existing Agricultural Use	10	Ø	Ø	1	1
TOTAL SITE ASSESSMENT POINTS	160	60	61	66	66
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	60	58	64	61
Total Site Assessment *(From Part VI above or a local site assessment)*	160	60	61	66	66
TOTAL POINTS *(Total of above 2 lines)*	260	120	119	130	127

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (1 3

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: AUGUST 2, 1996
Name Of Project: A-AD-6(1) SADDLE ROAD	Federal Agency Involved: USDOT FEDERAL HIGHWAY ADMINISTRATION
Proposed Land Use: HIGHWAY	County And State: HAWAII COUNTY, HAWAII
PART II *(To be completed by SCS)*	Date Request Received By SCS: 8/16/96

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).* Yes ☒ No ☐

Acres Irrigated: 12,899 | Average Farm Size: 358

Major Crop(s): MacNuts, Coffee, Beef | Farmable Land In Govt. Jurisdiction Acres: 727,700 % 28 | Amount Of Farmland As Defined in FPPA Acres: 569,000 % 22

Name Of Land Evaluation System Used: State of HI LESA | Name Of Local Site Assessment System: None | Date Land Evaluation Returned By SCS: 8/30/96

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site AC-1	Site AC-2	Site AC-3	Site AC-4
A. Total Acres To Be Converted Directly	443.5	536.8	479.3	572.6
B. Total Acres To Be Converted Indirectly	Ø	Ø	Ø	Ø
C. Total Acres In Site	443.5	536.8	479.3	572.6
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0	0	21.7	21.7
B. Total Acres Statewide And Local Important Farmland	17.9	29.8	17.9	29.8
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.003	0.005	0.007	0.009
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	61.5	90.0	28.5	43.6
PART V *(To be completed by SCS)* Land Evaluation Criterion: Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	57	48	72	63

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15	15	15	15
2. Perimeter In Nonurban Use	10	10	10	10	10
3. Percent Of Site Being Farmed	20	Ø	Ø	Ø	Ø
4. Protection Provided By State And Local Government	20	Ø	Ø	Ø	Ø
5. Distance From Urban Builtup Area	–	–	–	–	–
6. Distance To Urban Support Services	–	–	–	–	–
7. Size Of Present Farm Unit Compared To Average	10	10	10	10	10
8. Creation Of Nonfarmable Farmland	25	Ø	Ø	4	4
9. Availability Of Farm Support Services	5	5	5	5	5
10. On-Farm Investments	20	20	20	20	20
11. Effects Of Conversion On Farm Support Services	25	Ø	Ø	Ø	Ø
12. Compatibility With Existing Agricultural Use	10	Ø	Ø	1	1
TOTAL SITE ASSESSMENT POINTS	160	60	60	65	65
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	57	48	72	63
Total Site Assessment *(From Part VI above or a local site assessment)*	160	60	60	65	65
TOTAL POINTS *(Total of above 2 lines)*	260	117	108	137	128

Site Selected: | Date Of Selection | Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (10-83)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: October 15, 1996
Name Of Project: A-AD-6(1) SADDLE ROAD	Federal Agency Involved: US DOT Federal Highway Administration
Proposed Land Use: HIGHWAY	County And State: Hawaii County, Hawaii
PART II *(To be completed by SCS)*	Date Request Received By SCS: 10/23/96

	Yes	No	Acres Irrigated	Average Farm Size
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply — do not complete additional parts of this form).*	☒	☐	12,899	358

Major Crop(s)	Farmable Land In Govt. Jurisdiction	Amount Of Farmland As Defined In FPPA
MacNuts, Coffee, Beef	Acres: 727,700 % 28	Acres: 569,000 % 22
Name Of Land Evaluation System Used	**Name Of Local Site Assessment System**	**Date Land Evaluation Returned By SCS**
State of HI - LESA	None	12/4/96

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A B-6	Site B B-7	Site C B-8	Site D B-9
A. Total Acres To Be Converted Directly	576.7	457.4	550.7	553.2
B. Total Acres To Be Converted Indirectly	Ø	Ø	Ø	Ø
C. Total Acres In Site	576.7	457.4	550.7	553.2
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	21.7	0	0	0
B. Total Acres Statewide And Local Important Farmland	159.6	122.1	174.6	159.8
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.032	0.021	0.031	0.028
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	54.8	54.3	65.6	65.4
PART V *(To be completed by SCS)* Land Evaluation Criterion — Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	59	60	55	56

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15	15	15	15
2. Perimeter In Nonurban Use	10	10	10	10	10
3. Percent Of Site Being Farmed	20	1	1	1	Ø
4. Protection Provided By State And Local Government	20	Ø	Ø	Ø	Ø
5. Distance From Urban Builtup Area	–	–	–	–	–
6. Distance To Urban Support Services	–	–	–	–	–
7. Size Of Present Farm Unit Compared To Average	10	10	10	10	10
8. Creation Of Nonfarmable Farmland	25	4	Ø	Ø	Ø
9. Availability Of Farm Support Services	5	5	5	5	5
10. On-Farm Investments	20	20	20	20	20
11. Effects Of Conversion On Farm Support Services	25	Ø	Ø	Ø	Ø
12. Compatibility With Existing Agricultural Use	10	1	Ø	Ø	Ø
TOTAL SITE ASSESSMENT POINTS	160	66	61	61	60
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	59	60	55	56
Total Site Assessment *(From Part VI above or a local site assessment)*	160	66	61	61	60
TOTAL POINTS *(Total of above 2 lines)*	260	125	121	116	116

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (10-83)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: October 15, 1996
Name Of Project: A-AD-6(1) SADDLE ROAD	Federal Agency Involved: US DOT Federal Highway Administratic
Proposed Land Use: HIGHWAY	County And State: Hawaii County, Hawaii
PART II *(To be completed by SCS)*	Date Request Received By SCS: 10/23/96

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*	Yes ☒ No ☐	Acres Irrigated: 12899	Average Farm Size: 358
Major Crop(s): MacNuts, Coffee, Beef	Farmable Land In Govt. Jurisdiction: Acres: 727,700 % 28	Amount Of Farmland As Defined in FPPA: Acres: 569,000 % 22	
Name Of Land Evaluation System Used: State of HI LESA	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By SCS: 12/4/96	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site AC-6	Site BC-7	Site CC-8	Site DC-9
A. Total Acres To Be Converted Directly	570.2	450.9	544.2	546.7
B. Total Acres To Be Converted Indirectly	Ø	Ø	Ø	Ø
C. Total Acres In Site	570.2	450.9	544.2	546.7
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	21.7	0	0	0
B. Total Acres Statewide And Local Important Farmland	55.6	17.9	70.4	55.6
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.014	0.003	0.012	0.010
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	61.5	61.5	95.0	95.0
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	57	57	46	46

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15	15	15	15
2. Perimeter In Nonurban Use	10	10	10	10	10
3. Percent Of Site Being Farmed	20	Ø	Ø	Ø	Ø
4. Protection Provided By State And Local Government	20	Ø	Ø	Ø	Ø
5. Distance From Urban Builtup Area	–	–	–	–	–
6. Distance To Urban Support Services	–	–	–	–	–
7. Size Of Present Farm Unit Compared To Average	10	10	10	10	10
8. Creation Of Nonfarmable Farmland	25	4	Ø	Ø	Ø
9. Availability Of Farm Support Services	5	5	5	5	5
10. On-Farm Investments	20	20	20	20	20
11. Effects Of Conversion On Farm Support Services	25	Ø	Ø	Ø	Ø
12. Compatibility With Existing Agricultural Use	10	1	Ø	Ø	Ø
TOTAL SITE ASSESSMENT POINTS	160	65	60	60	60
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	57	57	46	46
Total Site Assessment *(From Part VI above or a local site assessment)*	160	65	60	60	60
TOTAL POINTS *(Total of above 2 lines)*	260	122	117	106	106

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side) Form AD-1006 (10-83)

APPENDIX B

PLANT AND ARTHROPOD SPECIES LISTS

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
ʻaʻaliʻi, ʻaʻaliʻi ku makani	*Dodonaea viscosa*
ʻae	*Polypodium pellucidum*
ʻaheahea	*Chenopodium murale, Chenopodium oahuense*
ʻahuʻawa	*Mariscus phleoides*
ʻaiakanene	*Coprosma ernodeoides*
ʻakala	*Rubus hawaiensis, Rubus macraei*
ʻakia	*Wikstroemia phillyreifolia, Wikstroemia sandwicensis, Wikstroemia uva-ursi*
ʻakoko, koko, ʻekoko, kokomalei	*Chamaesyce olowaluana*
ʻakolea	*Athyrium microphyllum*
ʻakolea	*Pleopeltis thunbergiana*
ʻaku	*Cyanea tritomantha*
ʻakuʻaku	*Cyanea platyphylla*
ʻalaʻala wai nui	*Peperomia cookiana, Peperomia leptostachya, Peperomia hypoleuca, Peperomia, macraeana, Peperomia tetraphylla*
ʻalapapa	*Medicago sativa*
ʻamaʻu	*Sadleria cyatheoides, Sadleria pallida, Sadleria soleyetiana*
ʻamaʻumaʻu	*Sadleria cyatheoides*
ʻanunu	*Sicyos anunu*
ʻawapuhi	*Zingiber zerumbet*
ʻaweoweo	*Chenopodium oahuense*
ʻekaha	*Pleopeltis thunbergiana*
ʻenaʻena	*Gnaphalium sandwicensium*
ʻeukalikia	*Eucalyptus* spp.
ʻiʻo nui	*Dryopteris wallichiana*
ʻieʻie	*Freycinetia arborea*
ʻihi	*Portulaca scleroscarpa, Portulaca oleracea*
ʻihi,ʻihi ʻai	*Oxalis corniculata*
ʻiliahi	*Santalum paniculatum*
ʻilihia	*Cyrtandra platyphylla*
ʻilima	*Sida fallax*
ʻiniko	*Indigofera suffruticosa*
ʻiwaʻiwa a kane	*Asplenium rhipidoneuron*
ʻiwaʻiwa, iwaiwi	*Asplenium* spp.
ʻiwaʻiwa	*Asplenium adiantum-nigrum*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
ʻiwaʻiwa	*Adiantum raddianum*
ʻiwaʻiwa	*Doryopteris decipiens*
ʻoali, ʻowali	*Pteris cretica*
ʻoaliʻi, ʻowaliʻi	*Asplenium trichomanes*
ʻoha wai	*Clermontia montis-loa, Clermontia parviflora, Clermontia peleana*
ʻoha kepau	*Clermontia hawaiiensis*
ʻohe	*Isachne distichophylla*
ʻohelo	*Vaccinium reticulatum, Vaccinium dentatum*
ʻohelo laʻau	*Vaccinium calyscinum*
ʻohelo ʻai	*Vaccinium reticulatum*
ʻohiʻa, ʻohiʻa lehua	*Metrosideros polymorpha*
ʻoka kilika	*Grevillea robusta*
ʻokole ʻoiʻoi	*Tagetes minuta*
ʻoliwa	*Olea europaea*
ʻolopa	*Cheirodendron trigynum*
ʻuhaloa	*Waltheria indica*
ʻuki	*Macherina angustifolia, Macherina mariscoides*
ʻulei, uʻulei	*Osteomeles anthyllidifolia*
abutilon, hairy abutilon, sweet hairy abutilon	*Abutilon grandifolium*
adenophorus	*Adenophorus sarmentosus*
African tulip	*Spathodea campanulata*
African dropseed	*Sporobolus africanus*
akulikuli kula	*Portulaca oleracea*
alani	*Pelea clusiifolia, Pelea volcanica*
albizia	*Paraserianthes falcateria*
alexandra palm	*Archontophoenix alexandrae*
alfalfa	*Medicago sativa*
alfiliaria	*Erodium cicutarium*
allseed	*Polycarpon tetraphyllum*
amaranth, spiny amaranth	*Amaranthus spinosus*
amaranth, slender amaranth	*Amaranthus viridis*
American carrot	*Daucus pusillus*
angiopteris	*Angiopteris evecta*
anini	*Eurya sandwicensis*
apple of Peru	*Nicandra physalodes*
apple of Sodom	*Solanum linnaeanum*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
apple	*Malus sylvestris*
aristea	*Aristea gerrardii, Aristida adscensionis*
arthrostema	*Arthrostema ciliatum*
Austrailian toon	*Toona ciliolata*
Australian maidenhair	*Adiantum hispidulum*
Australian saltbush	*Atriplex semibaccata*
Australian bluestem	*Dichanthium sericeum*
autograph tree	*Clusia rosea*
avocado	*Persea americana*
bamboo orchid	*Arundina graminifolia*
banyan	*Ficus microcarpa*
barbwire grass	*Cymbopogon refractus*
barley	*Hordeum leporinum*
beakrush	*Rhynchospora caduca*
beardgrass	*Schizachyrium condensatum*
bedstraw	*Galium divaricatum*
beggar's tick	*Glycine wightii*
Bermuda grass	*Cynodon dactylon*
bidens	*Bidens alba*
bitter herb	*Centaurium erythraea*
black mustard	*Brassica nigra*
black medick	*Medicago lupulina*
blackberry	*Rubus argutus*
blechnum	*Blechnum occidentale*
blue flax	*Linum bienne*
blue vervain	*Stachytarpheta urticifolia*
bluegrass, annual bluegrass	*Poa annua*
boerhavia	*Boerhavia coccinea*
brome, bromegrass	*Bromus* spp.
brome	*Bromus tectorum*
brome fescue	*Vulpia bromoides*
broomsedge	*Andropogon virginicus*
buffel grass	*Cenchrus ciliaris*
bull thistle	*Cirsium vulgare*
bur clover	*Medicago polymorpha*
buttonweed	*Spermacoce assurgens, Richardia brasiliensis*
California grass	*Brachiaria mutica*
California Christmas berry	*Heteromeles arbutifolia*
Canadian bluegrass	*Poa compressa*
Cape goosebery	*Physalis peruviana*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
carex	*Carex inversa, Carex wahuensis*
castor bean	*Ricinus communis*
chamaesyce	*Chamaesyce hyssopifolia*
cheese weed	*Malva parviflora*
chenopodium	*Chenopodium carinatum, Chenopodium hircinum*
Childing pink	*Petrorhagia velutina*
Christmas berry	*Schinus terebinthifolius*
clover, Alsike clover	*Trifolium* spp.
cocklebur	*Xanthium strumarium*
cock's foot, cocksfoot	*Dactylis glomerata*
coffeeberry	*Rhamnus californica*
Colombian cuphea	*Cuphea carthagenensis*
comb hyptis	*Hyptis pectinate*
common checkweed	*Stellaria media*
common mouse-ear chickweed	*Cerastium fontanum*
common horehound, white horehound	*Marrubium vulgare*
common vetch, spring vetch	*Vicia sativa*
cork oak	*Quercus subra*
corn speedwell	*Veronica arvensis*
Coulter pine	*Pinus coulteri*
cow pea	*Macroptilium latyroides*
cranesbill	*Geranium homeanum*
crassocephalum	*Crassocephalum crepidioides*
crassula	*Crassula sieberiana*
creeping modiola	*Modiola caroliniana*
Cretan brake	*Pteris cretica*
Cuba jute	*Sida rhombifolia*
cudweed, purple cudweed	*Gnaphalium purpureum*
cypress, Arizona cypress	*Cupressus arizonica*
cypress, Monterey cypress	*Cupressus macrocarpa*
Dallis grass	*Paspalum dilatatum*
dandelion, common dandelion	*Taraxacum officinale*
date palm	*Phoenix* sp.
Deptford pink	*Dianthus armeria*
deschampsia	*Deschampsia nubigena*
desmodium	*Desmodium intortum*
dissotis	*Dissotis rotundifolia*
dog tail	*Buddleia asiatica*
dubautia	*Dubautia linearis*
dwarf nettle, burning nettle, dog nettle	*Urtica urens*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
dwarf filmy fern	*Gonocormus minutus*
ekaha	*Elaphoglossum hirtum, Elaphoglossum reticulatum, Elaphoglossum wawrae*
ekoa	*Leucaena leucocephala*
elephant's foot	*Elephantopus mollis*
emex	*Emex spinosa*
eragrostis	*Eragrostis* af. *pilosa, Eragrostis leptophylla*
European strawberry	*Fragaria vesca*
European centaury	*Centaurium erythracea*
evening primrose	*Oenothera stricta*
everlasting	*Gnaphalium japonicum*
false heather	*Cuphea hyssopifolia*
false'ilima	*Sida rhombifolia*
false mallow	*Malvastrum coromandelianum*
fennel	*Foeniculum vulgare*
field madder	*Sherardia arvensis*
field mustard	*Brassica rapa*
filmy fern	*Sphaeroconium obtusum*
filmy fern	*Mecodium recurvum*
firebush	*Tibochina herbacea*
firethorn	*Pyracantha angustifolia*
flat rush	*Juncus planifolius*
Florida beggarweed	*Desmodium tortuosum*
foetid chamomile	*Anthemis cotula*
fountain grass	*Pennisetum setaceum*
furze	*Ulex europaeus*
fuzzy top	*Bothriochloa barbinodis*
gahnia	*Gahnia gahniformis*
galinsoga	*Galinsoga parviflora*
geranium	*Geranium dissectum, Geranium homeanum, Geranium retrorsum*
German ivy, Italian ivy	*Senecio mikanioides*
Glenwood grass	*Sacciolepis indica*
globe beakrush	*Rhynchospora globularis*
glorybush	*Melastoma candidum*
glossy nightshade	*Solanum americanum*
goat head	*Tribulus terrestris*
gold fern	*Pityrogramma chrysophylla*
golden crown-beard	*Verbesina encelioides*
goose grass	*Eleucine indica*
goosefoot	*Chenopodium album*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
gorse	*Ulex europaeus*
gosmore	*Hypochoeris radicata*
great mullein	*Verbascum thapsus*
green panicgrass	*Panicum maximum*
groundsel	*Senicio vulgaris*
guava	*Psidium guajava*
Guinea grass	*Panicum maximum*
gum tree	*Eucalyptus* spp.
gunpowder tree	*Trema orientalis*
ha'iwale	*Cyrtandra hawaiensis*
ha'uoi	*Verbena litoralis*
haha	*Cyanea degneriana, Cyanea pilosa*
hahala	*Cyrtandra paludosa*
hairy cat's ear	*Hypochoeris radicata*
hairy oatgrass	*Danthonia pilosa*
hairy horseweed	*Conyza bonariensis*
hairy vetch	*Vicia villosa*
hairy spurge, garden spurge	*Chamaesyce hirta*
hapu'u'i'i	*Cibotium chamissoi*
hapu'u	*Cibotium glaucum*
hard-stemmed lovegrass	*Eragrostis atropioides*
hawkweed	*Picris hieracioides*
hawk's beard	*Crepis capillaris*
hawk's beard	*Youngia japonica, Crepis capilliaris*
he'upueo	*Trisetum glomeratum*
he'upueo	*Agrostis avenacea*
hedge mustard	*Sisymbrium officinale*
Henry's crabgrass	*Digitaria ciliaris*
hesperocnide	*Hesperocnide sandwicensis*
hi'aloa	*Waltheria indica*
hilahila	*Mimosa pudica*
Hilo grass	*Paspalum conjugatum*
Hilo holly	*Ardisia crenata*
Himalayan raspberry	*Rubus ellipticus*
hinahina	*Geranium cuneatum*
ho'awa	*Pittosporum confertiflorum, Pittosporum hawaiiense*
ho'i'o	*Athyrium sandwichianum*
hoi kuahiwi	*Smilax melastomifolia*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
honohono	*Commelina diffusa*
honohono	*Oplismenus hirtellus*
horseweed	*Conyza canadensis*
hulumoa	*Korthalsella latissima*
hybrid na'ena'e	*Dubautia ciliolata X Dubautia scabra*
ilioha	*Conyza bonariensis*
impatiens	*Impatiens wallerana*
Indian paintbrush	*Castilleja arvensis*
indigo	*Indigofera suffruticosa*
ironwood	*Casuarina equisetifolia*
itchy crabgrass	*Digitaria setigera*
Japanese mat-rush	*Juncus effusus*
Japanese anemone	*Anemone hupehensis*
Jerusalem cherry	*Solanum psudocapsicum*
Jimson weed	*Datura stramonium*
Job's tears	*Coix lachryma-jobi*
juncus	*Juncus tenuis*
ka'ape'ape	*Cyrtomium falcatum*
ka'apeha	*Ricinus communis*
ka'imi	*Desmodium incanum*
kahili ginger	*Hedychium gardnerianum*
kalamoho, kalamoho lau li'i	*Pellaea ternifolia*
kaliko	*Euphorbia heterophylla*
kamakahala	*Labordia hedyosmifolia*
kamole	*Ludwigia octovalis*
kamole	*Polygonum capitatum, Polygonum glabrum*
kanakaloa	*Waltheria indica*
kanawao	*Broussasia arguta*
kawa'u	*Ilex anomala*
Kentucky bluegrass	*Poa pratensis*
ki nehe, ki	*Bidens pilosa*
kikania	*Xanthium strumarium*
kikawaio	*Cyclosorus cyatheoides*
kikuyu grass	*Pennisetum clandestinum*
kilau, kilau pueo	*Pteridium aquilinum*
kili'o'opu	*Kyllinga brevifolia, Kyllinga nemoralis*
kio'ele	*Hedyotis centranthoides*
kiponapona	*Phyllostegia racemosa*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
knotweed	*Polygonum glabrum, Polygonum capitatum*
ko'oko'olau	*Bidens menziesii* ssp. *filiformis*
koa	*Acacia koa*
koa haole	*Leucaena leucocephala*
koali, koali 'awa, koali 'awahia	*Ipomoea indica*
koko kahiki	*Chamaesyce hirta*
kolea lau li'i	*Myrsine sandwicensis*
kolea	*Myrsine lanaiensis, Myrsine lessertiana*
koli,,	*Ricinus communis*
koli'i	*Trematolobelia grandifolia*
kopiko	*Psychotria hawaiiensis*
Koster's curse	*Clidemia hirta*
kukae nene, kukaenene	*Coprosma ernodioides*
kukaepua 'a	*Digitaria ciliaris*
kukapua'a	*Digitaria setigera*
kumuniu	*Doryopteris decipiens*
kuolohia	*Rhynchospora chinensis*
la'au hano	*Datura stramonium*
lani wela	*Conyza candensis*
lantana, lakana	*Lantana camara*
lau-kahi	*Pellaea ternifolia*
laua'e haole	*Phlebodium aureum*
laua'e	*Microsorium scolopendria*
laukahi	*Dryopteris wallichiana*
laukahi kuahiwi	*Plantago hawaiensis*
lauki	*Chamaecrista nictitans*
laulele	*Taraxum officinale*
lepelepe a moa	*Selaginella arbuscula*
lepidium	*Lepidium densiflorum, Lepidium africanum, Lepidium bonariense*
leponene	*Coprosma ernodeoides*
lililehua	*Salvia coccinea*
lo'ulu	*Coniogramme pilosa*
London rocket	*Sisymbrium irio*
loulu	*Pritchardia beccariana*
lovegrass	*Eragrostis tenella*
lucerne	*Medicago sativa*
luzula	*Luzula hawaiiensis*
Lyon's grass	*Themeda villosa*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
ma'o	*Abutilon grandifolium*
ma'ohi'ohi	*Stenogyne microphylla*
mahinalua	*Grammitis tenella*
maidenhair fern	*Adiantum raddianum*
maiele	*Styphelia tameiameiae*
maile hohono	*Ageratum houstonianum*
maile	*Alyxia oliviformis*
makeke	*Brassica nigra*
makole	*Nertera granadensis*
mamaki	*Pipturus albidus*
mamane	*Sophora chrysophylla*
mango	*Mangifera indica*
manienie	*Cynodon dactylon*
manienie ali'i	*Eleusine indica*
manono	*Hedyotis terminalis*
mariscus	*Mariscus hillebrandii*
marsh purslane	*Ludwigia palustris*
mau'u lei	*Chloris barbata*
mau'u laiki	*Paspalum scrobiculatum*
mau'u la'ili	*Sisyrinchium acre*
mau'u 'aki'aki	*Fimbristylis dichotoma*
mau'u pu'uka	*Pycreus polystacyos*
Mayweed	*Anthemis cotula*
mehamehame	*Antidesma platyphyllum*
melilotus	*Melilotus indica*
melochia	*Melochia umbellata*
meu	*Cibotium hawaiense*
Mexican tea	*Chenopodium ambrosioides*
Mexican elder	*Sambucus mexicana*
milfoil	*Achillea millifolium*
milkwort	*Polygala paniculata*
moa, moa nahele	*Psilotum nudum*
modiola	*Modiola carolinianum*
mohihi	*Stenogyne calaminthoides*
mokihana kukae moa	*Pelea hawaiensis*
molasses grass	*Melinus minutifolia*
Monterey pine	*Pinus radiata*
mountain pili	*Panicum tenuifolium*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
mountain pili	*Trisetum glomeratum*
mugwort	*Artemisia vulgaris*
na'ena'e	*Dubautia scabra, Dubautia ciliolata, Dubautia linearis*
naio	*Myoporum sandwicense*
Napa thistle	*Centaurea melitensis*
narrow-leaved carpetgrass	*Axonopus fissifolius*
Natal redtop, Natal grass	*Rhynchelytrum repens*
naule	*Argemone glauca*
naupaka kuahiwi	*Scaevola chamissoniana*
needlegrass	*Stipa cernua*
neneleau	*Rhus sandwicensis*
ni'ani'au	*Nephrolepis exaltata*
ninika	*Lythrum maritimum*
nohoanu	*Geranium cuneatum*
nonesuch	*Medicago lupulina*
Norfolk Island pine	*Araucaria heterophylla*
nun's-hood	*Phaius tankarvilleae*
nutgrass	*Bulbostylis capillaris, Cyperus halpan*
oak fern	*Dryopteris dentata*
octopus tree	*Schefflera actinophylla*
ohe mauka	*Tetraplasandra oahuensis*
Ola'a beauty	*Torenia asiatica*
olive	*Olea europaea*
olomea	*Perrottetia sandwicensis*
olona	*Touchardia latifolia*
orange ginger	*Hedychium greenei*
oreobolis	*Oreobolus furcatus*
oxyspora	*Oxyspora paniculata*
pa'aila	*Ricinus communis*
pa'ihi	*Nasturtium sarmentosum*
pa'iniu	*Astelia menziesiana*
paco fern	*Athyrium esculentum*
pai'a	*Pteridium aquilinum*
pai'i'iha	*Christella dentata*
paina	*Casuarina equisetifolia*
pakahakaha	*Pleopeltis thunbergiana*
pakai kuku	*Amaranthus spinosus*
pakai	*Amaranthus viridis*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
pala	*Marattia douglasii*
pala'a	*Sphenomeris chusana*
palapalai	*Microlepia strigosa*
palapalai a kamapua'a	*Amauropelta globulifera*
palm grass	*Setaria palmifolia*
pamakani, Hamakua pamakani	*Ageratina riparia*
panicum	*Panicum pellitum*
panini, papipi	*Opuntia ficus-indica*
paperbark	*Melaleuca quinquenervia*
partridge pea	*Chamaecrista nictitans*
paspalum	*Paspalum notatum*
pawale	*Rumex skottsbergii, Rumex giganteus*
pennywort	*Hydrocotyle bowlesioides*
pepperwort, peppergrass	*Lepidium virginicum*
perennial veldtgrass	*Ehrharta calycina*
perennial ryegrass	*Lolium perenne*
petty spurge	*Euphorbia peplus*
Philippine ground orchid	*Spathoglottis plicata*
photinia	*Heteromeles arbutifolia*
pi'ipi'i lau manamana	*Asplenium lobulatum*
pigweed	*Portulaca oleracea*
pigweed	*Chenopodium album*
pikakani	*Crotalaria pallida*
pilau maile	*Paederia scandens*
pili, pili grass	*Heteropogon contortus*
pili uka	*Trisetum glomeratum*
pili 'uka	*Deschampsia nubigena*
pilo	*Coprosma montana, Coprosma ochracea*
pin clover	*Erodium cicutarium*
pipi	*Psilotum complanatum*
pipili	*Drymaria cordata*
pipiwai	*Eleocharis obtusa*
pitted beardgrass	*Bothriochloa pertusa*
plantain	*Plantago lanceolata, Plantago major*
plantain, narrow-leaved plantain, English plantain	*Plantago lanceolata*
pluchea	*Pluchea carolinensis*
plushgrass	*Chloris radiata*
poha, poha berry	*Physalis peruviana*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
pohe kula	*Centella asiatica*
polycarpon	*Polycarpon tetraphyllum*
polygonum	*Polygonum capitatum*
popolo	*Solanum americanum, Solanum nigrescens*
popolo kikania	*Solanum linnaeanum*
portulaca	*Portulaca pilosa*
prickly sida	*Sida spinosa*
prickly lettuce	*Lactuca serriola*
pteris	*Pteris vittata*
pua lele	*Crassocephalum crepidioides*
pua pilipili	*Desmodium uncinatum*
pua kala	*Cirsium vulgare*
pua pake	*Chrysanthemum leucanthemum*
pua kala, kala	*Argemone glauca*
pua lele	*Erectites valerianifolia*
pua hoku	*Hippobroma longiflora*
pua pilipili	*Desmodium sandwicense*
pualele	*Emilia fosbergii*
pualele	*Sonchus oleraceus*
puapua moa	*Ophioderma falcatum*
pukamole	*Lythrum maritimum*
pukiawe	*Styphelia tameiameiae*
puncture vine	*Tribulus terrestris*
rabbit-foot clover	*Trifolium arvense*
radiate fingergrass	*Chloris radiata*
ragweed, false ragweed	*Parthenium hysterophorus*
rat tail fescue	*Vulpia myuros*
rattail grass	*Sporobolus africanus*
rattail	*Sporobolus indicus*
rattlepod, fuzzy rattlepod, smooth rattlepod	*Crotalaria* spp.
red fescue	*Festuca rubra*
red clover	*Trifolium pratense*
reichardia	*Reichardia tingitana*
rescue grass	*Bromus willdenowii*
ricegrass	*Paspalum scrobiculatum*
ripgut grass	*Bromus rigidus*
rose apple	*Syzygium jambos*
rue	*Ruta graveolens*
Russian thistle	*Salsola kali*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
Safford's fern	*Polypodium saffordii*
saltbush	*Atriplex suberecta*
sambucus	*Sambucus* spp.
sandalwood	*Santalum paniculatum*
Santa Maria	*Parthenium hysterophorus*
scarlet sage, Texas sage	*Salvia coccinea*
scarlet pimpernel	*Anagallis arvensis*
scarlet pimpernel	*Arenaria serpyllifoila*
sedge, bog sedge	*Carex alligata*
senecio	*Senecio madagascariensis*
sheepgrass	*Eragrostis brownei*
shepard's purse	*Capsella bursa-pastoris*
sicyos	*Sicyos* spp.
silene	*Silene hawaiiensis*
silk oak, silver oak	*Grevillea robusta*
silver fern	*Pityrogramma calomelanoa*
small-flowered catchfly	*Silene gallica*
small bur clover	*Medicago minima*
smooth rattlepod	*Crotalaria pallida*
smooth cat's ear	*Hypochoeris glabra*
smutgrass	*Sporobolus africanus, Sporobolus indicus*
soap grass	*Cymbopogon refractus*
solanum	*Solanum nigrescens*
sorrel, sheep sorrell	*Rumex acetosella*
sourbush	*Pluchea carolinensis, Pluchea symphytifolia*
sowthistle	*Sonchus oleraceus*
Spanish needle	*Bidens pilosa*
Spanish clover, chili clover	*Desmodium sandwicense*
speedwell	*Veronica* spp.
spiny sowthistle	*Sonchus asper*
spleenwort	*Asplenium contiguum, Asplenium monanthes, Asplenium trichomanes*
spurge, garden spurge, prostrate spurge	*Chamaesyce* spp.
spurwort	*Sherardia arvensis*
St. John's wort	*Hypericum mutilum*
stenogyne	*Stenogyne microphylla*
stinkgrass	*Eragrostis cilianensis*
stinking everlasting	*Helichrysum foetidum*
stinkweed	*Tagetes minuta*
stitchwort	*Stellaria media*
sugarcane	*Saccharum officinarum*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
swamp mahogany	*Eucalyptus robusta*
swinecress	*Coronopus didymus*
swollen fingergrass	*Chloris barbata*
sword fern	*Nephrolepis cordifolia, Nephrolepis hirsutula*
Sydney blue gum	*Eucalyptus saligna*
tarweed	*Cuphea carthagenensis*
telegraph plant, telegraph weed	*Heterotheca grandiflora*
tetramolopium	*Tetramolopium humile*
thimbleberry	*Rubus rosifolius*
thyme-leaved speedwell, thyme speedwell	*Veronica serpyllifolia*
thyme-leaved sandwort	*Arenaria serpyllifoila*
ti	*Cordyline fruticosa*
tick clover	*Desmodium triflorum*
trefoil	*Lotus subbiflorus*
tritonia	*Crocosmia x crocosmimiifolia*
tsugi, Sugi pine	*Cryptomeria japonica*
tumble mustard	*Sisymbrium altissimum*
tumbleweed	*Salsola kali*
uhauhako	*Rumex giganteus*
uluhe	*Sticheris owhyhensis*
uluhe	*Dicranopteris linearis*
uluhe lau loa	*Hicriopteris pinnata*
uncinia	*Uncinia uncinata*
vasey grass	*Paspalum urvillei*
velvet grass	*Holcus lanatus*
Venus's looking glass	*Triodanis biflora*
vernalgrass, sweet vernalgrass	*Anthoxanthum odoratum*
violet crabgrass	*Digitaria violescens*
virgate mullein, wand mullein	*Verbascum virgatum*
wahini noho mauka	*Adenophorus tamariscinus*
wahlenbergia	*Wahlenbergia gracilis*
waiawi	*Psidium cattleianum*
Wainaku grass	*Panicum repens*
wawae'iole	*Lycopodium cernuum, Lycopodium phyllanthym, Lycopodium venustulum*
weed verbena	*Verbena litoralis*
West Indian dropseed	*Sporobolus indicus*
whin	*Ulex europaeus*
white sweet clover	*Melilotus alba*
white ginger	*Hedychium coronarium*

Vascular Plants Detected or Expected to Occur Within the Vicinity of the Project Area

Common Name	Scientific Name
white clover	*Trifolium repens*
wild bean	*Macroptilium latyroides*
wild radish	*Raphanus sativus*
wild rose iris	*Sisyrinchium rosulatum*
wild oats	*Avena fatua*
wilelaiki	*Schinus terebinthifolius*
willow herb	*Epilobium billardierianum, epilobium ciliatum*
wiregrass	*Eleusine indica*
wood groudsel	*Senecio sylvaticus*
wood rush	*Luzula hawaiiensis*
wood-fern	*Christella parasitica, Christella dentata*
woolly mullein, common mullein	*Verbascum thapsus*
wormseed	*Chenopodium ambrosioides*
yarrow, common yarrow	*Achillea millifolium*
yellow bluestem	*Andropogon virginicus*
yellow star thistle	*Centaurea melitensis*
yellow ginger	*Hedychium flavescens*
yellow-eyed grass	*Xyris platylepis*
yellow foxtail	*Setaria gracilis*
yellow wood sorrel	*Oxalis corniculata*

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

	Taxon	Status
ACARI (Mites)		
	Ctenacarus sp.	unknown
	Damaeus sp.	unknown
	Eustigmaeus segnis group	unknown
	Foveacheles sp.	unknown
	Neophyllobius sp.	unknown
	Raphignathus n. sp.	unknown
	Spinibdella thori	unknown
	Tydeus sp.	unknown
ARANEAE (Spiders)		
Araneidae	*Gasteracantha mammosa*	adventive
Linyphiidae	*Erigone* cf. *stygius*	endemic
Lycosidae	*Lycosa* sp.	endemic
Theridiidae	*Achaearanea tepidariorum*	adventive
CHILOPODA (Centipedes)		
Lithobiidae	*Lithobius* sp.	endemic
DIPLOPODA (Millipedes)		

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

	Taxon	Status
Cambalidae	*Nannolene* sp.	endemic
Paradoxosomatidae	*Oxidus gracilis*	adventive
INSECTA (Insects)		
COLLEMBOLA: Springtails		
Entomobryidae	unknown	unknown
Hypogastruridae	*Neanura hawaiiensis*	endemic
Isotomidae	unknown	unknown
ODONATA: Dragonflies & Damselflies		
Coenagrionidae (Damselflies)	*Megalagrion amaurodytum peles*	endemic
ORTHOPTERA: Grasshoppers, Katydids & Crickets		
Acrididae (Grasshoppers)	*Oedaleus abruptus*	adventive
Gryllidae (Crickets)	*Leptogryllus* sp.	endemic
	Trigonidomorpha sjostedti	adventive
Tettigoniidae (Katydids)	*Conocephalus saltator*	adventive
HETEROPTERA: True Bugs		
Lygaeidae (Seed Bugs)	*Geocoris punctipes*	adventive
	Nysius coenosulus	endemic
	Nysius sp. 1	endemic
	Nysius sp. 2	endemic
	Nysius sp. 3	endemic
	Nysius sp. 4	endemic
	Nysius sp. 5	endemic
	Nysius sp. 6	endemic
	Nysius sp. 7	endemic
	Nysius sp. 8	endemic
Miridae (Plant Bugs)	*Orthotylus* sp. 1	endemic
	Orthotylus sp. 2	endemic
	Opuna sharpianus	endemic
	Rhinacloa forticornis	adventive
Nabidae	*Nabis capsiformis*	adventive
Pentatomidae	*Coleotichus blackburniae*	endemic
	Nezara viridula	adventive
	Thyanta custator accerra	adventive
HOMOPTERA: Leafhoppers and Planthoppers		
Aphididae	*Rhopalosiphoninus latysiphon*	adventive
Cicadellidae (Leafhoppers)	*Balclutha incisa hospes*	adventive
	Balclutha sp.	endemic?
	Carneocephala sagittifera	adventive
	Deltocephalus sonorus	adventive
	Nesophrosyne pluvialis	endemic
Flatidae (Flatid planthoppers)	*Siphanta acuta*	adventive
COLEOPTERA: Beetles		
Aglycyderidae	*Proterhinus* sp.	endemic

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

	Taxon	Status
Anobiidae	*Holcobius* sp.	endemic
	Ozognathus sp.	adventive
Apionidae	*Perapion antiquum*	imported
Bruchidae	*Algarobius bottimeri*	adventive
Carabidae	*Gnathaphanus* sp.	adventive?
	Mecyclothorax sp.	endemic
	Pristonychus complanatus	adventive
Cerambycidae (Long-horned beetles)	*Plagithmysus blackburni*	endemic
	Plagithmysus filipes sophorae	endemic
	Plagithmysus looki	endemic
Chrysomelidae	*Diachus auratus*	adventive
Coccinellidae (Lady-bird beetles)	*Cryptolaemus montrouzieri*	imported
	Diomus notescens	imported
	Hippodamia convergens	imported
	Hyperaspis fimbriolata	imported
	Nephus bilucernarius	imported
	Rhyzobius forestieri	imported
	Rhyzobius lophanthae	imported
	Scymnus loewii	imported
Curculionidae (Weevils)	*Asynonychus godmanni*	adventive
	Hypera postica	adventive
	Otiorhynchus cribricollis	adventive
	Syagrius fulvitarsus	adventive
Dytiscidae	*Rhantus binotatus?*	adventive?
Elateridae (Click beetles)	*Conoderus exsul*	adventive
Staphylinidae (Rove beetles)	*Liophaena gracilipes*	endemic
Tenebrionidae (Darkling beetles)	*Blapstinus dilatatus*	adventive
	Gonocephalum bilineatum?	adventive
	Lobometopon diremptus	adventive
LEPIDOPTERA: Butterflies and Moths		
Cosmopterigidae	*Hyposmocoma* spp.	endemic
Crambidae	*Hellula undalis*	adventive
	Mestolobes nr. *minuscula*	endemic
	Orthomecyna ?n. sp.	endemic
	Tamsica cf. *hyacinthina*	endemic
Noctuidae	*Schrankia* sp. 1	endemic
	Schrankia sp. 2	endemic
Oecophoridae	*Stoeberhinus testaceus*	adventive
	Thyrocopa sp.	endemic
Pieridae	*Pieris rapae*	adventive
Tortricidae	*Cryptophlebia illepida*	adventive
DIPTERA: Flies		

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

	Taxon	Status
Agromyzidae	*Calycomyza humeralis*	adventive
	Liriomyza sativae	adventive
	Melanagromyza? sp.	adventive
	Ophiomyia lantanae	imported
Anthomyiidae	*Delia platura*	adventive
Asteiidae	*Asteia montgomeryi?*	endemic
Calliphoridae	*Calliphora vomitoria*	adventive
	Chrysomya rufifacies	adventive
	Dyscritomyia sp.	endemic
	Pollenia rudis	adventive
Cecidomyiidae	*Anarete johnsoni*	adventive
	unknown 1	unknown
	unknown 2	unknown
Ceratopogonidae	*Forcipomyia* prob. *hardyi*	endemic
	Forcipomyia pholetor	endemic
Chamaemyiidae	*Leucopis obscura*	imported
Chironomidae	unknown	unknown
Chloropidae	unknown	unknown
	Monochaetoscinella anonyma	adventive
Dolichopodidae	*Campsicnemus* n. sp. nr. *loxothrix*	endemic
	Campsicnemus scolimerus	endemic
	Eurynogaster sp.	endemic
Drosophilidae	*Drosophila crassifemur*	endemic
	Drosophila immigrans	adventive
	Drosophila melanogaster/simulans	adventive
	Drosophila paracracens	endemic
	Drosophila sp. 1 (cave species)	endemic
	Drosophila sp. 2 (surface species)	unknown
	Drosophila suzukii	adventive
	Scaptomyza apiciguttula	endemic
	Scaptomyza nr. *articulata*	endemic
Lonchaeidae	*Lonchaea polita*	adventive
Lonchopteridae	*Lonchoptera furcata*	adventive
Muscidae	*Brontaea quadristigma*	adventive
	Lispe metatarsalis	endemic
	Lispocephala sp.	endemic
Neriidae	*Telostylinus lineolatus*	adventive
Phoridae	*Diplonevra peregrina*	adventive
	Megaselia sp.	unknown
	unknown	unknown
Sarcophagidae	*Helicobia morionella*	adventive
	Ravinia lherminieri	adventive
Scatopsidae	*Coboldia fuscipes*	adventive

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

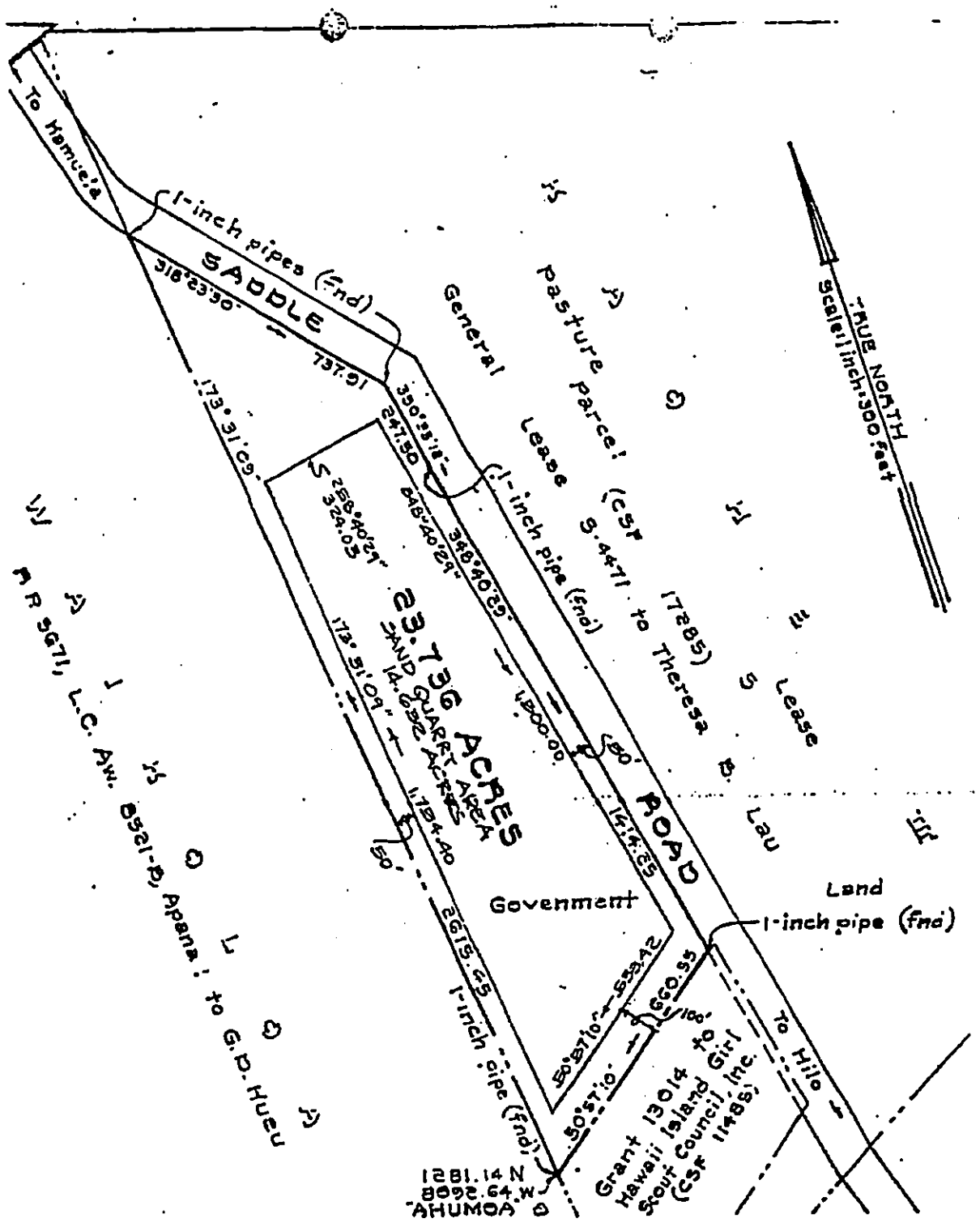
	Taxon	Status
Scenopinidae	*Scenopinus lucidus*	adventive
	Toxomerus marginatus	adventive
Sciaridae	unknown	unknown
Sepsidae	*Sepsis thoracica*	adventive
Sphaeroceridae	*Leptocera* sp.	adventive?
	Poecilosomella punctipennis	adventive
Syrphidae	*Allograpta exotica*	adventive
	Allograpta obliqua	adventive
	Simosyrphus grandicornis	adventive
	Toxomerus marginatus	adventive
Tachinidae	*Eucelatoria armigera*	adventive
	Gonia longipulvilli	adventive
	Lespesia archippivora	imported
	Trichopoda pilipes	adventive
Tephritidae	*Trupanea arboreae*	endemic
	Trupanea neoapicalis	endemic
	Trupanea n. sp. 1	endemic
	Trupanea sp.	endemic
Tipulidae	*Limonia nigropolita*	endemic
	Limonia sp. nr. *jacoba*	endemic
	Limonia sp. 1	endemic
HYMENOPTERA: Wasps, Bees and Ants		
Aphelinidae	unknown	unknown
Apidae	*Apis mellifera*	imported
Bethylidae	*Epyris sp.* not *extraneus*	unknown
	Parasierola sp.	unknown
	Sierola sp.	endemic
Braconidae	*Chelonus blackburni*	endemic?
	Cotesia marginiventris	imported
	Cotesia sp.	unknown
	unknown	unknown
	Habrobracon hebetor	adventive
	Meteorus laphygmae	imported
Chalcidae	*Dirhinus anthracina*	imported
Colletidae	*Hylaeus* (*Nesoprosopis*) sp. 1	endemic
	Hylaeus (*Nesoprosopis*) sp. 2	endemic
Diapriidae	*Stylaclista* sp.	adventive
	Trichopria soror?	endemic
Encyrtidae	*Aenasius? advena*	unknown
	Copidosoma sp.	unknown
	Epidinocarsis californicus	adventive
	unknown	unknown
	Ooencyrtus sp.	unknown

Insects and Related Arthropods Collected Within the Vicinity of the Project Area

	Taxon	Status
Eucoilidae	*Ganaspidium utilis*	imported
	unknown	unknown
	Pseudeucoila cf. *oreias*	unknown
Eulophidae	*Diglyphus* sp.	unknown
	Tetrastichus sp.	unknown
	unknown	unknown
Formicidae	*Cardiocondyla* sp.	adventive
	Linepithema humile	adventive
Halictidae	*Halictus* sp.	adventive?
Ichneumonidae	*Anomalon californicum*	adventive
	Casinaria infesta	adventive
	Diadegma blackburni	adventive
	Diadegma sp.	unknown
	Diplazon laetatorius	adventive
	unknown	unknown
	Pimpla punicipes	adventive
	Pristomerus hawaiiensis	endemic?
	Pristomerus spinator	imported
	Spilichneumon superbus	imported
Mymaridae	*Polynema* sp.	unknown
Platygasteridae	unknown	unknown
Pteromalidae	*Cyrtogaster* sp.	unknown
	unknown 1	unknown
	unknown 2	unknown
	Norbanus sp.	adventive?
	Pachyneuron sp.	adventive?
	Pteromalus puparum	imported
Scelionidae	*Baeus* sp.	unknown
	unknown 1	unknown
	unknown 2	unknown
	Trissolcus basalis	imported
	Trissolcus sp.	unknown
Sphecidae	*Dryudella immigrans*	adventive
	Ectemnius sp. 1	endemic
	Ectemnius sp. 2	endemic
Trichogrammatidae	unknown	unknown
Vespidae	*Odynerus* sp.	endemic
	Vespula pensylvanica	adventive
ISOPODA (sowbugs)		
Porcellionidae	*Porcellio* sp.	adventive

APPENDIX C

SAND QUARRY PARCEL MAP



PORTION OF THE GOVERNMENT LAND OF KAOHE

Kaohe III, Hamakua, Island of Hawaii, Hawaii

Scale: 1 inch = 300 feet

OB H-399 (85)

: BK

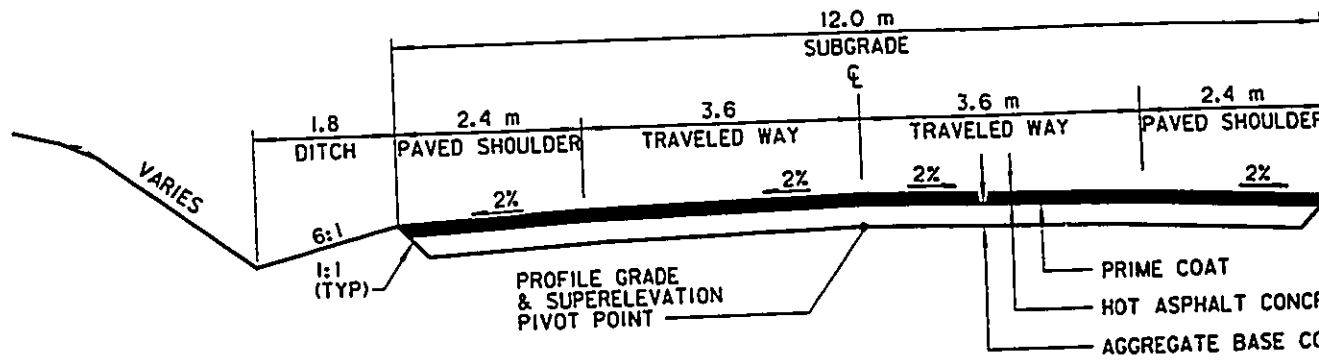
AX MAP: 4-4-15

SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII

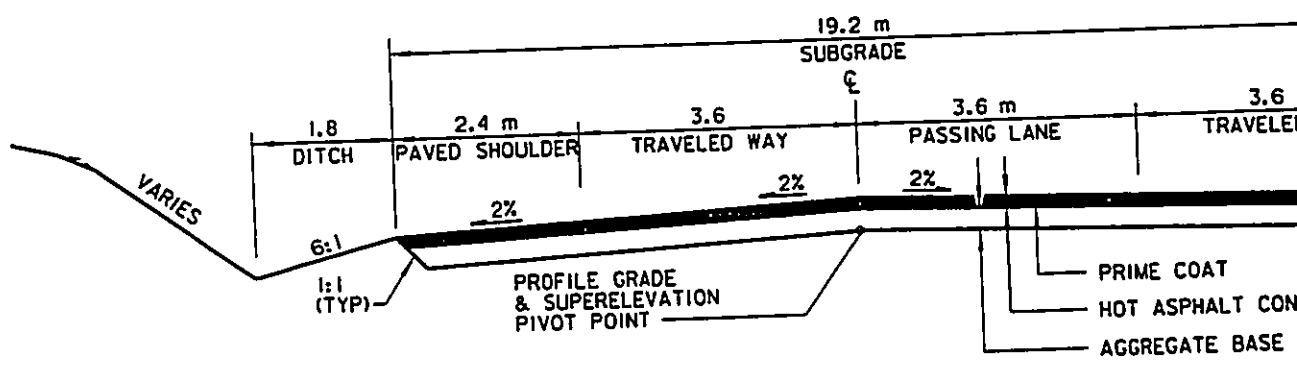
: I. F. No. 20,015

M.S.N. July 24, 1984

REDUCED IN FILE



TYPICAL SECTION A



TYPICAL SECTION A WITH PASSING LANE

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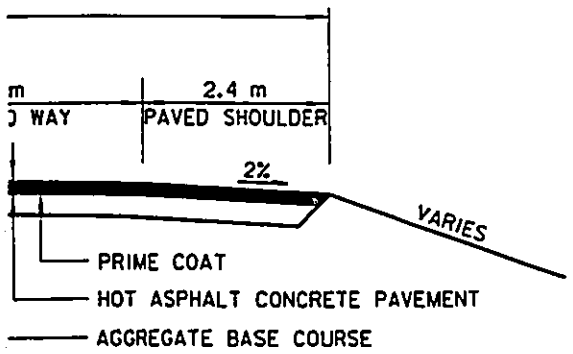
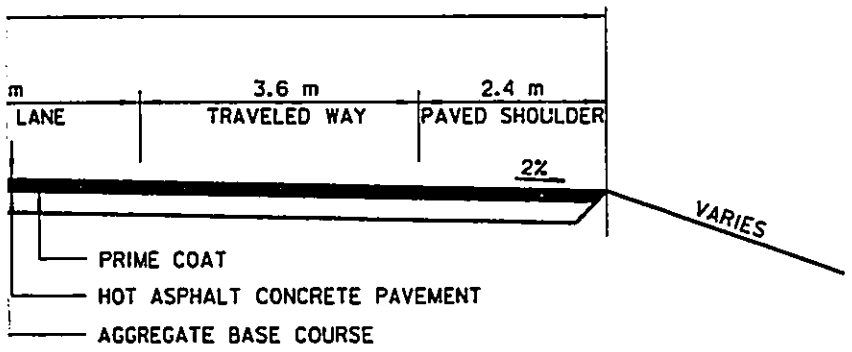


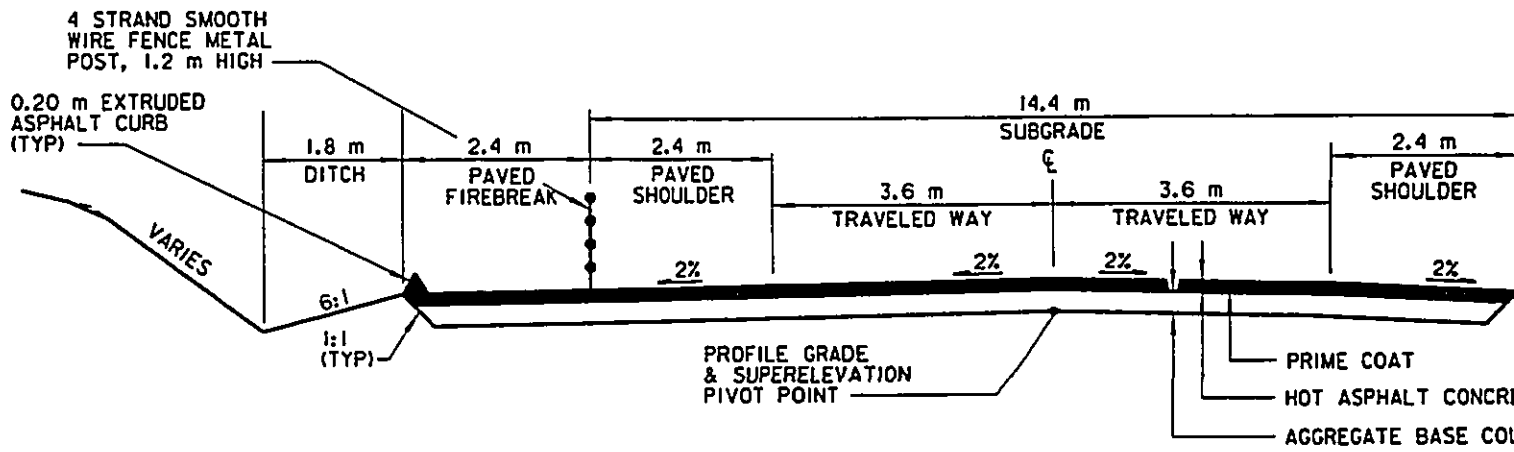


ING LANE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

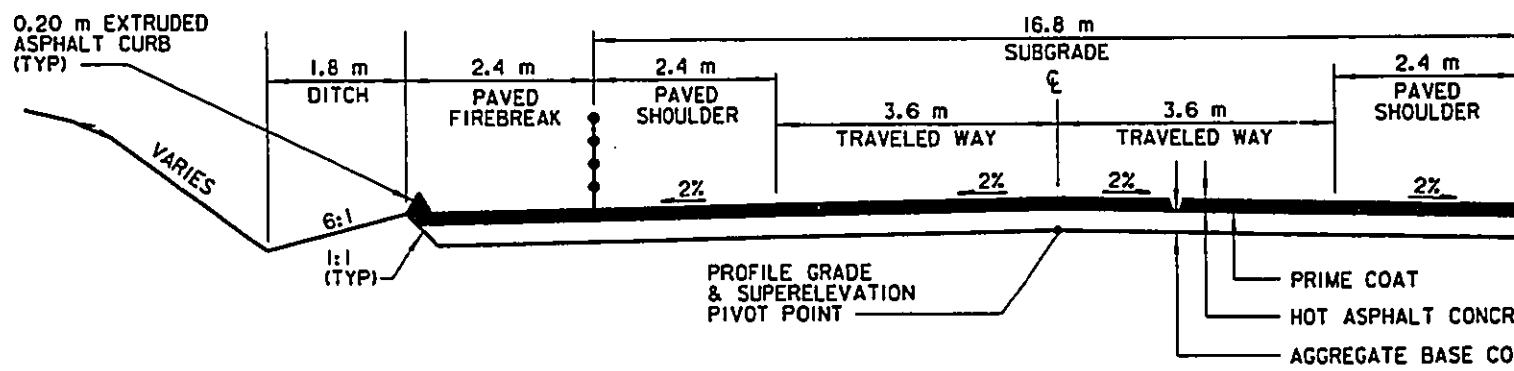
TYPICAL SECTIONS
PROPOSED

FIGURE 2.1.1
SHEET 1 OF 2



TYPICAL SECTION B

PTA-1 STA 10+000 TO PTA-1 STA 21+500
PTA-3 STA 10+000 TO PTA-1 STA 21+500
EX-2 STA 119+100 TO EX-2 STA 123+000



TYPICAL SECTION C

PTA-1 STA 21+500 TO PTA-1 STA 27+270
PTA-3 STA 21+500 TO PTA-1 STA 26+900 (Common t
PTA-3 STA 10+000 TO 12+500
EX-2 STA 129+000 TO EX-2 STA 132+500

DATETue Oct 7 13:54:01 1997
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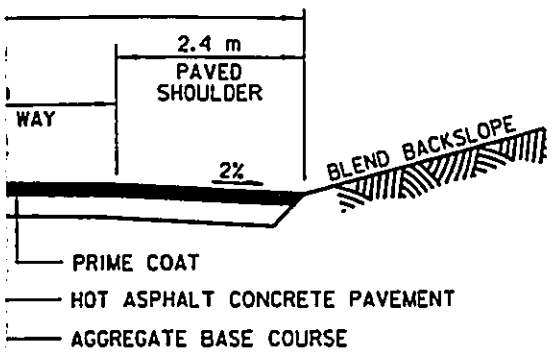
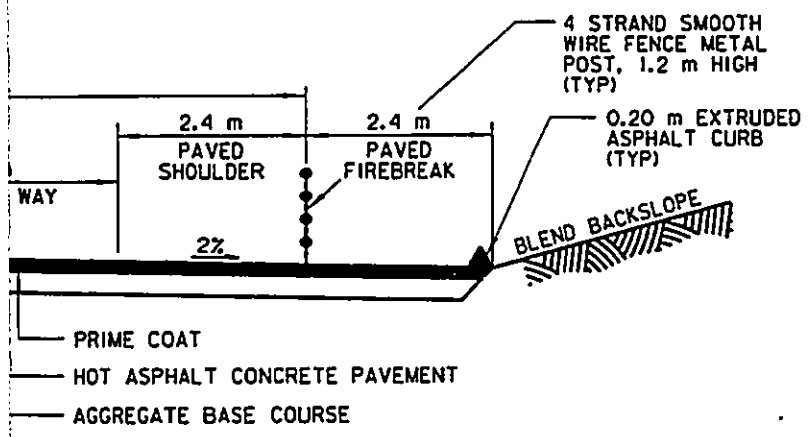


TA 21+500
TA 21+500
123+000



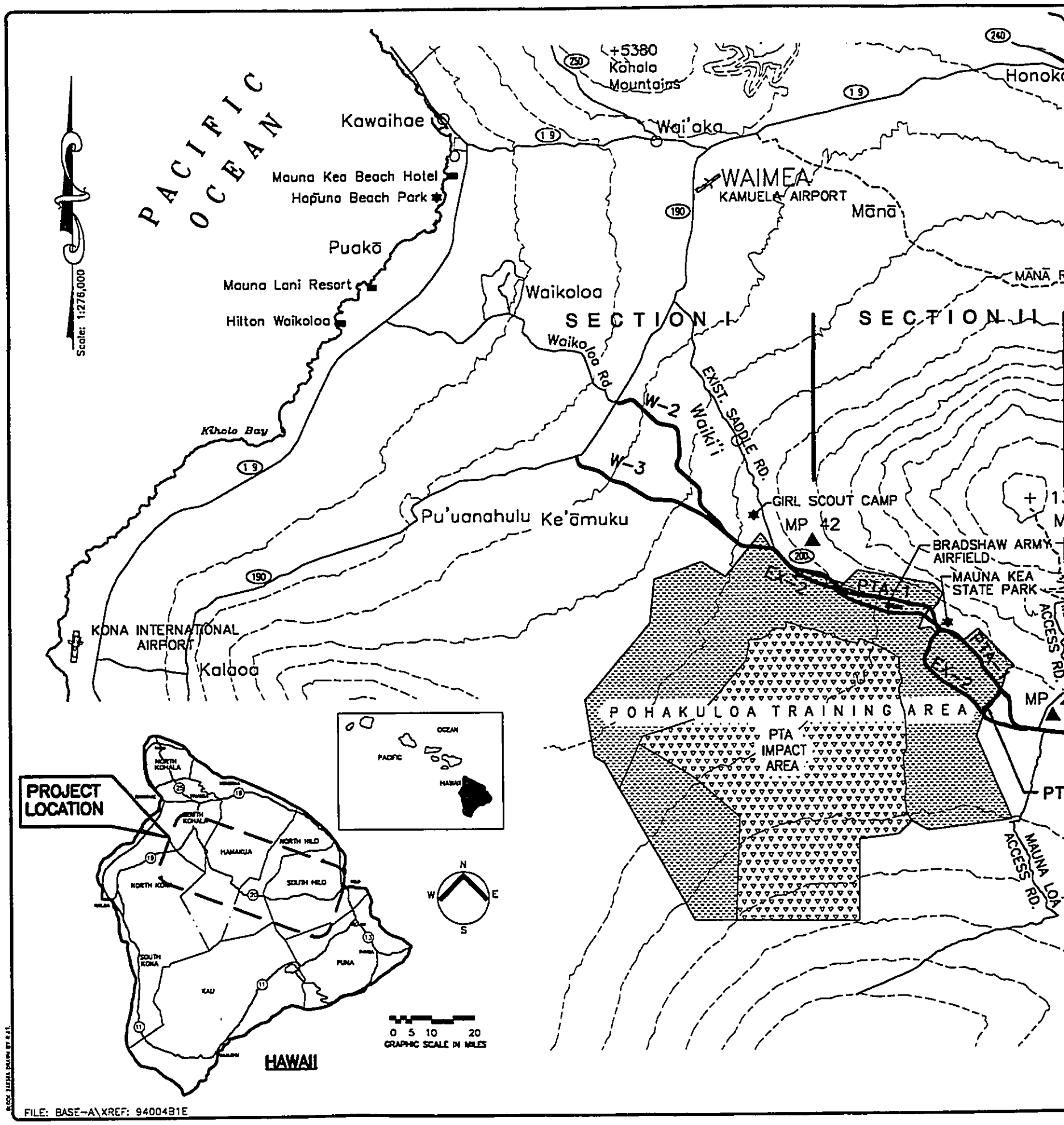
27+270
A 26+900 (Common to PTA-1)

132+500

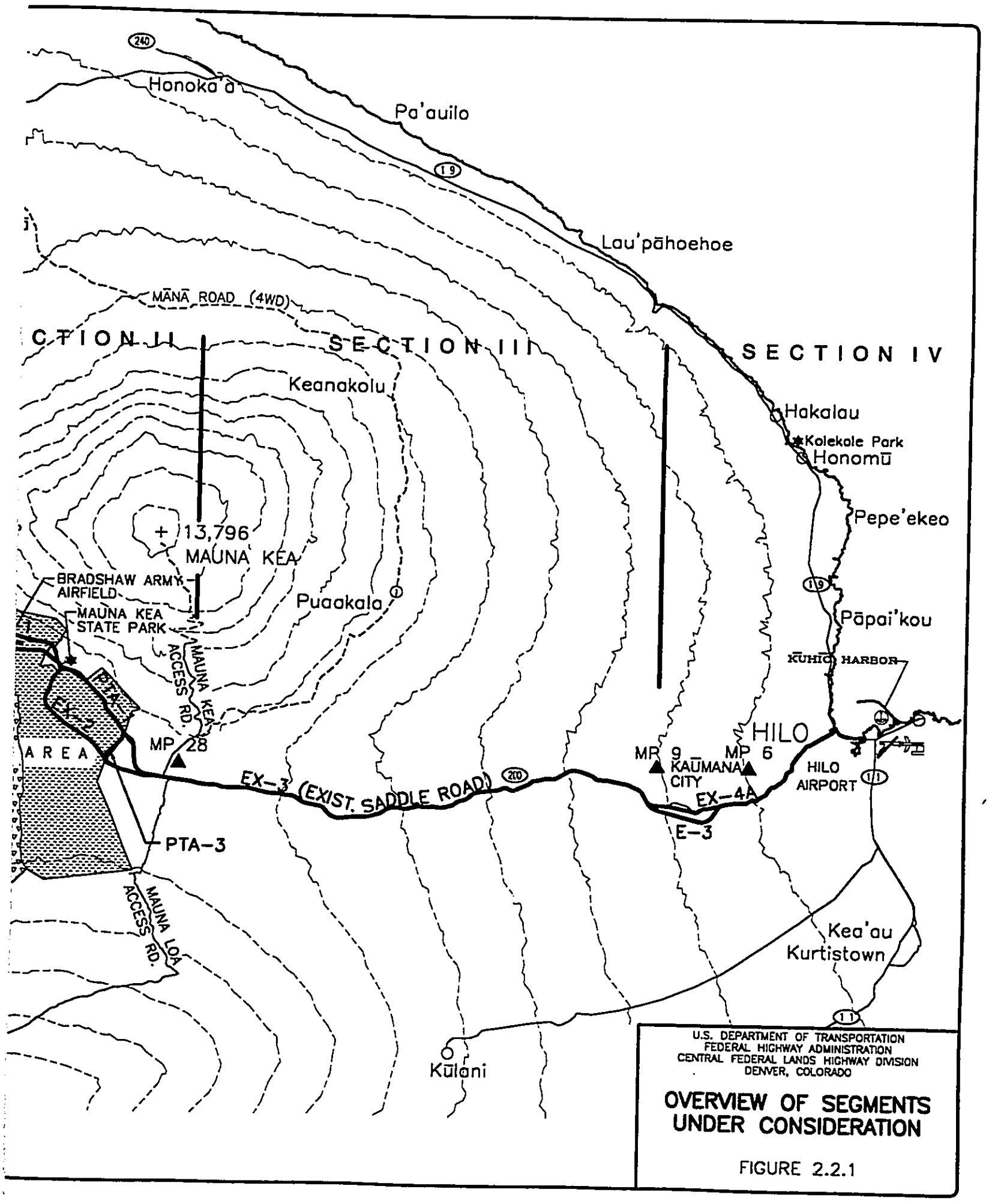
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

TYPICAL SECTIONS
PROPOSED

FIGURE 2.1.1
SHEET 2 OF 2



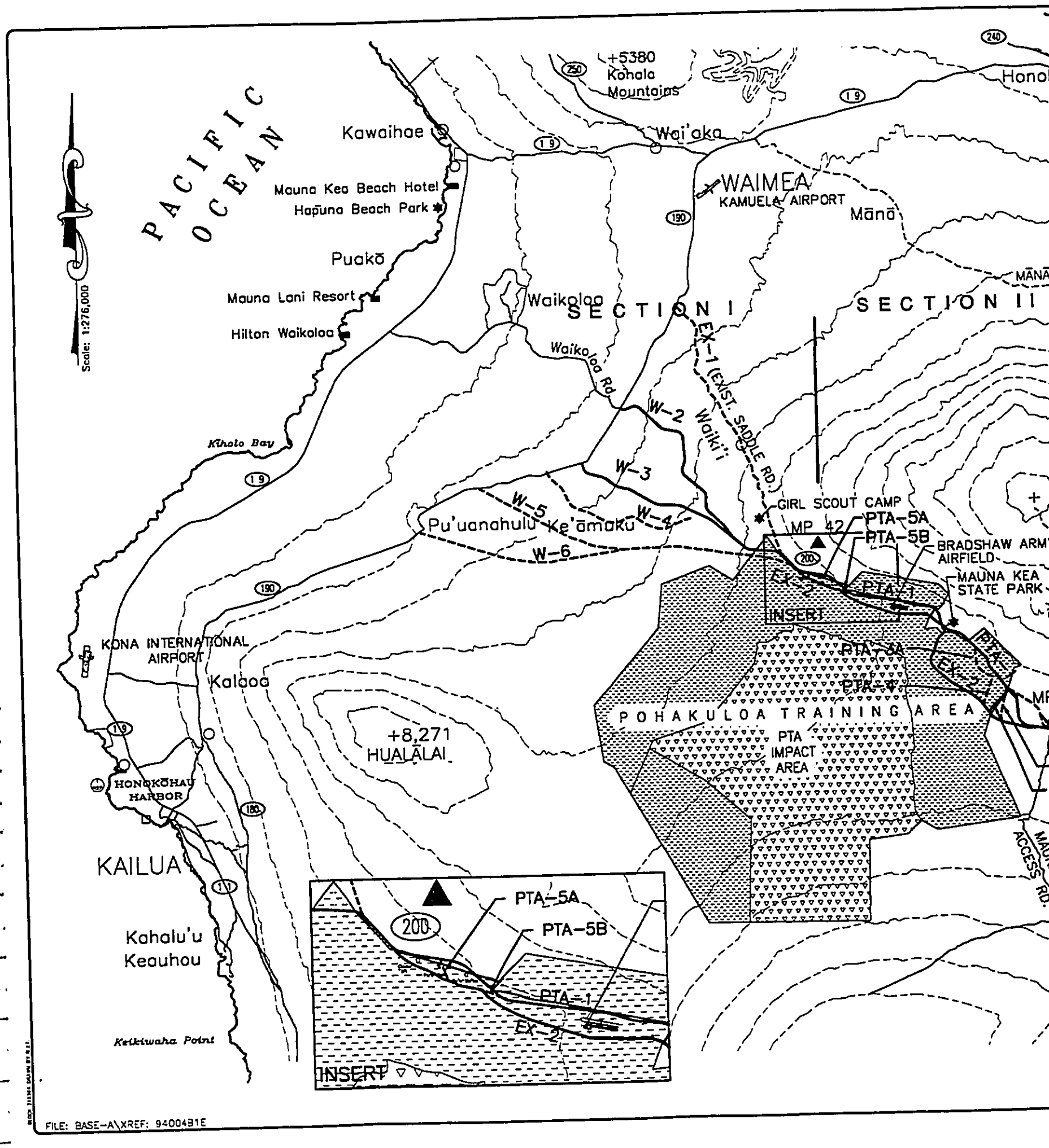
FILE: BASE-A\XREF: 9400431E



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

OVERVIEW OF SEGMENTS UNDER CONSIDERATION

FIGURE 2.2.1


PACIFIC OCEAN
Scale: 1:276,000
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
Kīholo Bay
+5380
Kohala Mountains
Waiʻaka
WAIMEA
KAMUELA AIRPORT
Mānā
MĀNĀ
Waikoloa
SECTION I
SECTION II
Waikoloa Rd
EX-1 (EXIST. SADDLE RD.)
Waikiʻi
W-2
W-3
W-4
W-5
W-6
Puʻuanahulu
Keʻāmoku
GIRL SCOUT CAMP
MP 42
PTA-5A
PTA-5B
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
EX-2
PTA-1
INSERT
PTA-3A
PTA-4
POHAKULOA TRAINING AREA
PTA IMPACT AREA
KONA INTERNATIONAL AIRPORT
Kalaoa
+8,271
HUALĀLAI
HONOKŌHAU HARBOR
KAILUA
Kahaluʻu
Keauhou
Kekiwaha Point
MAUNA ACCESS RD.
FILE: BASE-A\XREF: 94004B1E

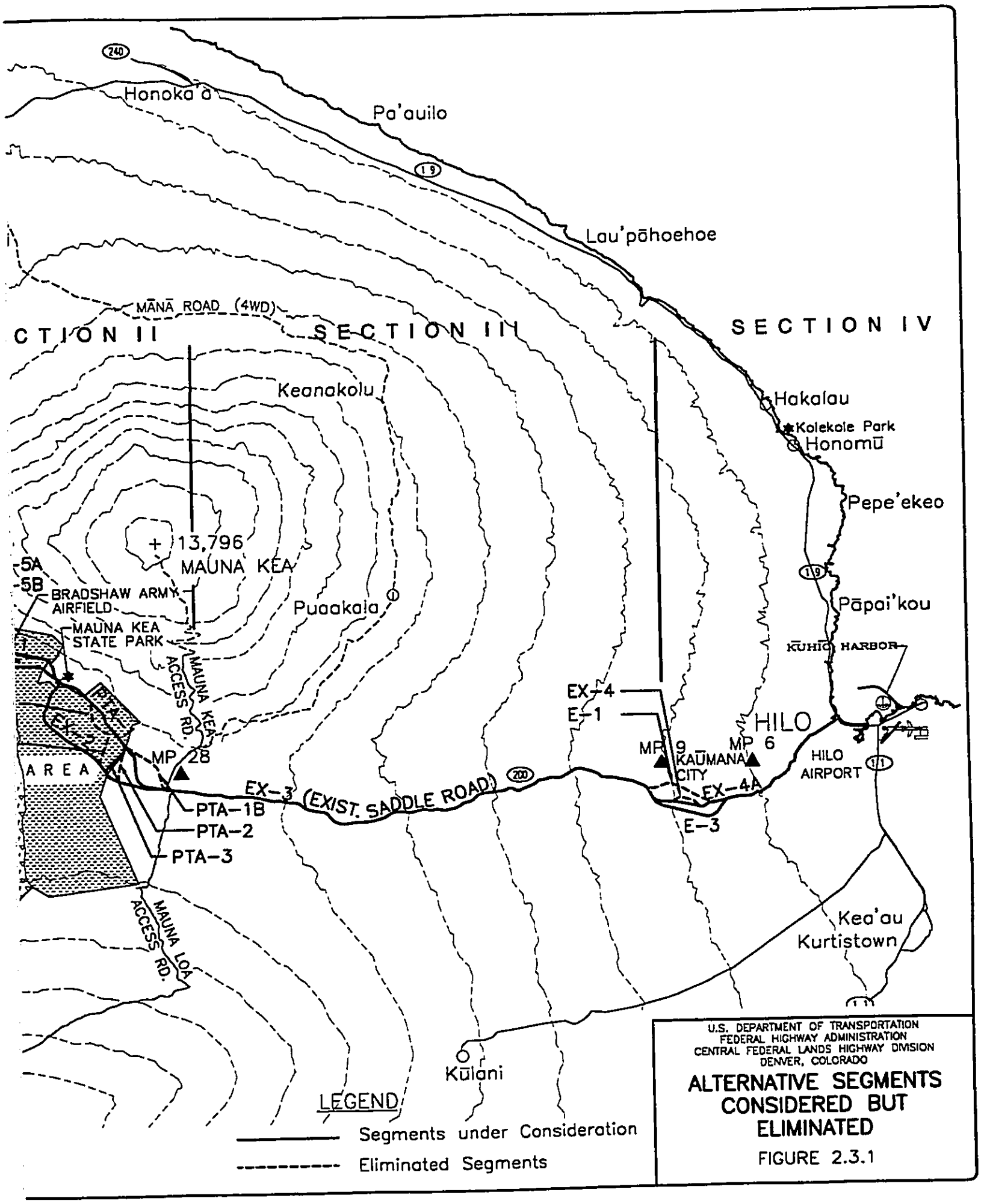
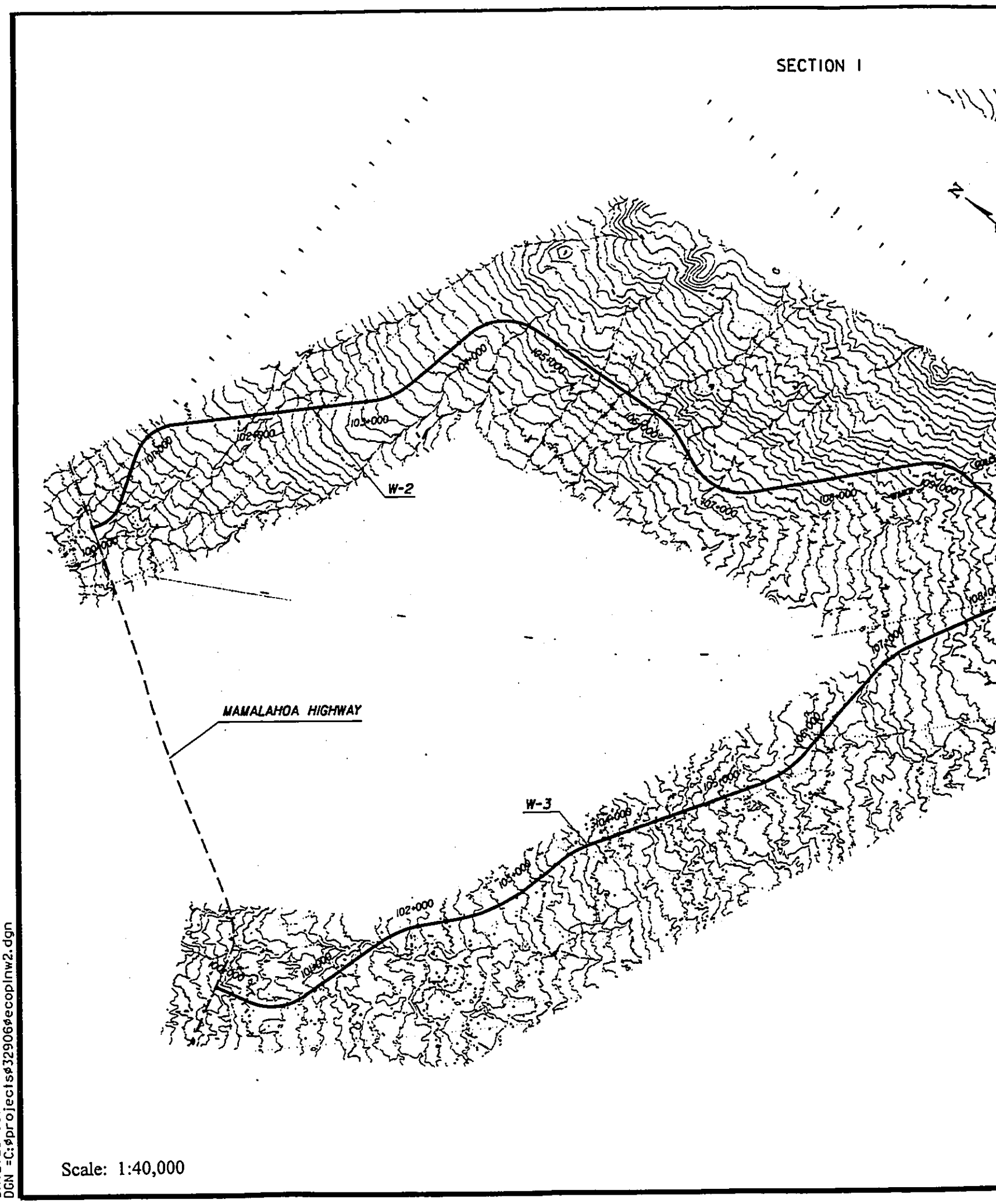

240
Honoka'a
Pa'auilo
19
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
CTION II
SECTION III
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
13,796
MAUNA KEA
-5A
-5B
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Pāpai'kou
KŪHIŌ HARBOR
MAUNA KEA ACCESS RD.
EX-4
E-1
HILO
MP 9
MP 6
KAŪMANA CITY
HILO AIRPORT
MP 28
AREA
EX-3 (EXIST. SADDLE ROAD)
200
EX-4A
E-3
PTA-1B
PTA-2
PTA-3
MAUNA LOA ACCESS RD.
Kea'au
Kurtistown
Kūlani
LEGEND
Segments under Consideration
Eliminated Segments
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
ALTERNATIVE SEGMENTS CONSIDERED BUT ELIMINATED

FIGURE 2.3.1



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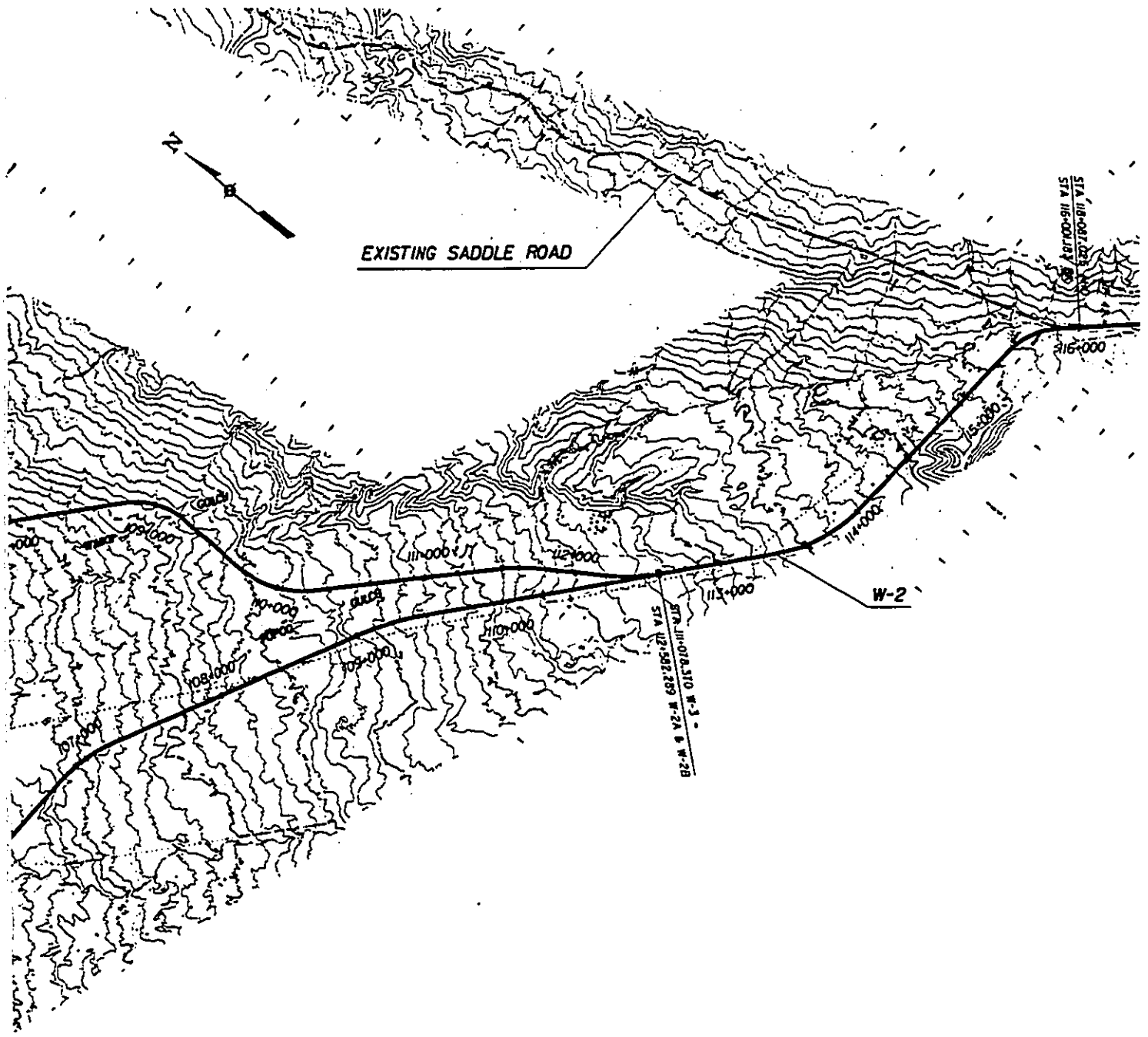
5



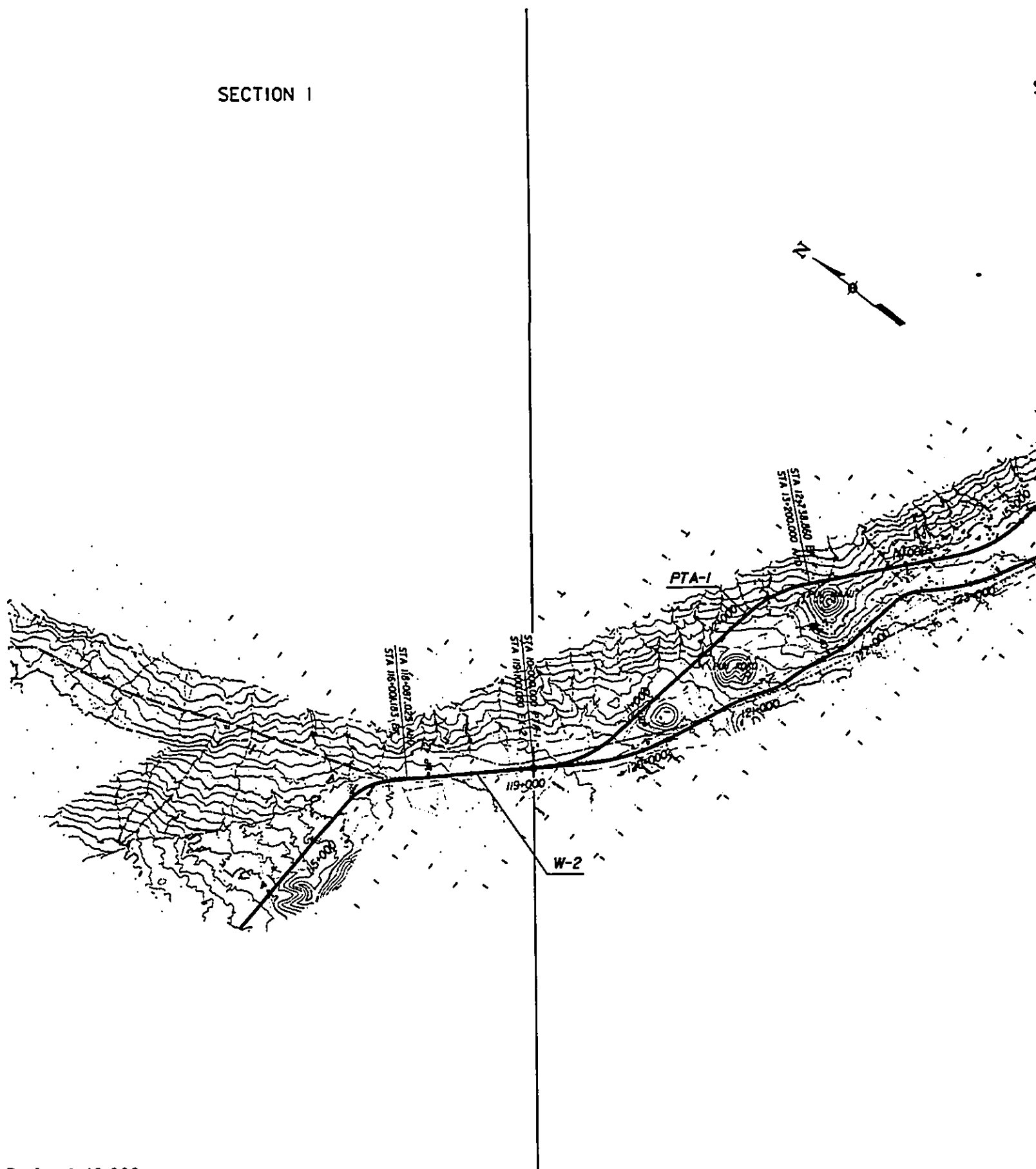
SHEET CONTENTS

W-2 STA 100+000 TO 116+000
W-3 STA 100+000 TO 111+073

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.4

SECTION 1



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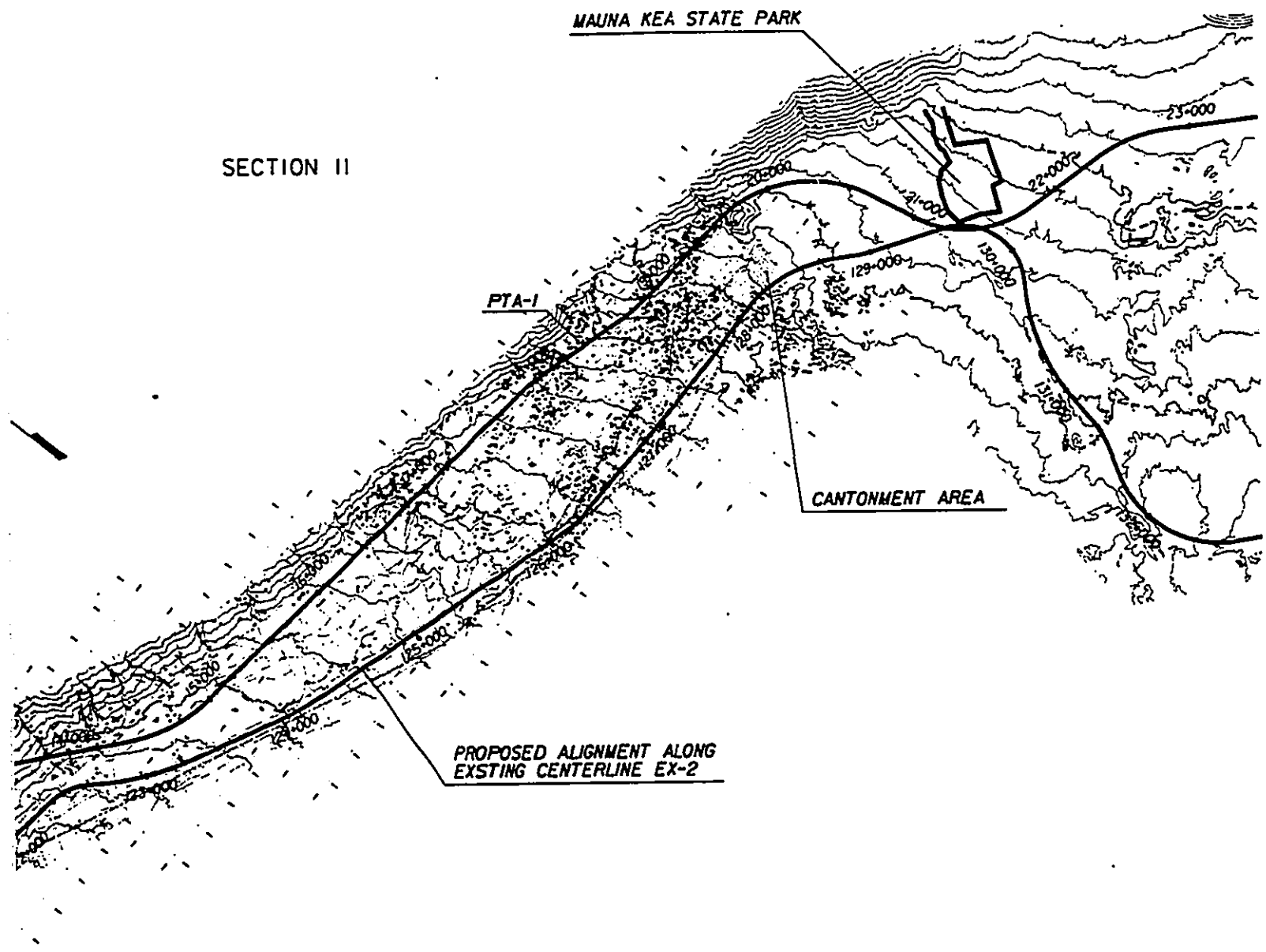


SHEET CONTENTS

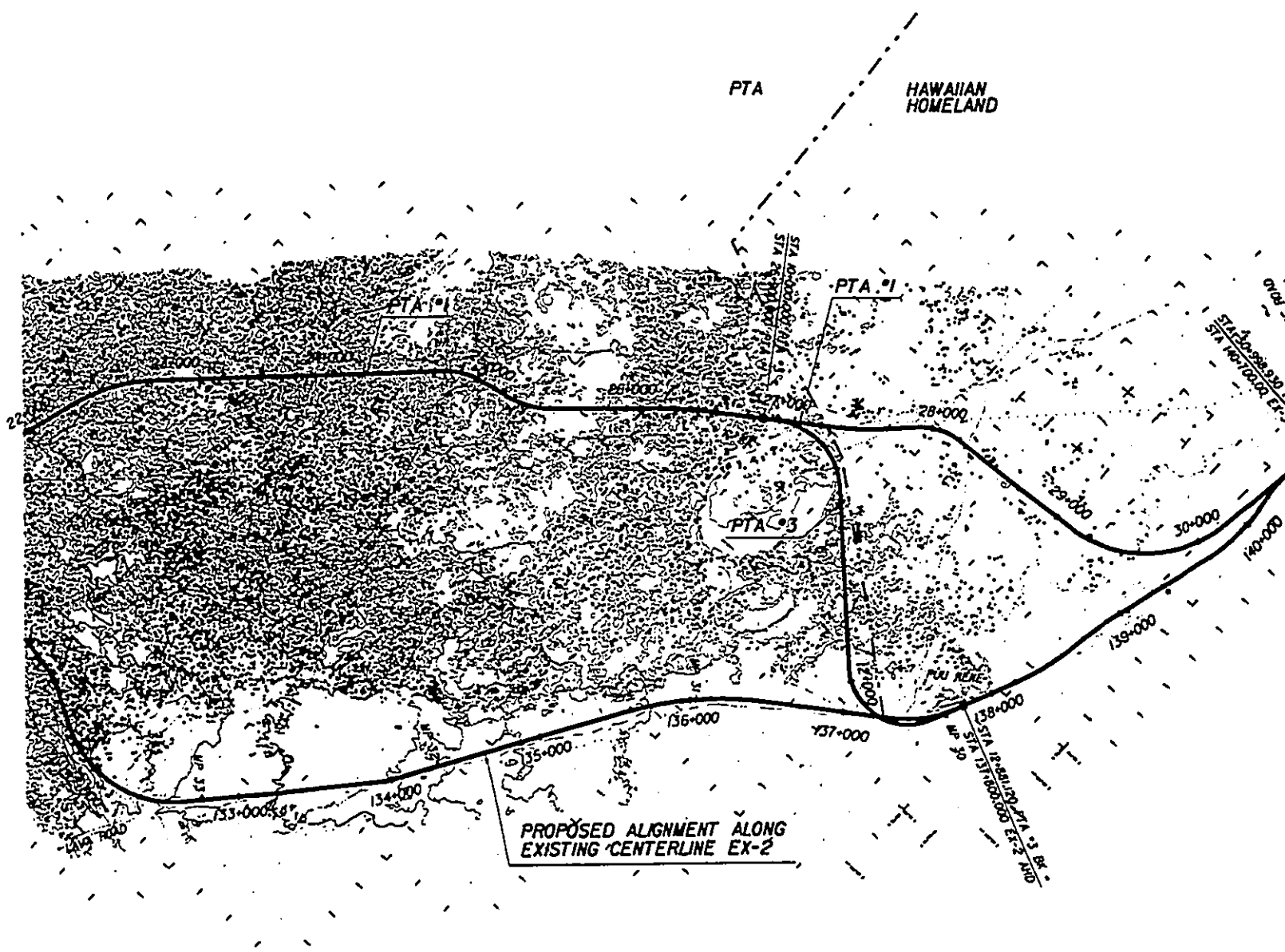
W-2	STA 114+500 TO 119+100
EX-2	STA 119+100 TO 132+000
PTA-1	STA 10+000 TO 23+000

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.5

RECEIVED AS FOLLOWS

SECTION II



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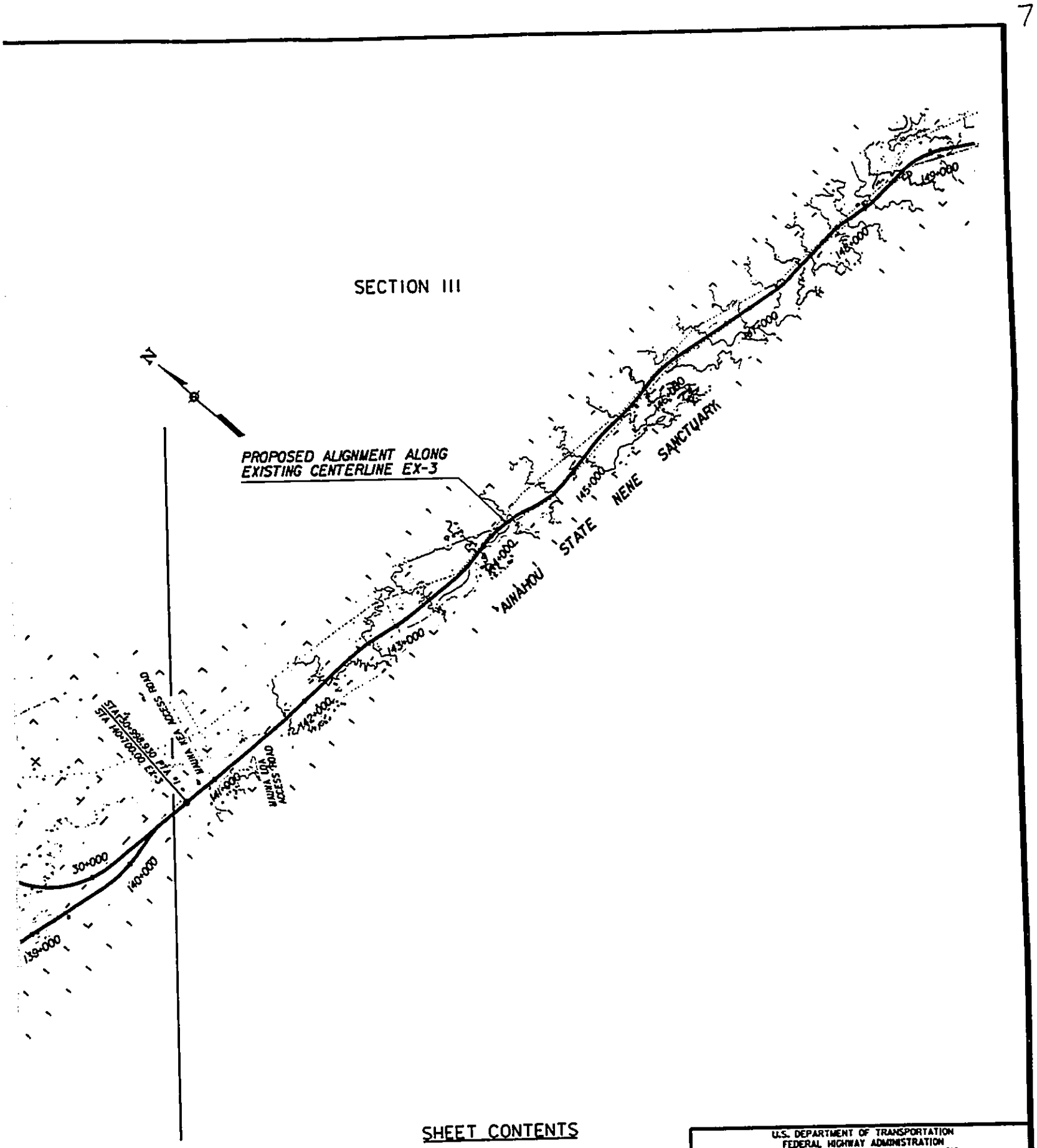


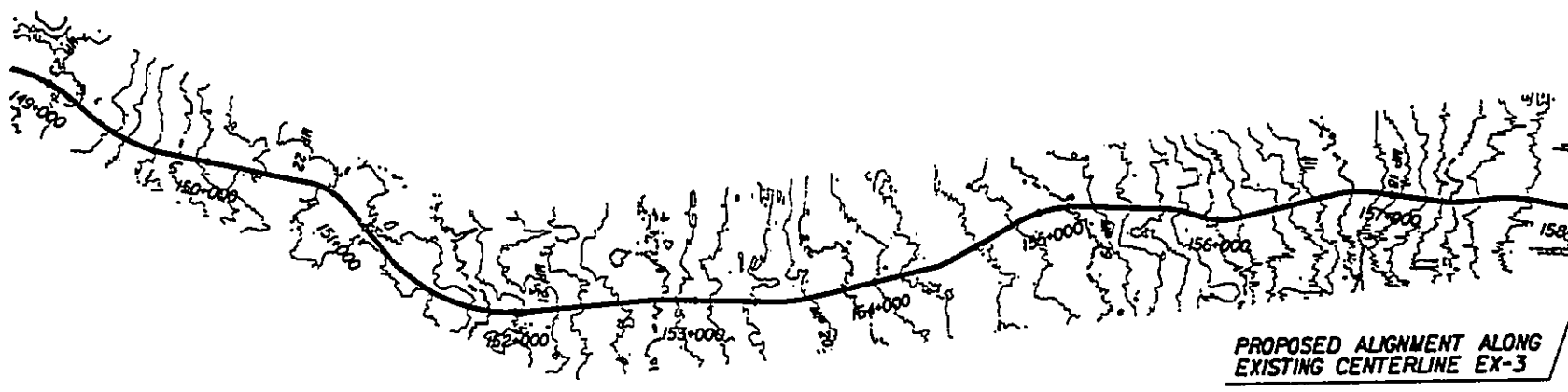
SHEET CONTENTS

EX-2	STA 132+000 TO 140+700
EX-3	STA 140+700 TO 149+000
PTA-1	STA 22+000 TO 30+999
PTA-3	STA 10+000 TO 12+881

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.6

SECTION III



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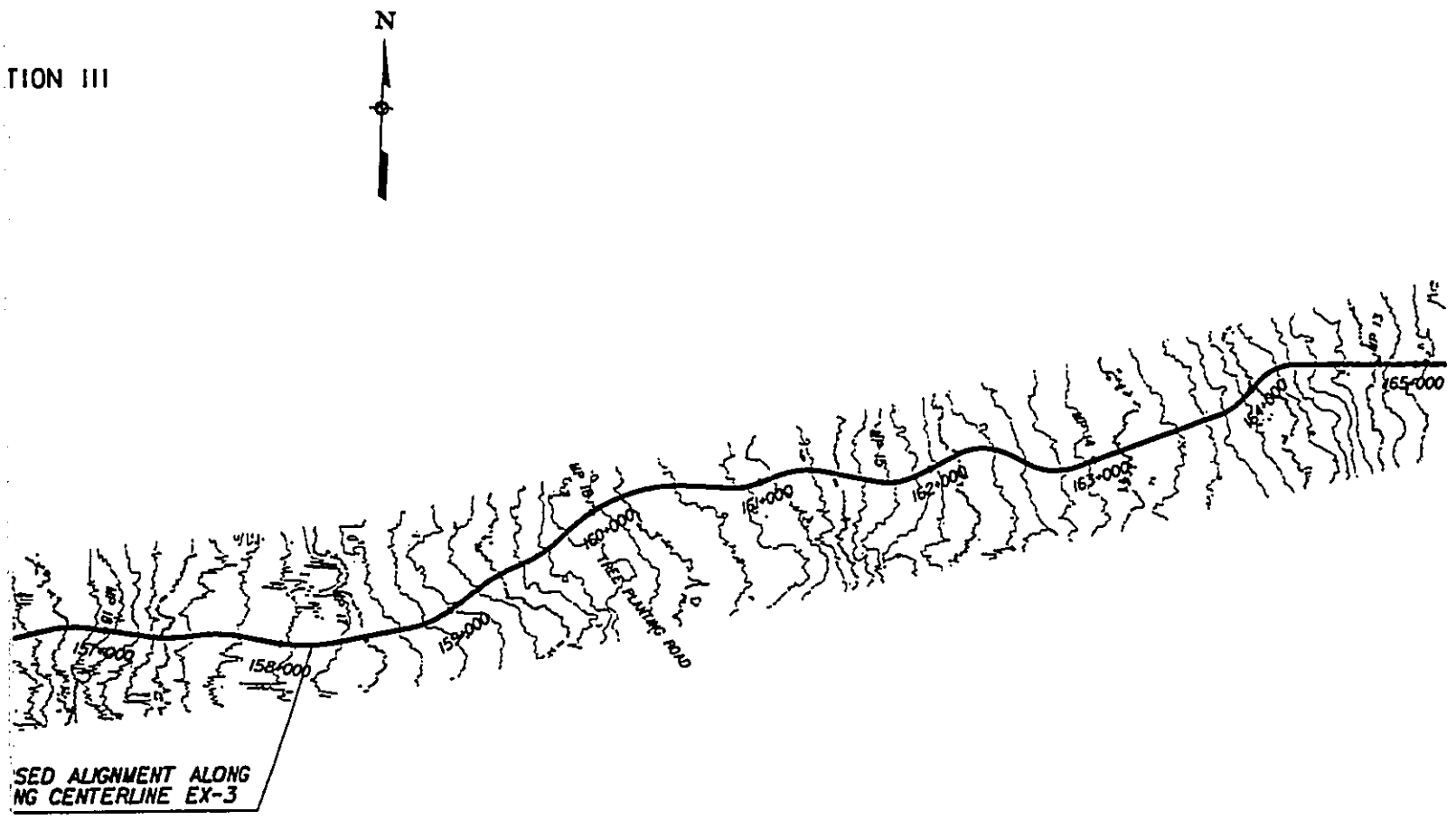
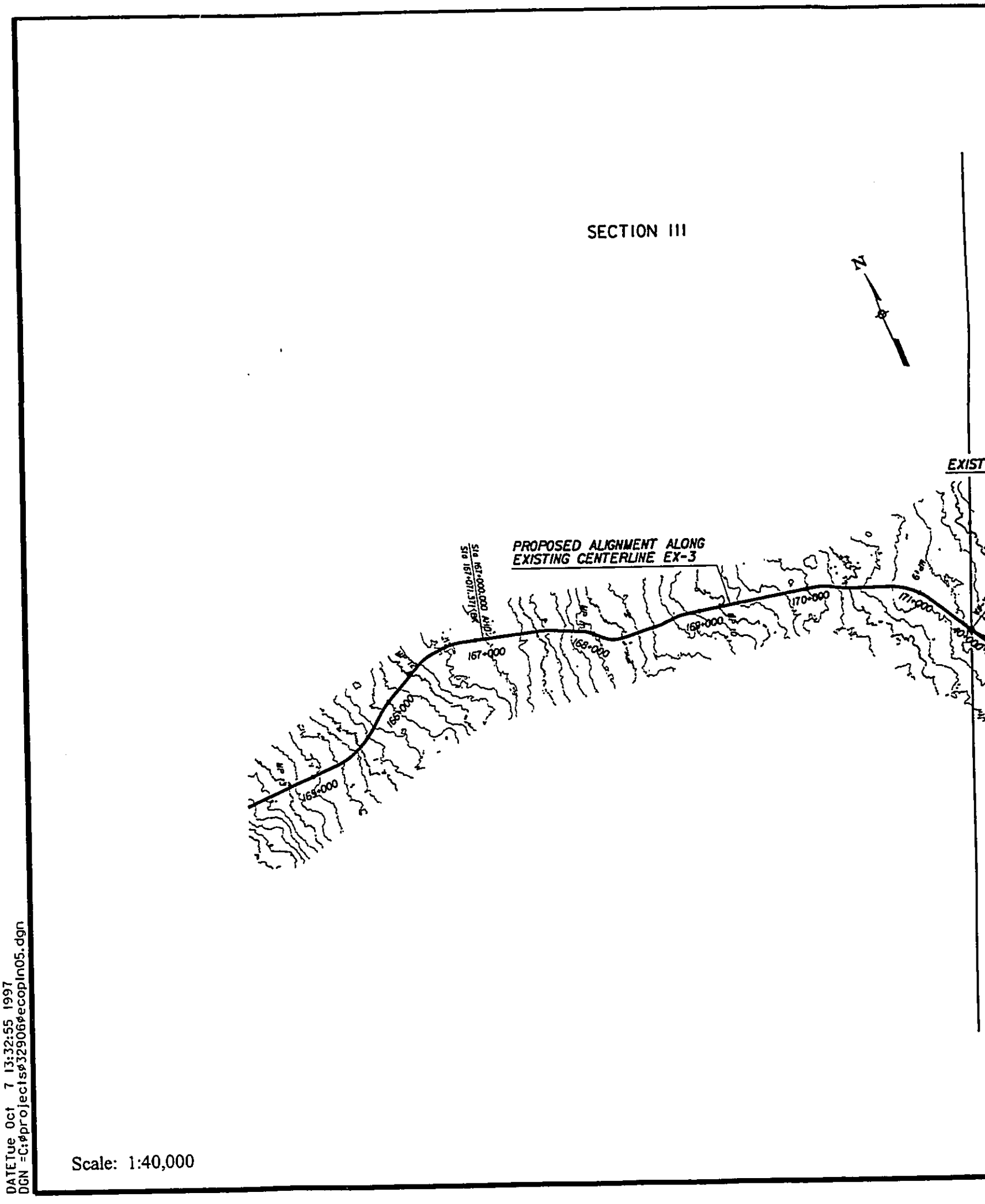


SHEET CONTENTS

EX-3 STA 149+000 TO 165+000

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.7



Scale: 1:40,000

DATETue Oct 7 13:32:55 1997
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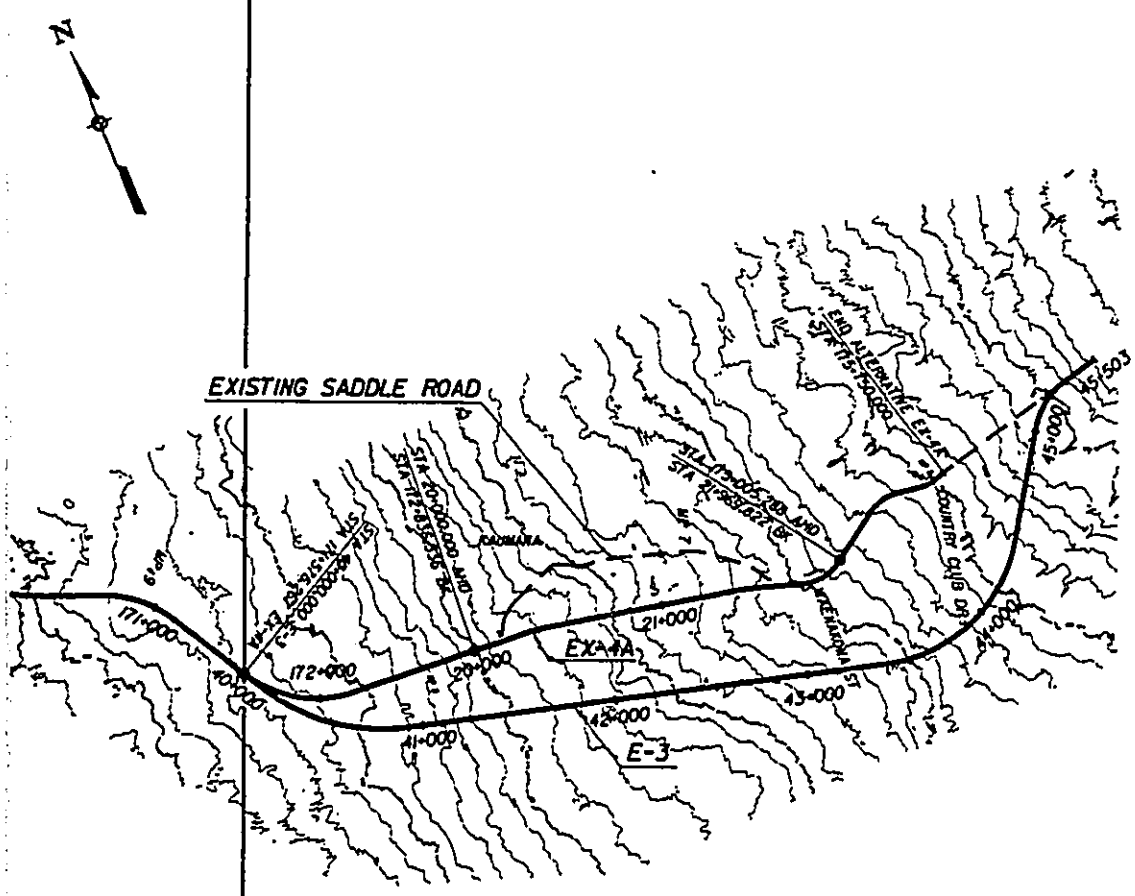
SECTION IV

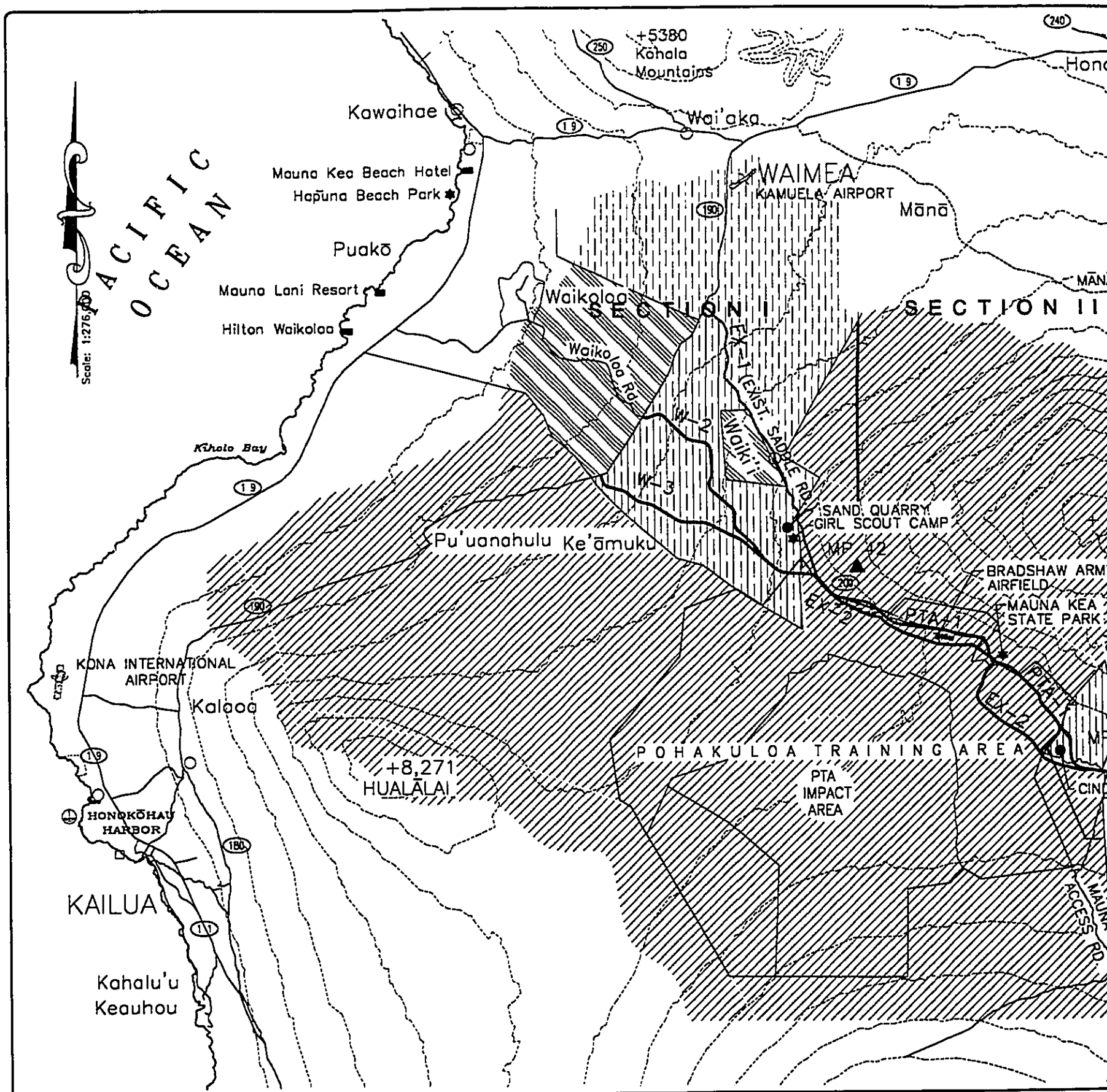


SHEET CONTENTS

EX-3	STA 165+000 TO 171+576
EX-4A	STA 171+576 TO 175+750
E-3	STA 40+000 TO 45+503

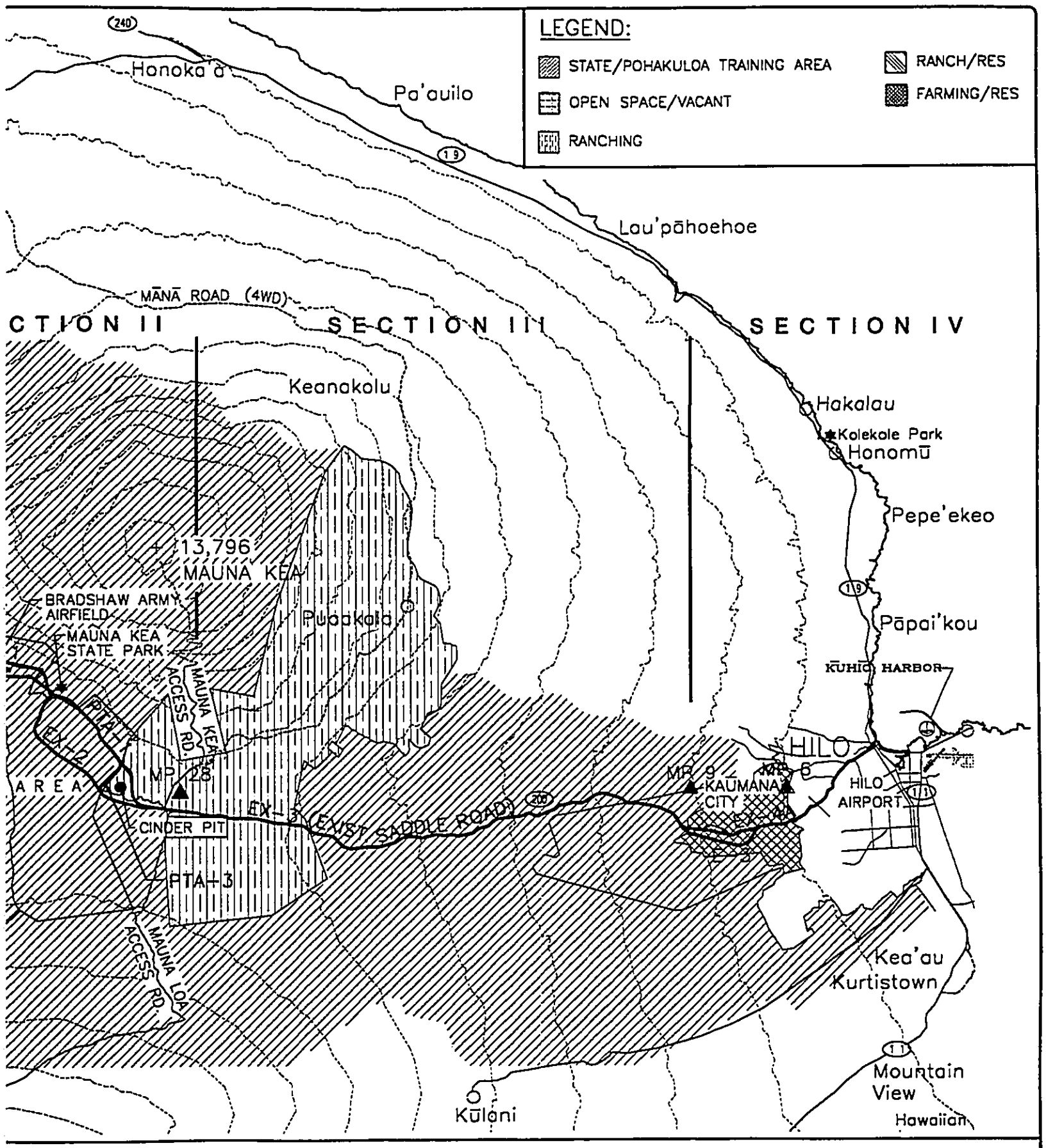
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PLAN SHEET
FIGURE 2.4.8



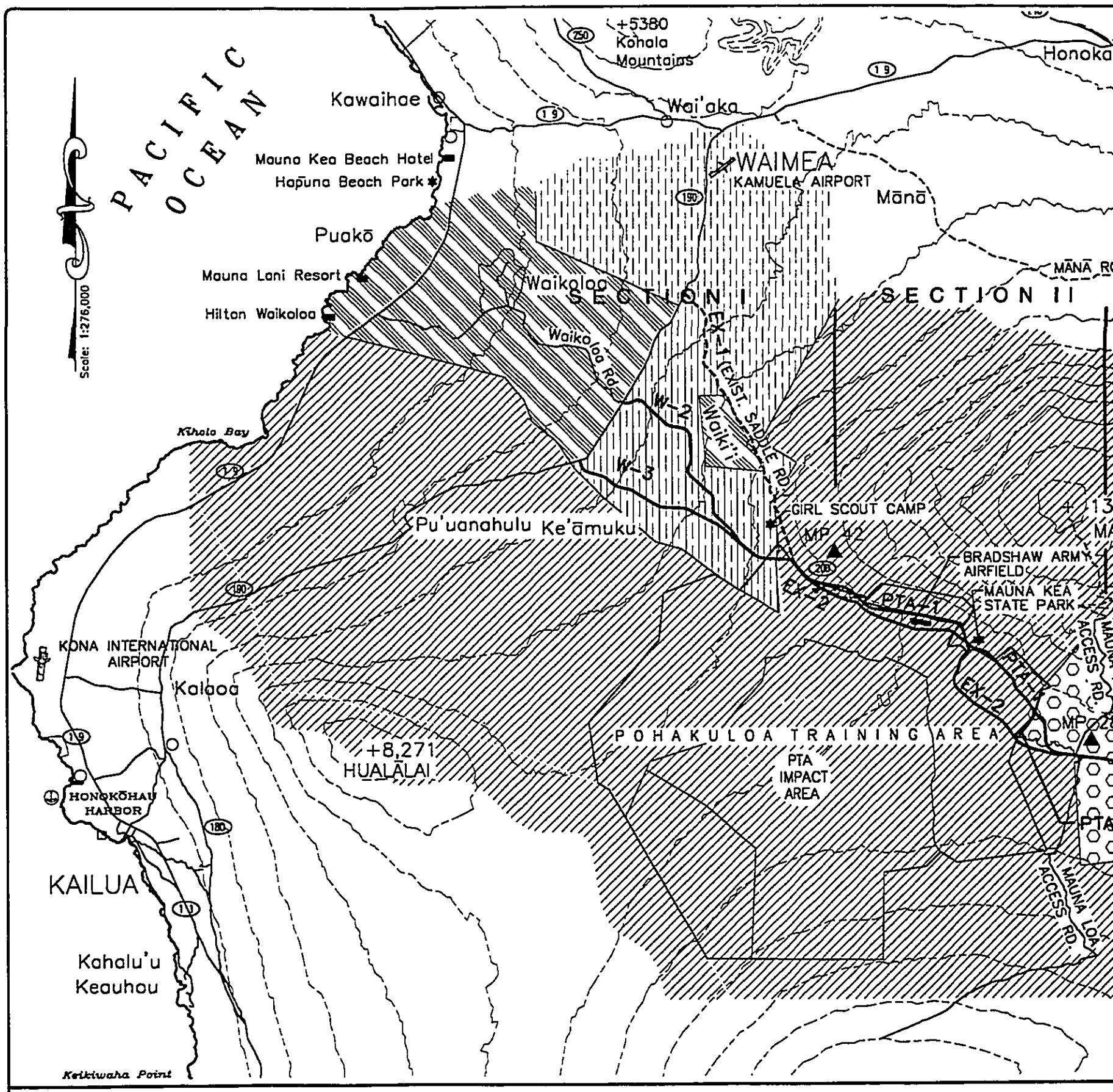
Source: Okahara & Associates Inc.

FILE: 3-1-1\XREF: BASE-A,94004B1E



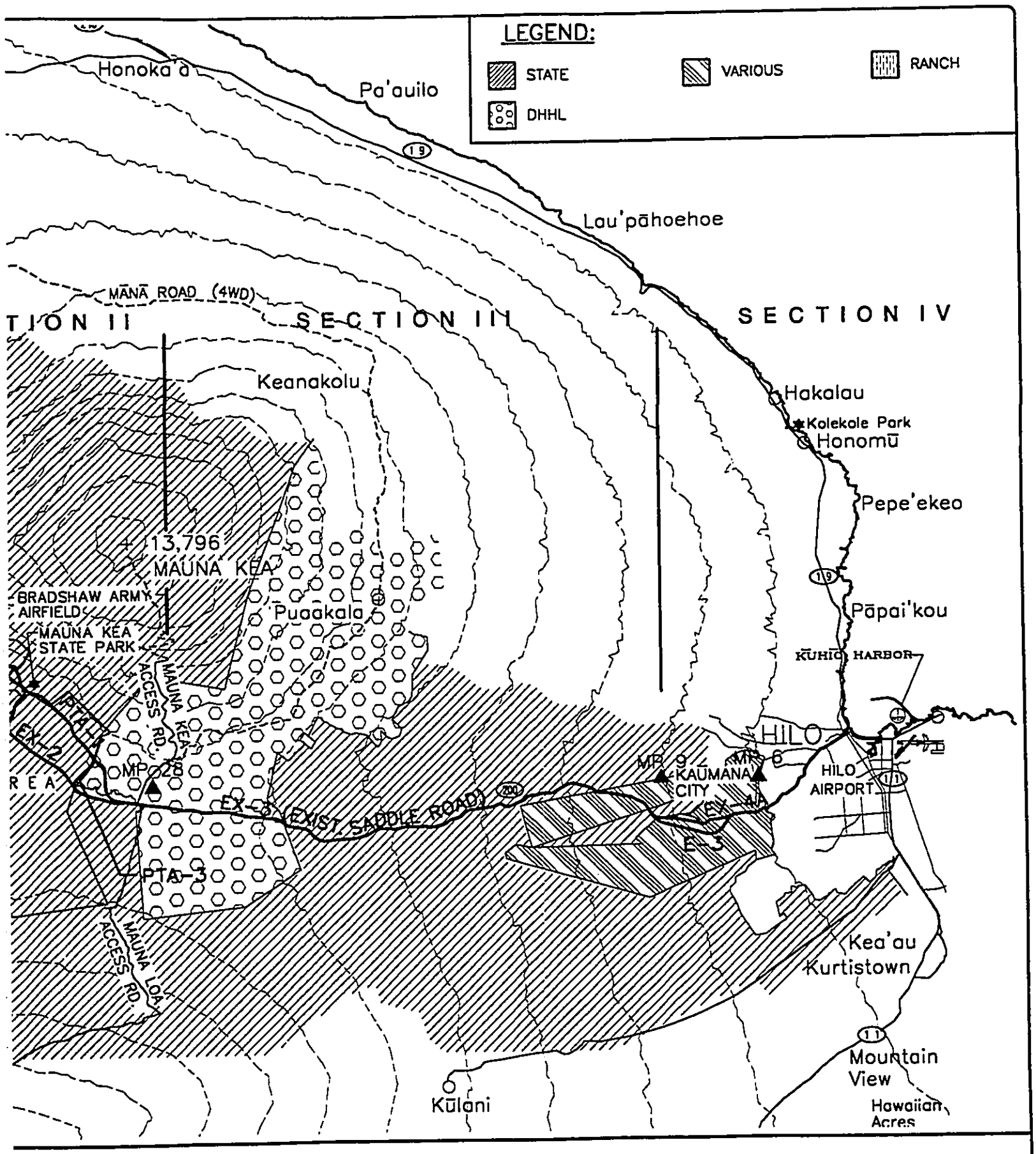
EXISTING LAND USE

FIGURE 3.1.1



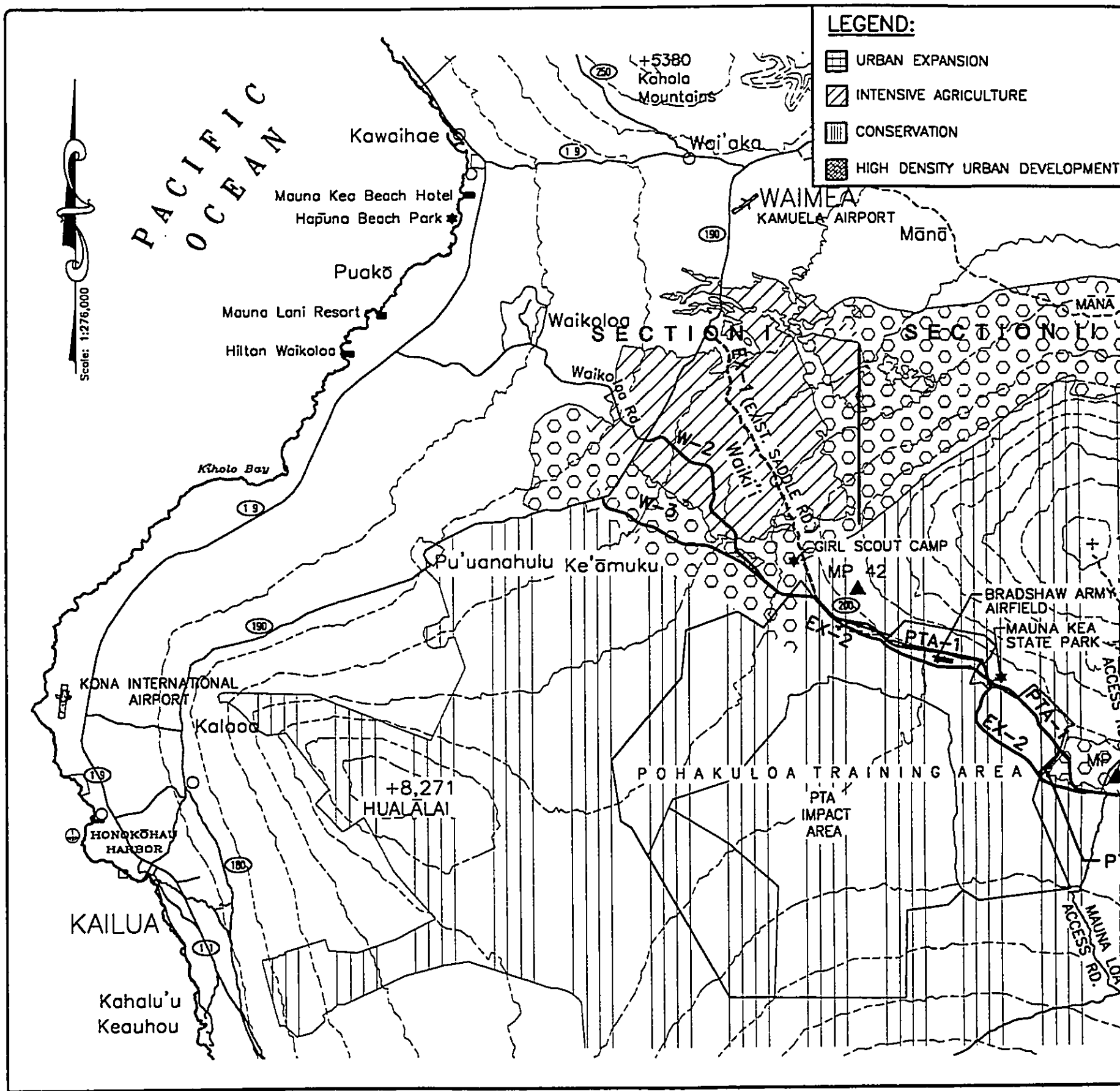
Source: County of Hawaii Tax Maps

FILE: 3-1-5\XREF: BASE-A.94004B1E



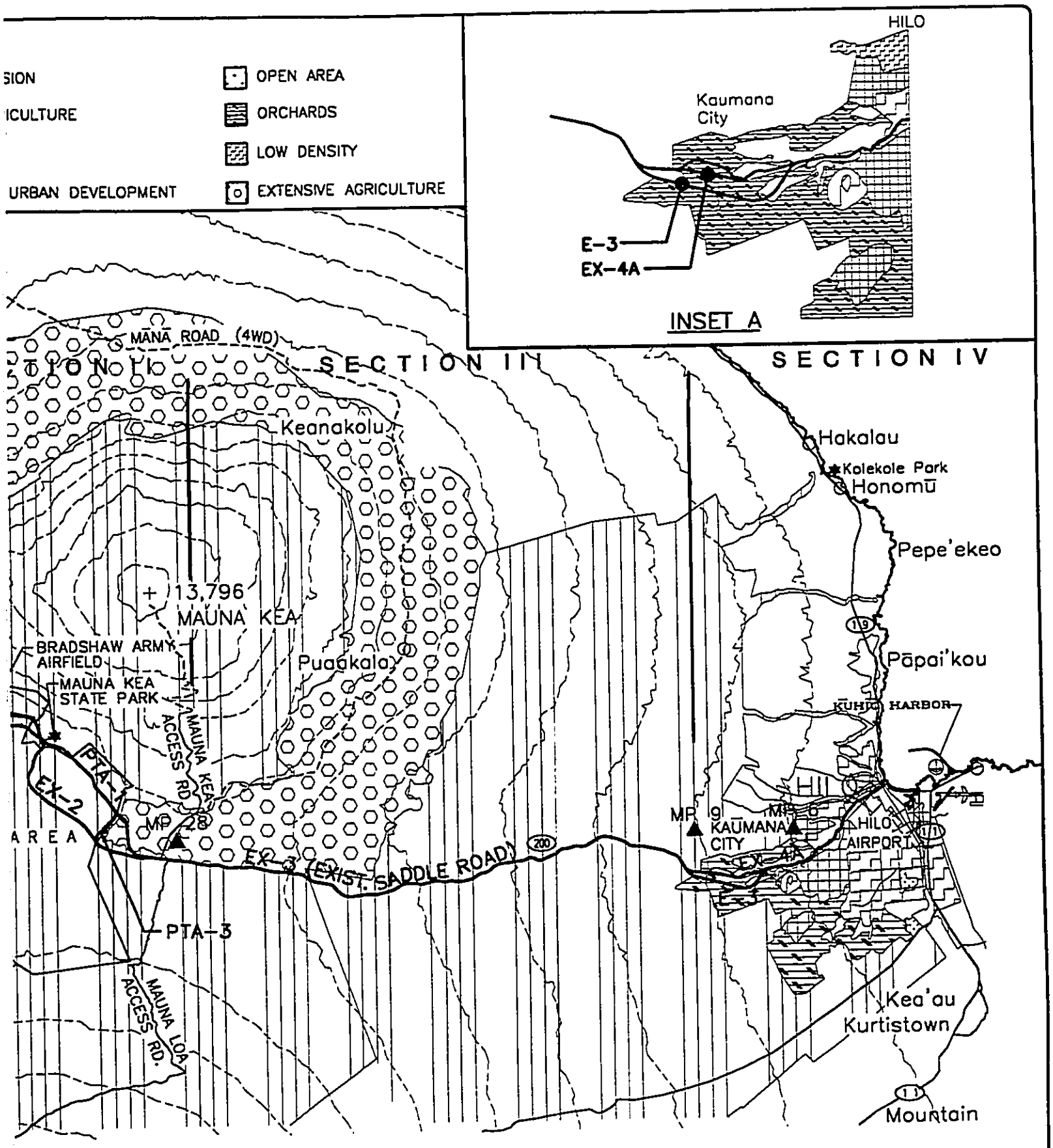
LAND OWNERSHIP

FIGURE 3.1.7



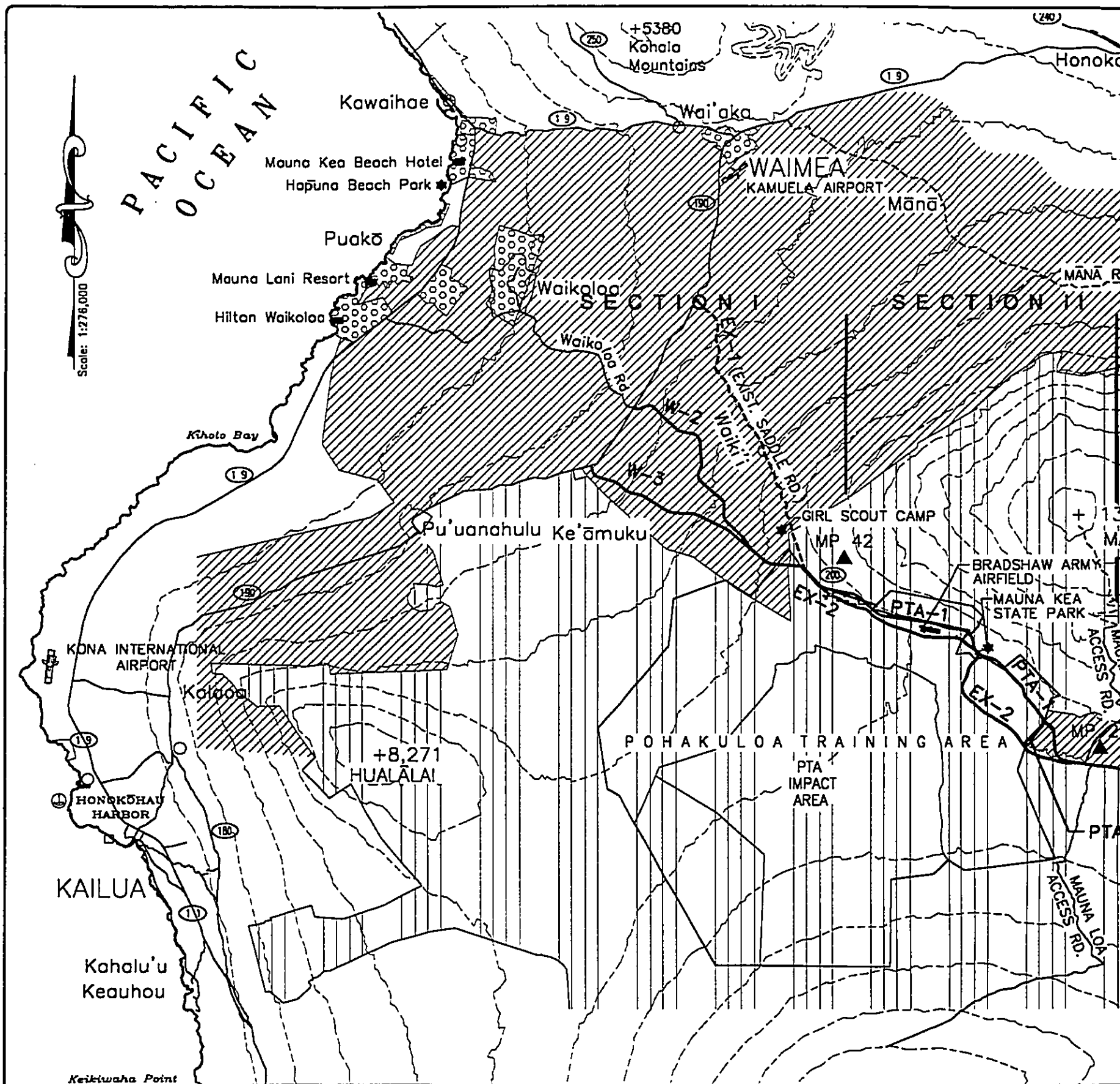
Source: The General Plan Hawaii County November, 1989

FILE: 3-1-2\XREF: 94004B1E,BASE-A



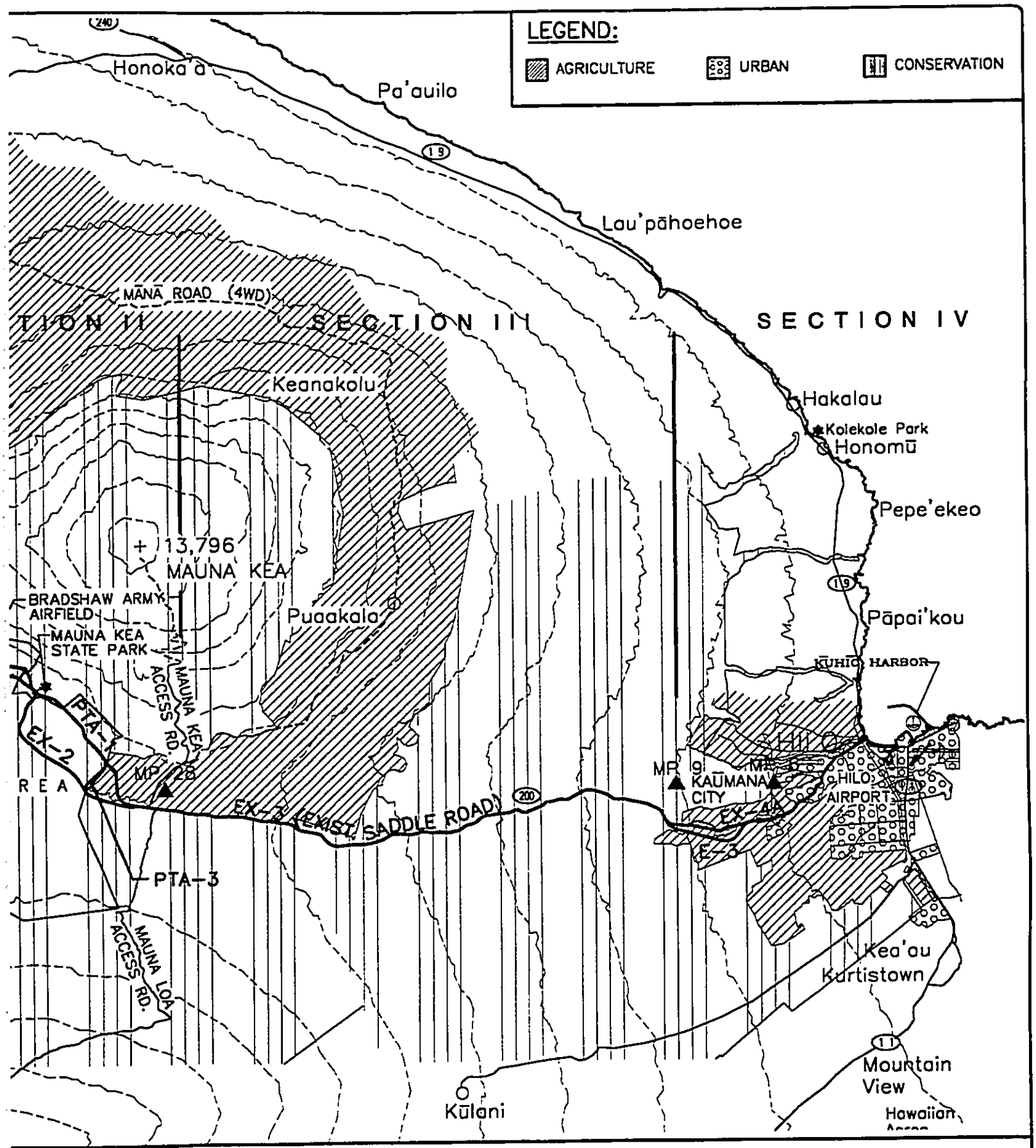
GENERAL PLAN LUPAG MAP DESIGNATION

FIGURE 3.1.3



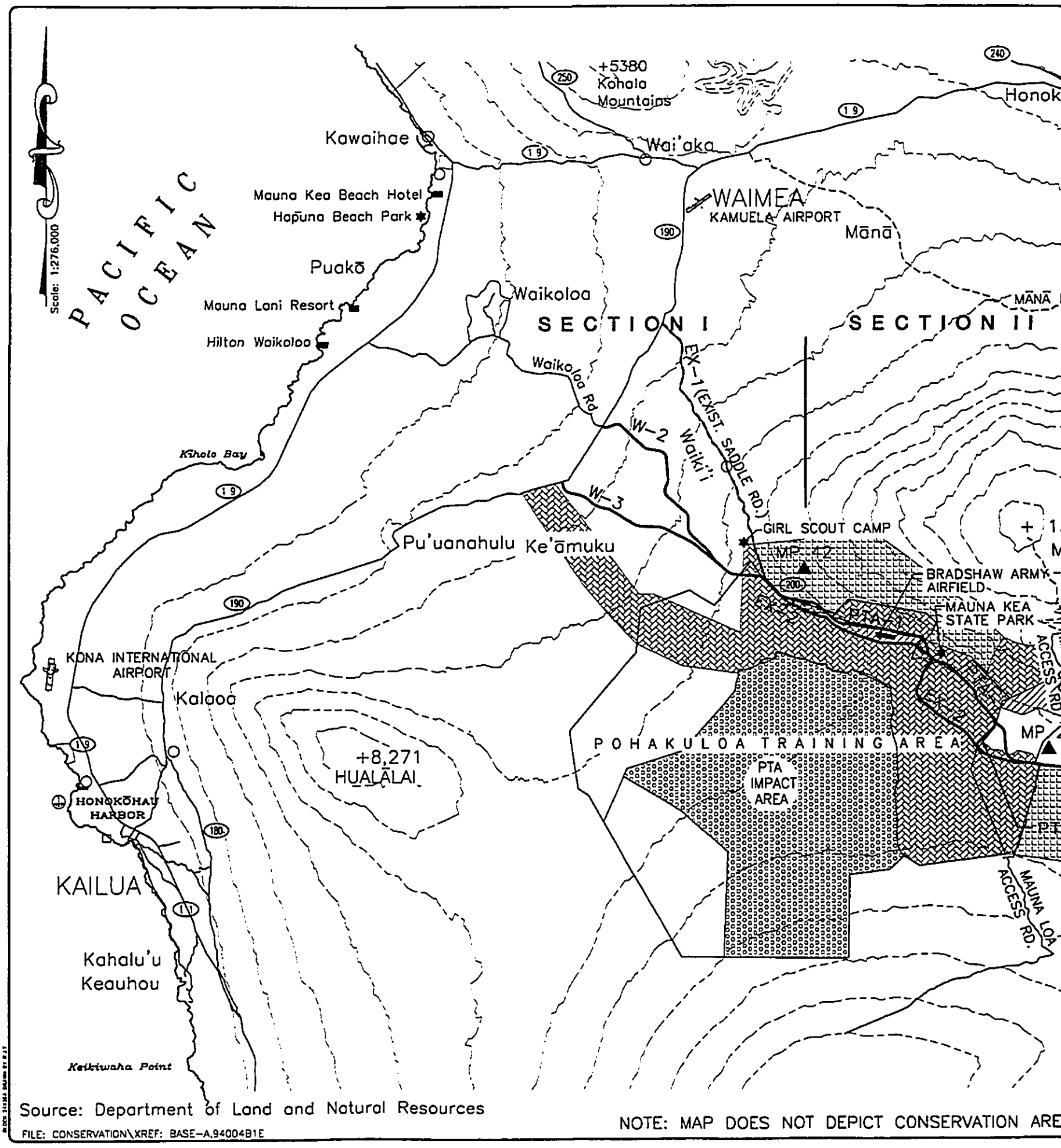
Source: State Land Use Commision

9-11-97\FILE: 3-1-3\XREF: BASE-A.94004B1E.LAND



STATE LAND USE DISTRICTS

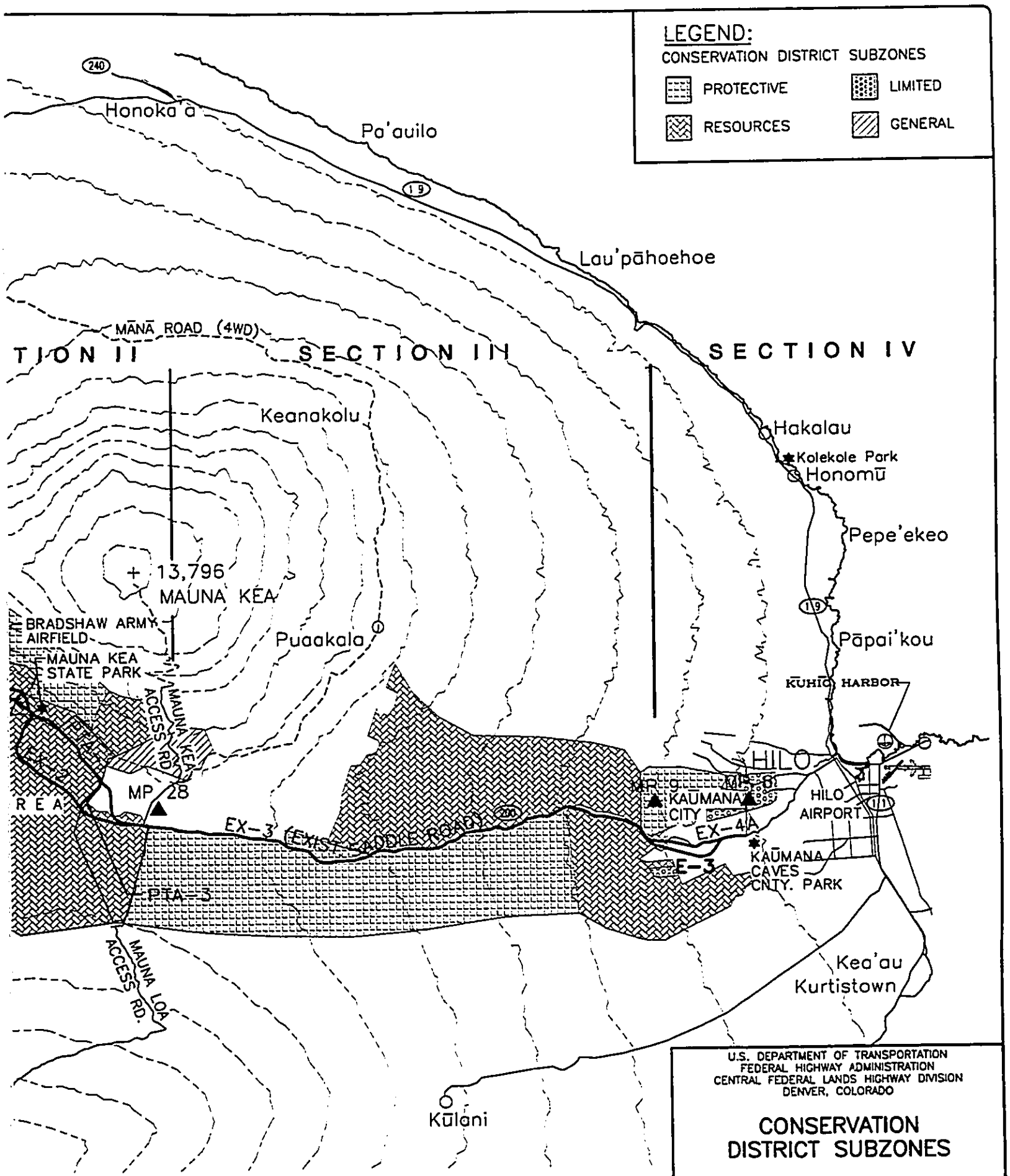
FIGURE 3.1.4



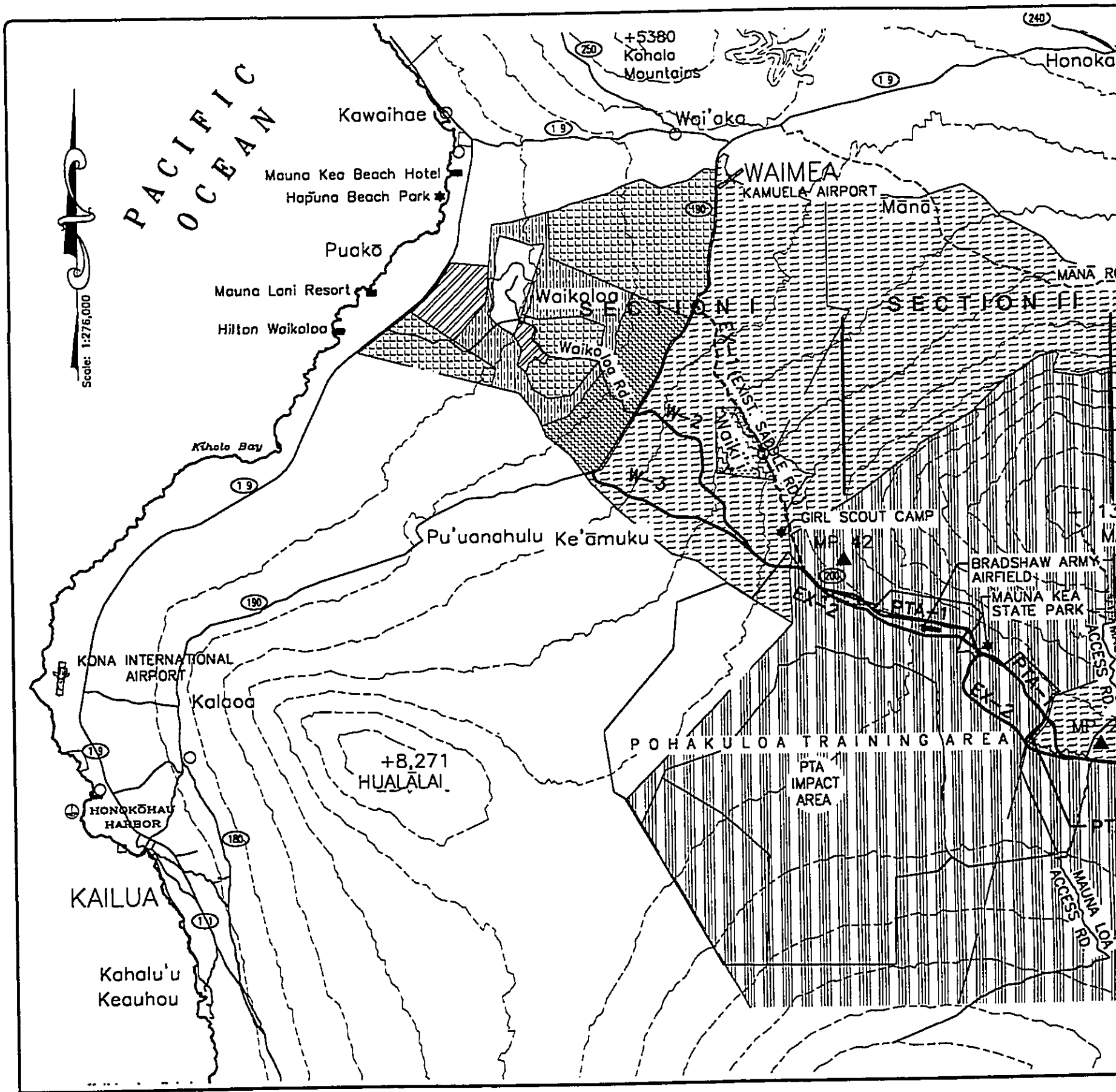
Source: Department of Land and Natural Resources

FILE: CONSERVATION\XREF: BASE-A,94004B1E

NOTE: MAP DOES NOT DEPICT CONSERVATION ARE

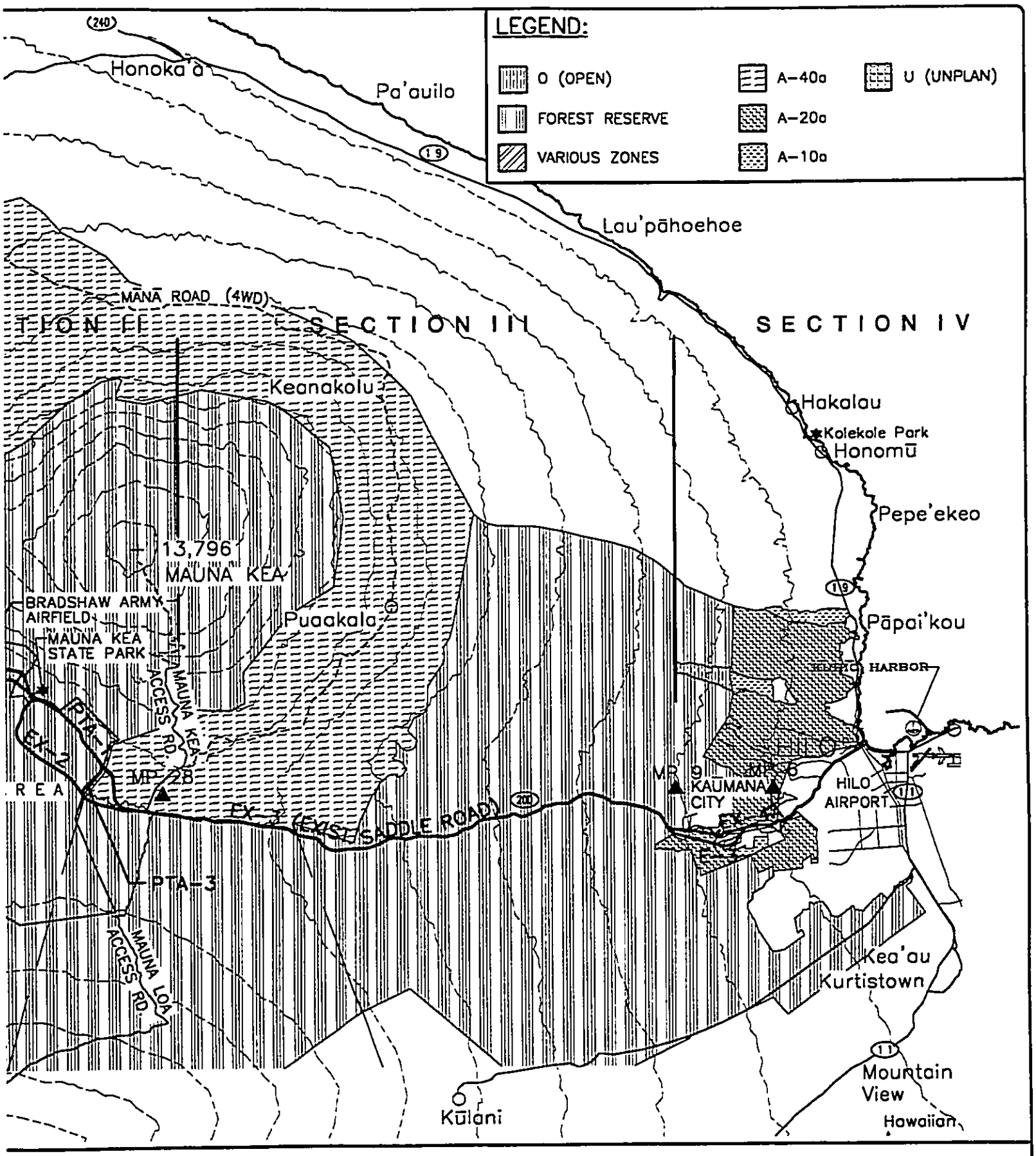


ONSERVATION AREAS OUTSIDE PROJECT VICINITY.



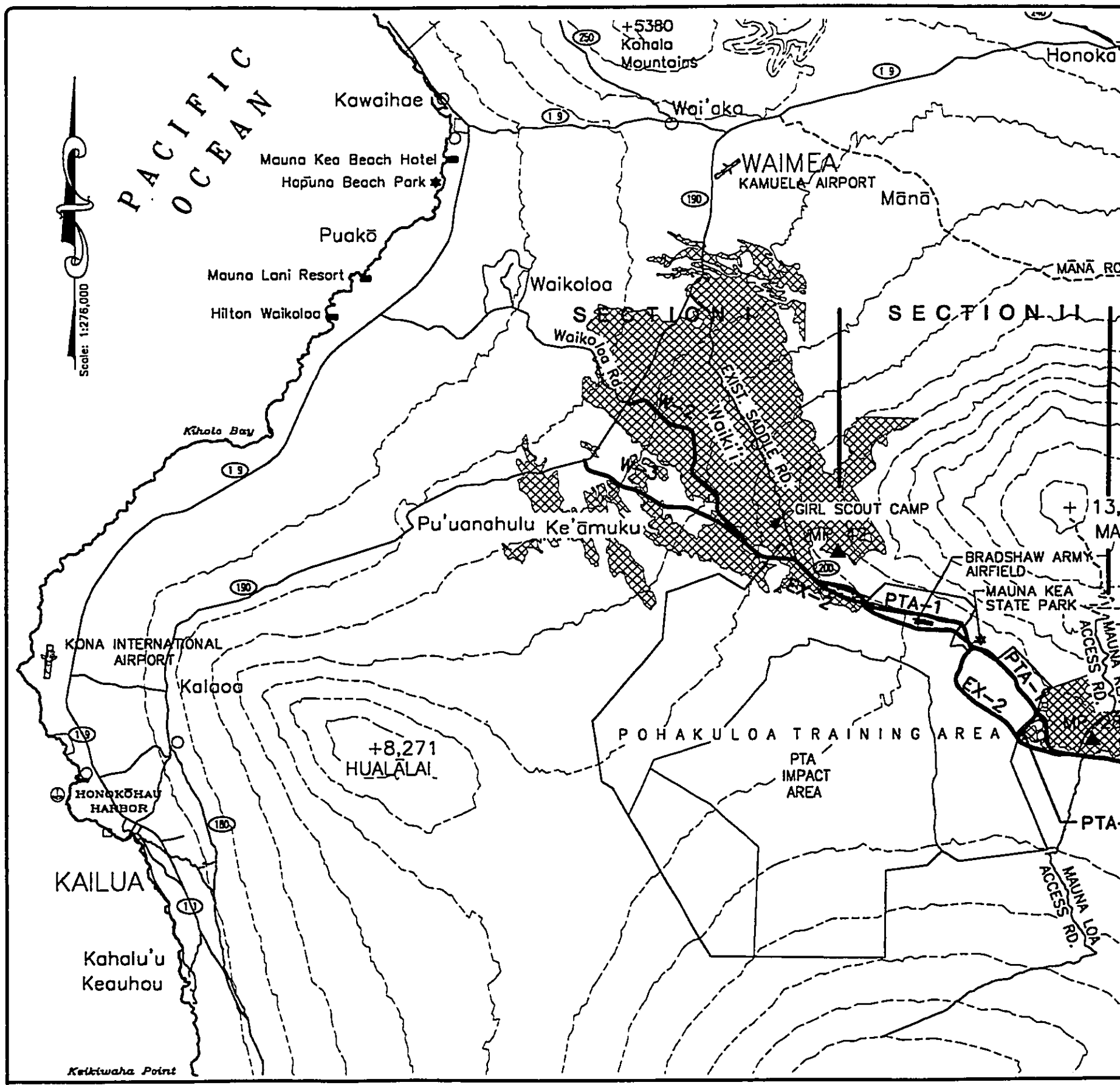
Source: County of Hawaii Zone Maps

DATE:9-11-97\FILE: 3-1-4\XREF: BASE-A,94004B1E,ZONEBIG:



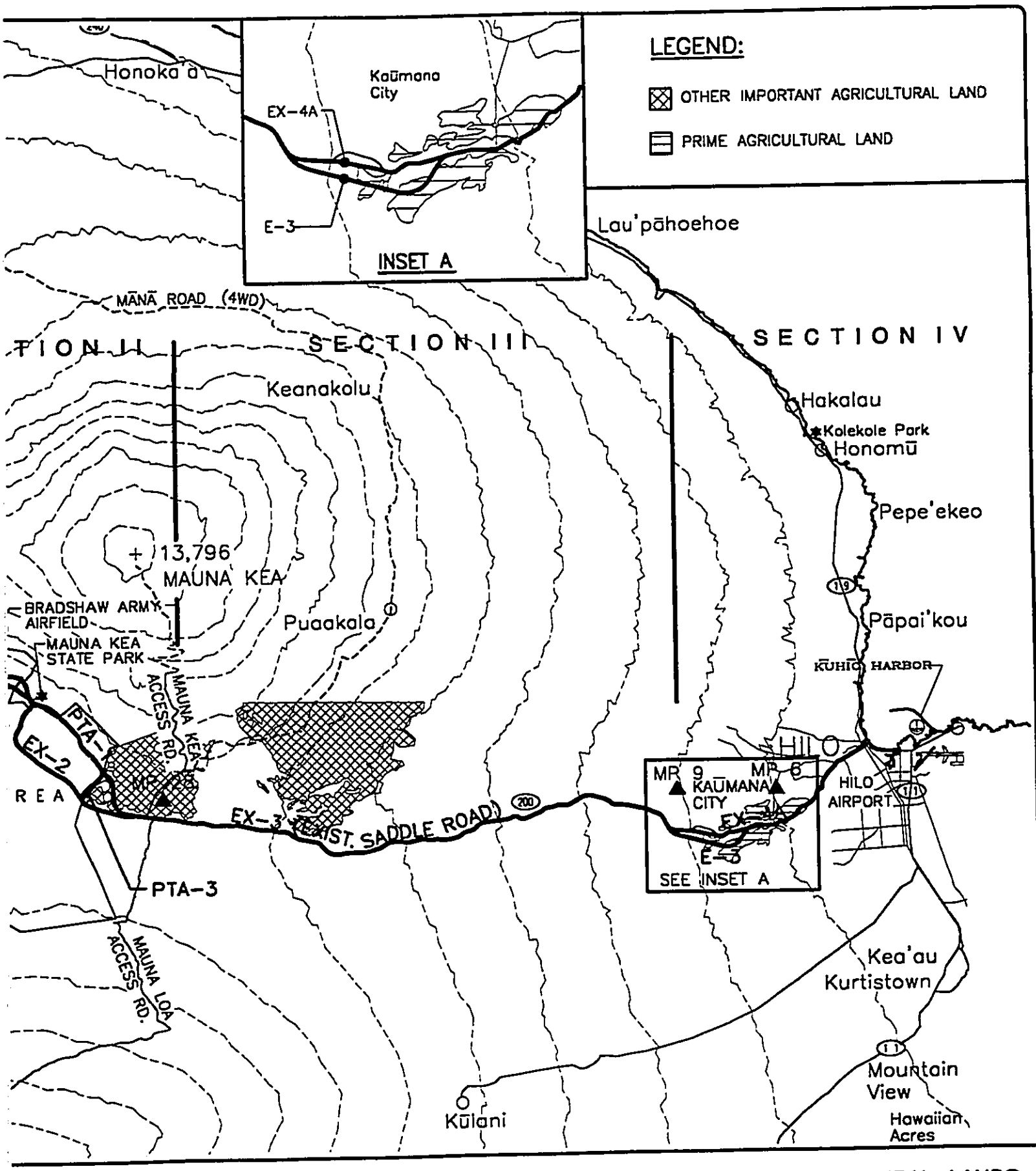
ZONING

FIGURE 3.1.6



Source: Department of Agriculture, State of Hawaii, Agricultural Lands of Importance to the State of Hawaii Maps, 1

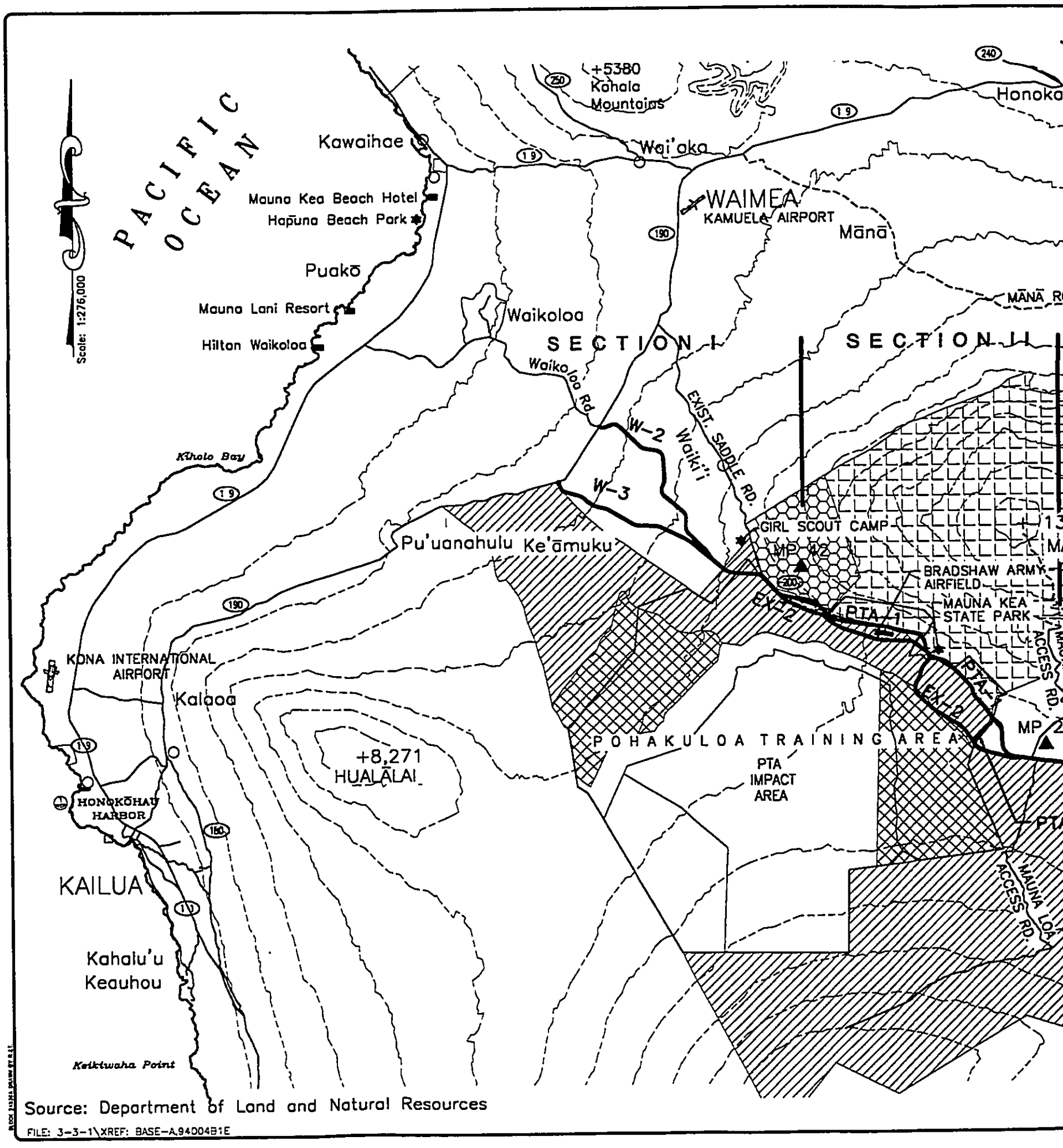
FILE: 3-2-1\XREF: BASE-A,94004B1E



of Hawaii Maps, 1976

AGRICULTURAL LANDS OF IMPORTANCE

FIGURE 3.2.1



Source: Department of Land and Natural Resources

FILE: 3-3-1\XREF: BASE-A94004B1E

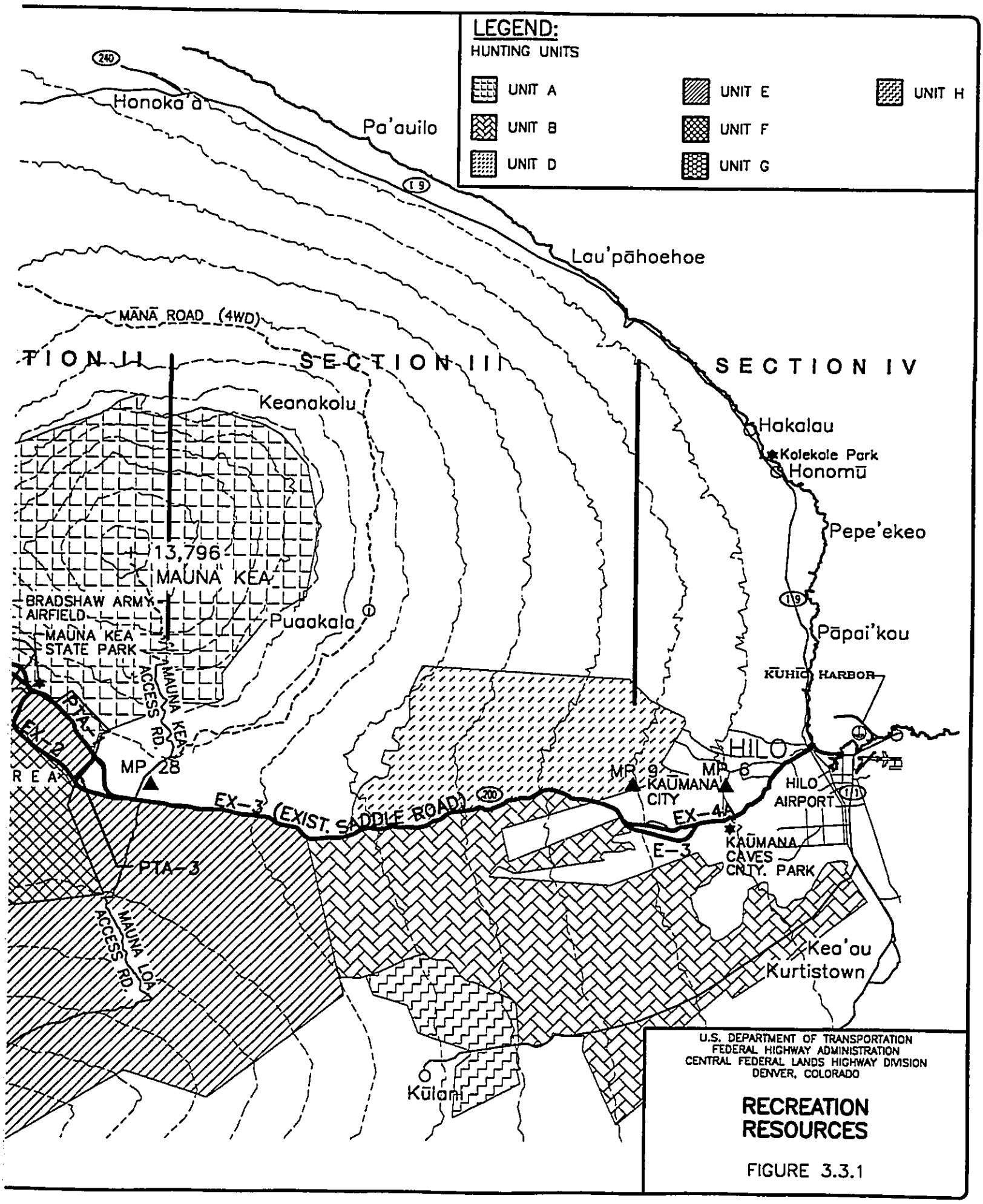
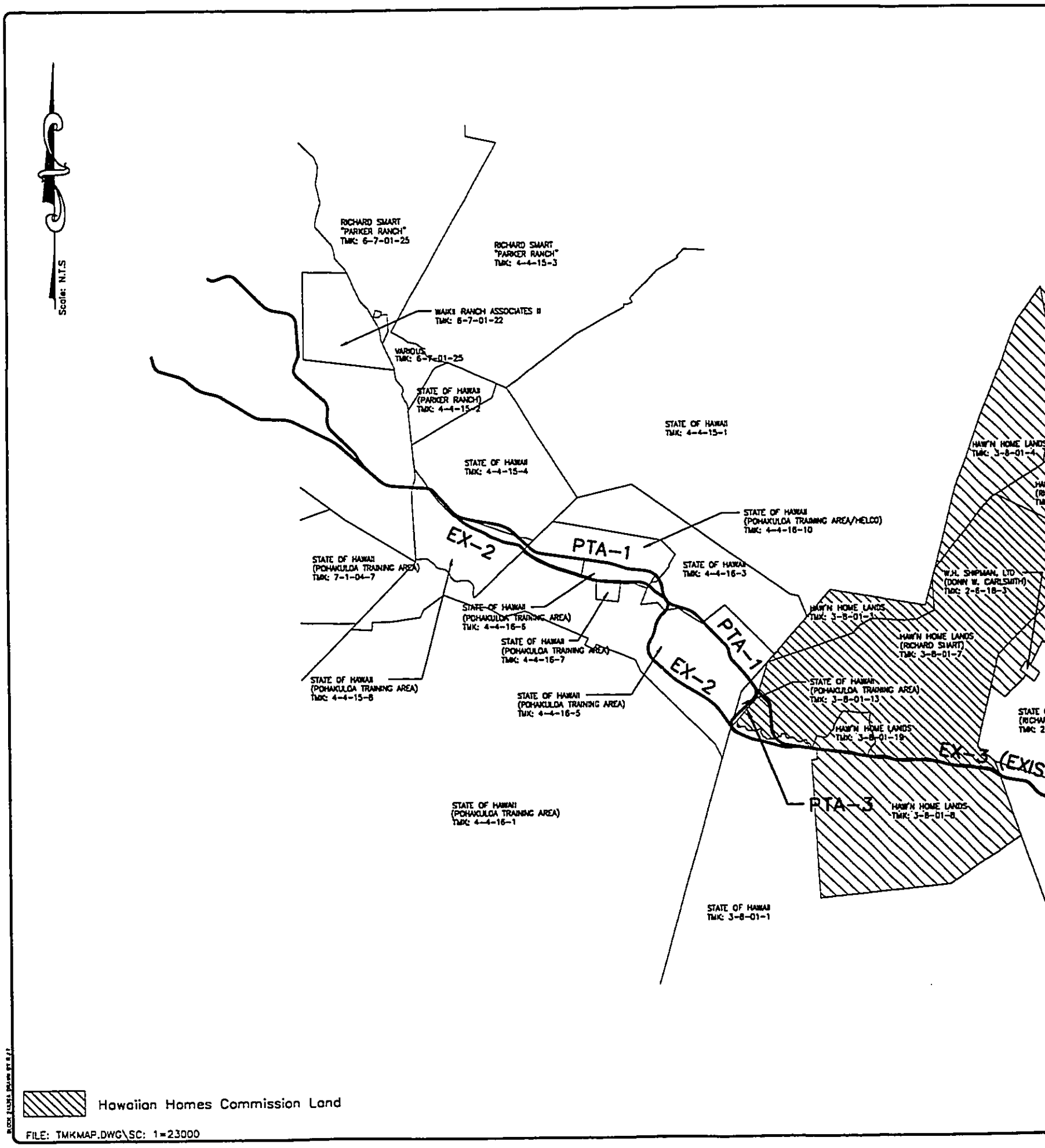
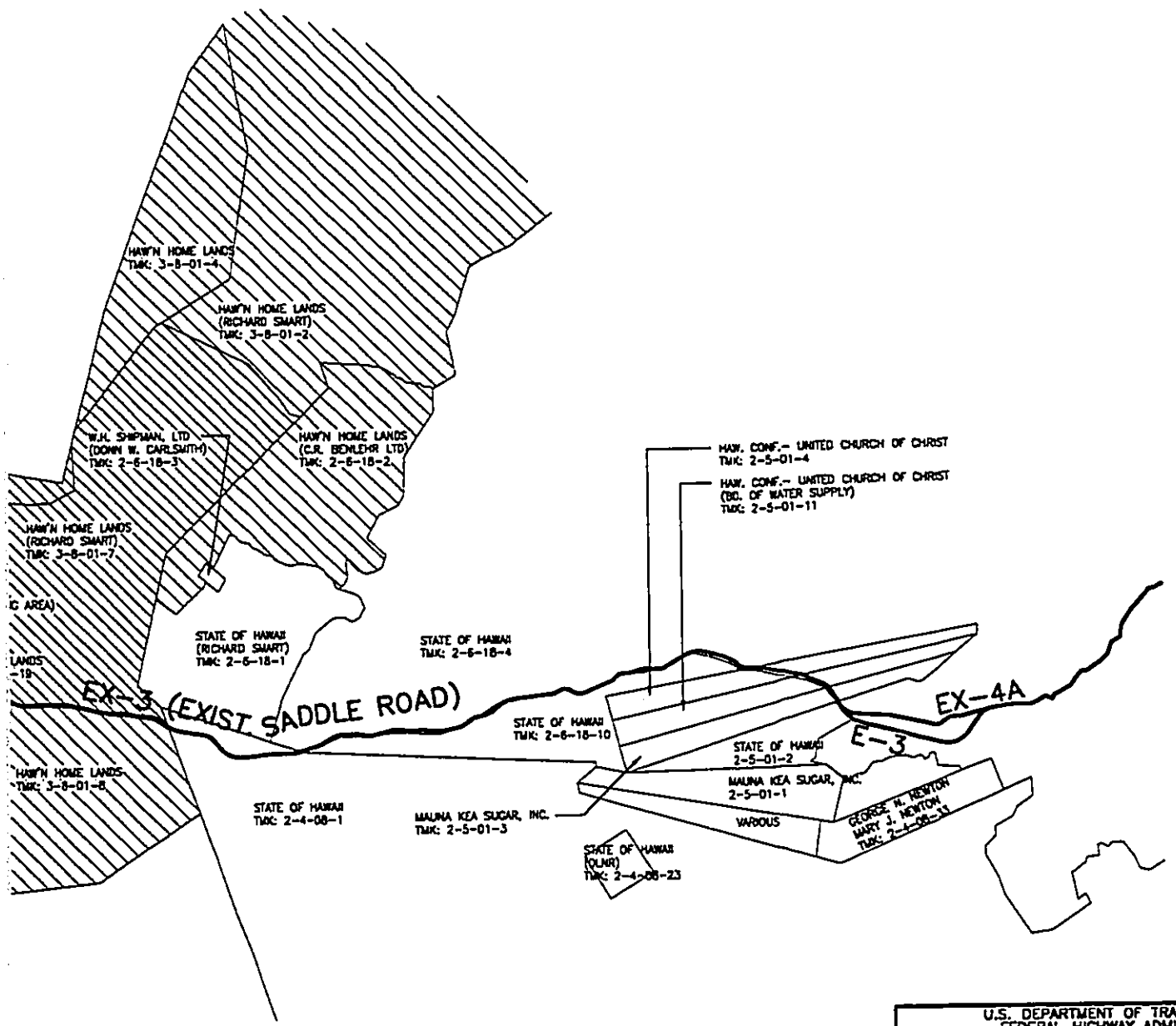

LEGEND:
HUNTING UNITS
UNIT A
UNIT B
UNIT D
UNIT E
UNIT F
UNIT G
UNIT H
240
Honoka'a
Pa'auilo
19
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
SECTION II
SECTION III
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
13,796
MAUNA KEA
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Pāpai'kou
KŪHIO HARBOR
MAUNA KEA ACCESS RD.
PTA-2
EX-2
MP 28
HILO
MP 9
MP 6
KAŪMANA CITY
HILO AIRPORT
EX-3 (EXIST. SADDLE ROAD)
EX-4A
E-3
KAŪMANA CAVES CNTY. PARK
PTA-3
MAUNA LOA ACCESS RD.
Kea'au
Kurtistown
Kūlani
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
RECREATION RESOURCES

FIGURE 3.3.1


Scale: N.T.S
RICHARD SMART "PARKER RANCH" TMK: 6-7-01-25
RICHARD SMART "PARKER RANCH" TMK: 4-4-15-3
WAIKI RANCH ASSOCIATES II TMK: 6-7-01-22
VARIOUS TMK: 6-7-01-25
STATE OF HAWAII (PARKER RANCH) TMK: 4-4-15-2
STATE OF HAWAII TMK: 4-4-15-1
STATE OF HAWAII TMK: 4-4-15-4
STATE OF HAWAII (POHAKULOA TRAINING AREA/HELCO) TMK: 4-4-16-10
EX-2
PTA-1
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 7-1-04-7
STATE OF HAWAII TMK: 4-4-16-3
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 4-4-16-6
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 4-4-16-7
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 4-4-15-8
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 4-4-16-5
PTA-1
EX-2
HAW'N HOME LANDS TMK: 3-8-01-3
W.H. SHIPMAN, LTD (DONN W. CARLSMITH) TMK: 2-6-18-3
HAW'N HOME LANDS (RICHARD SMART) TMK: 3-8-01-7
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 3-8-01-13
HAW'N HOME LANDS TMK: 3-8-01-19
EX-3 (EXIS
PTA-3
HAW'N HOME LANDS TMK: 3-8-01-8
STATE OF HAWAII (POHAKULOA TRAINING AREA) TMK: 4-4-16-1
STATE OF HAWAII TMK: 3-8-01-1
Hawaiian Homes Commission Land
FILE: TMKMAP.DWG\SC: 1=23000

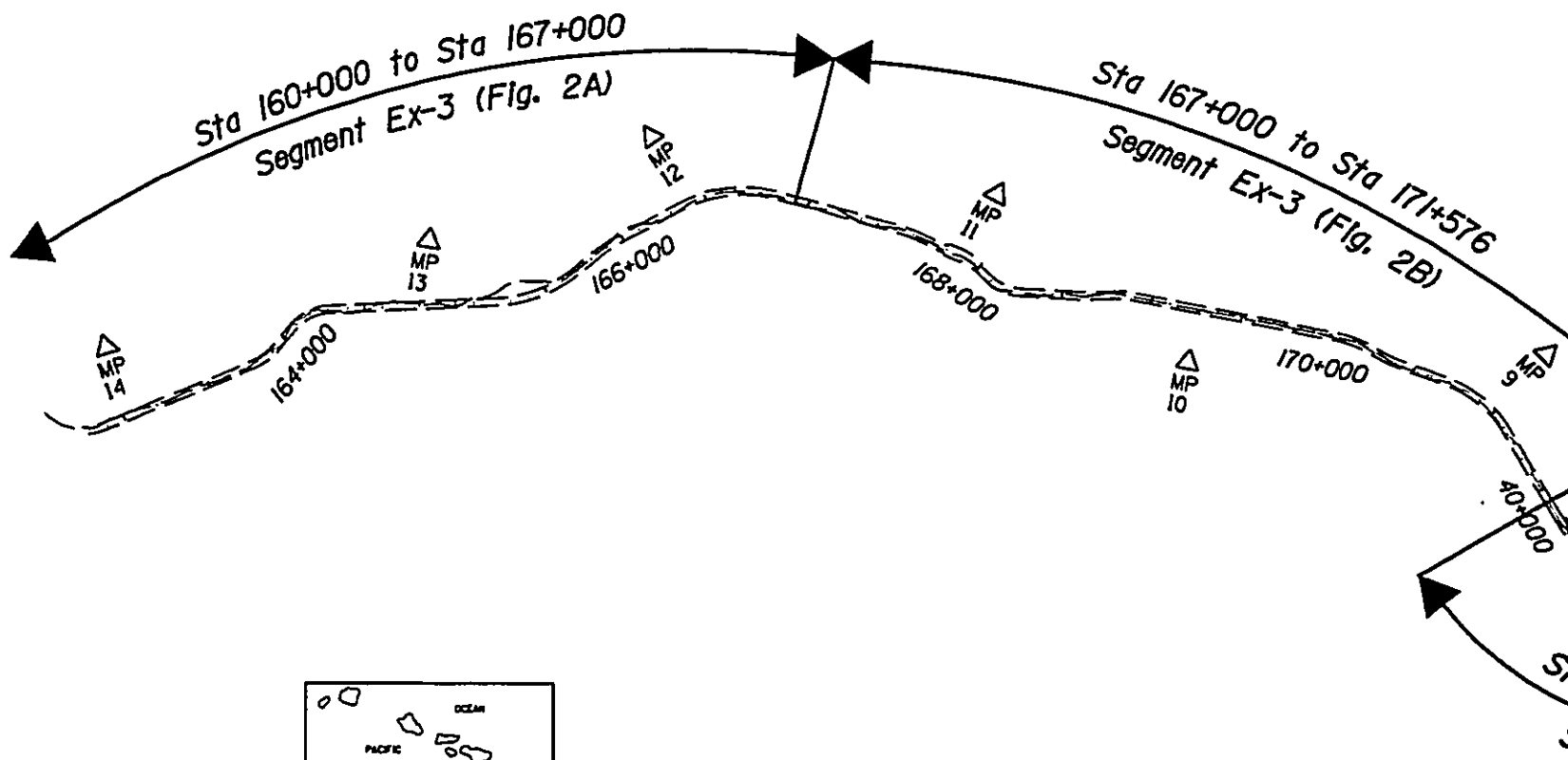
REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		

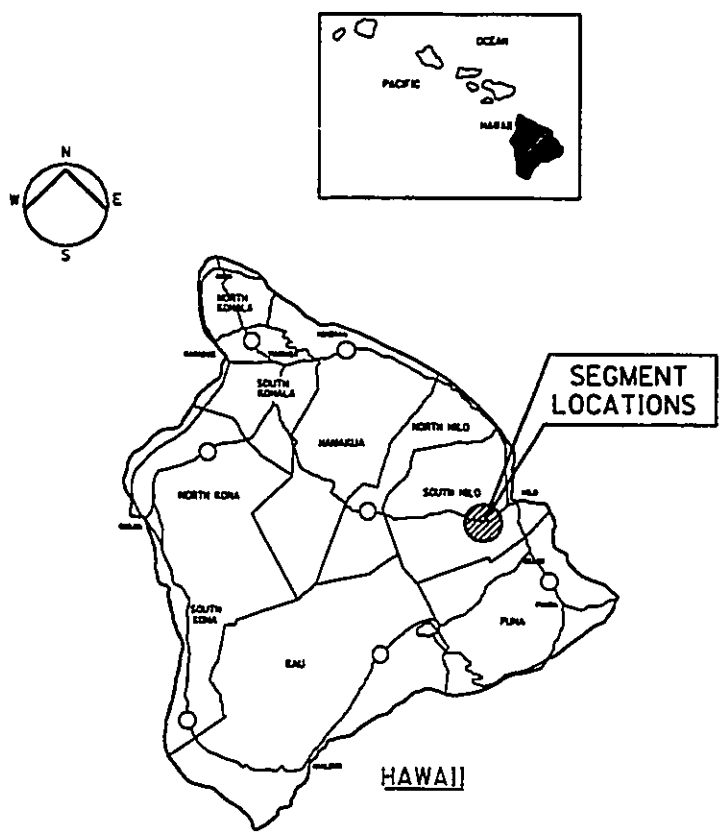


U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

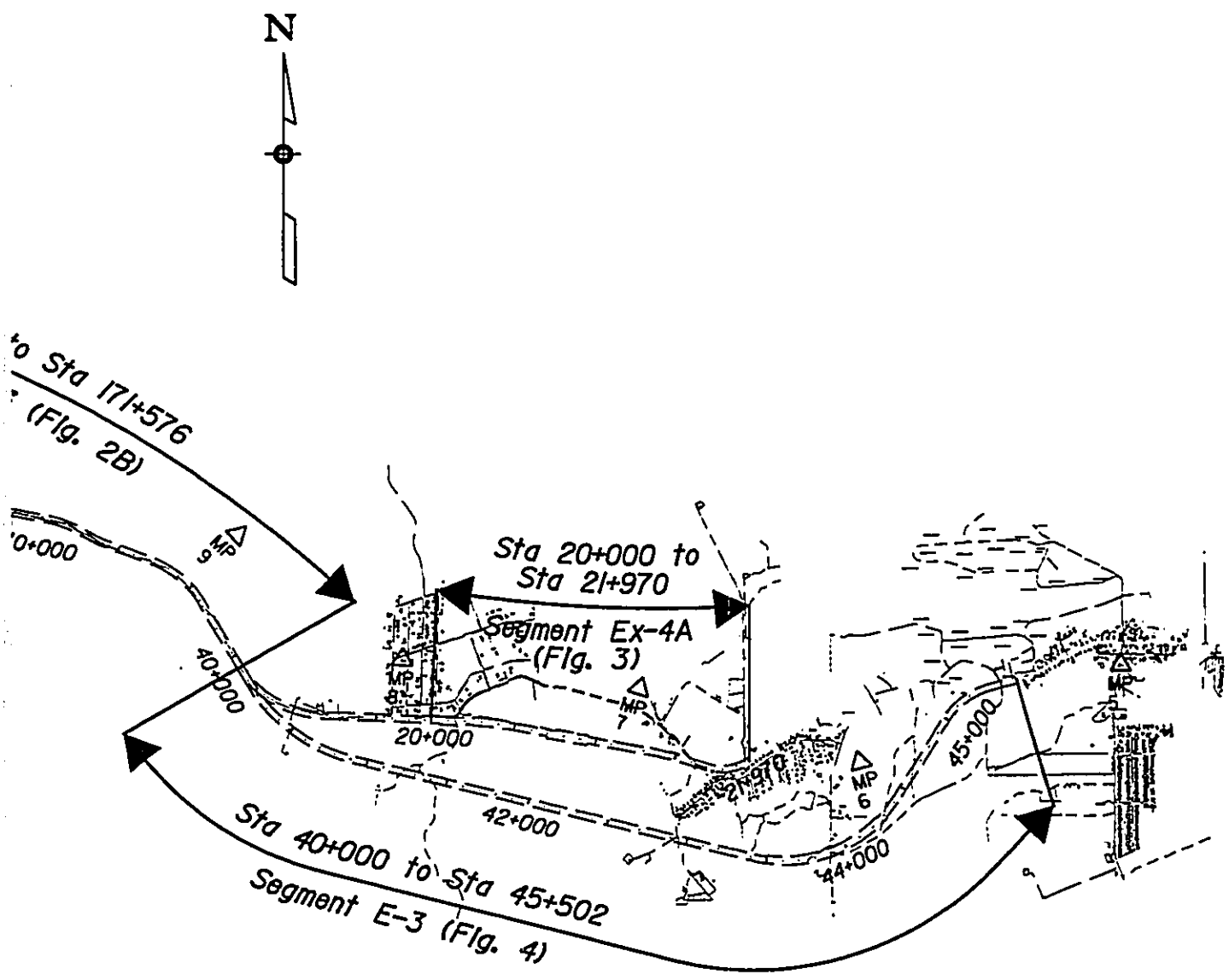
HAWAIIAN HOMES COMMISSION LAND

FIGURE 3.3.3


Sta 160+000 to Sta 167+000
Segment Ex-3 (Fig. 2A)
Sta 167+000 to Sta 171+576
Segment Ex-3 (Fig. 2B)
MP 14
MP 13
MP 12
MP 11
MP 10
MP 9
164+000
166+000
168+000
170+000
40+000


N
W
E
S
OCEAN
PACIFIC
HAWAII
NORTH KOHALA
SOUTH KOHALA
HAMAKUA
NORTH HILO
SOUTH HILO
NORTH KONA
SOUTH KONA
KAU
PUNA
SEGMENT LOCATIONS
HAWAII

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



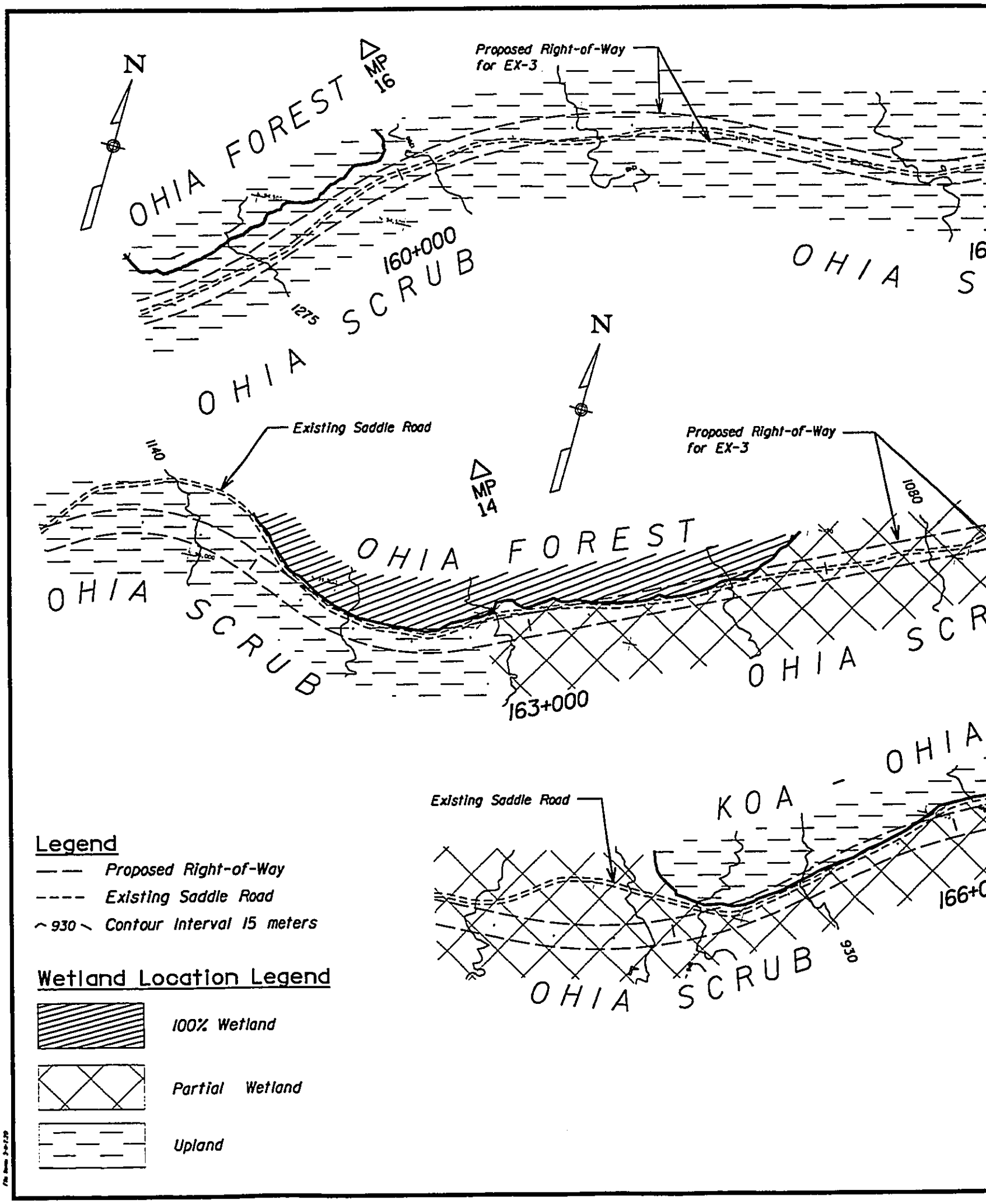
0 80000 160000

Graphic Scale in Meters

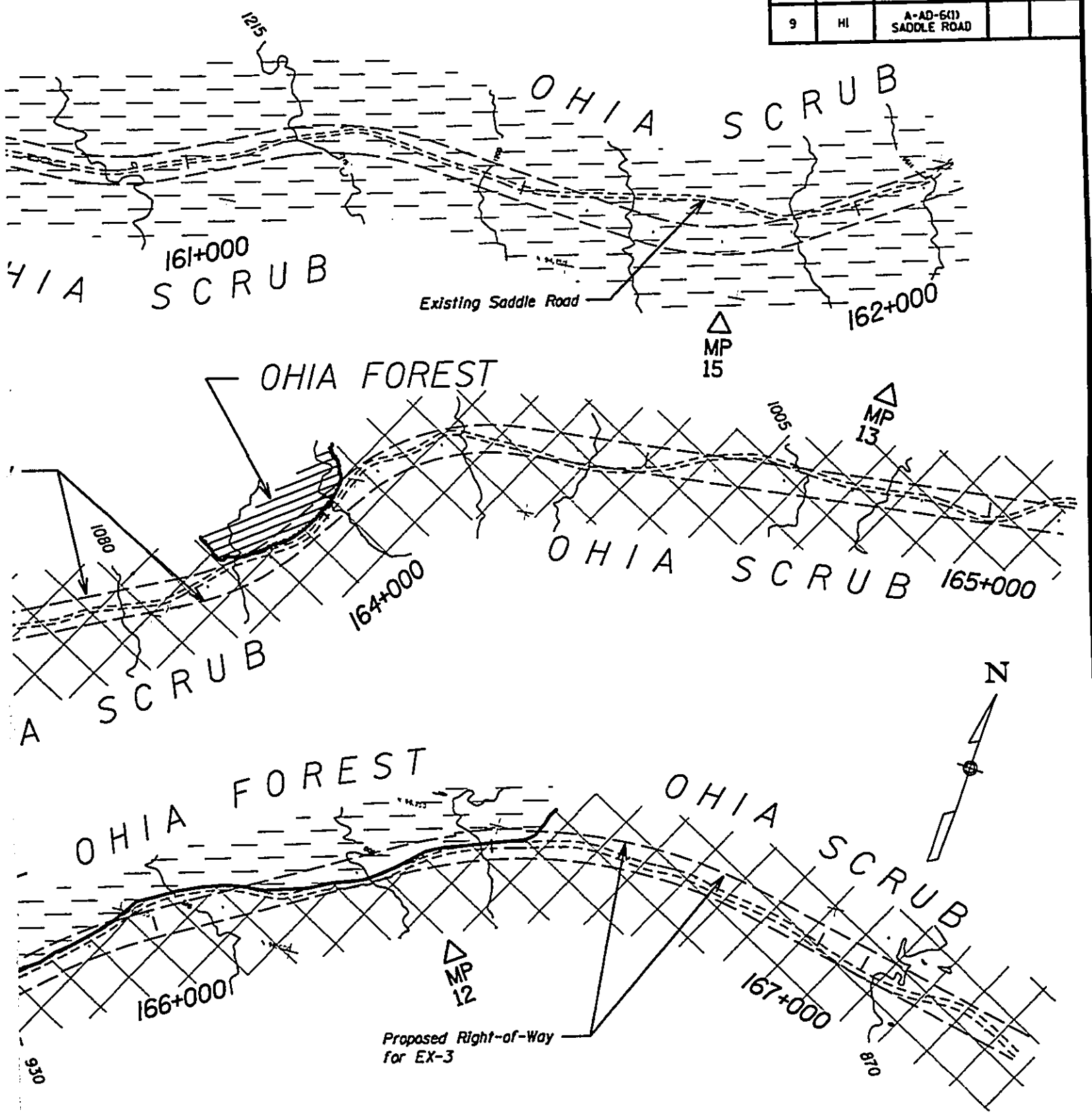
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND KEY MAP

FIGURE 3.11.1


N
MP 16
Proposed Right-of-Way for EX-3
OHIA FOREST
OHIA SCRUB
160+000
1275
OHIA
N
MP 14
Existing Saddle Road
1140
Proposed Right-of-Way for EX-3
1080
OHIA FOREST
OHIA SCRUB
OHIA
163+000
OHIA
KOA
Existing Saddle Road
930
OHIA SCRUB
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Wetland Location Legend
100% Wetland
Partial Wetland
Upland

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		

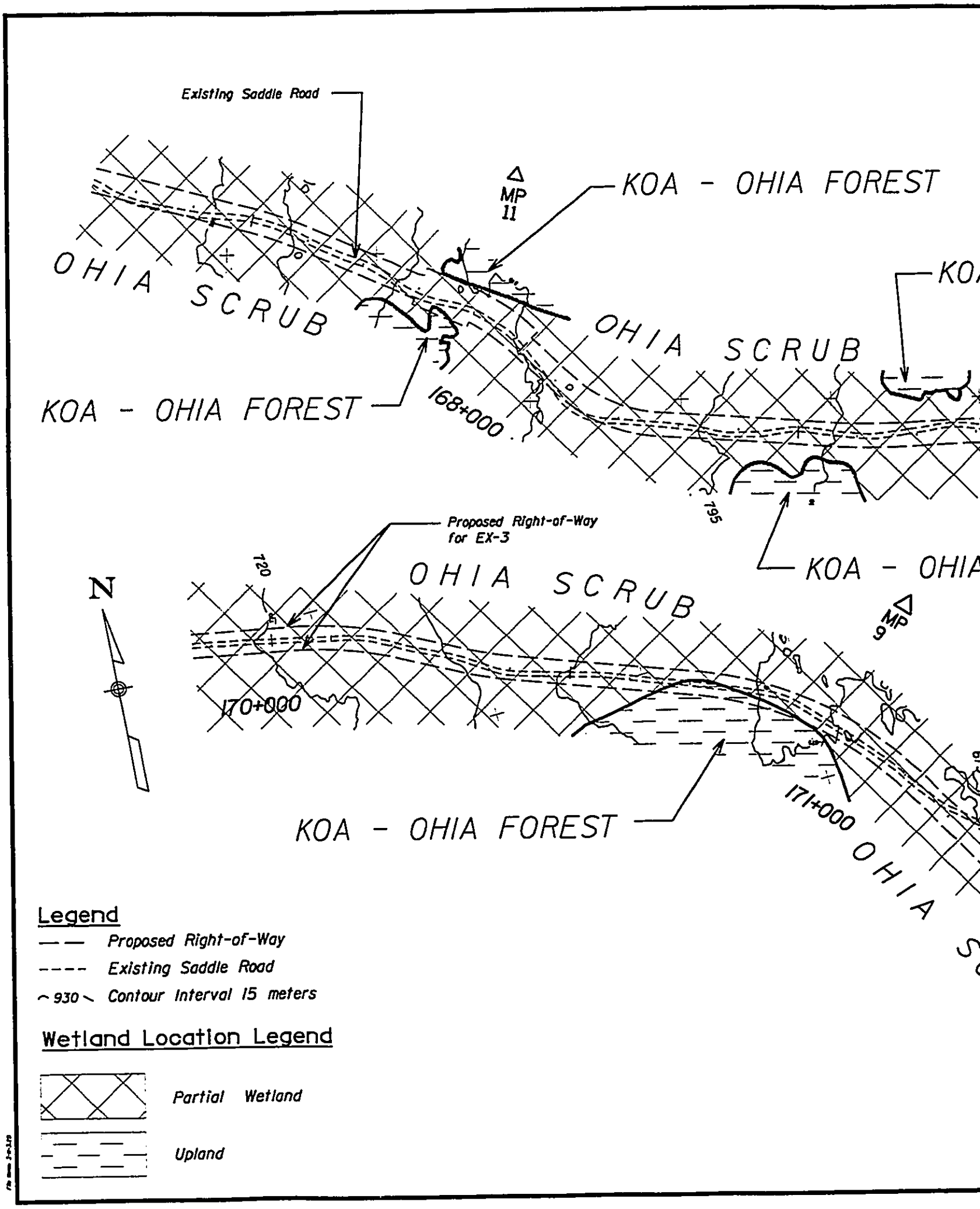


0 75 150
SCALE IN METERS

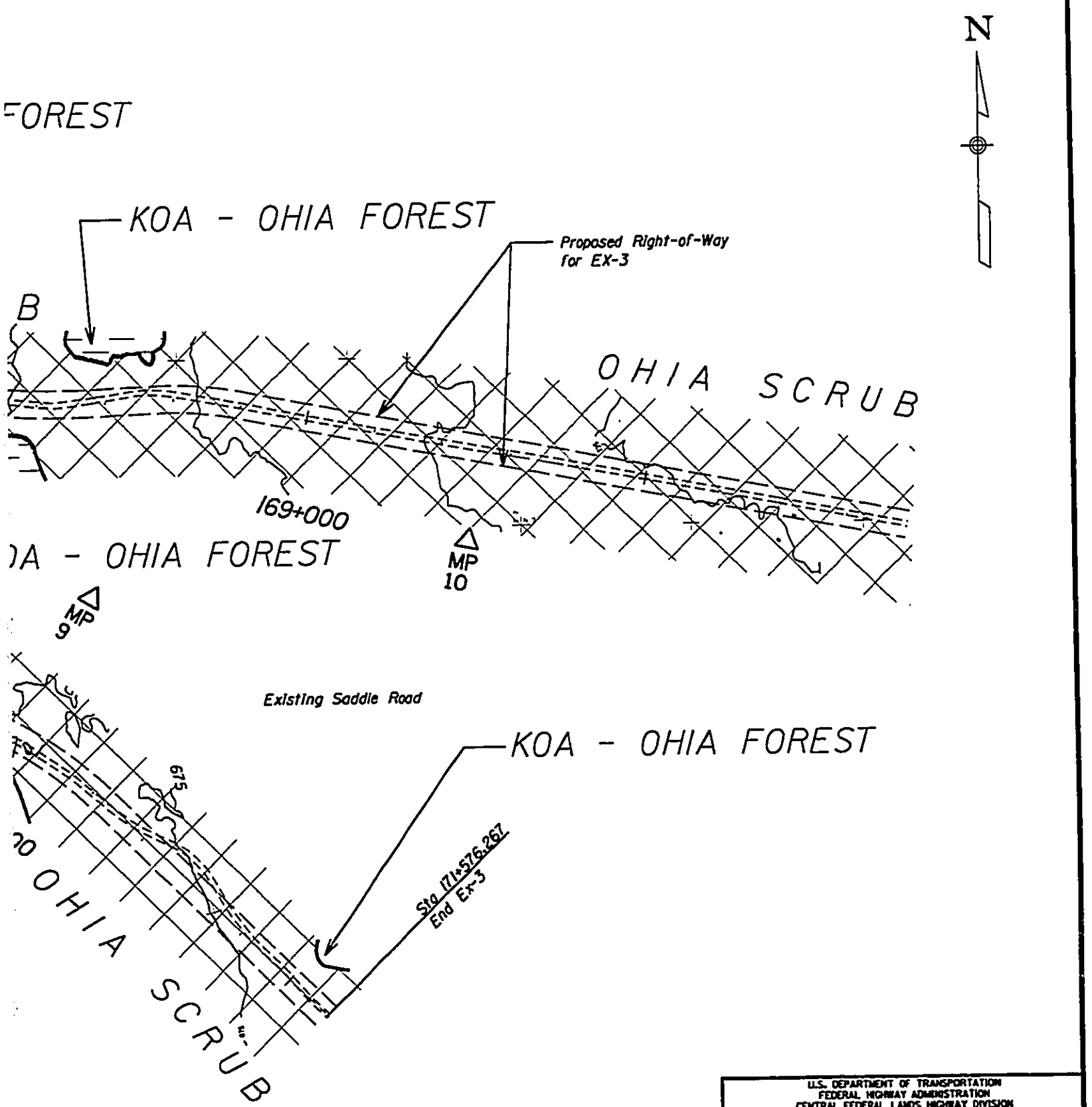
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND WETLAND CONDITION

SEGMENT EX-3
STA. 160+000 TO STA. 167+000
FIGURE 3.11.2


Existing Saddle Road
MP 11
KOA - OHIA FOREST
OHIA SCRUB
OHIA SCRUB
KOA - OHIA FOREST
168+000
795
Proposed Right-of-Way for EX-3
720
OHIA SCRUB
KOA - OHIA
N
MP 9
170+000
171+000
KOA - OHIA FOREST
OHIA
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Wetland Location Legend
Partial Wetland
Upland

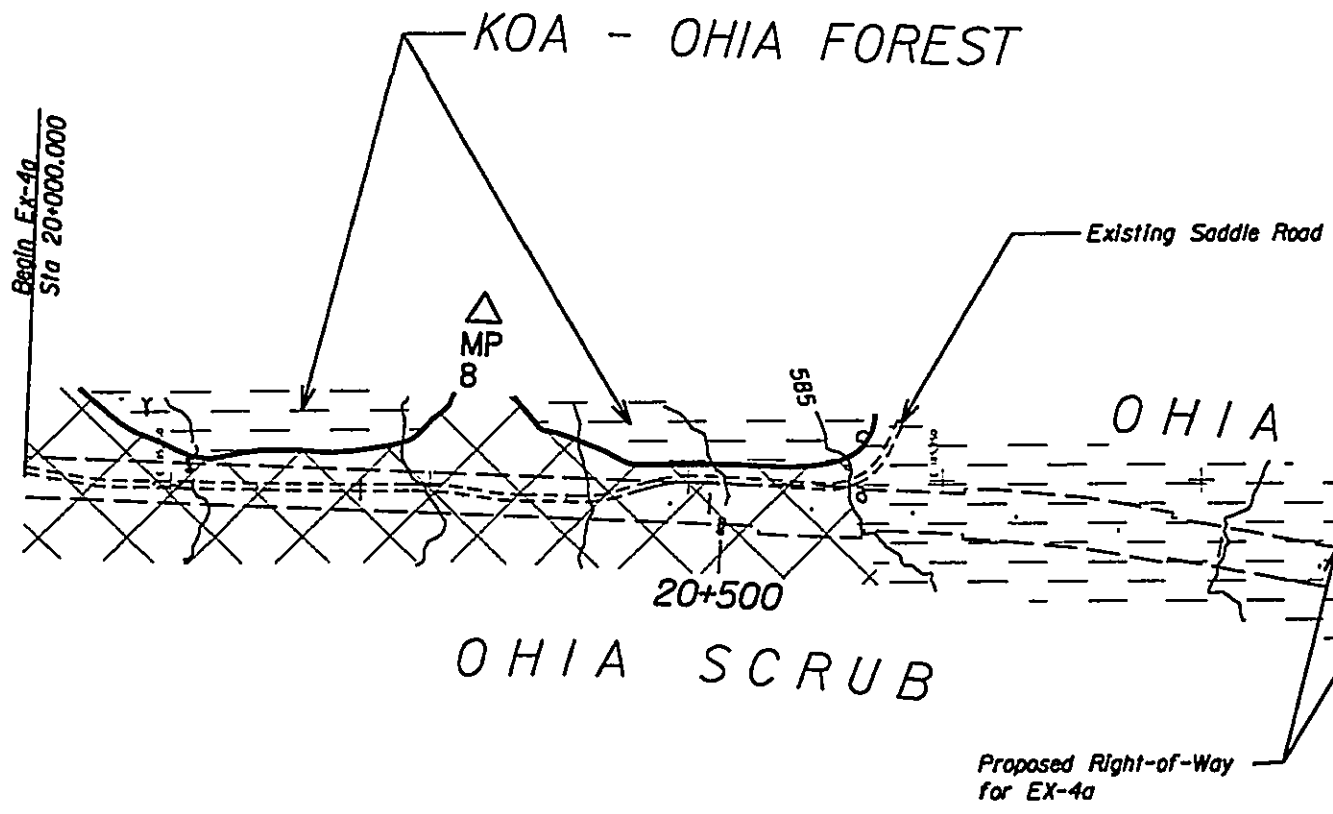
REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND WETLAND CONDITIONS

SEGMENT EX-3
STA. 167+000 TO STA. 171+576
FIGURE 3.11.3



KOA - OHIA FOREST

Legend

— — Proposed Right-of-Way

- - - - Existing Saddle Road

930 Contour Interval 15 meters

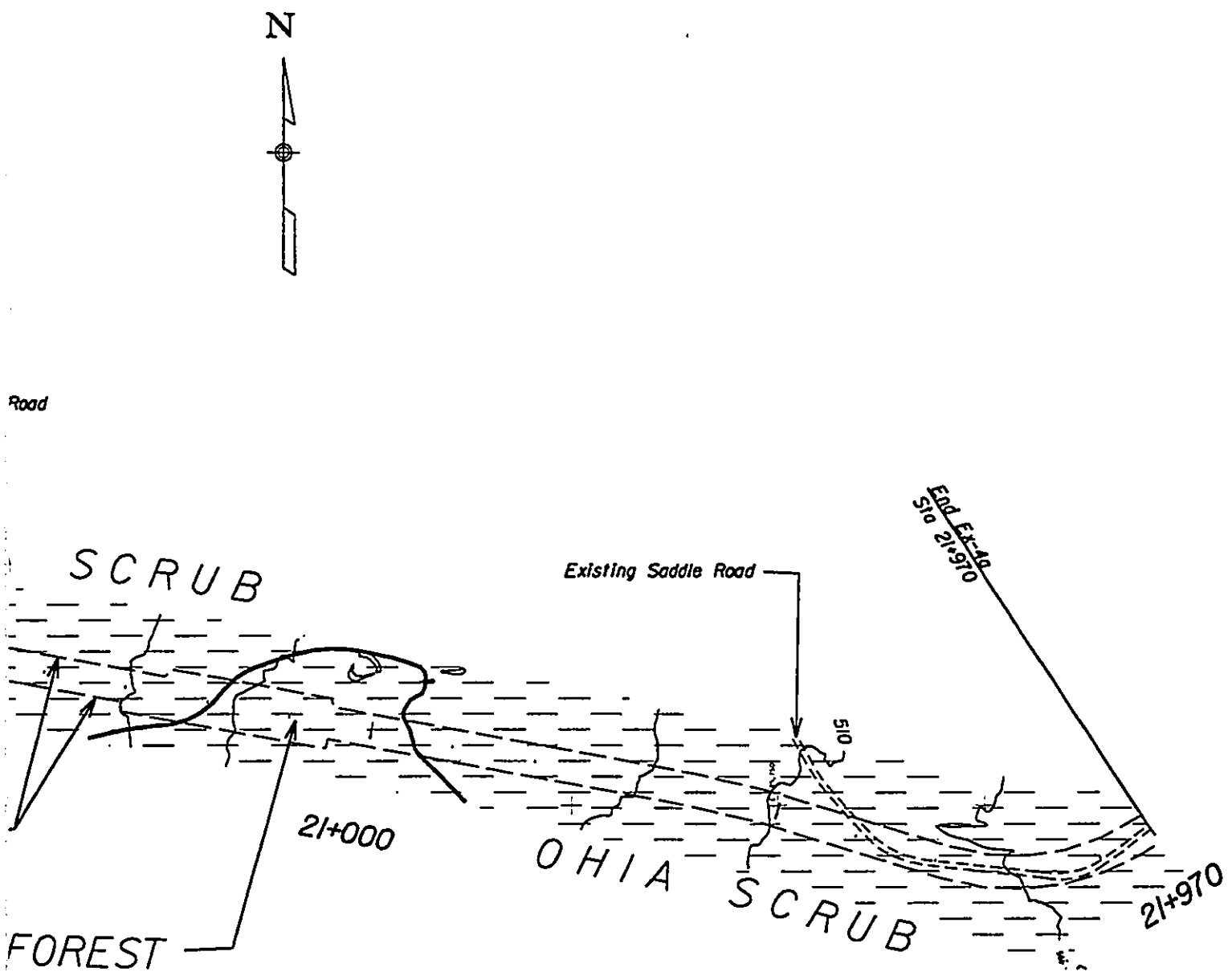
Wetland Location Legend

Partial Wetland

Upland

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		

22

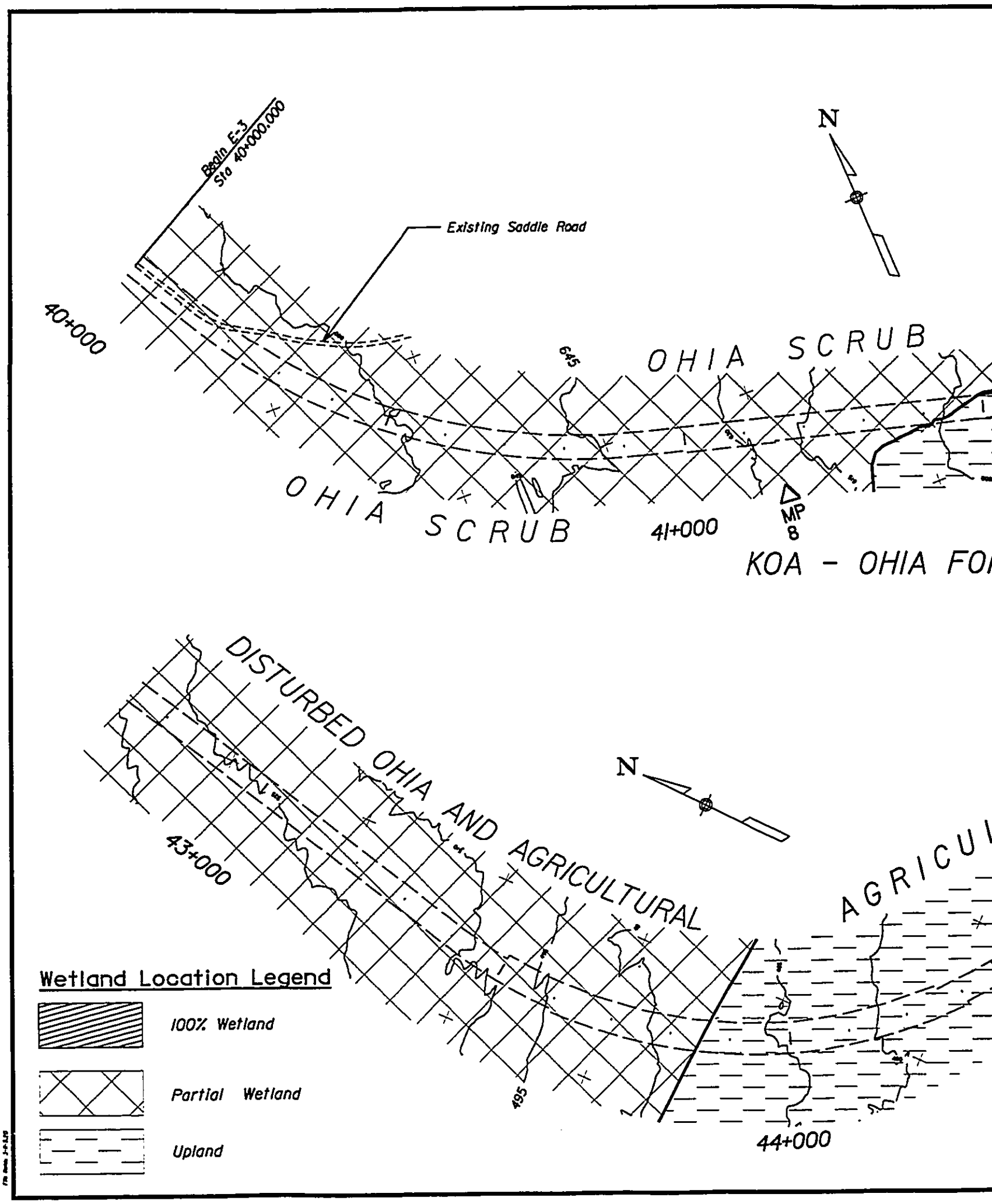


0 75 150
SCALE IN METERS

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

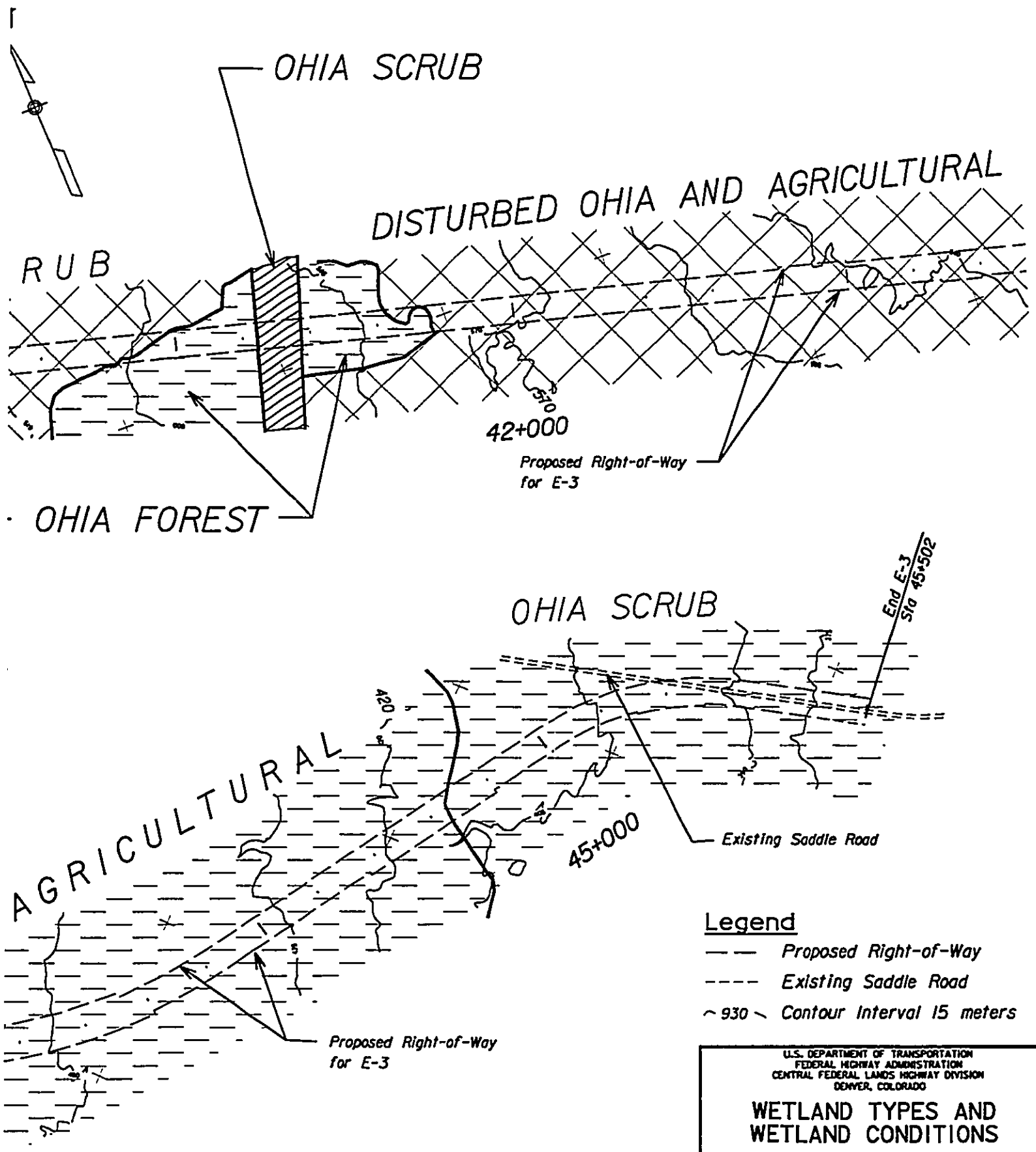
WETLAND TYPES AND WETLAND CONDITIONS

SEGMENT EX-4a
STA. 20+000 TO STA. 21+970
FIGURE 3.11.4


Begin E-3
Sta 40+000.000
Existing Saddle Road
N
40+000
645
OHIA SCRUB
OHIA SCRUB
41+000
MP
8
KOA - OHIA FO
DISTURBED OHIA AND AGRICULTURAL
N
43+000
AGRICU
495
44+000
Wetland Location Legend
100% Wetland
Partial Wetland
Upland

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		

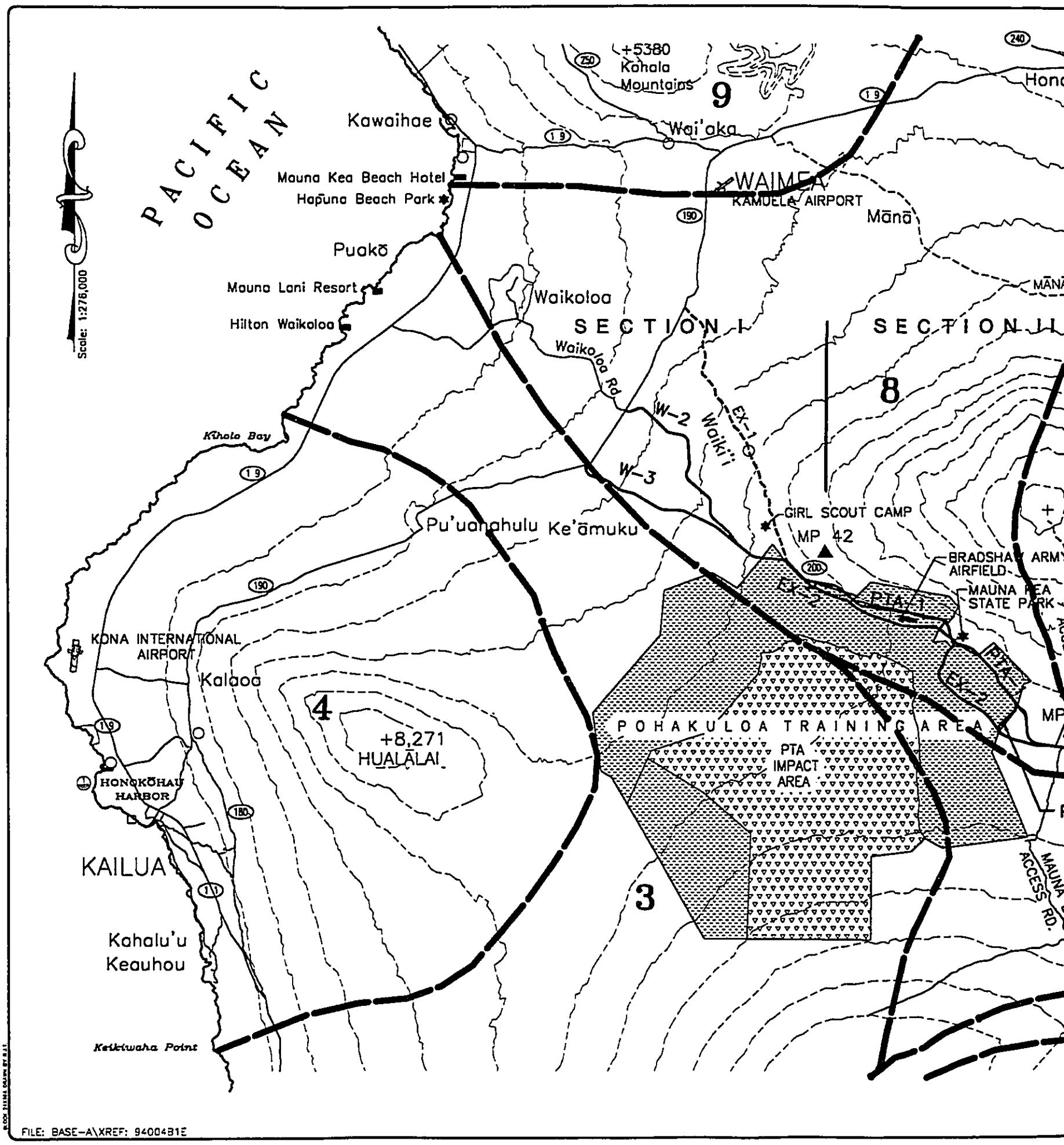
23



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

WETLAND TYPES AND WETLAND CONDITIONS

SEGMENT E-3
STA. 40+000 TO STA. 45+502
FIGURE 3.11.5



FILE: BASE-A\XREF: 94004B1E

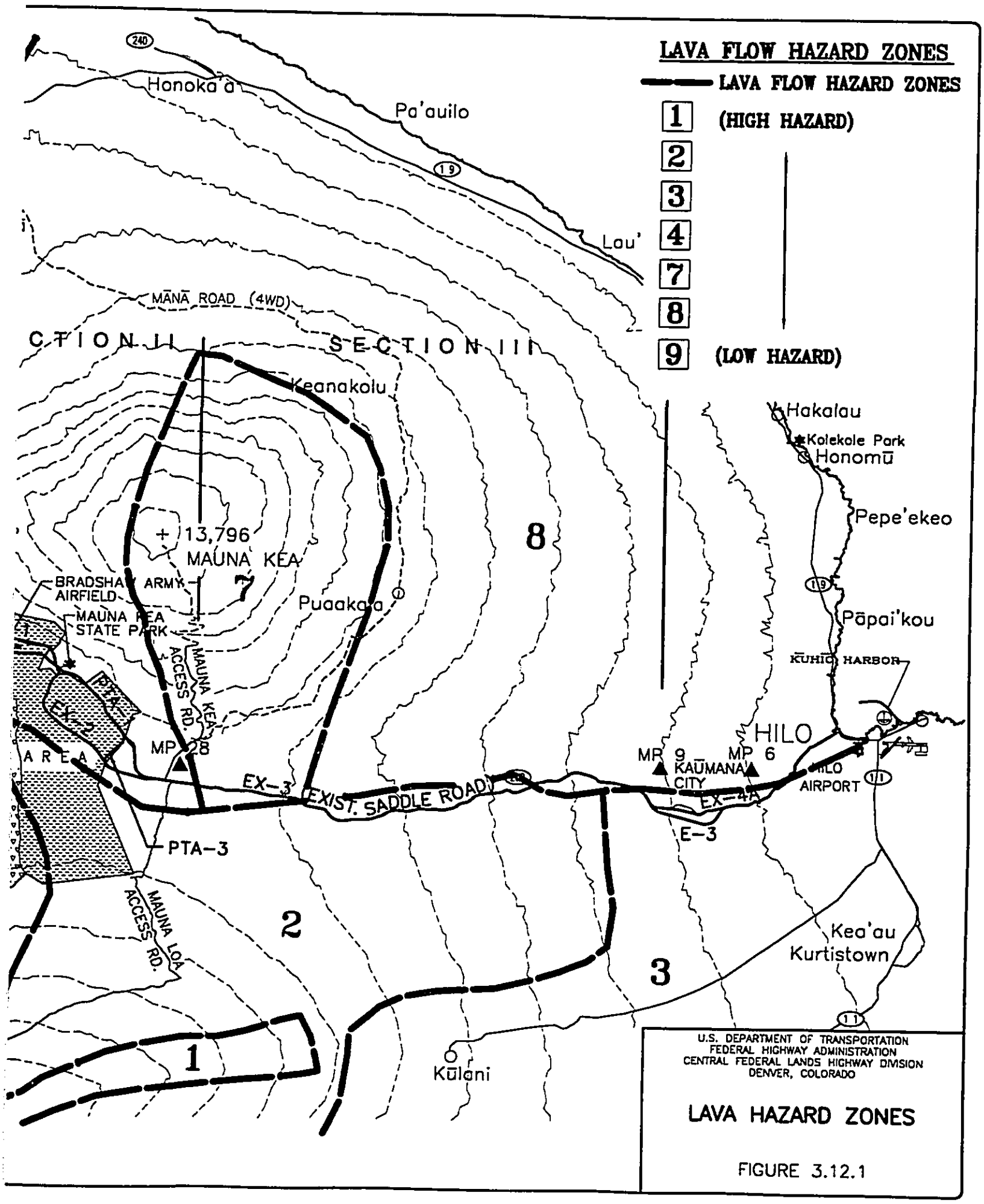
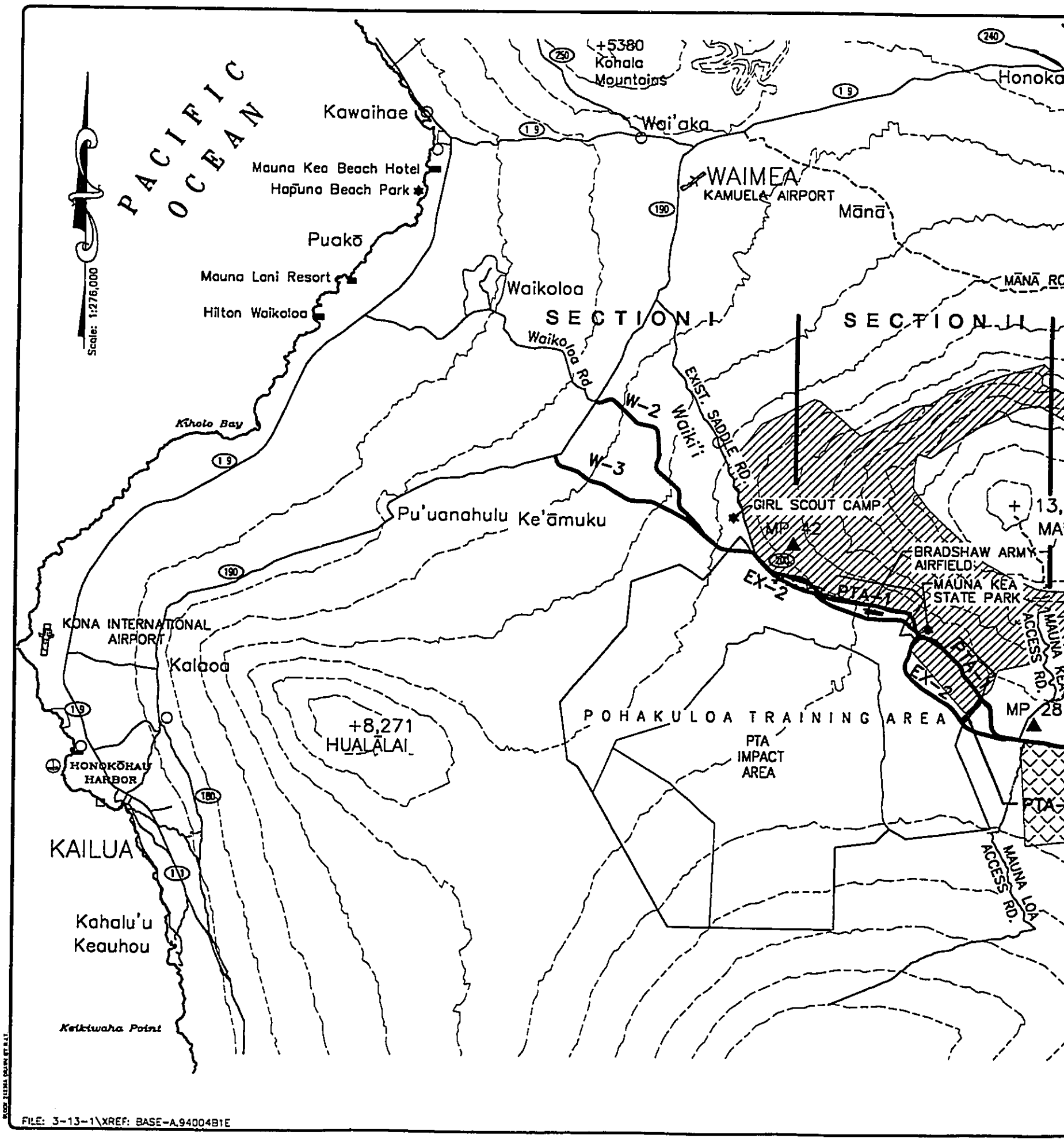
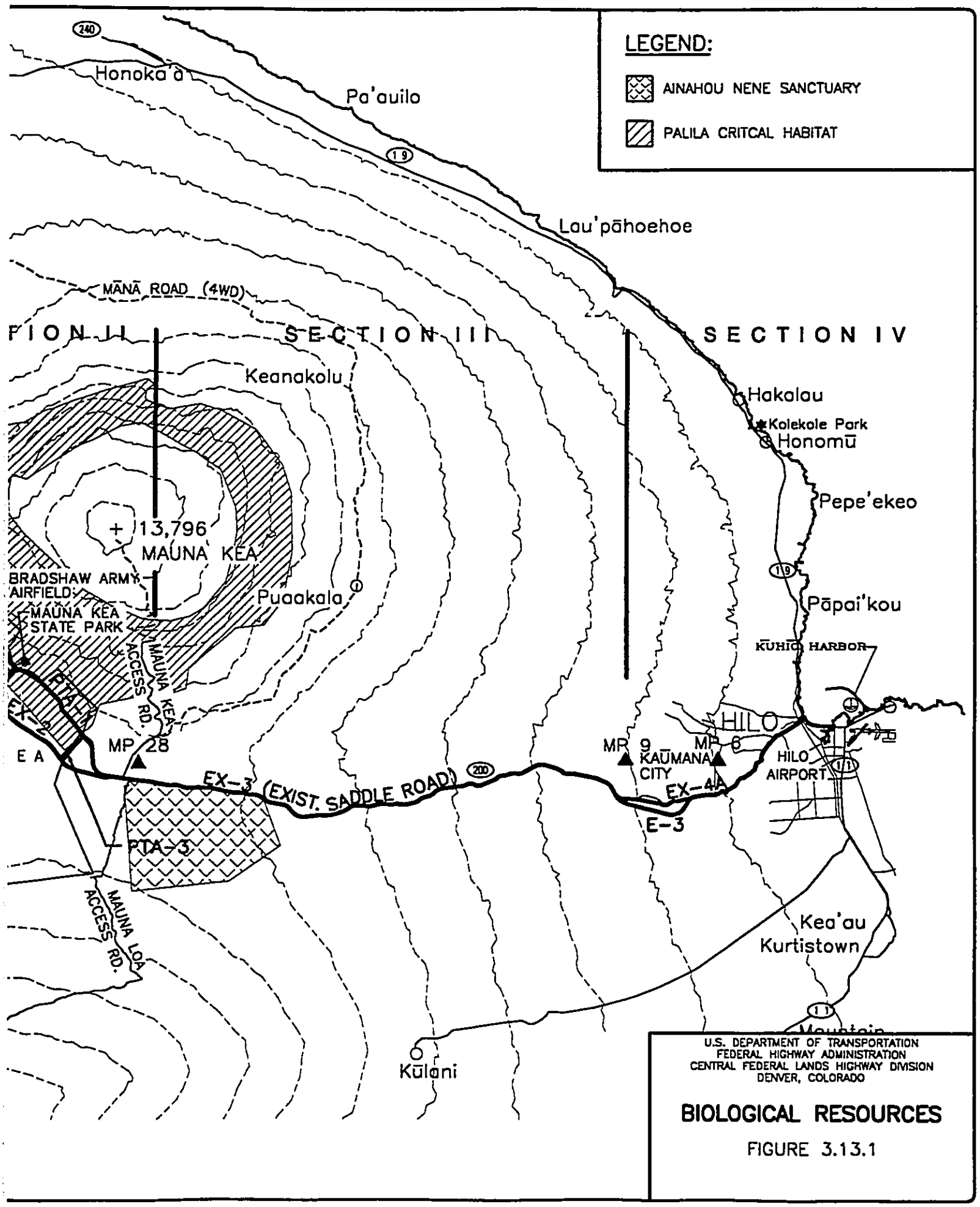
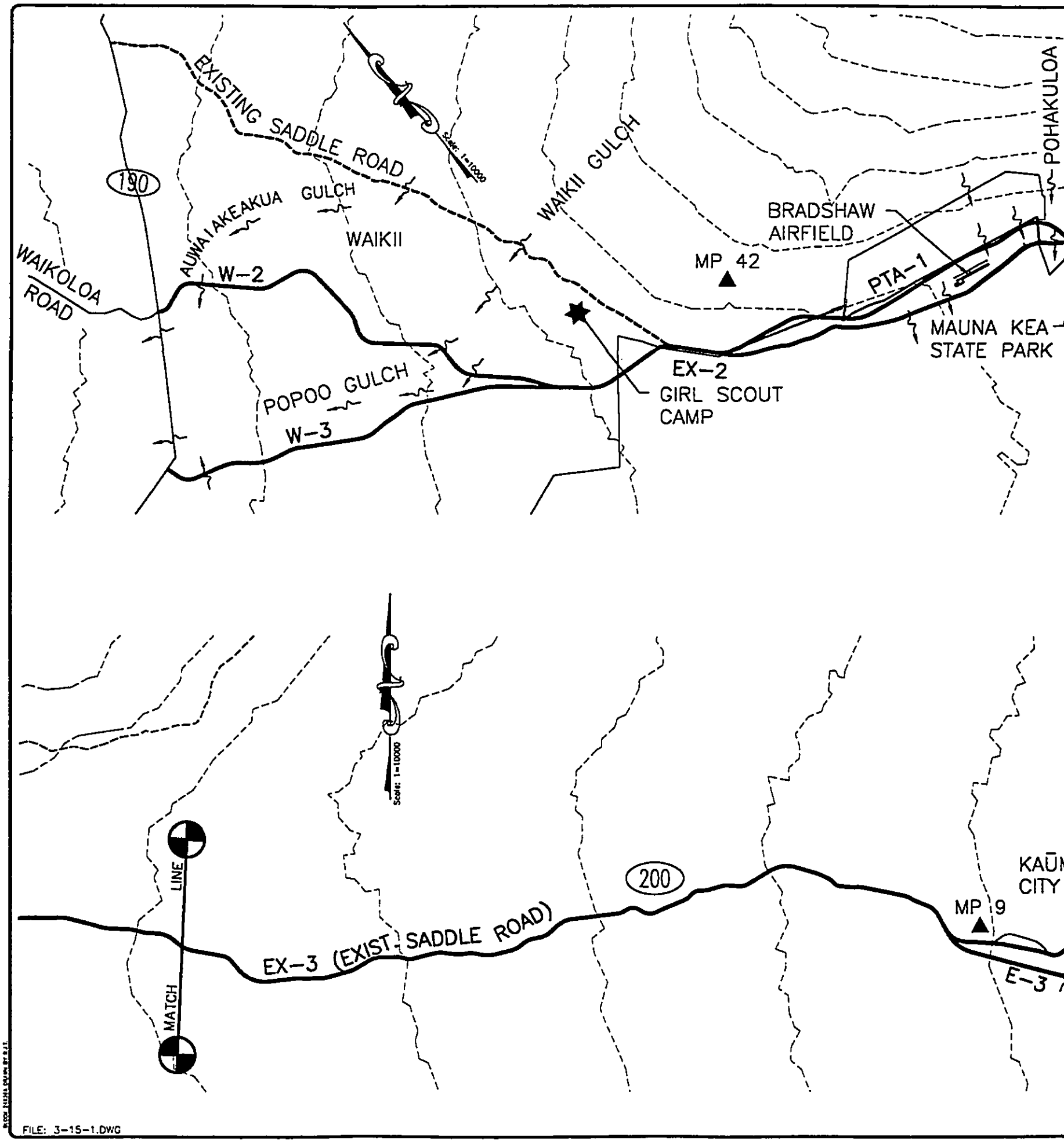

LAVA FLOW HAZARD ZONES
LAVA FLOW HAZARD ZONES
1 (HIGH HAZARD)
2
3
4
7
8
9 (LOW HAZARD)
Honoka'a
Pa'auilo
Lau'
MĀNĀ ROAD (4WD)
SECTION II
SECTION III
Keanakolu
13,796
MAUNA KEA
7
8
Puaakala
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
MAUNA KEA ACCESS RD.
PTA
EX-3
AREA
MP 28
EX-3
EXIST. SADDLE ROAD
PTA-3
MAUNA LOA ACCESS RD.
2
1
Kūlani
3
MR 9
MP 6
KAUMANA CITY
EX-4A
E-3
HILO
HILO AIRPORT
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Pāpai'kou
KUHIO HARBOR
Kea'au
Kurtistown
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
LAVA HAZARD ZONES

FIGURE 3.12.1


PACIFIC OCEAN
Scale: 1:276,000
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
Kiholo Bay
+5380
Kohala Mountains
Wai'aka
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka
MĀNĀ RO
Waikoloa
SECTION I
SECTION II
Waikoloa Rd
W-2
W-3
EXIST. SADDLE RD.
Waiki'i
GIRL SCOUT CAMP
MP 42
Pu'uanahulu
Ke'āmuku
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
EX-2
PTA-1
PTA-2
MAUNA KEA ACCESS RD.
MP 28
KONA INTERNATIONAL AIRPORT
Kaloaa
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA IMPACT AREA
HONOKŌHAU HARBOR
KAILUA
Kahalu'u
Keauhou
Kekiwaha Point
MAUNA LOA ACCESS RD.
FILE: 3-13-1\XREF: BASE-A,94004B1E


LEGEND:
AINAHOU NENE SANCTUARY
PALILA CRITCAL HABITAT
240
Honoka'a
Pa'auilo
19
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
SECTION III
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
13,796
MAUNA KEA
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Pāpai'kou
KUHIO HARBOR
MAUNA KEA ACCESS RD.
PTA-1
EX-2
HILO
MP 28
MP 9
MP 6
KAUMANA CITY
HILO AIRPORT
EX-3 (EXIST. SADDLE ROAD)
200
EX-4A
E-3
PTA-3
MAUNA LOA ACCESS RD.
Kea'au
Kurtistown
11
Kūloni
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
BIOLOGICAL RESOURCES
FIGURE 3.13.1


EXISTING SADDLE ROAD
190
WAIKOLOA ROAD
AUWAIAKEAKUA GULCH
WAIKII
W-2
WAIKII GULCH
POPOO GULCH
W-3
MP 42
BRADSHAW AIRFIELD
PTA-1
POHAKULOA
MAUNA KEA STATE PARK
EX-2
GIRL SCOUT CAMP
Scale: 1=10000
LINE
MATCH
200
EX-3 (EXIST. SADDLE ROAD)
MP 9
KAŪ
CITY
E-3
Scale: 1=10000
FILE: 3-15-1.DWG

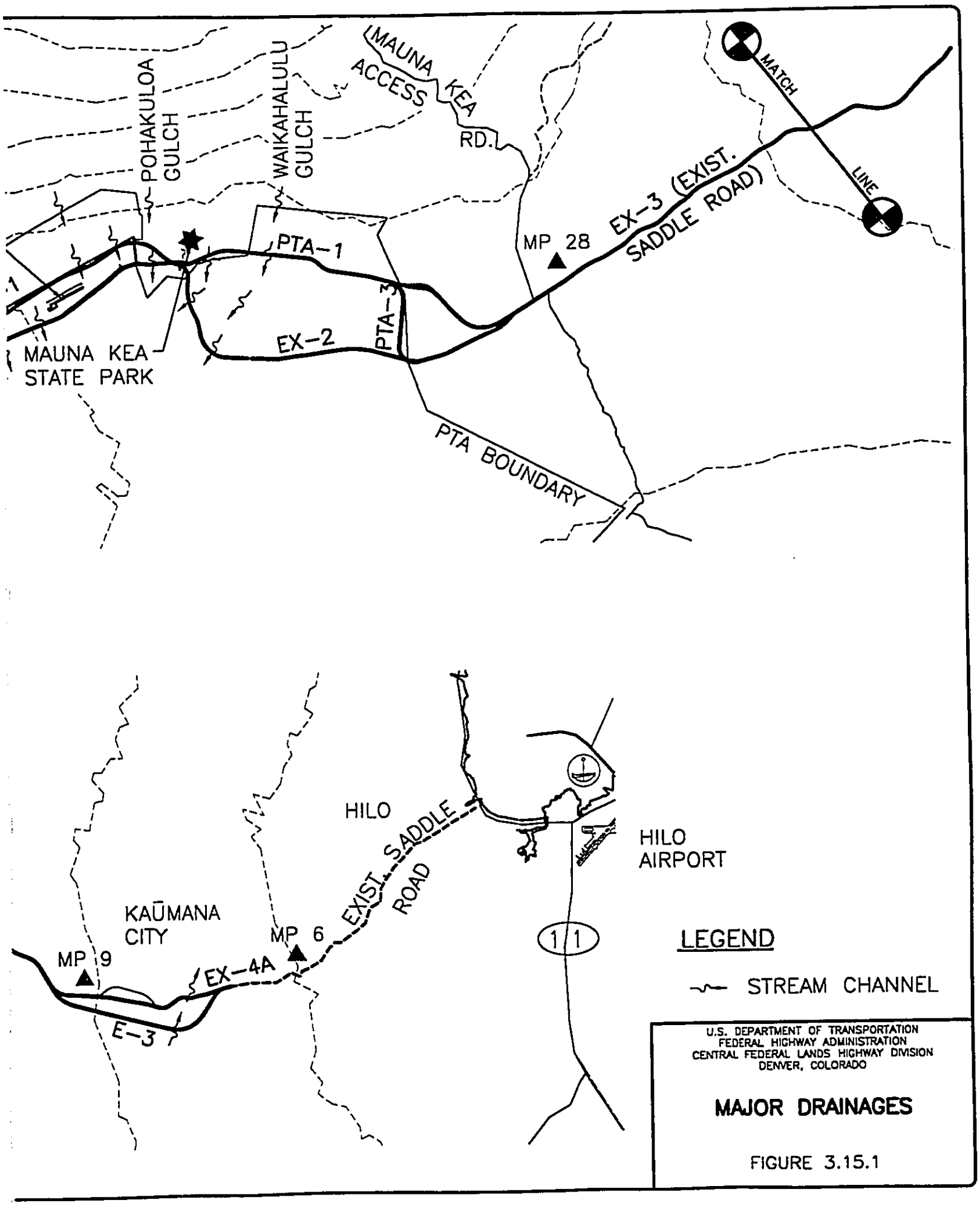
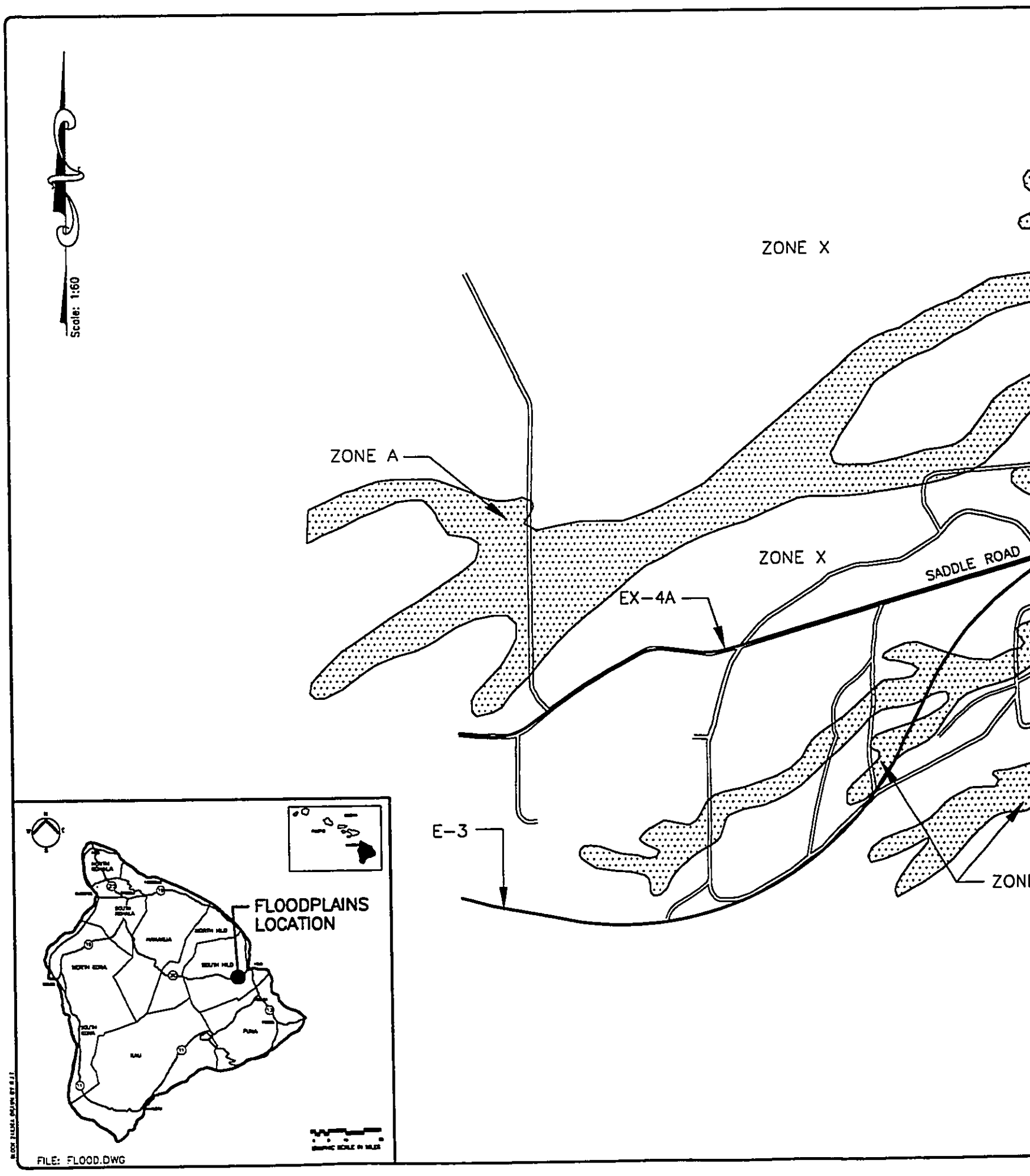
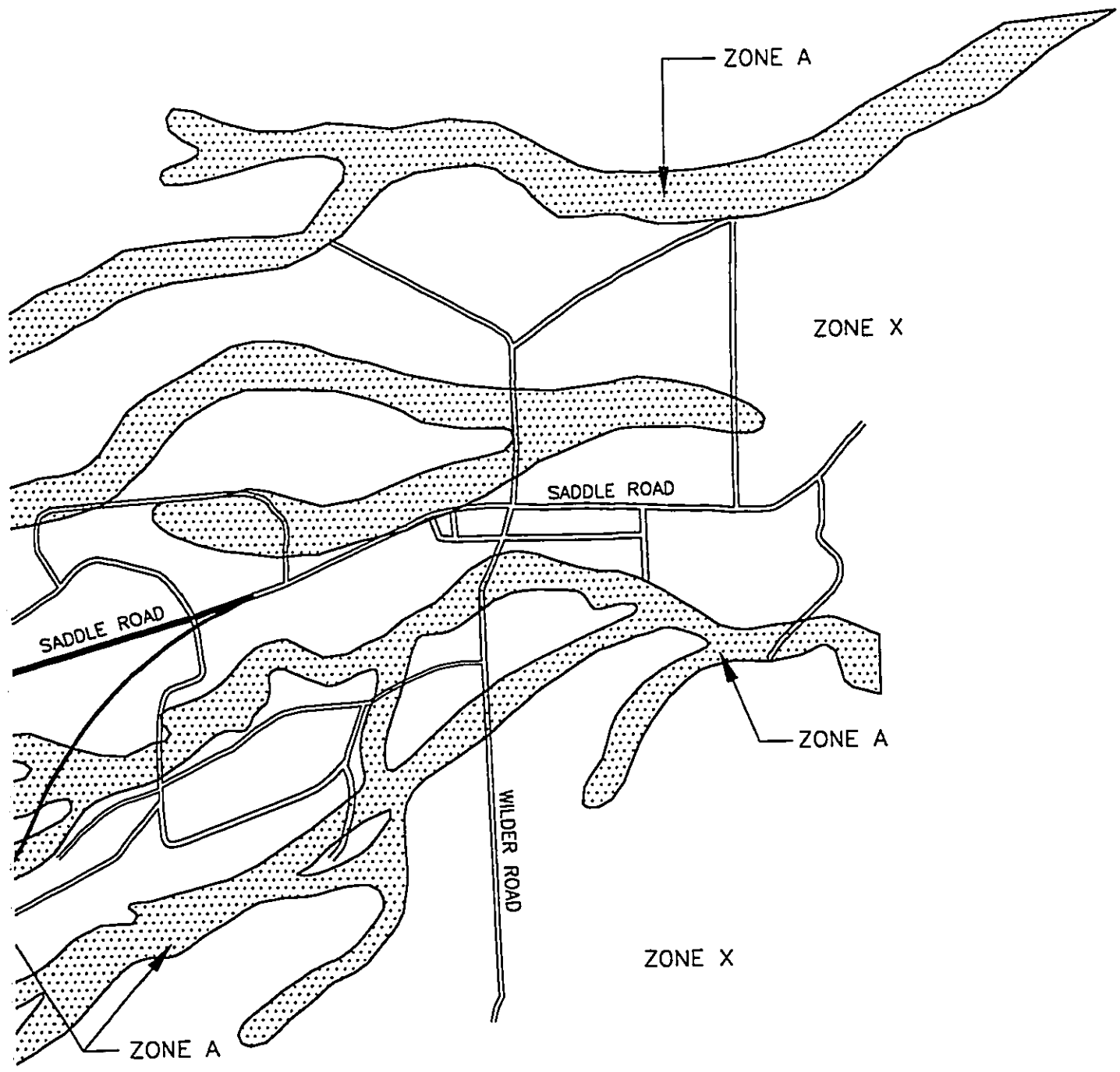

POHAKULOA GULCH
WAIKAHALULU GULCH
MAUNA KEA ACCESS RD.
MATCH LINE
EX-3 (EXIST. SADDLE ROAD)
MP 28
PTA-1
PTA-3
EX-2
MAUNA KEA STATE PARK
PTA BOUNDARY
HILO
EXIST. SADDLE ROAD
HILO AIRPORT
KAŪMANA CITY
MP 6
MP 9
EX-4A
E-3
11
LEGEND
STREAM CHANNEL
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
MAJOR DRAINAGES

FIGURE 3.15.1


Scale: 1:60
ZONE X
ZONE A
ZONE X
SADDLE ROAD
EX-4A
E-3
FLOODPLAINS LOCATION
FILE: FLOOD.DWG



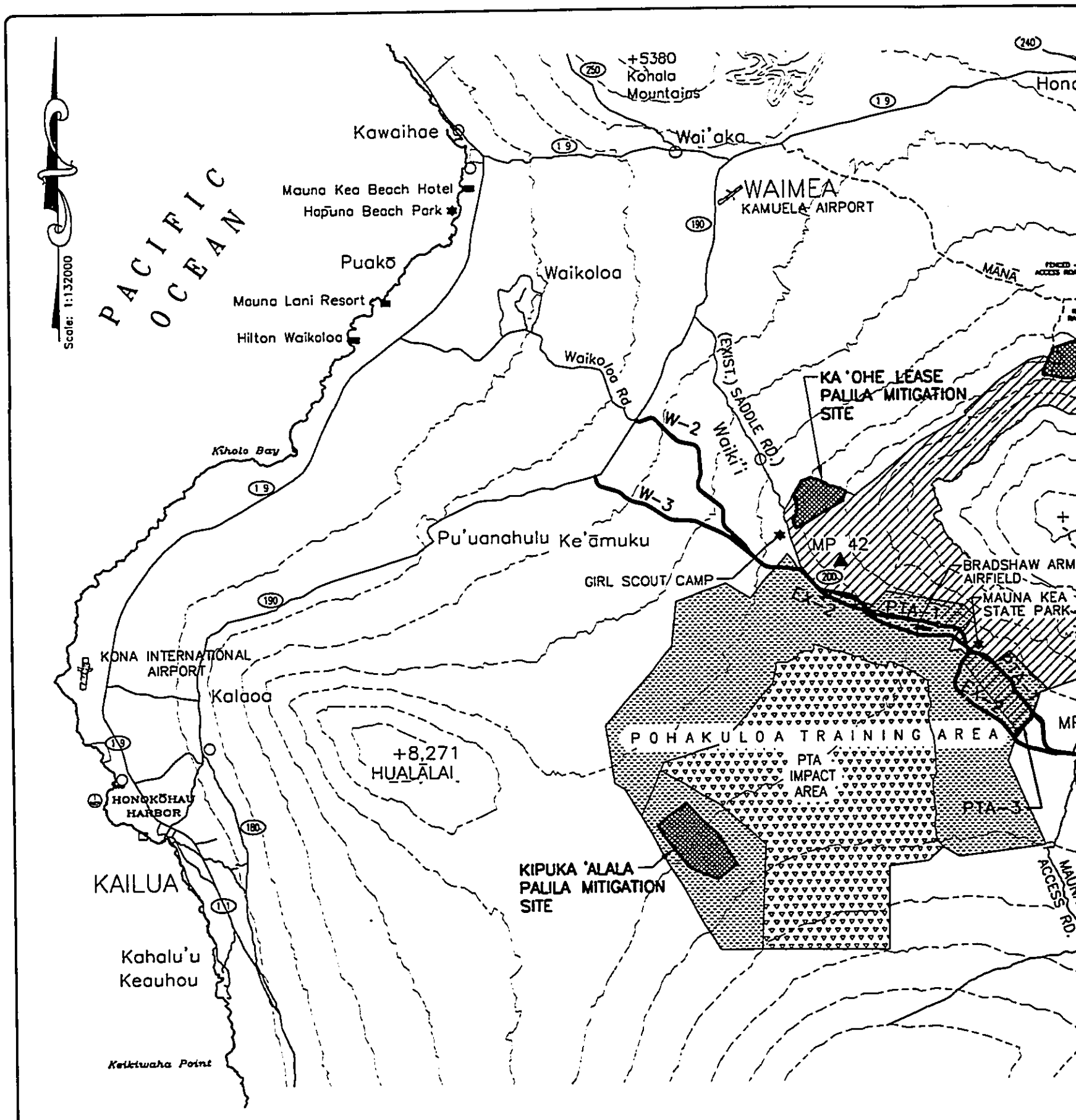
Zone A – No base flood elevations determined
Zone X – Areas outside 500 year floodplain

Area of 100 Year Flood

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

FEMA FLOODPLAINS

FIGURE 3.15.2

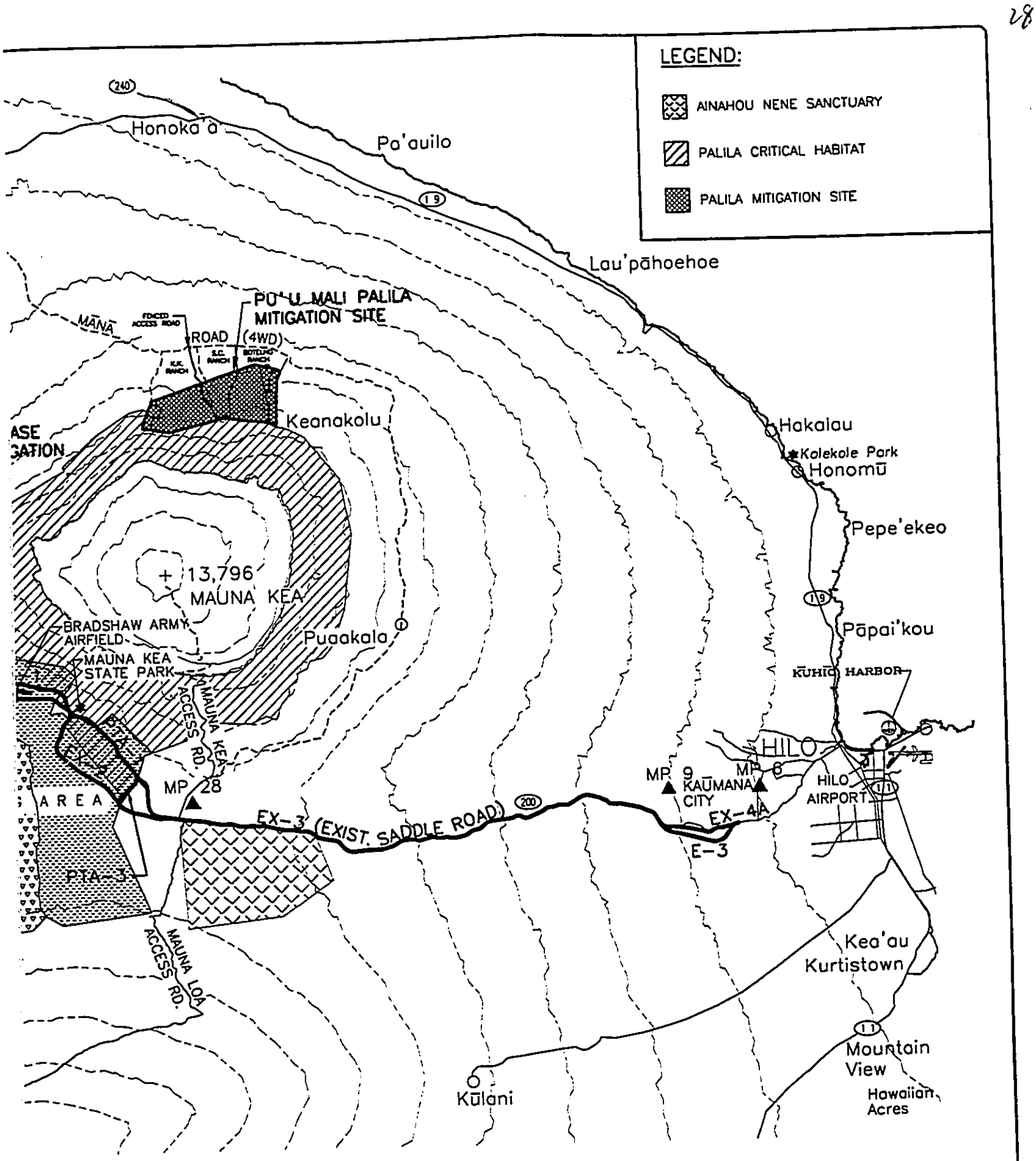


SADDLE ROAD (STATE ROUTE 200)

GRAPHIC SCALE

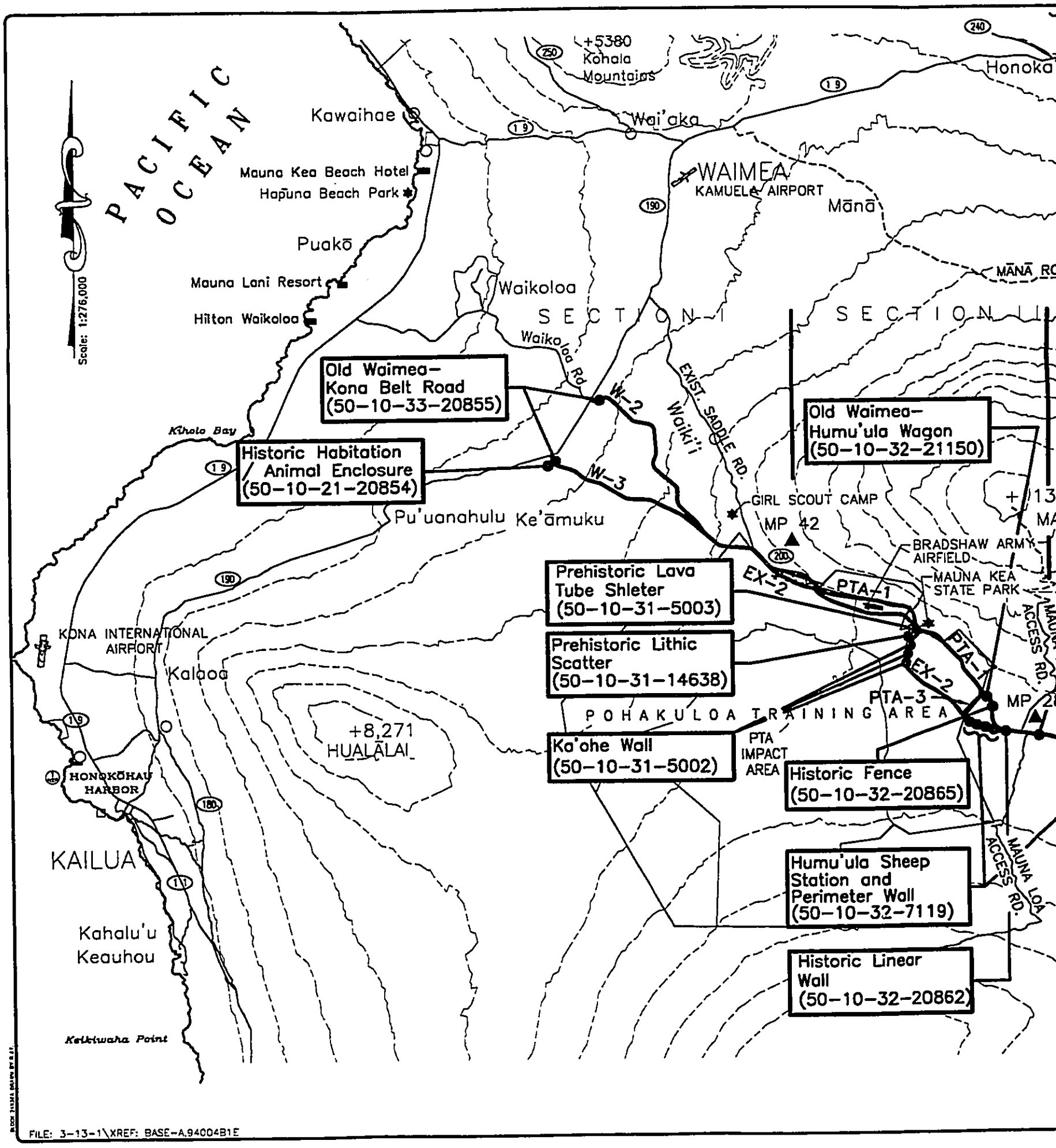
11000 5500 0 11000 22000 33000

(FEET)



PALILA MITIGATION SITES AND CRITICAL HABITAT

FIGURE 3.18.1


PACIFIC OCEAN
Scale: 1:276,000
Kawaihae
Mauna Kea Beach Hotel
Hapuna Beach Park
Puakō
Mauna Lani Resort
Hilton Waikoloa
+5380
Kohala Mountains
Wai'aka
WAIMEA
KAMUELA AIRPORT
Mānā
Honoka
MĀNĀ RO
Waikoloa
SECTION I
SECTION II
Waikoloa Rd.
Old Waimea–
Kona Belt Road
(50–10–33–20855)
W–2
W–3
EXIST. SADDLE RD.
Waiki'i
Old Waimea–
Humu'ula Wagon
(50–10–32–21150)
Kīholo Bay
Historic Habitation
/ Animal Enclosure
(50–10–21–20854)
Pu'uanahulu
Ke'āmuku
GIRL SCOUT CAMP
MP 42
BRADSHAW ARMY
AIRFIELD
MAUNA KEA
STATE PARK
Prehistoric Lava
Tube Shleter
(50–10–31–5003)
EX–2
PTA–1
Prehistoric Lithic
Scatter
(50–10–31–14638)
KONA INTERNATIONAL
AIRPORT
Kalaoa
+8,271
HUALĀLAI
POHAKULOA TRAINING AREA
PTA–3
MP 2
Ka'ohe Wall
(50–10–31–5002)
PTA
IMPACT
AREA
Historic Fence
(50–10–32–20865)
HONOKŌHAU
HARBOR
KAILUA
Humu'ula Sheep
Station and
Perimeter Wall
(50–10–32–7119)
MAUNA LOA
ACCESS RD.
Kahalu'u
Keauhou
Historic Linear
Wall
(50–10–32–20862)
Kekīwaha Point
FILE: 3-13-1\XREF: BASE-A.94004B1E

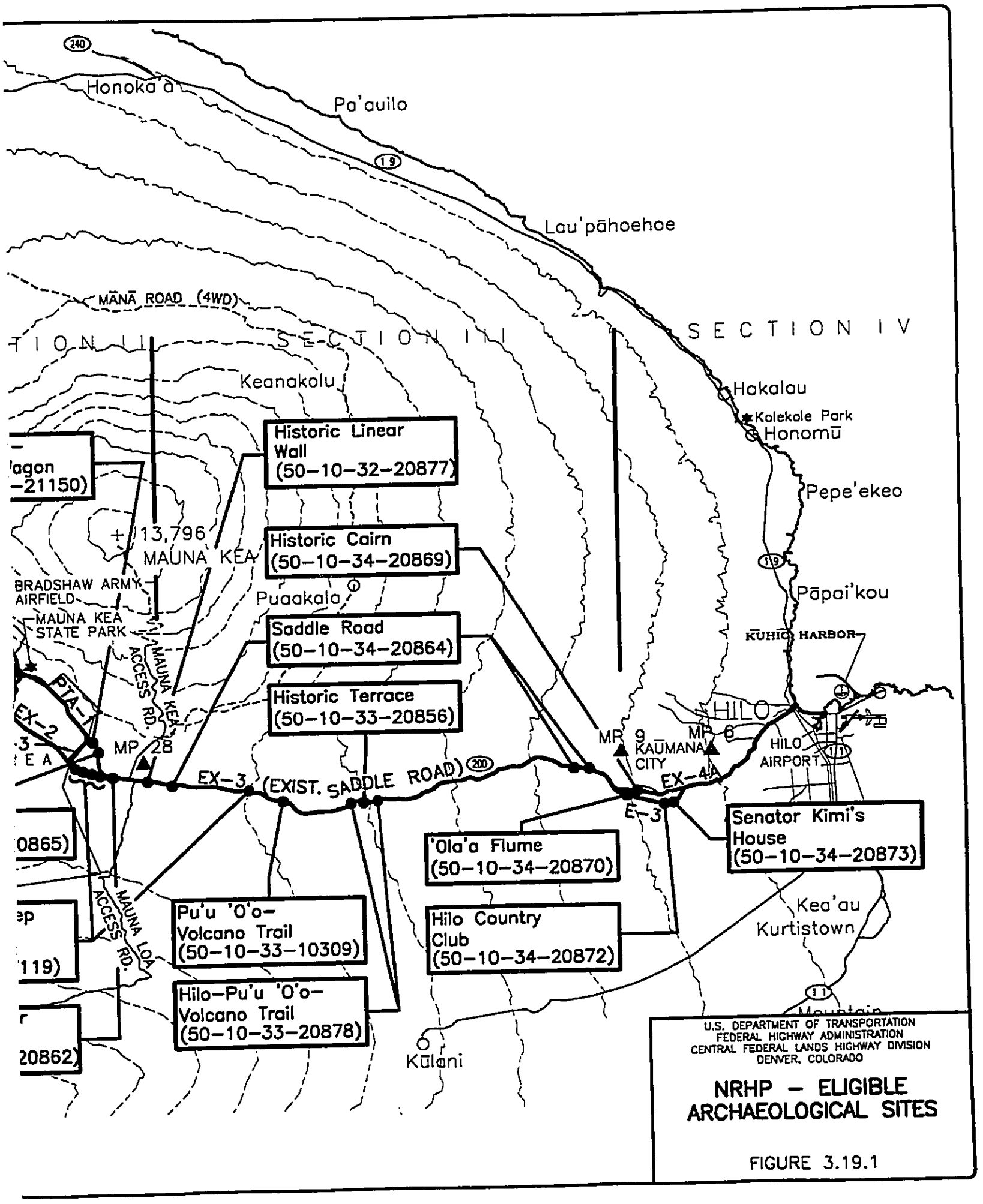
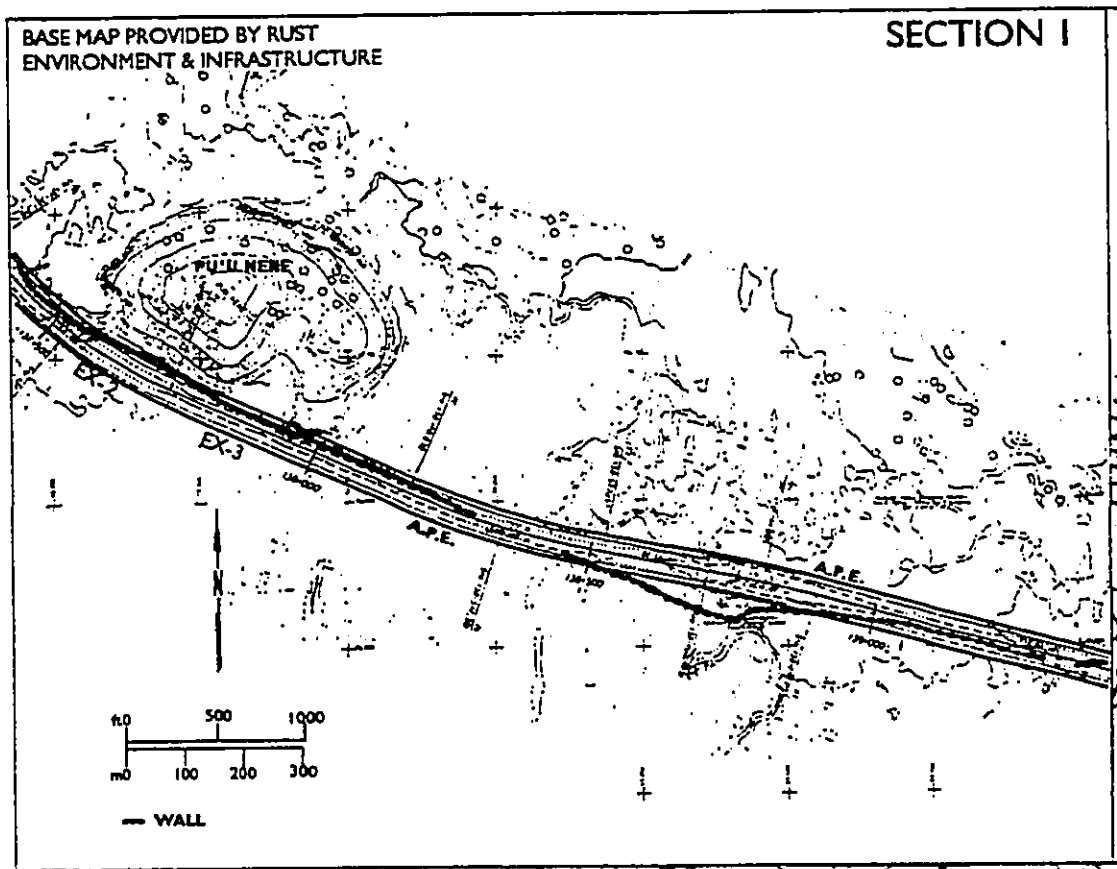
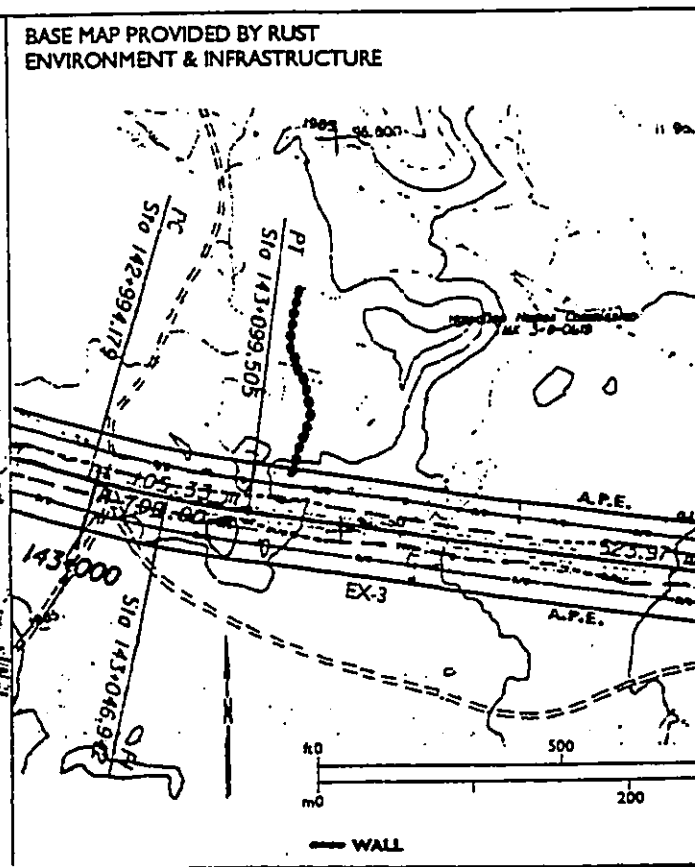
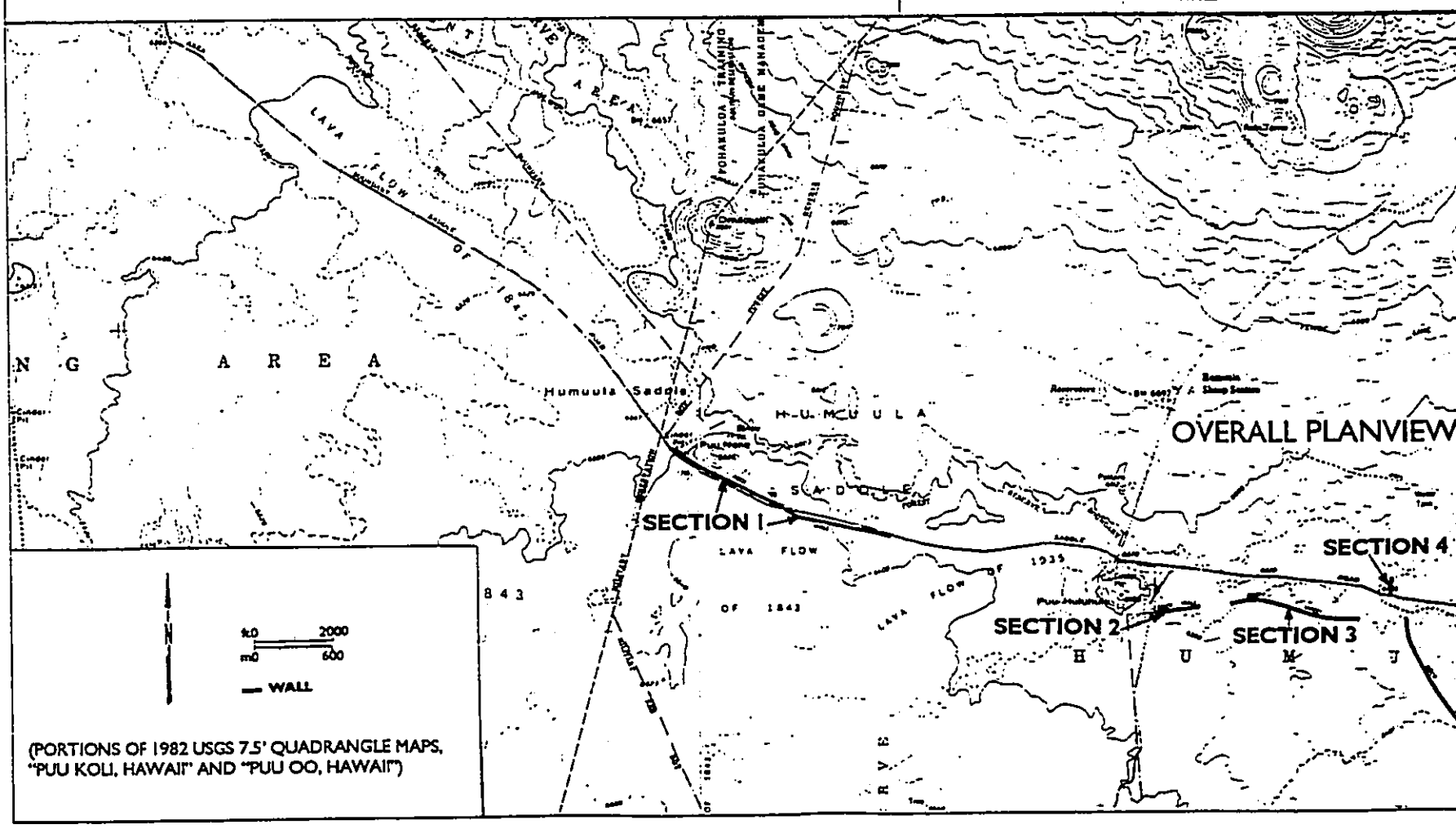

240
Honoka'a
Pa'auilo
19
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Historic Linear Wall (50-10-32-20877)
13,796
MAUNA KEA
Historic Cairn (50-10-34-20869)
BRADSHAW ARMY AIRFIELD
MAUNA KEA STATE PARK
Puaakala
Pāpai'kou
Saddle Road (50-10-34-20864)
KŪHIŌ HARBOR
MAUNA KEA ACCESS RD.
Historic Terrace (50-10-33-20856)
HILO
MP 28
MP 9
MP 6
KAŪMANA CITY
HILO AIRPORT
EX-3 (EXIST. SADDLE ROAD) 200
EX-4A
E-3
Senator Kimi's House (50-10-34-20873)
'Ola'a Flume (50-10-34-20870)
Pu'u 'O'o-Volcano Trail (50-10-33-10309)
Hilo Country Club (50-10-34-20872)
Kea'au
Kurtistown
MAUNA LOA ACCESS RD.
Hilo-Pu'u 'O'o-Volcano Trail (50-10-33-20878)
Kūlani
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
NRHP – ELIGIBLE ARCHAEOLOGICAL SITES

FIGURE 3.19.1

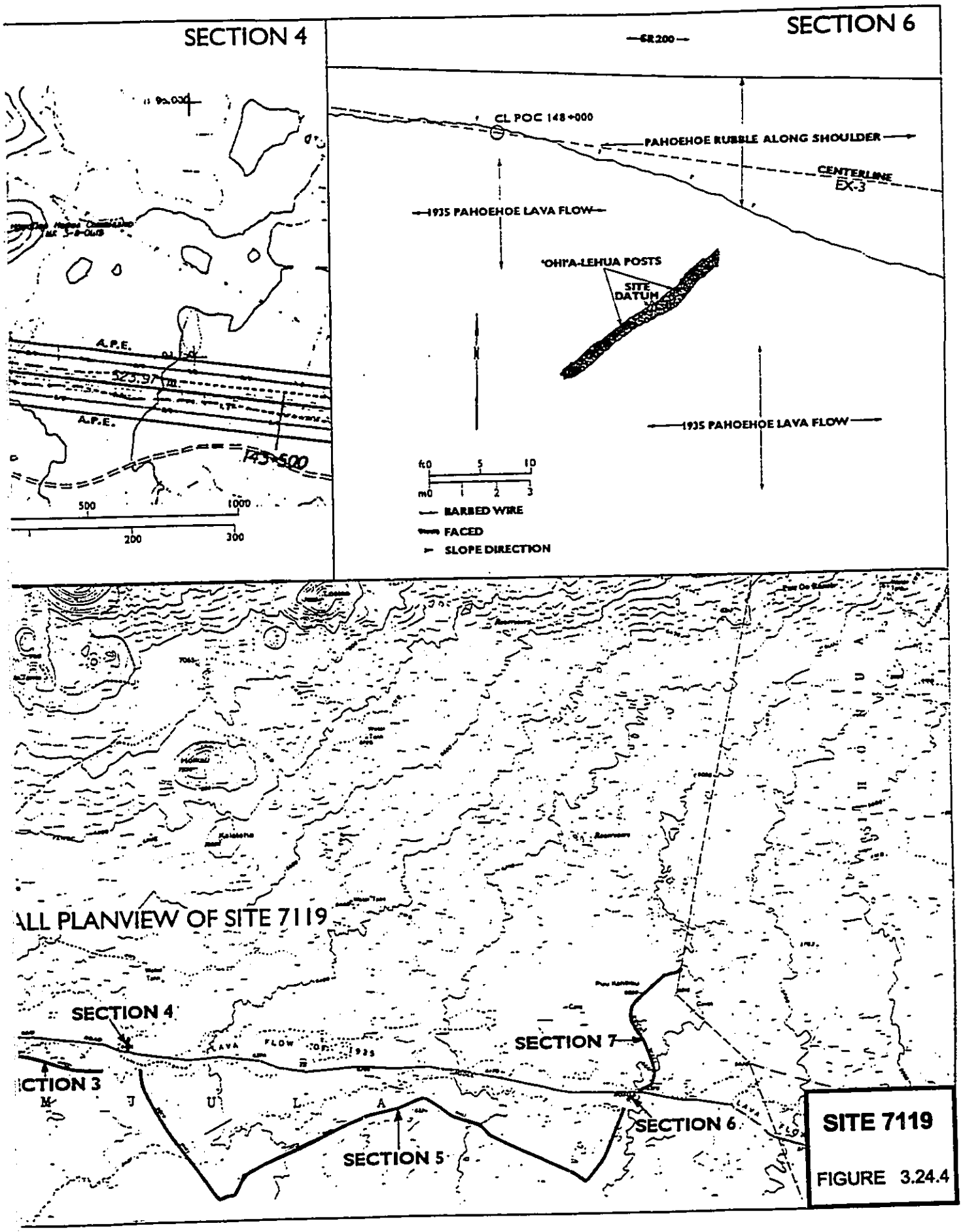
RECEIVED AS FOLLOWS





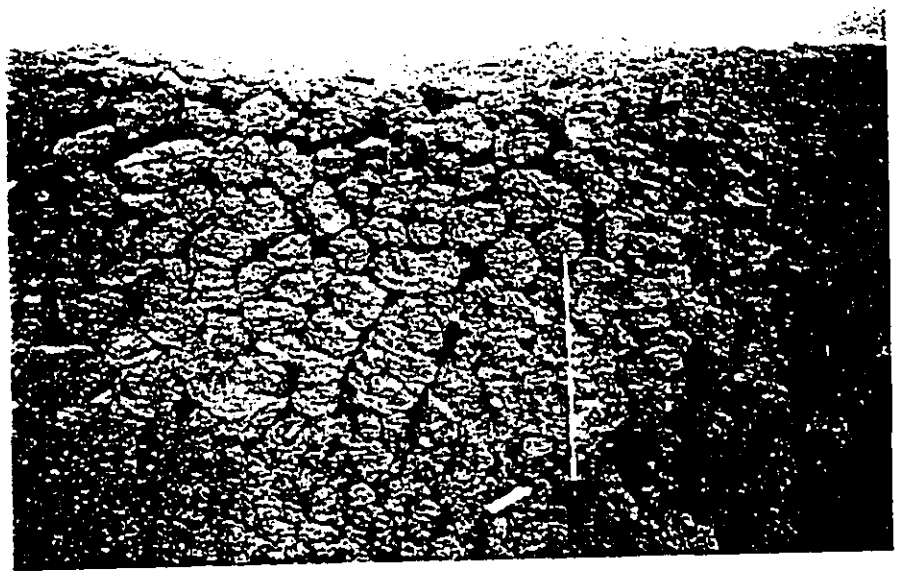


RECEIVED AS FOLLOWS



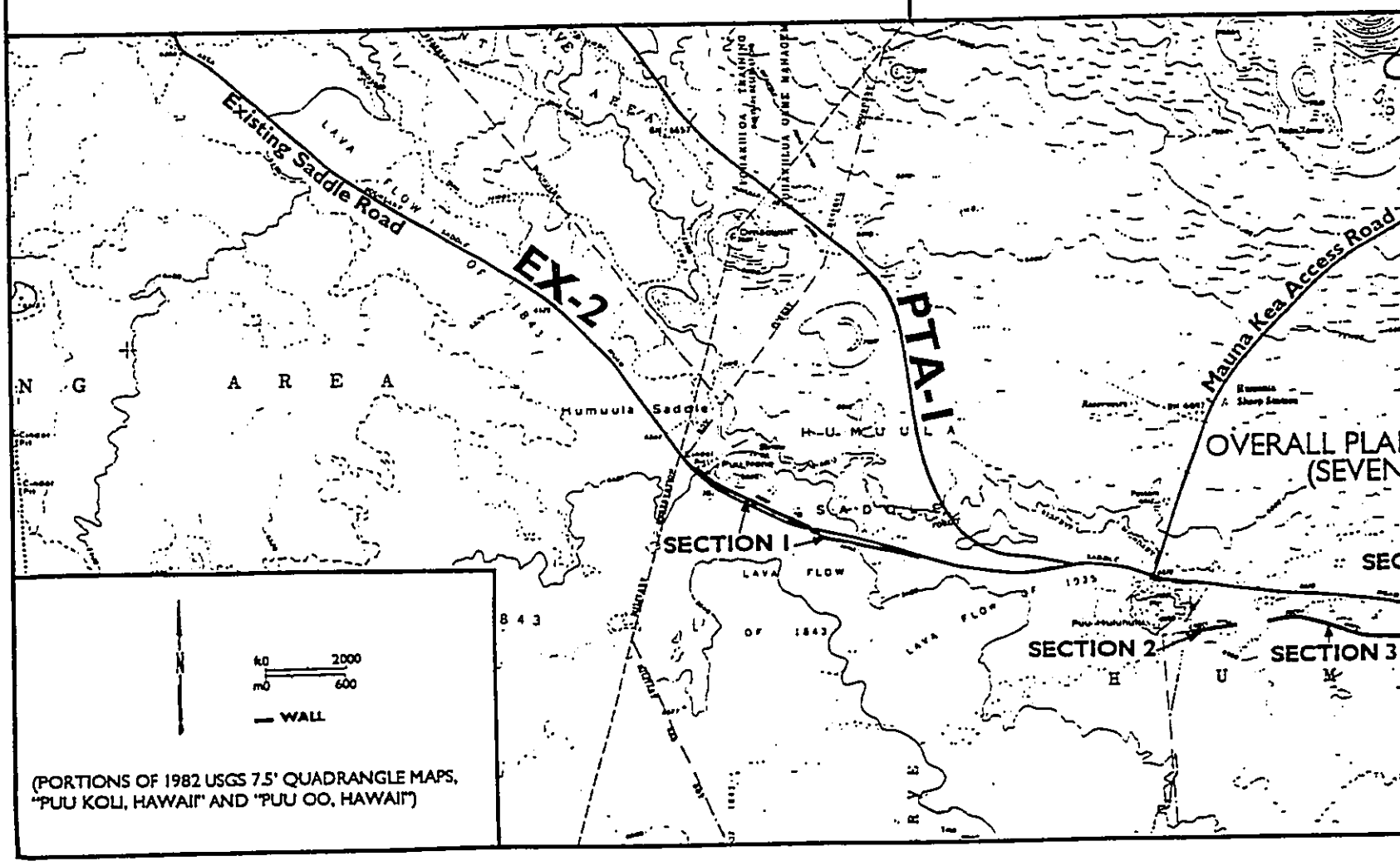
SITE 7119

FIGURE 3.24.4

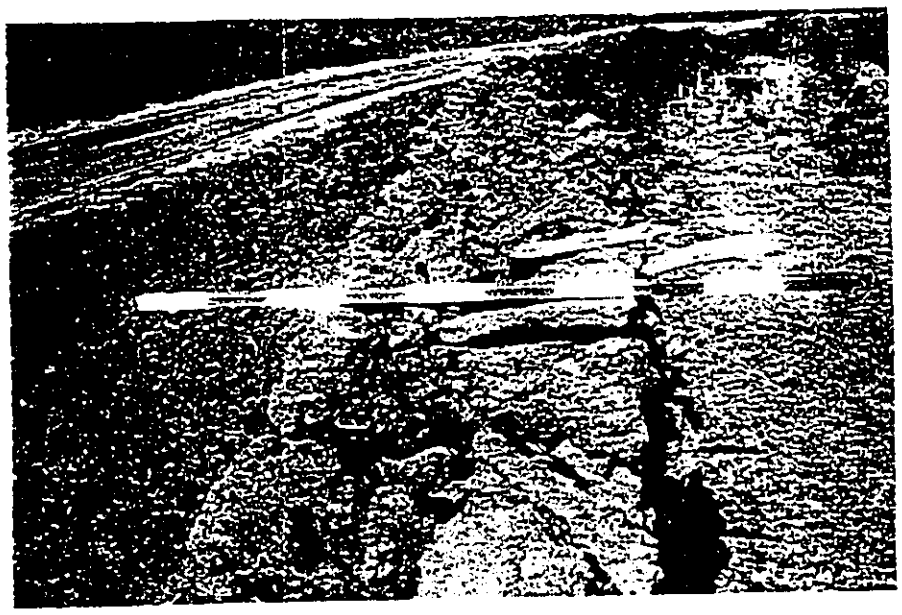
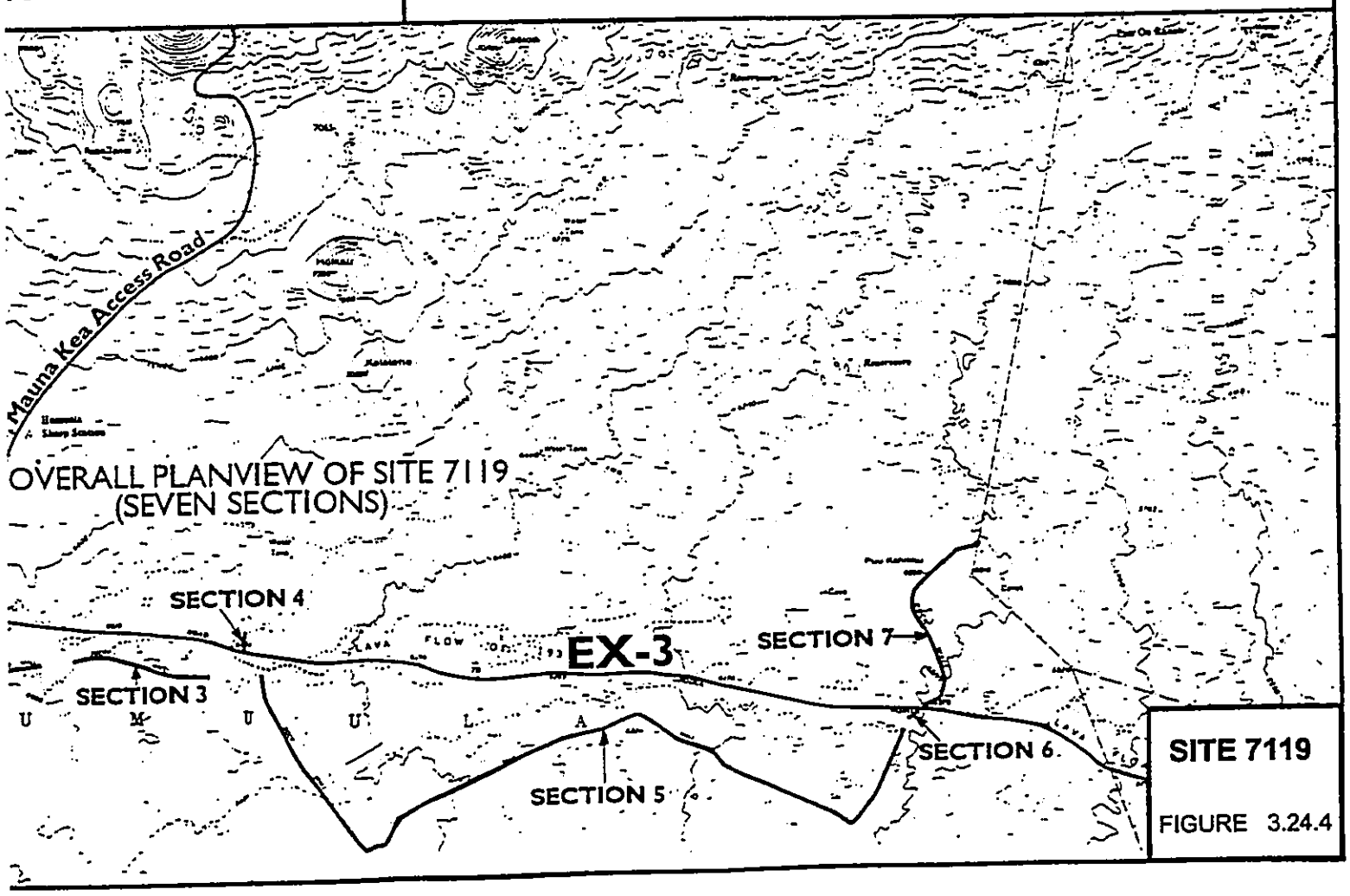


Typical Wall Construction

Typical Wall Cross-Section



'ross-Section



Typical Wall Construction