perched groundwater may exist at higher elevations on Hualalai. The specific configuration of groundwater resources in the project area is unknown. The development of off-site water sources to support the proposed project is discussed in Chapter 4, Section 4.8.

3.3.1.2 Surface Water and Drainage

There are no perennial streams, existing drainage facilities, or defined natural drainage ways on the project property or the reservoir site. The high permeability of the existing soils is evident by the absence of any natural storm water channels or gullies in the project area. No floodways ~~or flood zones~~ have been identified in the project area. The project site is located in Flood Zone X according to the Flood Insurance Rate Map (FIRM). The National Flood Insurance Program does not have any regulations for developments within Zone X. In general, because of the high permeability of the soil types on the project lands, drainage of surface waters is relatively rapid.

3.3.2 Potential Impacts and Mitigation Measures

Potential Short-Term Impacts:

On-site precipitation currently percolates to the underlying groundwater. This would continue to be the case during and after site development. The NPDES permit requirements, including the BMP plan, will require contractors to manage materials to prevent the discharge of pollutants into the ground. It is recommended that during and after development, landscape management practices be applied in public and private areas to minimize the use of fertilizers and pesticides that could potentially enter the groundwater. The developer and its contractor will be required to conform to NPDES permit requirements during construction. The use of BMPs, such as storm drainage filtration devices, are recommended to prevent pollutants from entering the groundwater. It is anticipated that short-term impacts upon the local groundwater quality would not be significant.

There are no surface water bodies on or near the project site. The developer will be required to comply with NPDES permit requirements, including the BMP plan and Chapter 10 – Erosion and Sedimentation Control - of the County Code during construction to prevent the discharge of sediment from the site. As areas of the site are developed, drainage systems would collect runoff

that would discharge to the subsurface. The project would be designed to comply with the County's Storm Drainage Standard, such that runoff volumes and rates would not increase as a result of site development. The project would have no significant short-term effects on surface waters because there would be no increase of runoff from the site.

Potential Long-Term Impacts:

It is recommended that the developer implement measures to reduce the amount of pollutants from entering the groundwater by including BMPs such as storm drain filtration devices, ground stabilization with landscape and hardscape, educational warning signs on the drainage systems with wording such as "DUMP NO WASTES. GOES TO GROUNDWATER AND OCEAN. HELP PROTECT HAWAI'I'S ENVIRONMENT," and coordinating environmental educational programs for the project area residents with the DOH Clean Water Branch.

Rainfall runoff from the developed site would collect in the drainage systems and percolate into the ground in the on-site seepage areas, seepage wells, and dry wells. Runoff volumes and rates would not increase as a result of site development in compliance with the County's Storm Drainage Standard, and the project would have no significant long-term effects on surface waters.

The Impacts of the Alternatives on Groundwater ~~and~~, Hydrology, Surface Water and Drainage

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			No impacts to groundwater, surface water and drainage are anticipated under the No Action Alternative.
2. Alternative A		✓		The project would be required to comply with the NPDES permit requirements, County Erosion and Sedimentation Control and County Storm Drainage Standards. Storm drain filtration devices and other measures are recommended to reduce potential impacts to groundwater. Runoff volumes and rates would not increase.
3. Alternative B		✓		The project would be required to comply with the NPDES permit requirements, County Erosion and Sedimentation Control and County Storm Drainage Standards. Storm drain filtration devices and other measures are recommended to reduce potential

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
				impacts to groundwater. Runoff volumes and rates would not increase.
4. Alternative C		✓		The project would be required to comply with the NPDES permit requirements, County Erosion and Sedimentation Control and County Storm Drainage Standards. Storm drain filtration devices and other measures are recommended to reduce potential impacts to groundwater. Runoff volumes and rates would not increase.

3.4 SOILS AND AGRICULTURE POTENTIAL

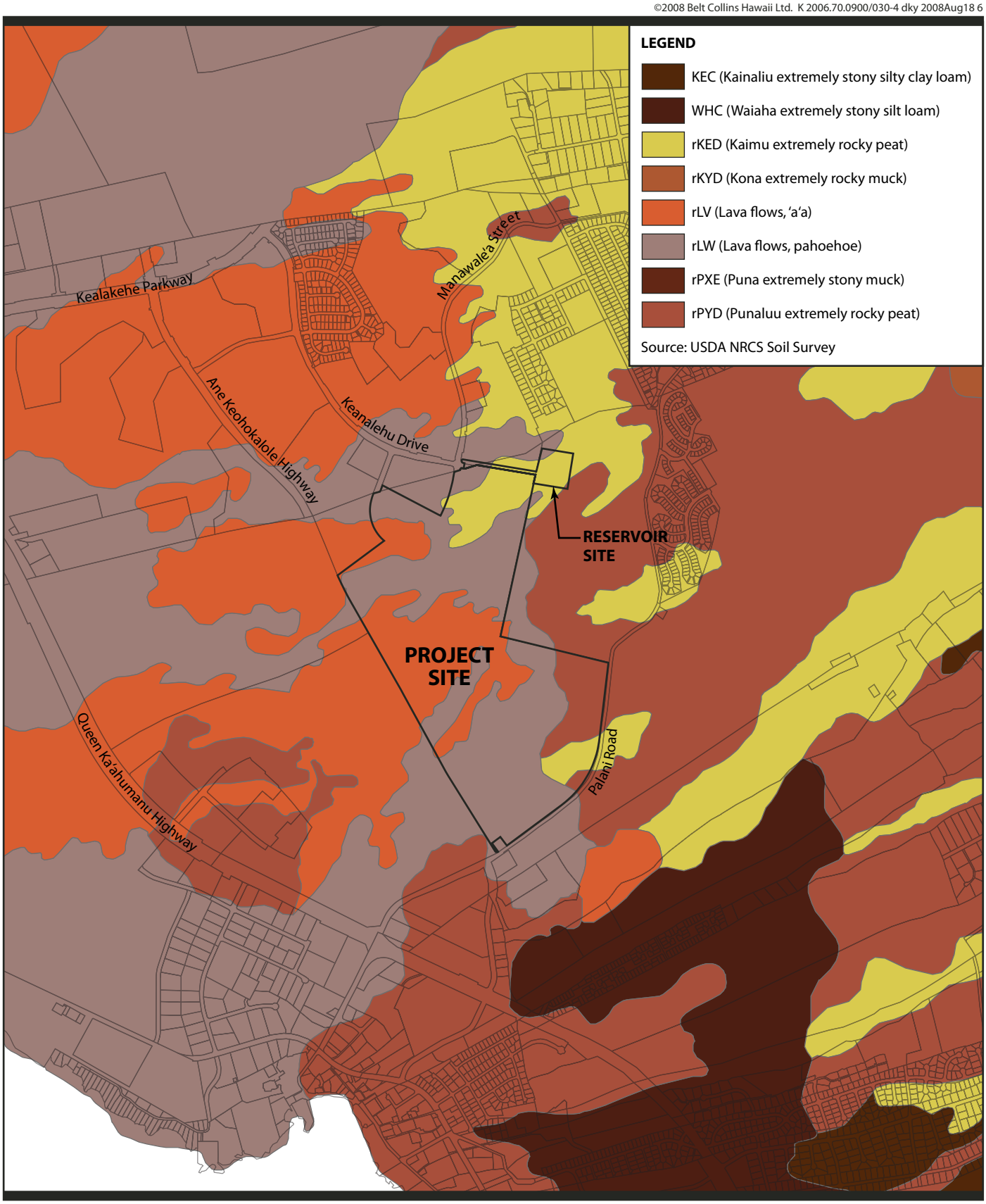
Three soil suitability studies have been prepared for lands in Hawai‘i: (1) the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey, (2) the State Department of Agriculture’s (DOA) Agricultural Lands of Importance to the State of Hawai‘i (ALISH), and (3) the University of Hawai‘i (UH) Land Study Bureau (LSB) Overall Productivity Rating. These reports describe the soils’ physical attributes and evaluate the relative productivity of different soil types for agricultural production purposes.

3.4.1 Existing Conditions

The project site and the reservoir site have poor agronomic conditions. Generally, the terrain is primarily characterized by bare ‘a‘a L~~l~~ava F~~f~~lows and bare P~~p~~ahoehoe L~~l~~ava F~~f~~lows ranging in age from 3,000 to 5,000 years old. Soils are extremely rocky, rainfall is low, and water is not available for crop farming. There are no existing irrigation improvements. No agricultural activities are taking place on the project site.

3.4.1.1 Housing Project Site

USDA NRCS Soil Survey: The USDA NRCS classifies the soils on the subject property as ‘a‘a Lava Flows (rLV), Pahoehoe Lava Flows (rLW), Kaimu extremely ~~rocky~~ stony peat (rKED), and Punaluu extremely rocky peat (rPYD), representing the Punaluu series of well-drained, thin organic soils that have developed over pahoehoe lava bedrock; they are found on uplands and are rapidly permeable, with slow run-off, and a slight erosion hazard. The bare ‘a‘a L~~l~~ava F~~f~~lows and bare P~~p~~ahoehoe L~~l~~ava F~~f~~lows predominate (Figure 3-1).



BeltCollins

NORTH

0 1000 2000

SCALE IN FEET

Figure 3-1
SOIL TYPES

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‘A‘a Lava Flows (rLV). ‘A‘a lava has practically no soil cover and is generally bare of vegetation except for mosses, lichens, ferns, and a few ‘ohi‘a trees. The surfaces of ‘a‘a flows are masses of clinkery, hard, sharp pieces piled in tumbled heaps that are difficult to traverse on foot. It has been demonstrated that the clinkery ‘a‘a surface can be easily moved and crushed by bulldozers into relatively smooth surface cobbles 1 to 4 inches in size. In areas of higher rainfall, the ‘a‘a surface contributes substantially to the underground water supply and is used for watershed.

Pahoehoe Lava Flows (rLW). Pahoehoe Llava Fflows, similar to the ‘a‘a flows, are also a miscellaneous soil type. This lava has a billowy, glassy surface that is relatively smooth. In some areas, the surface is rough and broken with hummocks and pressure domes. Pahoehoe lava generally has no soil cover and is typically bare of vegetation except for mosses and lichens. Soil is, however, found in cracks and depressions that have been transported there by wind and storm runoff. In areas of higher rainfall, this lava contributes to the groundwater supply through percolation.

Punaluu extremely rocky peat (rPYD). This soil type is found on the lower leeward side of Mauna Loa. Rock outcrops occupy 40 to 50 percent of the structure. In a representative profile the surface layer is black peat about 4 inches thick and underlain by pahoehoe lava bedrock. This soil type is medium acid. The peat is rapidly permeable while the pahoehoe lava is very slowly permeable, although water moves rapidly through the cracks. Runoff is slow and the erosion hazard is slight. This soil is used for pasture land.

Kaimu extremely stony peat (rKED). This soil type is generally found on the lower slopes of Mauna Loa. In a representative profile, the surface layer is very dark brown, extremely stony peat about 3 inches thick. It is underlain by fragmental ‘a‘a lava and the soil is neutral in reactions. Permeability is rapid, runoff is slow, and the erosion hazard is slight. This soil is not suitable for cultivation.

Agricultural Lands of Importance to the State of Hawai‘i: The ALISH ratings were developed in 1977 by the NRCS, the UH College of Tropical Agriculture and Human Resources, and the State DOA. Land is classified into four broad categories (1) Prime agricultural land,

which is land best suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (2) Unique agricultural land, which is non-Prime agricultural land used for the production of specific high-value crops (e.g., coffee and taro); (3) Other agricultural land, which is non-Prime and non-Unique agricultural and that is important to the production of crops; and (4) Unclassified which are lands that are not rated.

The vast majority of the subject property is "Unclassified." A portion of the subject property is rated as "Other" (Figure 3-2).

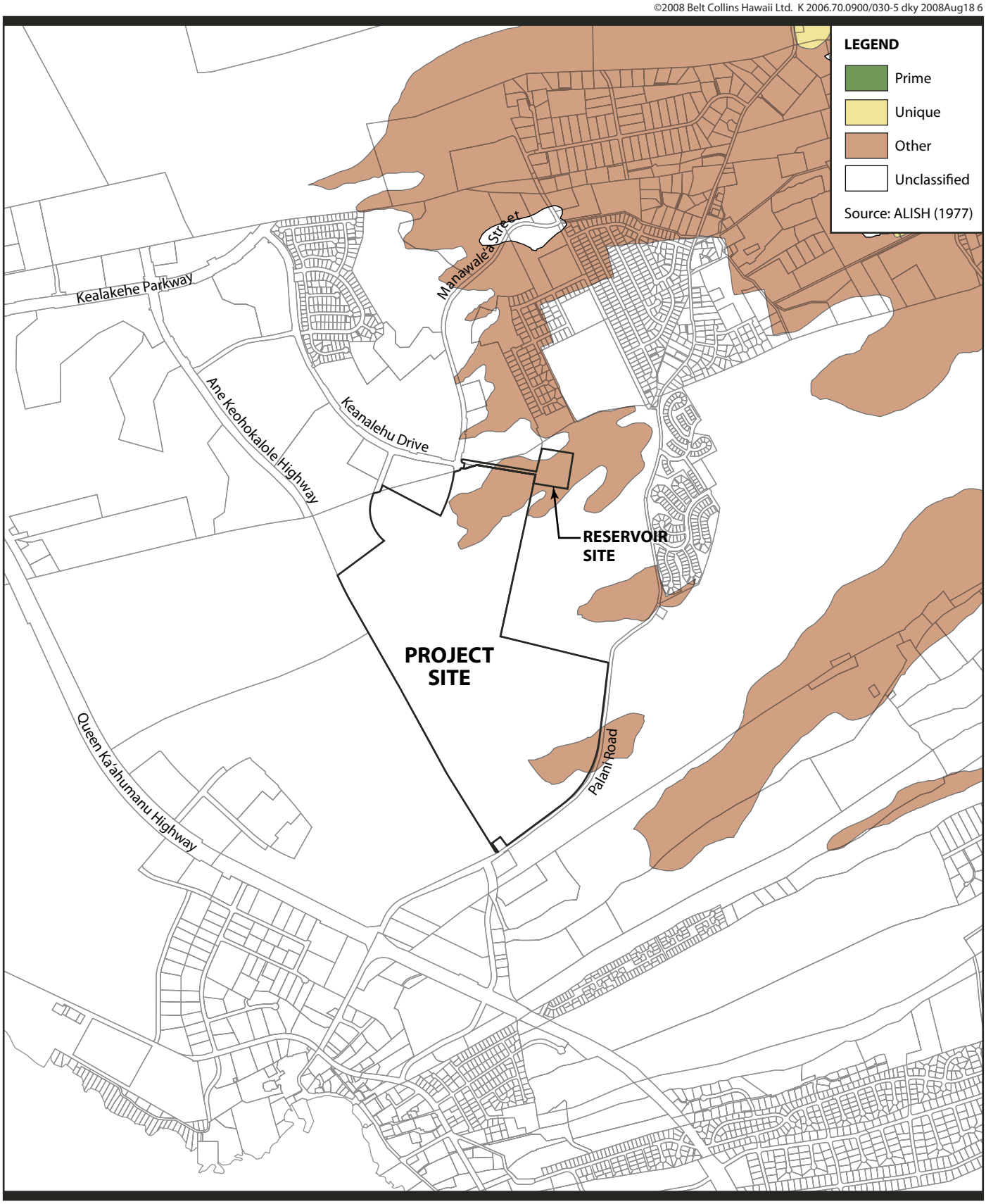
Land Study Bureau Detailed Land Classification: In 1972, the UH LSB developed the Overall Productivity Rating, which classifies soils according to five levels of productivity using the letters A, B, C, D, and E. The letter A represents the highest class of productivity and E the lowest class of agricultural productivity.

The entire subject property is classified as level "E" soils, which is the lowest agricultural productivity rating (Figure 3-3).

3.4.1.2 Reservoir Site

USDA NRCS Soil Survey: The USDA NRCS classifies the soils on the reservoir property as primarily Kk~~k~~aimu extremely ~~rocky~~ stony peat (rKED). A very small portion is Pp~~p~~ahoehoe Ll~~l~~ava Ff~~f~~lows (rLW) (Figure 3-1).

Kaimu extremely stony peat (rKED). This soil type is generally found on the lower slopes of Mauna Loa. In a representative profile, the surface layer is very dark brown, extremely stony peat about 3 inches thick. It is underlain by fragmental ‘a‘a lava and the soil is neutral in reactions. Permeability is rapid, runoff is slow and the erosion hazard is slight. This soil is not suitable for cultivation.



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SCALE IN FEET

Figure 3-2
AGRICULTURAL LANDS OF IMPORTANCE

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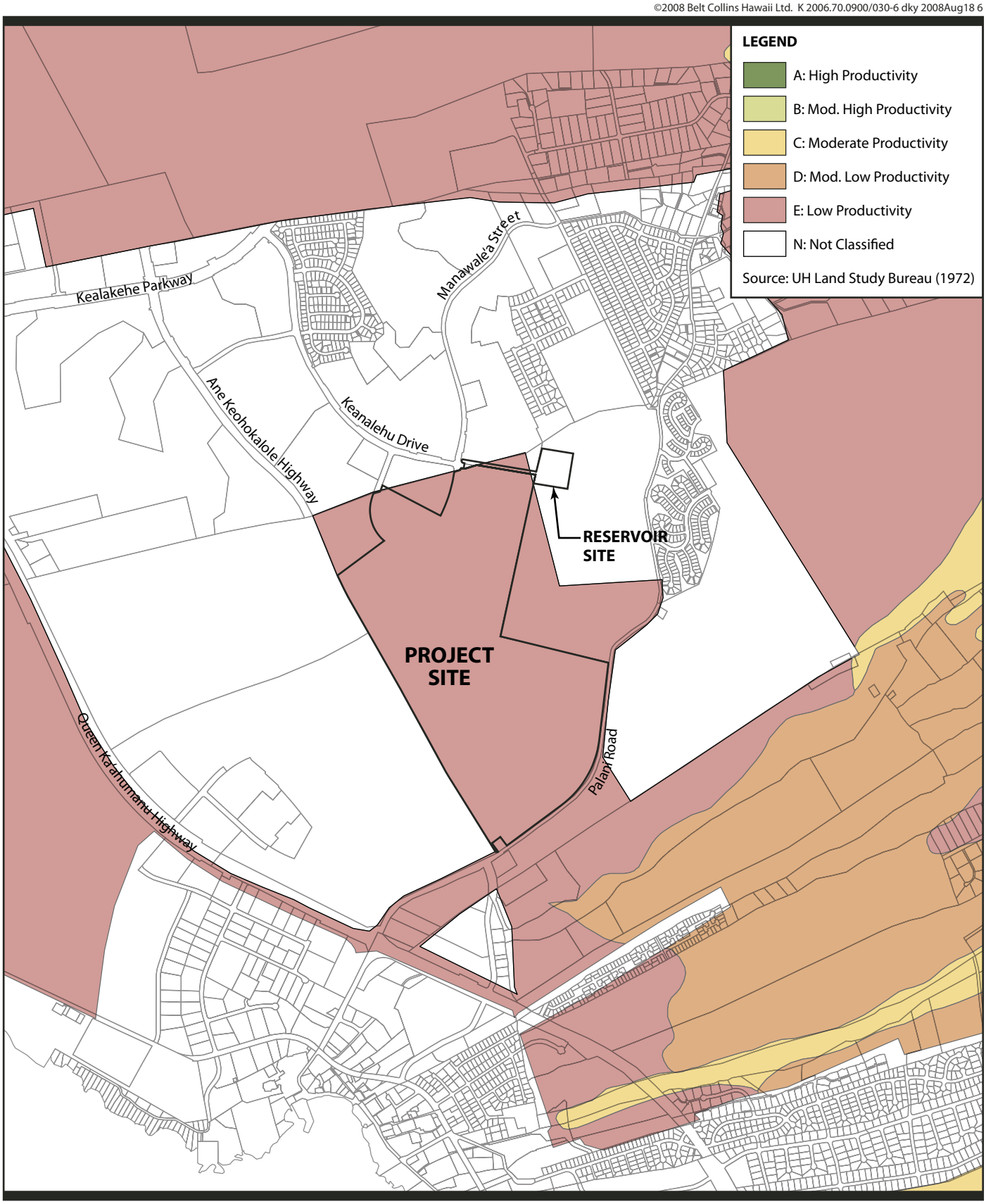

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SCALE IN FEET

Figure 3-3
SOIL PRODUCTIVITY

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Pahoehoe Lava Flows (rLW). Pahoehoe ~~lava~~ Lava F~~f~~lows, similar to the ‘a‘a flows, are also a miscellaneous soil type. This lava has a billowy, glassy surface that is relatively smooth. In some areas, the surface is rough and broken with hummocks and pressure domes. Pahoehoe lava generally has no soil cover and is typically bare of vegetation except for mosses and lichens. Soil is, however, found in cracks and depressions that have been transported there by wind and storm runoff. In areas of higher rainfall, this lava contributes to the groundwater supply through percolation.

Agricultural Lands of Importance to the State of Hawai‘i: Under ALISH, most of the reservoir site is classified as “Other” agricultural land, which is non-Prime and non-Unique agricultural land that is important to the production of crops (Figure 3-2).

Land Study Bureau Detailed Land Classification: The reservoir site is designated as “Not Classified” (Figure 3-3).

3.4.2 Potential Impacts and Mitigation Measures

The project site and reservoir sites are comprised of poor, low-quality, and extremely rocky soils. The soils are predominately bare ‘a‘a L~~l~~ava F~~f~~lows and bare P~~p~~ahoehoe L~~l~~ava F~~f~~lows. The land is unfavorable for commercial crop production. Because the subject properties are not currently used for agricultural activities, the proposed project would not have any impact on existing agricultural activities. The commitment of the Keahuolu project land to housing and other related development would not adversely affect agricultural activities.

The Impacts of the Alternatives on Soil and Potential for Agriculture

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			There are no existing agricultural operations on the subject property. No impacts to soils or the potential for agricultural activity are expected under the No Action Alternative.
2. Alternative A	✓			The subject properties have poor soils and lack irrigation water. The land is unsuitable for commercial crop production. No adverse impacts to soils or the potential for agricultural activity are anticipated under Alternative A. No mitigation measures are warranted.

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
3. Alternative B	✓			The subject properties have poor soils and lack irrigation water. The land is unsuitable for commercial crop production. No adverse impacts to soils or the potential for agricultural activity are anticipated under Alternative B. No mitigation measures are warranted.
4. Alternative C	✓			The subject properties have poor soils and lack irrigation water. The land is unsuitable for commercial crop production. No adverse impacts to soils or the potential for agricultural activity are anticipated under Alternative C. No mitigation measures are warranted.

3.5 NATURAL HAZARDS

The potential natural hazards to which the project area could be subjected include earthquakes, volcanic eruptions, and tsunamis. Because of the nature of the land and soil types, floods due to rainwater surface runoff are unlikely to occur.

3.5.1 Earthquakes

3.5.1.1 Existing Conditions

The County of Hawai‘i is one of the most seismically active areas on Earth with more destructive earthquakes than in any other comparably sized area in the United States. The Kona area is subject to earthquakes with intensities up to VIII on the Modified Mercalli Scale.[1]

The most recent damaging earthquakes to impact Hawai‘i occurred on October 15, 2006. According to the Hawaiian Volcano Observatory:

> “…two damaging earthquakes struck the northwest side of Hawai‘i Island early on Sunday morning, October 15, 2006. The first was a magnitude-6.7 that occurred at 7:07 AM HST and was located 20 km northeast of the Kona airport at a depth of 38 km. Seven minutes later, a second earthquake, assigned a magnitude-6.0, struck 44 km north of the Kona airport at a depth of 20 km. While the two were events

[1] According to the Federal Emergency Management Agency, during an earthquake with an intensity of VIII on the Modified Mercalli Scale, drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Tree branches break. Hillsides might crack if the ground is wet. Water levels in wells might change.

only 7 minutes apart, the difference in depths means that the M6.0 may not be an aftershock of the M6.7 and that they are independent quakes.

Over 80 aftershocks with magnitudes greater than 1.7 were recorded in the first 24 hours after the quake. The largest was a magnitude 4.2 that occurred at 10:35 AM HST on October 15. Like the second earthquake, preliminary locations for most of the aftershocks placed them at depths less than 20 km.

These earthquakes were felt statewide but most strongly in the North Kona and Kohala areas. The shaking was strong enough to cause power generators to trip offline in Hawai'i, Maui, and O'ahu counties. Damage was reported mostly on the west side of Hawai'i island but also on Maui and O'ahu. There were no reported fatalities." (http://hvo.wr.usgs.gov)

3.5.1.2 Potential Impacts and Mitigation Measures

The Uniform Building Code (UBC), prepared by the International Conference of Building Officials (ICBO), recommends that the entire island of Hawai'i meet the UBC standards for Seismic Zone 4 (the highest on the code's range from 0 to 4). All structures will be constructed in compliance with the UBC standards for Zone 4.

The Impacts of Earthquakes on the Alternative

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action		✓		Regardless of whether the property remains undeveloped or developed, it is subject to the impacts of earthquakes. No mitigation measures are warranted.
2. Alternative A		✓		Construction of the improvements will be required to comply with the UBC's standards for Zone 4.
3. Alternative B		✓		Construction of the improvements will be required to comply with the UBC's standards for Zone 4.
4. Alternative C		✓		Construction of the improvements will be required to comply with the UBC's standards for Zone 4.

3.5.2 Volcanic Hazards

3.5.2.1 Existing Conditions

The project site is situated on the ~~west~~ west-facing flank of the Hualalai volcano. Of the three active volcanoes on the island of Hawai'i, Hualalai is considered to be the least active. Its last

eruption in 1801 produced lava flows that inundated the Ka‘upulehu and Keahole areas of North Kona. Hualalai is considered by geologists to be representative of a post-shield stage of Hawaiian volcanism, which is characterized by a marked decrease in the eruption rate as the volcano drifts off the Hawaiian hotspot. The estimated lava production rate for Hualalai over the past 3,000 years is about 2 percent of the current rate of Kilauea volcano.

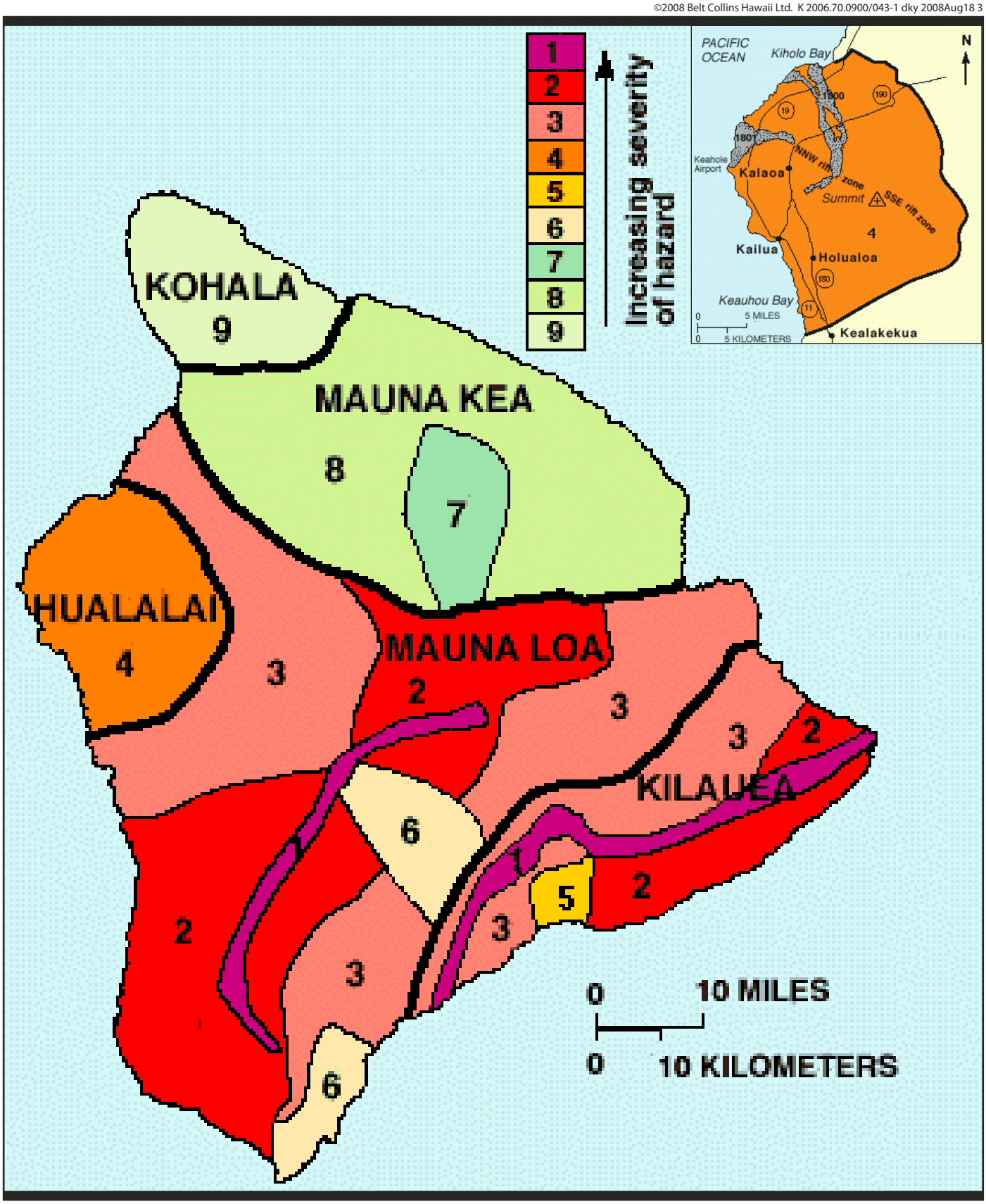
The last volcanic eruption of Hualalai in the area of the project lands occurred in 1800-1801. Lavas emerged from the northwest volcanic rift zone at about the 1,600-foot elevation (in the vicinity of the Puhi-a-Pele Cinder Cone, just makai of Mamalahoa Highway), creating a flow that entered the ocean north of Keahole Point. Although lava flows on Hualalai have typically covered large areas, the rift zones of the volcano do not seem to have a distinctly higher degree of hazard than do its flanks. As such, lava flow hazards for the project site are relatively low.

Lava Flows

Hualalai volcano is identified as being fully contained in Llava Hhazard Zzone 4. Maps showing volcanic hazard zones on the island of Hawai‘i were first prepared in 1974 by Donald Mullineaux and Donald Peterson of the U.S. Geological Survey and were revised in 1987. The current map (Figure 3-4) divides the island into zones that are ranked from 1 through 9 based on the probability of coverage by lava flows, with 9 being the lowest. The subject properties are located in Hhazard Zzone 4. Other direct hazards from eruptions, such as tephra fallout and ground cracking and settling, are not specifically considered on the hazard map; however, these hazards also tend to be greatest in the areas of highest hazard from lava flows.

Tephra

In addition to lava-flow hazard zones, hazard zones for tephra falls (ashfall) have also been defined for Hawai‘i (Mullineaux, et al., 1987). The hazard from tephra fall for all of Hualalai Volcano is ashfall-Hhazard Zone 2, which indicates that tephra falls from lava fountains could be frequent but thin. Tephra is a general term for fragments of volcanic rock and lava that are blown into the air by explosive volcanic eruptions, hot gases in eruptive columns, or by lava



Source: http://pubs.usgs.gov/gip/hazards/maps.html

Figure 3-4
BIG ISLAND LAVA ZONES

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fountains. Large-sized tephra typically falls back to the ground close to the erupting vent, forming a cinder cone, while smaller-sized tephra can be carried on the wind as volcanic ash. The largest volcanic eruptions that have occurred on Earth, such as Krakatoa in Indonesia in the early 1800s, and Mount Saint Helens in Washington State in the 1980s, ejected volcanic ash into the upper atmosphere that was then carried around the planet by winds and remained suspended there for years.

3.5.2.2 Potential Impacts and Mitigation Measures

Lava Flows

According to Drs. John P. Lockwood and Michael O. Garcia in their recent report on geological conditions at the Hawaii Electric Light Company's (HELCo) Keahole Generating Plant (about a mile northwest of the Keahuolu project), Hualalai is a geologically active volcano with clusters of eruptions occurring about every 500 years. Thus, the probability is relatively high that Hualalai could erupt somewhere within the next few centuries. However, the odds are low that such an eruption would threaten the subject property (Keahole Generating Station, Final EIS, January 2005).

The Impacts of Lava Flows on the Alternatives

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			Based on the statistical probability of risk, the likelihood of volcanic hazards adversely affecting the subject property is minimal. No mitigation measures are warranted.
2. Alternative A	✓			Based on the statistical probability of risk, the likelihood of volcanic hazards adversely affecting the subject property is minimal. No mitigation measures are warranted.
3. Alternative B	✓			Based on the statistical probability of risk, the likelihood of volcanic hazards adversely affecting the subject property is minimal. No mitigation measures are warranted.
4. Alternative C	✓			Based on the statistical probability of risk, the likelihood of volcanic hazards adversely affecting the subject property is minimal. No mitigation measures are warranted.

Tephra

According to the geological study conducted in 2005 for the Keahole Generating Station, there is no evidence that tephra has fallen in low-lying areas away from Hualalai's summit and rift zone. As the project is over nine miles downslope from Hualalai's summit, it is outside of the volcano's high summit area. While it is possible that a high fountaining episode during some future eruption of Hualalai could produce ash fall, based on the eruptive character of Hualalai, this hazard is expected to be slight in relation to the subject property.

The Impacts of Tephra on the Alternatives

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			Due to the project's location, the risk of tephra fall on the subject property is anticipated to be slight.
2. Alternative A	✓			Due to the project's location, the risk of tephra fall on the subject property is anticipated to be slight. No mitigation measures are warranted.
3. Alternative B	✓			Due to the project's location, the risk of tephra fall on the subject property is anticipated to be slight. No mitigation measures are warranted.
4. Alternative C	✓			Due to the project's location, the risk of tephra fall on the subject property is anticipated to be slight. No mitigation measures are warranted.

3.5.3 Tsunami Inundation

3.5.3.1 Existing Conditions

The most severe tsunami to impact the Hawaiian Islands in historic times struck on April 1, 1946. Maximum runups were reported to be 55 feet at Pololu Valley in Kohala. Waves surged inland more than a mile and a half in some areas.

The lowest portion of the Keahuolu project area is about one mile inland from the shoreline and is situated on the west facing slope of Hualalai, with the housing site at elevations ranging from 300 to ~~500~~ 580 feet above sea level, and the reservoir site at elevations ranging from 580 to 640 feet above sea level.

3.5.3.2 Potential Impacts and Mitigation Measures

Due to the project's location, probable impacts from tsunami are highly unlikely. No mitigation measures are warranted.

The Impacts of Tsunami Inundation on the Alternatives

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			The subject property is located outside the coastal tsunami evacuation area.
2. Alternative A	✓			The subject property is located outside the coastal tsunami evacuation area. No mitigation measures are warranted.
3. Alternative B	✓			The subject property is located outside the coastal tsunami evacuation area. No mitigation measures are warranted.
4. Alternative C	✓			The subject property is located outside the coastal tsunami evacuation area. No mitigation measures are warranted.

3.6 TERRESTRIAL FLORA

3.6.1 Existing Conditions

3.6.1.1 Keahuolu Project Site - TMK (3) 7-4-21: 20

Botanical field surveys were conducted on the project site in 1989 and 2007. No threatened or endangered species were found in the 1989 or the 2007 botanical field survey. No sensitive types of vegetation such as wetlands or dryland forest were found within the 272-acre project site. The area is comprised of lava flows of various ages which are covered mostly by an alien-dominated scrub vegetation that has been highly disturbed in the past.

The 1989 botanical survey was conducted by Char and Associates for the QLT "Keahulou Lands of Kailua-Kona, Hawaii" 1990 EIS. The 1989 Char survey covered an area of 1,100 acres. The current 272-acre project site was within the much larger area surveyed by Char, which extended west of the current project site and makai of the Queen Ka'ahumanu Highway.

Art Whistler, Ph.D. conducted the 2007 botanical field survey from April 4 - 7, 2007. All plant species encountered during the survey were recorded. Particular care was taken in areas of ʻa'a lava since this is where most of the native species and all of the endangered species have been reported elsewhere in the region. A copy of the 2007 botanical report is included in Appendix B. The following is a summary of the report.

Based upon Whistler's 2007 survey of the project site, there are four main kinds of vegetation at the site: (1) Managed Land Vegetation along Palani Road, dominated by alien species; (2) *Prosopis* Woodland dominated by kiawe (*Prosopis pallida*) and koa haole (*Leucaena leucocephala*) along the southern boundary of the property; (3) *Leucaena* Scrub dominated by koa haole (*Leucaena leucocephala*) in combination with alahe'e (*Psydrax odoratum*) and fountain grass (*Pennisetum setaceum*) in the lower part of the property and on soil on the upper part; and (4) *Schinus*/*Psydrax* scrub dominated by Christmas berry (*Schinus terebinthifolius*) and alahe'e (*Psydrax odoratum*) on or near lava flows.

Managed Land Vegetation. This comprises areas of the parcel that are under periodic or frequent management, such as the edges of roads. This is a relatively minor component of the overall vegetation on the project site because only the roadsides of Palani Road are currently being managed.

***Prosopis* Woodland.** This type of vegetation, which is dominated by the tall alien tree species kiawe (*Prosopis pallida*), is found only in an indistinct zone north of and paralleling Palani Road. There is an open woodland with few other tree species besides the koa haole (*Lucaena leucocephala*). Two other trees that are more common outside of this zone are occasional here, Christmas berry (*Schinus terebinthifolius*) and the native alahe'e (*Psydrax odoratum*). The ground cover is sometimes dense, dominated mostly by Guinea grass (*Panicum maximum*) and Philippine violet (*Barleria cristata*), two species otherwise uncommon at the study site. Talinum (*Talinum triangulare*), a succulent weed, is also often common in places. Other than the alahe'e, few native species are found here, mostly because of the dominance of the kiawe. This type of vegetation was called "Kiawe woodland" by Char and Associates (1989).

***Leucaena* Scrub.** *Leucaena* scrub is classified as disturbed, since fires periodically sweep through the area and goats are known to be present. These two factors account for the dominance of alien species, which are better adapted to these disruptive conditions than are the native species. According to some sources, fountain grass is rapidly expanding its range in the Kona district of Hawai‘i.

The *Leucaena* scrub vegetation is found on areas of older lava flows dominated by the alien scrubby tree koa haole (*Leucaena leucocephala*). It is not a homogeneous type of vegetation since with increasing elevation going eastward up the slope its density and the species associated with it change. On the lower portions of the study site, koa haole is mostly one to three meters in height, scattered in an open-to-dense matrix of *Pennisetum setaceum* (fountain grass). Also significant here is the native shrub or small tree alahe‘e (*Psydrax odoratum*), which in some places is almost a co-dominant.

Several other trees and shrubs are found here, but in low numbers. This includes the alien tree Christmas berry (*Schinus terebinthifolius*) and the alien shrub klu (*Acacia farnesiana*). Fountain grass dominates most of the open areas having some soil, but a number of other herbaceous species are found in the shade of koa haole or on pahoehoe rocks free of fountain grass, particularly talinum (*Talinum triangulare*), air plant (*Kalanchoë pinnata*), lantana (*Lantana camara*), and carrion flower (*Stapelia gigantea*).

Two indigenous vines are found in the area, huehue (*Cocculus trilobus*), which is common, and kowali-‘awa (*Ipomoea indica*), which is uncommon. The native herb ‘ala‘ala-wai-nui (*Peperomia leptostachya*) is occasional on rocks. At higher elevations, koa haole is generally less dominant and is gradually replaced with Christmas berry (*Schinus terebinthifolius*). On deeper soils, however, it extends up to higher elevations. This vegetation was called “Scrub” by Char and Associates (1989).

***Schinus/Psydrax* Scrub.** This is the type of vegetation on more recent lava flows, ones that are decidedly composed of ‘a‘a lava. It is the same vegetation described by Char in 1989 as “*Canthium*/Christmas Berry Shrubland” (*Canthium* is the old name for *Psydrax*). It is found in a patchy distribution within the site in areas comprised of lava flows of various ages and stages of

development into soil. This vegetation gradually increases in frequency with increasing elevation, particularly above the 400-foot elevation because this vegetation is dominated by species that do better in the somewhat wetter conditions found upslope.

The main species dominating this community is the alien tree Christmas berry (*Schinus terebinthifolius*) along with the indigenous tree alahe‘e (*Psydrax odoratum*). These two species are also found at lower elevations mostly on or near ‘a‘a lava flows. At higher elevations on the project site these species are ~~dominate~~ dominant rather than being of secondary importance to koa haole (*Leucaena leucocephala*). The third most prevalent tree in this community is the koa haole, which, as noted above, sometimes forms nearly pure strands on some soil types. The fourth most prevalent tree is the introduced shrub or small tree klu (*Acacia farnesiana*). Other tree species found include the uncommon endemic ‘ohe (*Reynoldsia sandwicensis*), the uncommon indigenous shrub pua pilo (*Capparis sandwichiana),* the somewhat more common endemic shrub or tree mamane (*Sophora chrysophylla*), the occasional indigenous shrub ‘a‘ali‘i (*Dodonaea viscosa*), and the introduced (by Polynesians) noni (*Morinda citrifolia*).

The ground cover is also sparse in this type of vegetation, with scattered clumps of fountain grass (*Pennisetum setaceum*) found mostly in pockets of soil or pahoehoe, and perhaps being the most common species found here. The ground cover is particularly sparse under the dense canopy of the Christmas berry trees. Second in prevalence is probably the air plant (*Kalanchoë pinnata*), which forms a dense undergrowth in some places but is entirely lacking in others. There are many patches of huehue (*Cocculus trilobus*) and a few patches of kowali-‘awa (*Ipomoea indica*) and the native fern kupukupu (*Nephrolepis exaltata*), as well as the thorny alien shrub lantana (*Lantana camara*). In a few places at the highest elevations, the endemic subshrub *Bidens micrantha* ssp. *ctenophylla* occurs. This species was a candidate for federal listing as endangered or threatened but was never classified as such, and hence has no protected status. It is occasional in other areas of similar vegetation at about the same elevation in the area (Whistler 2006).

Like *Leucaena* Scrub, the *Schinus/Psydrax* Scrub vegetation is classified as disturbed, since fires periodically sweep through the area, and goats are known to be in the area. It somewhat matches the description of the “Lowland Dry Shrublands,” which is described as occurring in leeward

situations on most of the main islands at 330- to 2,000-foot elevation and as being open and not exceeding 10 feet in height.

A comprehensive list of the 83 plant species recorded within the 272-acre project site is in Table 3-1. Of the 83 plant species, 17 are native and of those native species, 6 are endemic and 11 indigenous. Endemic plants are species restricted to a single region or area; in the case of Hawai‘i, they are found only in Hawai‘i. Indigenous plants are species that are native to a region or place, but are also found elsewhere other than Hawai‘i. No species federally listed as threatened or endangered were found during either the 1989 or 2007 botanical field surveys.

One endemic shrub found within the project site, ko’oko’olau (*Bidens micrantha* ssp. *ctenophylla*), was at one time considered a candidate species for federal listing as endangered or threatened, but it was never classified as such and hence has no protected status. It occurs in other places north of Kona, where it is sometimes even found in disturbed places such as quarries.

Table 3-1: Plant Species Found on the Keahuolu Project Site TMK 7-4-21:20

Species	Common Name	Status
FERNS AND FERN ALLIES		
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis exaltata (L.) Schott	kupukupu	I
POLYPODIACEAE (Common Fern Family)		
Phymatosorus grossus	laua‘e	X
(Langsd. & Fisch.) Brownlie PSILOTACEAE (Psilotum Family)		
Psilotum nudum L.	moa	I
MONOCOTS		
COMMELINACEAE (Spiderwort Family)		
Rhoeo spathacea (Sw.) Stearn	oyster plant	X
POACEAE (Grass Family)		
Chloris barbata (L.) Sw.	swollen fingergrass	X
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili grass	I?
Panicum maximum Jacq.	Guinea grass	X
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X

Species	Common Name	Status
DICOTS		
ACANTHACEAE (Acanthus Family)		
Barleria cristata L.	Philippine violet	X
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas betty	X
APOCYNACEAE (Periwinkle Family)		
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X
ARISTOLOCHIACEAE (Dutchman's Pipe Family)		
Aristolochia littoralis Parodi	pelican flower	X
ARALIACEAE		
Reynoldsia sandwicensis A. Gray	ʻohe	E
Schefflera actionphylla (Endl.) Harms	octopus tree	X
ASCLEPIADACEAE (Milkweed Family)		
Stapelia gigantea N.E. Brown	carrion flower	X
ASTERACEAE (Sunflower Family)		
Bidens cynapiifolia Kunth	West Indian beggar's-tick	X
Bidens micrantha Gaud. ssp. *ctenophylla* (Sherff) Nagatga & Ganders	---	E
Bidens pilosa L.	beggar's-tick	X
Emilia sonchifolia (L.) DC.	pualele, emilia	X
Pluchea carolinensis (Jacq.) G. Don	pluchea	X
Tridax procumbens L.	coat buttons	X
BIGNONIACEAE (Bignonia Family)		
Jacaranda mimosifolia D. Don	jacaranda	X
Spathodea campanulata P. Beauv.	African tulip tree	X
BUDDLEIACEAE (Butterfly-bush Family)		
Buddleia asiatica Lour.	dogtail, heuloʻilio	X
CACTACEAE (Cactus Family)		
Opuntia ficus-indica (L.) Mill.	prickly pear, panini	X
CANNABACEAE (Marijuana Family)		
Cannabis sativa L.	pakalolo, marijuana	X
CAPPARACEAE (Caper Family)		
Capparis sandwichiana DC	pua pilo	E
Cleome gynandra L.	African spider flower	X
CARICACEAE (Papaya Family)		
Carica papaya L.	papaya	X
CLUSIACEAE (Mangosteen Family)		
Clusia rosea Jacq.	autograph tree	X

Species	Common Name	Status
CONVOLVULACEAE (Morning-Glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali-'awa	I
Ipomoea obscura (L.) Ker-Gawl.	bindweed	X
CRASSULACEAE (Stonecrop Family)		
Kalanchoë pinnata (Lam.) Pers.	air plant	X
Kalanchoë tubiflora (Haw.) Raym.-Hamet	chandelier plant	X
CUCURBITACEAE (Gourd Family)		
Coccinea grandis (L.) Voigt	ivy gourd	X
Momordica charantia L.	wild bittermelon	X
CUSCUTACEAE (Dodder Family)		
Cuscuta sandwichiana (Cuscutaceae)	kauna 'oe	E
EUPHORBIACEAE (Spurge Family)		
Aleurites moluccana (L.) Willd.	candlenut, kukui	P
Chamaesyce hirta (L.) Millsp.	garden spurge	X
Euphorbia heterophylla L.	kaliko	X
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X
Ricinus communis L.	castor bean	X
FABACEAE (Pea Family)		
Abrus precatoris L.	rosary pea	X
Acacia farnesiana (L.) Willd.	klu	X
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X
Erythrina sandwicensis	wiliwili	E
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Macroptilium lathyroides (L.) Urb.	cow pea	X
Pithecellobium dulce (Roxb.) Benth.	'opiuma, Manila tamarind	X
Prosopis pallida (Humb. & Bonpl.ex Willd.) Kunth	kiawe, mesquite	X
Samanea saman (Jacq.) Merr.	monkeypod	X
Senna occidentalis (L.) Link	coffee senna	X
Sophora chrysophylla (Salisb.) Seem.	mamane	E
LAMIACEAE (Mint Family)		
Hyptis pectinata (L.) Poir.	comb hyptis	X
MALVACEAE (Mallow Family)		
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida fallax Walp.	'ilima	I
Sida spinosa L.	prickly sida	X

Species	Common Name	Status
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
Ficus ribiginosa Desf.	Port Jackson fig	X
Morus alba L.	mulberry	X
MYRTACEAE (Myrtle Family)		
Psidium guajava L.	guava	X
NYCTAGINACEAE (Four-o'-Clock Family)		
Boerhavia coccinea Mill.	---	X
Bougainvillea glabra Choisy	bougainvillea	X
PASSIFLORACEAE (Passionflower Family)		
Passiflora foetida L.	love-in-a-mist	X
PHYTOLACCACEAE (Polkweed Family)		
Rivina humilis L.	rouge plant	X
PIPERACAEAE (Pepper Family)		
Peperomia leptostachya Hooker & Arnott	ʻalaʻala-wai-nui	I
PLUMBAGINACEAE (Leadwort Family)		
Plumbago zeylanica L.	ʻilieʻe	I
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	common purslane	X
Portulaca pilosa L.	ʻihi	X
Talinum triangulare (Jacq.) Willd.	talinum	X
PROTACEAE (Protea Family)		
Macadamia ternifolia F. Muell.	macadamia	X
RUBIACEAE (Coffee Family)		
Morinda citrifolia L.	Indian mulberry, noni	P
Psydrax odoratum (Forst. f.) A.C. Sm. & S. Darwin	alaheʻe	I
SAPINDACEAE (Soapberry Family)		
Dodonaea viscose Jacq.	ʻaʻaliʻi	I
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	ʻuhaloa	I
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta cayennensis (Rich.) Vahl	blue rat's-tail	X

E = endemic (found only in Hawai'i). **I** = indigenous (native to Hawai'i as well as other geographic areas). **P** = Polynesian introduction (introduced to Hawai'i by Polynesians before the advent of the Europeans). **X** = Introduced or alien (not native; introduced to Hawai'i, either accidentally or intentionally, after the advent of the Europeans).

3.6.1.2 Keahuolu Reservoir Site - TMK (3) 7-4-21: por. 14 and por. 21

The approximately seven-acre reservoir site, located along the northeast corner of the project site, ranges in elevation from approximately 580 to 640 feet above msl. The botanical field survey of the reservoir site was conducted by Art Whistler, Ph.D. on December 5th and 15th, 2007. No threatened or endangered species were found and no sensitive types of vegetation such as wetlands or dryland forest were found within the reservoir site. The site is currently covered with scrubby vegetation dominated by native and alien shrub and tree species on lava flows of various ages.

A total of 40 plant species was recorded on the reservoir site. Of these, 10 native species were found – 2 endemic and 8 indigenous species. However, the majority of the species encountered during the survey are naturalized "alien" plants that were accidentally or intentionally introduced to Hawai'i, but which have now become established in the islands and can spread on their own.

Only two types of vegetation are found on the reservoir site: (1) Managed Land Vegetation, and (2) *Schinus/Psydrax* Scrub.

Managed Land Vegetation. This comprises land that is under periodic or frequent management, such as dirt roads or recently bulldozed tracks. It is a relatively minor component of the overall vegetation on the reservoir property. There is a recently bulldozed track dominated mostly by weeds, particularly the alien subshrub coffee senna (*Senna occidentalis*), fountain grass (*Pennisetum setaceum*), koa haole (*Leucaena leucocephala*), and talinum (*Talinum triangulare*).

***Schinus/Psydrax* Scrub.** This type of vegetation covers the whole reservoir site and along the proposed temporary access road. This vegetation type is characteristic of more recent lava flows, particularly ones that are decidedly composed of ʻaʻa lava. The amount of the alien koa haole (*Leucaena leucocephala*) present is nearly equal to that of the other two main species—the alien Christmas berry (*Schinus terebinthifolius*) and the indigenous alaheʻe (*Psydrax odoratum*).

Other less common native tree and shrub species found here include mamane (*Sophora chrysophylla*), ʻaʻaliʻi (*Dodonaea viscosa*), ʻilima (*Sida fallax*), and the endemic subshrub *Bidens micrantha* ssp. *ctenophylla.* Several other alien tree and shrub species are also occasional to uncommon here, including silk oak (*Grevillea robusta*), jacaranda (*Jacaranda mimosifolia*), autograph tree (*Clusia rosea*), Chinese banyan (*Ficus microcarpa*), monkey pod (*Samanea saman*), guava (*Psidium guajava*), klu (*Acacia farnesiana*), and the Polynesian-introduced noni (*Morinda citrifolia*).

The ground cover is sparse in this type of vegetation, with scattered clumps of fountain grass (*Pennisetum setaceum*) found mostly in pockets of soil or pahoehoe. The ground cover is particularly sparse under the dense canopy of the Christmas berry trees. Second in prevalence in the ground cover is Natal redtop (*Rhynchelytrum repens*), which occurs mostly in patches. The indigenous herbaceous vine huehue (*Cocculus trilobus*) is common climbing over the low trees, and the indigenous vine kowali-ʻawa (*Ipomoea indica*) occurs in a few patches. Scattered pockets or individuals of the thorny alien shrub lantana (*Lantana camara*) are also present. Other native species present include the herbs ʻalaʻala-wai-nui (*Peperomia leptostachya*) and spurflower (*Plectranthus parviflorus*), and the subshrub ʻuhaloa (*Waltheria indica*). Other alien ground cover species include the succulent air plant (*Kalanchoë pinnatum*), partridge pea (*Chamaecrista nictitans*), and Madagascar periwinkle (*Catharanthus roseus*).

This vegetation is classified as disturbed because of the high number of alien species present. The main disturbance is caused by fires that periodically sweep through the area, and goats are probably in the area. A list of the native plant species recorded within the reservoir site are in Table 3-2. A complete list of all plant species found on the reservoir site is in Appendix B.

Table 3-2: Native Plant Species ~~F~~found on the Proposed Reservoir Site TMK 7-4-21: por. 014 and por. 21

Species	Common Name	Status
Endemic Species		
Bidens micrantha ssp. *ctenophylla*	----------	E
Sophora chrysophylla	mamane	E
Indigenous Species		
Cocculus trilobus	huehue	I
Dodonaea viscosa	ʻaʻaliʻi	I
Ipomoea indica	koali-ʻawa	I
Peperomia leptostachya	ʻalaʻala-wai-nui	I
Plectranthus parviflorus	spurflower	I
Psydrax odoratum	alaheʻe	I
Sida fallax	ʻilima	I
Waltheria indica	ʻuhaloa	I

E = endemic (found only in Hawaiʻi).
I= indigenous (native to Hawaiʻi as well as other geographic areas).

3.6.2 Potential Impacts and Mitigation Measures

There are no botanical impediments to the proposed project. Because no species are federally listed as threatened or endangered, no mitigation is needed.

3.6.2.1 The Housing Project Site

No federally listed threatened or endangered species were found on the project site. A total of 83 plant species were recorded on the 272-acre Keahuolu project site (Table 3-1). Of these, 17 are native species - 6 endemic species and 11 indigenous species. The majority of the 83 species encountered during the survey are naturalized "alien" plants that were accidentally or intentionally introduced to Hawaiʻi, but ~~which~~ that have now become established in the island and can spread on their own. In a few places at the highest elevations, the endemic subshrub *Bidens micrantha* ssp. *ctenophylla* occurs. This species was a candidate for federal listing as endangered or threatened, but was never classified as such, and hence has no protected status.

3.6.2.2 The Reservoir Site

No federally listed threatened or endangered species were found on the reservoir site. A total of 40 plant species were recorded on the reservoir site. Of these, 10 are native species - 2 endemic species and 8 indigenous species (Table 3-2). The majority of the 40 species encountered during the survey are naturalized "alien" plants that were accidentally or intentionally introduced to Hawai'i, but ~~which~~ that have now become established in the island and can spread on their own. One endemic subshrub was present, *Bidens micrantha* ssp. *ctenophylla*. This species was a candidate for federal listing as endangered or threatened, but was never classified as such, and hence has no protected status.

The Impacts of the Alternatives on Terrestrial Flora

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			If the subject property is undeveloped, its vegetation will remain undisturbed.
2. Alternative A		✓		No threatened or endangered species were found. The majority of the species found are naturalized alien plants. Potential impacts are not anticipated to be significant adverse impacts because no endangered species are present. No mitigation measures are warranted.
3. Alternative B		✓		No threatened or endangered species were found. The majority of the species found are naturalized alien plants. Potential impacts are not anticipated to be significant adverse impacts because no endangered species are present. No mitigation measures are warranted.
4. Alternative C		✓		No threatened or endangered species were found. The majority of the species found are naturalized alien plants. Potential impacts are not anticipated to be significant adverse impacts because no endangered species are present. No mitigation measures are warranted.

3.7 TERRESTRIAL FAUNA

3.7.1 Existing Conditions

Phillip Bruner conducted a field survey in May 2008 of the proposed Keahuolu Affordable Housing Project and Reservoir site [TMK (3) 7-4-021: 020 and TMK (3) 7-4-021: Por. 021]. The goals of this field survey were:

1. Documentation of the species of birds and mammals currently on the property.

2. Examination of the site for the purpose of identifying the natural resources available to wildlife in this region.

3. Devoting special attention to documenting the presence and possible use of this property by native and migratory species particularly those that are listed as threatened or endangered.

The property examined is presently covered in dense, second growth forest composed of primarily alien species of trees, brush, and grass. The surrounding land contains residential, commercial, schools, and other similar undeveloped property.

The field survey was conducted over two consecutive days (May 27-28, 2008). The observations were made in the early morning and late in the day when the birds are most active. The property was covered on foot and all birds seen or heard were documented.

Native Land Birds:

No native land birds were observed during this field survey. The only species that might be seen, on occasion, in this area is the endangered Hawaiian Hawk (*Buteo solitarius*) and the Hawaiian Short-eared Owl (*Asio flammeus sanwichensis*). The Hawaiian Short-eared Owl is not listed as endangered or threatened on the island of Hawai‘i. Aside from the Hawaiian Hawk, no other native land birds would be expected to occur on this property.

Native Waterbirds:

No native waterbirds were recorded and would not be expected on this site. No wetland habitat was found on this survey.

Seabirds:

No nesting seabirds were seen during the field survey and would not be expected to nest in this area due to the human disturbance and predators.

Migratory Birds:

No migratory shorebirds were observed. No habitat suitable for shorebirds currently occurs on this site.

Alien (Introduced) Birds:

Nineteen alien species were observed during the course of this survey. None of the birds are listed as threatened or endangered.

Mammals:

The skeletal remains of a feral pig (*Sus scrofa*) and two live adult pigs were observed on May 27, 2008. No rats (*Rattus spp.*), mice (*Mus musculus*), or cats (*Felis catus*) were seen but likely occur on and around the property. No endangered Hawaiian Hoary Bats (*Lasiurus cinereus semotus*) were detected by the ultrasound device during a night search on the property on May 27, 2008.

3.7.2 Potential Impacts and Mitigation Measures

Potential impacts to the various species were evaluated. All habitats on the property were thoroughly surveyed. The birds and mammals found were those to be expected in this region. The endangered Hawaiian Hawk and the non-endangered Hawaiian Short-eared Owl occur in man-altered as well as native habitats throughout the island of Hawai‘i. A change in the land use at this site will produce small, local increases and decreases in the populations of alien birds.

Ultimately, there are no avifaunal or feral mammal impediments to carrying out the proposed project.

~~3.7TERRESTRIAL FAUNA~~

~~3.7.1Existing Conditions~~

~~Phillip Bruner conducted a survey in 1989 of avifauna and feral mammals for the QLT's "Keahulou Lands of Kailua-Kona, Hawaii" 1990 EIS. The 1989 Bruner survey covered an area of 1,100 acres. The current 272-acre project site was within the much larger area surveyed by Bruner, which extended west of the current project site and makai of the Queen Ka'ahumanu Highway.~~

~~No threatened, endangered, or native species of birds or mammals were observed on the 1,100 acres during faunal field surveys conducted in 1989. No native species of land or water/sea birds were recorded during the site survey. Although the short-eared owl or pueo (*Asiofammeus sandwichensis*) was not recorded during the survey, it has been found in similar habitat elsewhere on the west side of the island of Hawai'i. Of all of the shorebird species that winter in Hawai'i, the Pacific Golden Plover (*Pluvialis fulva*) is the most abundant. No plover were recorded during the faunal survey, likely due to the time of year and the lack of suitable habitat. Some exotic (introduced) species of birds were recorded within the project area during the 1989 survey, with the most abundant being the Japanese white-eye (*Zosterops japonica*), nutmeg mannikin (*Lonchura punctulata*), and zebra dove (*Geopelia striata*).~~

~~The terrestrial fauna of the 1,100-acre area was surveyed in late June to early July 1989. The complete results of that survey are included in Appendix C. The following summarizes the information contained in the report.~~

~~Resident Endemic (Native) Land and Water Birds - No endemic species were recorded during the site survey. The short-eared owl or pueo might be expected to occasionally occur within the project boundaries. The species is relatively common on the island of Hawai'i, particularly at higher elevations. This species is listed by the State DLNR, but not the U.S. Fish and Wildlife~~

Service, as endangered on O'ahu but not on other Hawaiian islands. Although not recorded during the survey, pueo have been found in similar habitat elsewhere in West Hawai'i. No other endemic birds would be expected in the project area given the location and nature of the habitats available.

Migratory Indigenous (Native) Birds – Migratory shorebirds winter in Hawai'i between the months of August through May. Of all the shorebird species that winter in Hawai'i, the Pacific Golden Plover is the most abundant. This species prefers open areas such as mud flats, lawns, pastures, plowed fields, and roadsides. The birds are site-faithful and many establish foraging territories that are defended vigorously. The populations tend to remain fairly stable over many years. No plover were recorded during the survey, probably due to the time of the year and the lack of suitable habitat within the 1,100-acre area.

Resident Indigenous (Native) Birds and Seabirds – No indigenous species were recorded nor would any be expected at the project site given the nature of the habitat available. No seabirds were seen within the 1,100-acre study area. Some native seabirds nest and roost in barren lava flows in Hawai'i, but at a much higher elevation than the area surveyed.

Exotic (Introduced) Birds – A total of 17 species of exotic (introduced) species were recorded during the survey. A listing of the species, their relative abundance, and general habitat preferences is included in Table 1 of Appendix C.

In summary, the most abundant species were the Japanese White-eye (*Zosterops japonica*), Nutmeg Mannikin (*Lonchura punctulata*), and Zebra Dove (*Geopelia striata*). Black and Gray Francolin (*Francolinus francolinus* and *F. pondicerianus* respectively) were also common within the 1,100-acre study area. The following exotic bird species may also occur on or near the project area: Erckel's Francolin (*Francolinus erckelii*), California Quail (*Callipepla californica*), Japanese Quail (*Coturnix japonica*), and Northern Mockingbird (*Mimus polyglottos*). Unexpected species sightings included the Lavender Waxbill (*Estrilda caerulescens*) and a parrot that was too far away to positively identify.

Feral Mammals - A total of 18 Small Indian Mongoose (*Herpestes auropunctatus*) were seen during the survey. Two cats were also recorded along with the skeletal remains of pigs and cows. Evidence of rats and mice were also found. No individuals of the endemic and endangered Hawaiian Hoary Bat (*Lasiurus cinerus semotus*) were observed during the survey, despite attempts to sight the species. This species roosts solitarily in trees and has been sighted in West Hawai'i.

The reservoir site was not within the 1989 study area. However, the approximately seven-acre reservoir site is adjacent to the 1,100-acre area originally surveyed. It is assumed here for assessment purposes that the avifaunal and feral mammal species expected to be observed on the reservoir site would be similar to those actually surveyed on the 1,100 acre original study area.

3.7.2Potential Impacts and Mitigation Measures

The Keahuolu habitat provides a limited range of living spaces that are utilized by the typical array of exotic species of birds expected to occur at the project site and reservoir site. Potential impacts to the bird and mammal species that occur or might occur on both sites have been evaluated in terms of increasing or decreasing population levels, loss of available habitat, and potential impacts to endangered or threatened species.

The proposed development would create a more urban environment that might increase the abundance of some species such as the Common Myna (*Acridotheres tristis*) and House Sparrow (*Passer domesticus*). The significance of these potential bird population increases is somewhat subjective, depending on the reviewer's like or dislike of these particular species. The population levels of these species are not particularly threatened. However, any increase in population levels is not expected to positively or adversely affect either the population levels of other species or the nature of the proposed project. Other species populations, such as Japanese White-eye, Warbling Silverbill (*Lonchura malabarica*), and some game birds like Black Francolin, may decline as a result of the project. This could be seen by some as an adverse impact. However, other habitat opportunities are available on the island and in the West Hawai'i area. As such, in this instance, the impact is viewed as insignificant. As noted above, no

endangered or threatened species of birds or mammals were observed within the area surveyed. No impacts to these species would occur as a result of the project.

Given the lack of adverse impacts, mitigation measures to minimize potential adverse impacts do not appear warranted. Project landscaping will replace some of the natural habitat to be lost (creating lawns favored by Pacific Golden Plover), while increased human activities will reduce some species populations. The majority of the bird and mammal life to be impacted is exotic species, for which other habitat opportunities in West Hawai'i exist.

The Impacts of the Alternatives on Terrestrial Fauna

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			There would be no adverse impacts to faunal resources under the No Action Alternative. The project site does not contain any threatened or endangered fauna species. The property does not contain any unusual or unique habitat important to fauna.
2. Alternative A	✓			The proposed uses should pose no threat to the relative abundance of birds and mammals in this region of the island of Hawai'i. These properties are not known to contain any threatened or endangered fauna species, nor contain any unusual or unique habitat important to fauna. No mitigation measures are warranted.
3. Alternative B	✓			The proposed uses should pose no threat to the relative abundance of birds and mammals in this region of the island of Hawai'i. These properties are not known to contain any threatened or endangered fauna species, nor contain any unusual or unique habitat important to fauna. No mitigation measures are warranted.
4. Alternative C	✓			The proposed uses should pose no threat to the relative abundance of birds and mammals in this region of the island of Hawai'i. These properties are not known to contain any threatened or endangered fauna species, nor contain any unusual or unique habitat important to fauna. No mitigation measures are warranted.

3.8 INVERTEBRATE SURVEY

SWCA Environmental Consultants conducted a biological survey of lava tube caves on the project site. The survey report is included in Appendix H. The study's objectives included: (1) conducting a biological survey of caves within the project area; (2) specifically identifying biologically significant caves; (3) compiling a list of faunal species found in the caves,

particularly invertebrates; and (4) providing management recommendations for the more biologically significant caves.

3.8.1 Existing Conditions

SWCA entered onto the project site and conducted a series of cave surveys from June 18-20, 2008. Surface reconnaissance surveys were first conducted to locate and document known cave entrances and any previously unidentified features on the site. Once reconnaissance surveys were completed, a list of cave sites proposed for more detailed inventory survey was developed. The focus of these inventory surveys was to develop a general understanding of the troglobitic[2] cave fauna within the Keahuolu project site.

The SWCA study team found eight cave openings at Keahuolu, of which three caves appeared to have a suitable habitat for troglobitic arthropods. SWCA found a total of 14 distinct species of arthropods within four caves. Of these 14 species, SWCA collected and examined 13 species. Current State and Federal regulations provide no special (or specific) protection for any of these species.

Only two possible native cave species are represented in SWCA's findings: the Rhagidiid mite, which belongs to a group with two known blind cave species and an eyed species known from fumaroles near Kilauea, and the cave moth (*Schrankia* species). The remaining eleven species are classified as alien invaders. The full list of species is located in Table 2 of Appendix H and summarized below.

Acari (Mites): Only one species of mite was identified. The Rhagidiidae is described as a pale predatory mite with conspicuous eyespots.

Araneae (Spiders): Six species of spiders were identified by SWCA during the survey.

Collembola (Springtails): One species of Springtails was discovered (Entomobryidae: Genus species [unidentified]).

[2] Troglobitic animals live entirely in the dark parts of caves and are adapted for life in total darkness.

Insecta (Insects): Five species of insects were identified.

3.8.2 Potential Impacts and Mitigation Measures

The lava tubes and caves in the Keahuolu project site contain a variety of invertebrates. SWCA concluded that these biological resources do not present a regulatory obstacle to development. None of the identified species is listed as threatened or endangered.

Potential impacts to these species were evaluated. Ultimately, the disposition of the surveyed caves will depend upon whether they contain significant archaeological or cultural material. Mitigation measures are recommended for those caves and/or lava tubes identified for preservation by the SHPD. A determination as to the preservation of caves and/or lava tubes containing no archaeological or cultural resources will be made by the developer pursuant to the final development plan. In all likelihood, caves and/or lava tubes containing no significant archaeological or cultural resources will be destroyed during site grading and preparation, as the invertebrates inventoried in them do not warrant preservation. Furthermore, the caves pose a liability to the landowner if someone should enter one and become injured. In some instances, a cave or lava tube containing no archaeological or cultural resources may be preserved by the developer because the area surrounding it may not require mass grading. In those cases, the entrance will likely be blocked or hidden to prevent intentional or unintentional trespassing.

SWCA made the following recommendations to minimize impacts on caves, particularly those known to contain cultural resources:

- Minimize adding topsoil or impermeable material to the surface directly above known caves and preserves.
- Control invasive plant species within the preserves. For landscaping, utilize native plants and avoid aggressive, fire-prone, non-native grasses.
- Exercise care to minimize surface disturbance during construction within the general vicinity of known caves.

- Prevent wildfires and develop a rapid response plan to fires within the proposed project area.
- If unsurveyed caves are encountered during construction and the caves are accessible, allow a biological survey if appropriate.

4CHAPTER FOUR: DESCRIPTION OF THE EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

4.1 ARCHAEOLOGICAL AND HISTORIC RESOURCES – HOUSING PROJECT SITE

Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological survey and prepared a preliminary ~~cultural impact assessment (~~CIA~~)~~ for the proposed Keahuolu Affordable Housing Pproject site, comprised of approximately 272 acres. The CIA study is discussed in Section 4.3. The overall objective of the archaeological survey and the CIA is to comply with the current historic preservation requirements of the Hawai'i ~~State Historic Preservation Division (~~SHPD~~)~~.

The specific objectives of the survey were fourfold: (a) ~~to identify all potentially significant~~ to re-identify and re-locate specific archaeological remains present within the study area; (b) to collect information sufficient to evaluate and document the potential significance of all identified remains; (c) to evaluate the potential impacts of any proposed development upon any identified significant remains; and (d) to recommend appropriate measures that would mitigate any adverse impacts upon identified significant remains. The PHRI archaeological survey report is ~~summarized~~ excerpted below. Appendix D contains the complete report.

4.1.1 Historical Background

4.1.1.1 Early Land Uses

The area of North Kona between Kailua Bay and Keauhou Bay to the south is generally recognized as containing the population core and the most fertile agricultural area of North Kona (Kirch 1985:166; Kelly 1983). To the north of Kailua Bay, beginning at Honokohau, is the relatively dry Kekaha district of North Kona, with its barren lava inlands and coastal fishponds (Springer 1986:121). Keahuolu is situated in the transition zone between these two contrasting

environmental districts, and is immediately north of Kailua Bay, a center of both political and economic activities since before Western contact.

The southern boundary of Keahuolu, at the shoreline, is located at Mahaihale. Between Kukailimoku Point and the Keahuolu boundary is a narrow strip of coastal land that is within Lanihau ahupua'a (where much of the old Kona Airport is located). Consequently, the shoreline of Keahuolu is considerably narrower than expected, given the width of the ahupua'a less than a half-mile inland of the coast. About 1.2 miles of Keahuolu lands (north-south) are fronted by Lanihau along the shoreline.

Kukailimoku Point and the coastal sand dunes to the north and south were apparently repeatedly used during the prehistoric and early historic periods as burial grounds. Jackson's 1883 survey map locates graves at Kukailiomoku and a relatively large burial ground at Kaliliki Point to the south. Jackson referred to one massive masonry tomb as Kamehameha's Tomb (Neller 1980:5). Reinecke located additional graves in Lanihau and Keahuolu in 1930, and more recently Neller reported on exposed human remains at nine different locations along the coast~~,~~ : five in Lanihau and four at the Lanihau/Keahuolu boundary (Neller 1980:11-13). Historic period burials were also recently identified at Pawai Bay by Neighbor Island Consultants (1973).

According to Ellis:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potatoe (sic), the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots (Ellis 1963:31).

The ahupua'a of Keahuolu was awarded to Ane Keohokalole during the Mahele of 1848. According to testimony documented during the Mahele, two walled houselots in Keahuolu had been held by Keohokalole's ancestors "from very ancient times" (Foreign Testimony 3:573). At least one of these lots was located along the shoreline. Keohokalole sold portions of her 15,000-20,000-acre grant to the government and other parties, with the balance being transferred to her heir, Lili'uokalani.

There is little historic information concerning traditional Hawaiian land use for the inland portion of the project area in Keahuolu, and no kuleana grants were awarded there. Nineteenth century descriptions of inland Keahuolu by government surveyors reflect the same general environmental conditions present in the barren lava lands of Kekaha to the north. Emerson surveyed the area in the 1880s, and his map (Reg. Map 1280) denotes "rough pahoehoe, little vegetation" in the Keahuolu ahupua'a. David Kalakaua (1869) described the lower inland portions of Keahuolu as being suitable for livestock grazing, an assessment found in numerous nineteenth century descriptions of North Kona ~~kula~~ Kula lands.

No historic references specifically describing traditional agricultural activities in inland Keahuolu have been located~~;~~, but~~,~~ it is apparent from the archaeological record observed at Keahuolu, Kealakehe, and Honokohau 2nd~~,~~ that agricultural activities (apparently prehistoric) were relatively intense in the area designated historically as grazing land.

Comparisons by Kelly (1983) between the kuleana lands claimed and lands actually awarded in North Kona indicate to her that dryland agriculture was being conducted historically until the time of the Mahele, when vast expanses of Kula lands were granted to Konohiki, who utilized it as livestock grazing land (Kelly 1983:67). Kelly found that garden land claims located in the Kula zone were generally not awarded to the claimants.

The forested upland area of Keahuolu was historically the primary agricultural zone and the location of kuleana grants. In a letter dated July 8, 1869, from David K. Kalakaua to his sister, Lili'uokalani, a detailed description of Keahuolu is provided. Kalakaua writes:

> This land is situated in the District of North Kona, bounded by the ahupua'a of Lanihau (in Kailua) belonging to Prince Lunalilo on the Ka'u side, and on the Kohala side, by Kealakehe, a government land and Honokohaniki belonging to Ke'elikolani. Keahuolu runs clear up to the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and 'ohi'a abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas etc. Breadfruit trees grow wild as well as the Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat, &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more.

During Emerson's 1880 Government Survey of North Kona, he identified the makai (seaward) edge of a forest zone, which he described as "lava covered with scattering forest and dense masses of ki root" (Kelly 1983:58). The land below this forest edge was described as "rocks covered with long grass" (Kelly 1983:58). According to Kelly's estimations, the forest edge occurred at an average elevation of 550 to 650 feet around Kailua and to the south (1983:58). However, it appears that the forest edge was somewhere between 750 and 800 foot elevation in Keahuolu (see reproduction of Emerson's map in Kelly 1983:59). This approximation places the nineteenth century forest edge very close to the eastern (mauka) boundary of the entire QLT project area. According to Emerson's documentation of nineteenth century vegetation, the project area would be within the Kula zone.

It was shortly after the systematic delineation of Kula lands as grazing land that the Kuakini Wall was constructed. This wall extends from Kahalu'u Bay to the southern portion of Keahuolu, at an average distance of about 1 mile from the coastline. At the northern end in Keahuolu, the wall is at an elevation of 220 feet; further to the south, its average elevation is 160 feet. The purpose of the wall, as proposed by Kelly (1983:75), was to keep the free-ranging livestock contained within the Kula zone, and out of the coastal settlements and gardens. Kuakini Wall does not cross Keahuolu, but extends about 600 feet north of Palani Road, at which point it turns west (or a later western extension was added) for a distance of approximately 1,200 feet. Why the wall ends where it does, rather than at an ahupua'a boundary, trail, or some type of land division feature, is unknown. There is a definite concentration of habitation and agricultural features at the end of the wall, to the south of the western extension.

Sometime during the late 1890s, a sisal mill was established in Keahuolu along the south side of the old Palani Road corridor. This mill location is shown on a 1924 U.S. Geological Survey (USGS) topographic map, at 428 feet above msl. Kelly reports that a 500-acre tract of land was cultivated in sisal, and was known as the McWayne sisal tract (Kelly 1983:89). Recent informant interviews conducted by Wong-Smith indicate that as much as 1,000 acres may have been in sisal cultivation in Keahuolu and Kealakehe. According to informant Mr. Minoru Inaba, the mill was surrounded by sisal fields and was in operation until 1924.

The location of the sisal tract is yet to be determined; if, however, it surrounded the mill, as indicated by Mr. Inaba, it would have been near the current project area. There are scattered clumps of sisal near the project area, and a very concentrated growth along a section of the old Palani Roadbed, at 600 feet above msl. In the area of the concentrated sisal are a series of walled enclosures and ramps that abut the old roadbed (State Inventory of Historic Places [SIHP] Site 13435). This site is apparently at too high an elevation to correlate with the mill; it may, however, be associated with the sisal transport operations.

In comparing Keahuolu land use with Kealakehe to the north, it appears that Keahuolu was exposed to far less livestock grazing than Kealakehe. Lands in Kealakehe between 200 and 600 feet above msl appear to have been used in this manner for about a century. The absence of ranching features and the relatively good preservation of most surface features in Keahuolu attest to a more limited use of the area for cattle.

4.1.1.2 Regional Settlement Pattern

Several general settlement pattern models have been generated by researchers such as Cordy (1981, 1995, 2000), Newman (1970a), Kelly (1983), and others. Though differing in detail, these models generally divide up the region into five basic environmental zones: the Shoreline, Kula, Kaluʻulu, ʻApaʻa, and ʻAmaʻu.

The Shoreline zone extends, typically, from the high-tide line inland approximately 200 meters. In Kailua this is the area from the shore to approximately Aliʻi Drive. In this zone, permanent settlement began in Kona c. A.D. 1000-1200 (Cordy 2000:248). Several large and densely populated royal centers were situated at several locations along the shoreline between Kailua and Honaunau (Cordy 1981;1995) such as Kailua, Holualoa, Kahaluʻu, and Kealakekua (Cordy 2000:248). These included dwellings for rulers, chiefs, and the supporting populace, places of refuge, and other structures. Within these residential areas, large and small heiau, sporting areas, and burial clusters are present. These may extend beyond the Sshoreline zone. Burials occur in caves, within finely built platforms, rock mounds, and houses in the shoreline, and are more often to be found in the near-shore Kula zone (Cordy 1995; Haun et al. 1998; Schilt 1984; Tainter 1973). Fishing and farming, of course, were the major exploitation avenues, with

clearings in the forest uplands and small garden plots in the Kula zone. Thus, trails existed to facilitate transportation between the shoreline and the upper regions.

The Kula zone consists primarily of dry and open land with few trees and considerable grass cover. Soil development in Central Kona is limited, however, with a fair amount of exposed lava bedrock. This land was planted primarily in scattered sweet potato patches. However, behind Kailua, breadfruit, taro, and forest banana were also grown in this zone (Cordy 2000:255), at least in the historic period. Use of this zone appears to have occurred as early as AD 1000s to 1300s. It is considered to extend to the 500 foot elevation mark, ~~although~~ but it may extend further, to approximately the 600-800 foot elevation, the 40-50 inch rainfall line (c.f. Cordy 1995:17). Archaeologically, this zone is characterized by stone planting/clearing mounds, terraces, small soil clearings, and planting pits. Some permanent habitations are found, but at a much lower density than at the shore. Permanent habitation may have first started in the 1400s to 1600s, at least in the adjacent ahupua‘a of Pua‘a (Cordy 2000:255).

The Kalu‘ulu zone is referred to as the breadfruit zone. Early explorers described this zone as breadfruit with sweet potatoes and wauke (paper mulberry) underneath (cf. Menzies 1920:75-76). It may have been perhaps one-half mile wide (Kelly 1983:62). Here walled fields occur at the 600-800 foot elevation, which may be start of ~~this~~ the breadfruit zone in this area.

The ‘Apa‘a zone is described as a dryland taro and sweet potato zone. In historic accounts it is described as an area divided by low stone and earth walls into cleared rectangular fields in which sweet potato and dryland taro were planted. On the edges of the walls, sugarcane and ti were planted (cf. Menzies 1920:75-76). Bananas and wauke were also present (cf. Ellis 1963:32). Newman estimated that this zone began at the 1,000 foot elevation and extended to the 2,500 foot elevation, although recent archaeological research has found formal walled fields beginning more commonly at the 600-800 foot elevation. In reality, it has been found that there is much variation within the Kona Field System (cf. Cordy 1995:10-13).

The ‘Ama‘u zone is the banana zone, which may extend from the 2,000 foot ~~elevation~~ to the 3,000 foot elevation, and is characterized by bananas and plantains being grown in cleared forest areas.

4.1.1.3 Chronology

This brief chronology uses terminology developed by Burtchard (1993) and Haun et al. (1998). The Kona Field System was not brought to Kona as a fully developed system. Rather, it grew out of, and integrated with, the evolving socio-political structure and increasing population in the island chain. The first inhabitants of the island of Hawai‘i probably arrived by at least AD 600, and focused habitation and subsistence activity on the windward side of the island (Burtchard 1993; Kirch 1985; Hommon 1976). To date, there is no archaeological evidence for occupation of the Kona region during this initial, or Colonization (AD 300 to 600) stage of island occupation.

There is also little indication that during the subsequent period, Early Expansion (AD 600 to 1100), much activity was taking place in Kona (Burtchard 1993). Through the first half of the Early Expansion Period, permanent habitation was still concentrated on the windward side. It is likely that windward residents traveled to the leeward Kona coast to fish and collect other resources (Cordy 1995). By the latter half of the Early Expansion Period, permanent habitation was beginning in Kona (Cordy 1981, 1995; Schilt 1984). Habitation was concentrated along the shoreline and lowland slopes, and informal fields were probably situated in the Kula and higher elevations, areas with higher rainfall.

Agricultural fields and habitation areas expanded across the slopes and coastal area of Hualalai during the Late Expansion Period (AD 1100 to 1400) (Burtchard 1993; Cordy 1995). The earliest fields may have been located in the southern portion of the system (Schilt 1984; Wolforth and Rosendahl 1998), with new fields expanding northward over time (Haun et al. 1998).

The development of the extensive formal walled fields sometime during the initial stages of the Intensification Period (AD 1400 to 1600) is taken as a mark of the initiation of the Kona Field System (Schilt 1984). The development of formal walled fields may be in part a by-product of the need to extract more subsistence resources from an increasingly limited agricultural base, since the population in Kona had increased dramatically during this period. Radiocarbon dates from habitation structures, shelter caves, and agricultural soils are plentiful from this period

(Burtchard 1995; Haun et al. 1998; Schilt 1984). During this period, the stratified chiefdom structure becomes clearly developed in the archaeological record. Large residential complexes and heiau reflect the segregation of places and power for the growing hierarchy of high and lower chiefs, and ceremonial stewards (Cordy 1981; Haun et al. 1998; Hommon 1976). The produce from the formal walled fields was distributed to higher chiefs through a hierarchy of lower chiefs responsible for management and collection of the cultivated and wild resources.

By the time of the Competition Period (AD 1600 to 1800), the chiefly centers and larger heiau were in place, reflecting the growth in power of the rulers and chiefs in the region (Barrera 1971; Hammatt and Folk 1980). Resources may have reached their maximum carrying capacity, resulting in social stress between neighboring groups. Hostility between groups is reflected archaeologically with the development of refuge caves during this period (Schilt 1984). This volatile period was probably accompanied by internal rebellion and territorial annexation (Hommon 1986; Kirch 1985). It is thought by some researchers that population declined during this period, but several researchers, e.g. Cordy (1995), contend that population continued to grow up to the time of European contact (Burtchard 1993).

Afterwards, during the next time period, that of the last of the ruling chiefs (1800 to 1819), settlement and land use patterns stayed primarily the same as previously. But the ~~next~~ subsequent period, the period of the merchants and missionaries~~,~~ (1820 to 1847), saw the introduction of foreign ideas, plants, animals, diseases, religion, and trade, and the end of the kapu system. The royal centers were no longer functioning as focal points for religious and political activity, and the population at the royal centers and the population of the commoners dropped overall.

During the next period, the Great Mahele and Its Legacy~~,~~ (1848-1899), the implementation of privately owned land resulted in major changes to the settlement and land use patterns in Kona. By the end of this period, foreign landowners and business people had greater control over broad land use practices. The upland agricultural fields were modified to coffee growing, and permanent habitations were built with modern materials upland and along the shore. The population, due to disease, reached a low during this period, but began to climb as foreign laborers and more business people arrived. Finally, during the last period (1900-1959), the

Territorial Period, the population remained relatively stable and lowland occupation was concentrated in the small villages of Kailua and Keauhou, with permanent residences with gardens and pens scattered along the shoreline, while upland habitation was associated with agricultural and ranching pursuits (Haun et al. 1998).

4.1.2 Existing Conditions – Archaeological Survey

4.1.2.1 Field Methods

The archaeological field survey of the housing project site began on March 1, 2007, and concluded on July 9, 2007. Conducting the survey were PHRI Supervisory Archaeologist Alan B. Corbin, M.A., assisted by Field Technician Leonard Kubo, B.A. During the course of the survey, twelve archaeological sites that had been previously identified during ~~the course of~~ an archaeological survey conducted in 1990 by Donham were re-located and re-identified.

The initial stage of site re-location involved the study of previously compiled site inventory maps, overall project maps, and aerial photos in order to determine the probable locations of sites that had been previously identified during the inventory stage. If the site was not found at its probable location, further methodology was employed. Using office-compiled distance and bearing from known points in the landscape, compass and tape were used in the field to estimate the site's probable location. If the site was not found at that location, a circular grid was established at that point, and surveyors walked transects that radiated in all directions out from that point. In this manner, despite extremely overgrown and dense vegetation that limited visibility to less than ten feet at times, all sites but one (Site 13396) were eventually located. All re-located sites were flagged with white-and-red stripped flagging. Subsequent to the re-location and flagging, all re-located sites were located using global positioning system (GPS) equipment. Sites were located with GPS as single points for smaller, single-feature sites, or by multiple points that established a polygonal area.

4.1.2.2 Findings

As stated above, during the course of the survey, twelve (12) archaeological sites that had been identified in previous archaeological surveys were re-identified and re-located within the project area. These sites are shown in Figure 4-1~~Figure 41~~ and are listed in Table 4-1.

These sites had been previously identified during the course of an archaeological survey conducted in 1990, during which time significance assessments and recommendations for the sites were presented (Donham 1990) (SHPD approval letter of 2/17/93, Log 6839, Doc. 9302RC34; see Appendix D of this EIS).

The assessments and recommendations were reiterated in an archaeological mitigation plan that was approved by the SHPD (Jensen et al. 1992) (SHPD approval letter of 12/21/93, Log 10361, Doc. 9312RC02; see Appendix D of this EIS).

Later, the archaeological mitigation plan was amended by PHRI Letter Report 1152-052493, which outlined the sampling block methodology to be used during mitigation (dated June 10, 1993~~; –~~, PHRI Letter 1152-052493, to D. Hibbard, SHPD, from A. Walker, PHRI; SHPD approval letter dated 7/28/1993, Log 8976, Doc 9307RC40; see Appendix D of this EIS).

The final significance assessments and recommendations are summarized in Table 4-1.

One of the sites slated for preservation and interpretive development, Site 13396, a platform originally located a short distance west of Sites 13394 and 13395, was not relocated during the course of the survey. It was apparently destroyed by construction of a firebreak road corridor subsequent to the original Donham survey.

Four sites (Sites 13395, 13408, 13409, and 13410) are located within Sample Block E (Figure 4-1~~Figure 41~~). Block E was established as a sample block of the QLT mitigation plan (Jensen et al. 1992). Block E, which is 400 feet by 400 feet, was chosen so that data collected from it could be compared with similar sized sample blocks (Blocks A-D and F), which are not on the Keahuolu Affordable Housing P~~p~~roject site.

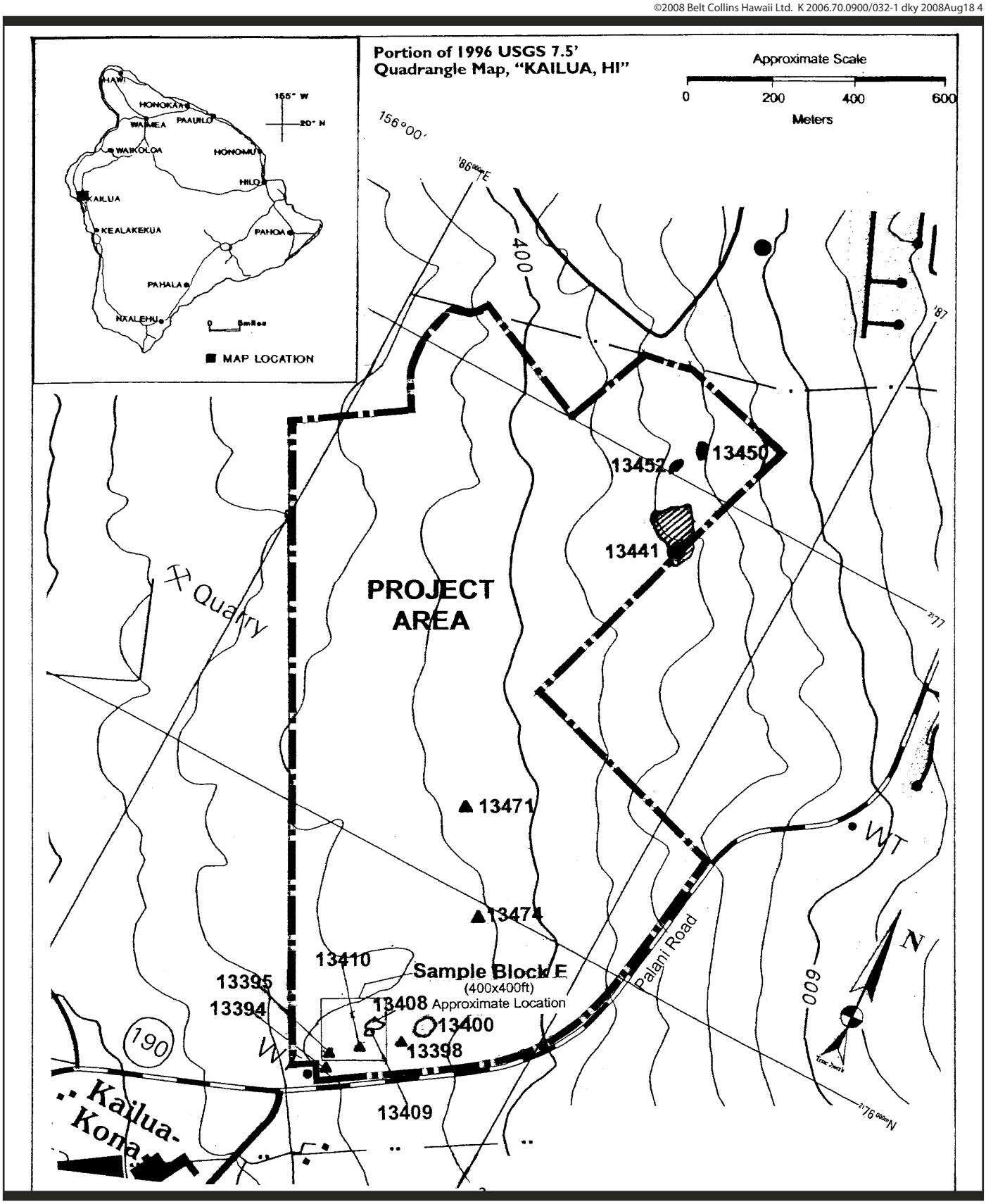


Figure 4-1
PROJECT SITE ARCHAEOLOGICAL SITE LOCATIONS

HHFDC Keahuolu Affordable Housing Project
Environmental Impact Statement
September 2008

Source: Paul H. Rosendahl, Ph.D., Inc. November 14, 2007

Table 4-1: Summary of General Significance Assessments and Recommended General Treatments – Project Site

SIHP Site Number	Formal Site Type	Functional Interpretation	Significance Category					General Recommendations			
			A	B	C	D	E	FDC	NFW	PID	PAI
13394	Alignment	Agriculture				D		FDC			PAI
13395	Platform	Habitation/possible burial			C	D	E*	FDC		PID	PAI *
13398	Platform, wall, cairn	Habitation/agricultural			C	D		FDC		PID	
13400	Wall, enclosure	Agricultural/land division			C	D		FDC		PID	
13408	Platform, terrace, five walls, two enclosures, 10+ *pahoehoe* excavations	Habitation/agricultural/ possible burial			C	D	E*	FDC		PID	PAI *
13409	Three platforms, two walls, an enclosure, and three terraces	Habitation/agricultural/ possible burial			C	D	E*	FDC		PID	PAI *
13410	Platform	Habitation			C	D		FDC		PID	
13441	Seven platforms, five terraces, wall remnant, wall, mound, cave, enclosure	Habitation/agriculture			C	D			NFW	PID	
13450	Steppingstone trail	Transportation				D		FDC			
13452	Paved trail	Transportation				D		FDC			
13471	Upright, platform, cave	Habitation/agricultural/ ceremonial				D		FDC			
13474	Cave	Habitation				D		FDC			

Notes:

General Significance Categories:

A = Important for historical contribution to significant events and/or broad patterns of history

B = Important for association with the lives of important individuals in history

C = Excellent example of site type at local, region, island, state, or national level

D = Important for information content

E – Culturally significant

Recommended General Treatments:

FDC~~CD~~ = Further data collection necessary (detailed recording, surface collections, and limited excavations, and possibly subsequent data recovery/mitigation excavations)

NFW = No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential

PID = Preservation with some level of interpretive development recommended (including appropriate related data recovery work)

PAI = Preservation "as is," with no~~r~~ further work (and possible inclusion into landscaping), or possible minimal further data collection necessary

* = Provisional assessment; definite assessment pending completion of further data collection

These results in turn could then be compared to similar sized sample blocks placed on the adjacent ahupua‘a of Kealakehe. The blocks were selected so that they would, as a group, incorporate a wide variety of the site and feature types, and would incorporate various soil and bedrock types at different elevation levels.

4.1.3 Potential Impacts and Mitigation Measures

At the time of this writing, SHPD has approved the 1990 archaeological inventory survey and the 1993 archaeological mitigation plan for the project area. A copy of the SHPD approval letters are in Appendix D of this EIS.

The 1993 archeological mitigation plan outlines all of the data recovery work that remains to be done in the project area. Data recovery work (detailed recording, surface collections, possibly excavations) needs to take place at eleven of the twelve sites within the project boundary. In addition, the entire Sample Block E needs to be recorded in detail (definition of the block, vegetation clearing, and detailed mapping ~~of the entire block~~).

The data recovery work would also include burial testing at Sites 13395, 13408, and 13409. If human remains are found at any of the sites, a burial treatment plan for the project area would be needed. This plan will be prepared in consultation with the SHPD and the Hawaii Island Burial Council and requires the final approval of these two agencies. This plan would include a search for lineal and cultural descendents, detailed descriptions of each burial, and burial treatments, including preservation buffers and possible structural protection measures.

Seven of the twelve sites are recommended for “preservation with some level of interpretive development recommended.” Four of the twelve sites are recommended for “preservation as is.” A preservation plan detailing treatments (preservation buffer zones, interpretation measures, maintenance, etc.) for all preservation sites needs to be prepared and approved by the SHPD.

The Impacts of the Alternatives on the Project Site's Archaeological and Historic Resources

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			Data recovery and preservation of sites would not occur. Uncontrolled vegetation growth would eventually lead to the gradual loss of sites and decreased accessibility.
2. Alternative A		✓		Archaeological sites and cultural resources determined to be significant under State criteria would be preserved. Data recovery plans, site preservation plans and burial treatment plans would be prepared as required.
3. Alternative B		✓		Archaeological sites and cultural resources determined to be significant under State criteria would be preserved. Data recovery plans, site preservation plans and burial treatment plans would be prepared as required.
4. Alternative C		✓		Archaeological sites and cultural resources determined to be significant under State criteria would be preserved. Data recovery plans, site preservation plans and burial treatment plans would be prepared as required.

4.2 ARCHAEOLOGICAL AND HISTORIC RESOURCES – RESERVOIR SITE

Rechtman Consulting, LLC conducted an archaeological inventory survey for the proposed reservoir site and associated service road within Keahuolu and Kealakehe ahupua'a, North Kona District, island of Hawai'i. The proposed reservoir and service road are part of the off-site development of infrastructure facilities associated with the proposed Keahuolu Affordable Housing Pproject. The reservoir site is adjacent to the housing project site. The historical background information prepared by Rechtman is generally similar to that prepared by PHRI. Therefore, the historical background information for the reservoir site and surrounding area are not repeated below. The Rechtman archaeological inventory survey report is summarized below. Appendix E contains the entire report.

The reservoir site is located makai of Palani Road and is situated approximately 595 feet above sea level, with an associated service road that extends west from the reservoir site. The reservoir

and service road are located on undeveloped land owned by the State DHHL and encompass an area measuring roughly 7.3 acres within TMK (3) 7-4-21: por. 014, por. 020, and por. 021.

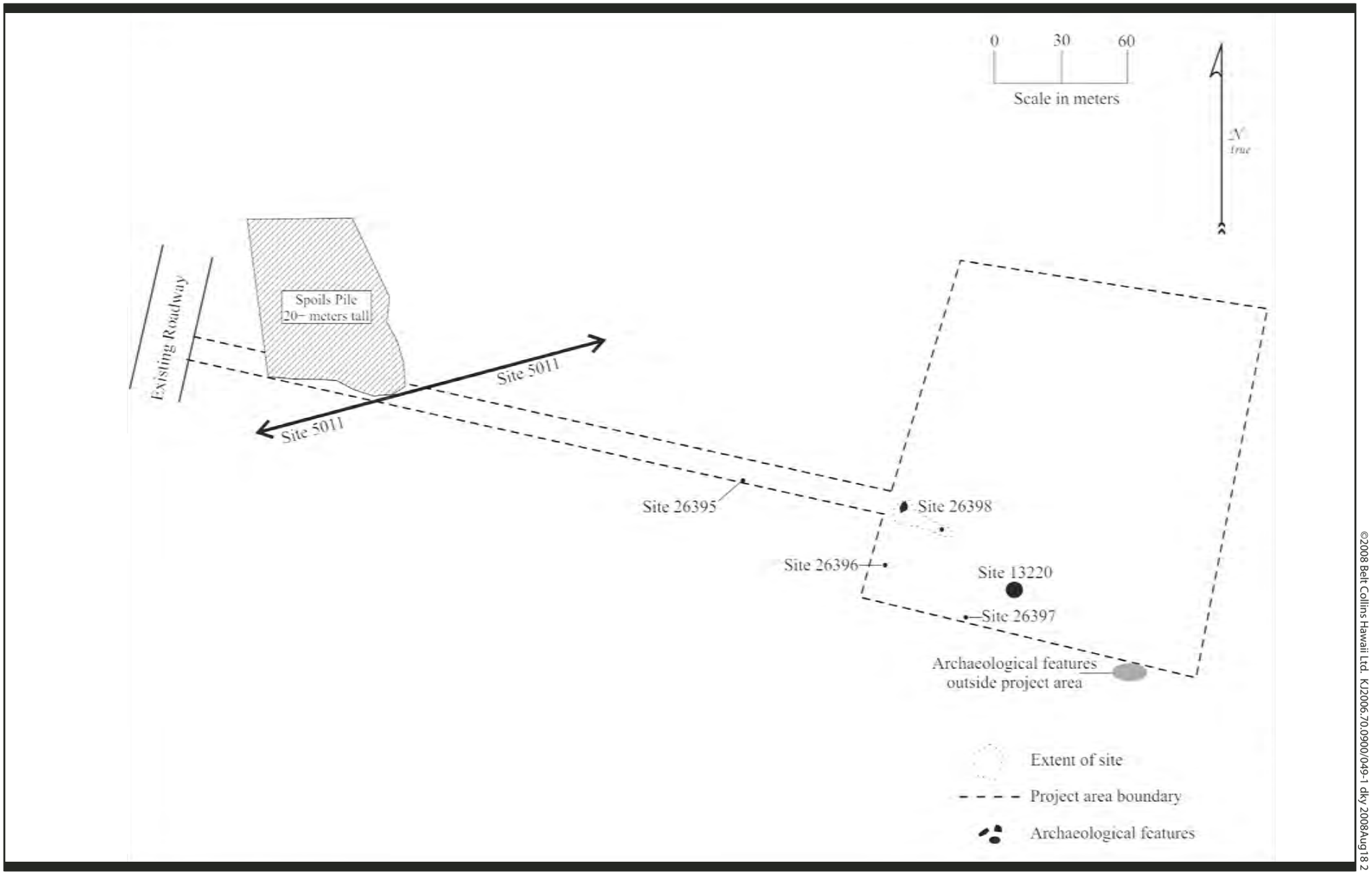
4.2.1 Existing Conditions - Archaeological Survey

Fieldwork for the current inventory survey was conducted on December 18-20, 2007 with ~~follow~~ follow-up subsurface testing on January 9, 2008. Six sites were recorded as a result of the current inventory survey~~; ,~~ four newly recorded sites and two previously recorded sites ~~were identified~~. The sites' locations are depicted on Figure 4-2~~Figure 42~~.

The previously recorded sites include an agricultural complex (SIHP Site 13220) and a boundary wall (SIHP Site 5011) (Donham 1990a). The newly recorded sites consist of three cairns (SIHP Sites 26395, 26396, and 26397), and a multi-feature site (SIHP Site 26398). All of the sites with the exception of Site 5011 appear to have been constructed and/or utilized during the Precontact P~~p~~eriod. SIHP Site 5011 is a core-filled boundary wall and because of its construction method was likely built during the Historic Period.

During the current survey, a triangular stacked mound was observed outside of the project area, along the eastern end of the southern boundary. As this site was outside the project area, it is not detailed in the current study and was not assigned an SIHP site number. It is shown on Figure 4-2~~Figure 42~~ to facilitate its protection during any future development activities that may occur in association with the construction of the reservoir and service road.

The six sites - Sites 5011, 13220, 26395, 26396, 26397, and 26398 - are all considered significant under Criterion D for information they have yielded relative to past use of the current project area. It is proposed, however, that the information collected during the previous and current inventory surveys is sufficient to document these sites and to mitigate any potential negative impacts resulting from the proposed development of the reservoir and service road. No further work is recommended for the six sites. The significance and recommended treatments for the four sites are presented in Table 4-2.



Belt Collins

NORTH

Figure 4-2
PROPOSED RESERVOIR SITE ARCHAEOLOGICAL SITE LOCATIONS

HHFDC Keahuolu Affordable Housing Project
Environmental Impact Statement
September 2008

Table 4-2: Site Significance and Treatment Recommendations — Proposed Reservoir Site on DHHL Land

SIHP No.	Function	Temporal Association	Significance	Recommended Treatment
5011 *	Boundary wall	Historic	D	No further work
13220 *	Agricultural complex	Precontact	D	No further work
26395	Cairn	Precontact	D	No further work
26396	Cairn	Precontact	D	No further work
26397	Cairn	Precontact	D	No further work
26398	Cairn	Precontact	D	No further work

* While these sites have been previously subject to evaluation and recommendation, the current study provides a re-evaluation relative to the current project area.

4.2.2 Potential Impacts and Mitigation Measures

The sites recorded were assessed for their significance based on criteria established by the DLNR SHPD and contained in the HAR 13513-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence.

No further work is recommended for the six sites. However, it is recommended that an archaeological monitor be present during the initial grubbing and grading associated with this project in an effort to insure the protection of nearby archaeological features observed during the original survey of the project area (see Figure 4-2~~Figure 42~~). A monitoring plan for the proposed development area should be prepared and submitted to the DLNR SHPD prior to any groundbreaking activities.

The Impacts of the Alternatives on the Proposed Reservoir Site on DHHL Land Archaeological and Historic Resources

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			Uncontrolled vegetation growth would eventually lead to the gradual loss of sites and decreased accessibility.
2. Alternative A		✓		No further work is recommended by the archaeologist. A monitoring plan should be prepared and submitted to the DLNR SHPD prior to groundbreaking.
3. Alternative B		✓		No further work is recommended by the archaeologist. A monitoring plan should be prepared and submitted to the DLNR SHPD prior to groundbreaking.
4. Alternative C		✓		No further work is recommended by the archaeologist. A monitoring plan should be prepared and submitted to the DLNR SHPD prior to groundbreaking.

4.3 CULTURAL RESOURCES

4.3.1 Purpose, Background and Objectives

A ~~Cultural Impact Assessment (~~CIA~~)~~ was conducted by PHRI for the Keahuolu Affordable Housing Pp~~project. The area of study for the CIA includes the housing site and reservoir site. The PHRI CIA report is in Appendix D of this EIS.

The purpose of this CIA is to comply with the requirements of HRS Chapter 343, as amended by ~~H.B~~House Bill. No.2895 H~~.~~D~~.~~1 of the Hawai‘i State Legislature (2000) and approved by the Governor as Act 50 on April 26, 2000, and which among other things requires that environmental assessments (EAs) and EISs identify and assess the potential effects of any proposed project upon the "…cultural practices of the community and State…." HRS Chapter 343 was amended by the State Legislature because of the perceived need to assure that the environmental review process explicitly addressed the potential effects of any proposed project upon "…Hawai‘i's culture, and traditional and customary rights." Guidelines previously prepared and adopted by the State OEQC (1997) provide compliance guidance. Both Act 50 and the OEQC Guidelines for Assessing Cultural Impacts mandate consideration of all the different groups comprising the multi-ethnic community of Hawai‘i. This inclusiveness, however, is

generally understated, and the emphasis, intent, and evolution of both the legislative action and the guidelines —is clearly meant to be primarily upon aspects of Native Hawaiian culture – particularly traditional and customary access and use rights.

Cultural resources include a broad range of often overlapping categories of cultural items – places, behaviors, values, beliefs, objects, records, stories, and so on. A traditional cultural property (TCP) is one specific type of cultural resource that falls within the purview of the historic preservation review process. A TCP is a historic property or place that is important because it possesses "traditional cultural significance":

> "Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices....
>
> A traditional cultural property, then, can be defined generally as one that is...[important/significant]...because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1990:1).

In addition, it is important to realize that sometimes a TCP may not have a visible physical manifestation:

> Although many traditional cultural properties have physical manifestations that anyone walking across the surface of the earth can see, others do not have this kind of visibility, and more important, the meaning, the historical importance of most traditional cultural properties can only be evaluated in terms of the oral history of the community (Sebastian 1993:22).

There are at least two significant differences that distinguish TCPs as a subset within the larger sphere of cultural resources. First, while cultural resources such as practices and beliefs may be spatially associated with general types of geographical areas, such as the exposed lava lands of the Keahole Point area, a TCP is a specific physical entity or feature with a definable boundary, such as a specific location within the current project site. Second, while cultural resources such as practices and beliefs can include general cultural behaviors such as the gathering of various

natural resources for general subsistence, industrial, or ceremonial uses, a TCP is a specific place or feature directly associated with specific behaviors, the continuity of which over time, in either actual practice or remembrance, can be demonstrated.

Based on these two significant distinctions, it is possible to suggest three types of practitioner claims relating to cultural practices, beliefs, and features that are likely to be encountered in the course of conducting a CIA study. These claims can be referred to as (a) TCP claims, (b) traditional and customary cultural practice claims, and (c) contemporary, or neo-traditional, cultural practice claims.

TCP claims would be those ~~which~~ that lie within the purview of the current historic preservation review process (DLNR 2001a,b); that is, they are claims involving the traditional practices and beliefs of a local ethnic community or members of that community that (a) are associated with a definable physical property (an entity such as a site, building, structure, object, or district), (b) are founded in the history of the local community, (c) contribute to the maintenance of the cultural identity of the community, and (d) demonstrate a historical continuity of practice or belief up to the present through either actual practice or historical documentation. Furthermore, to qualify as a legitimate TCP within the historic preservation context, a potential TCP must be able to demonstrate its historical significance in terms of established evaluation criteria, such as those of the National Register of Historic Places and/or the Hawai‘i Register of Historic Places.

Traditional and customary cultural practice claims would be those Native Hawaiian claims ~~which~~ that lie within the purview of Article XII, Section 7, of the Hawai‘i State Constitution (“Traditional and Customary Rights”) and various other state laws and court rulings, particularly as reaffirmed in 1995 by the Hawai‘i State Supreme Court in the decision commonly referred to as the “PASH decision,” and as further clarified more recently in its 1998 decision in State of Hawai‘i v. Alapa‘i Hanapi and its 2000 decision in Ka Pa‘akai o Ka ‘Aina et al. v. Land Use Commission, State of Hawai‘i et al. The notable points of the decisions in PASH and in Hanapi can be summarized as follows: (a) the reasonable exercise of ancient Hawaiian usage is entitled to protection under Article XII, Section 7, of the Hawai‘i State Constitution; and (b) those persons claiming their conduct is constitutionally protected must prove that they are ~~a~~ Native Hawaiian as defined in PASH, that the claimed right is constitutionally protected as a traditional

or customary Native Hawaiian practice, and that the exercise of the right is occurring on undeveloped or less than fully developed property. Ka Pa'akai generally reaffirms the same points as in the PASH and Hanapi decisions and, in addition, (a) indicates the explicit responsibility of the regulatory agency involved in any application review to arrive at affirmative and substantive conclusions regarding potential impacts upon traditional and customary Native Hawaiian cultural practices and resources, and (b) suggests an "analytical framework" for the identification of and potential impacts upon any such cultural practices and resources.

Traditional Native Hawaiian cultural practices can be categorized as two general types: (a) practices with active behaviors involving both observable activities with material results and their inherent values or beliefs; and (b) practices with more passive behaviors that seek to produce nonmaterial results. The former type of behaviors, practices with active behaviors, for example, would involve practices like the gathering and collecting of different animal and plant resources for various purposes, such as subsistence, medicinal, adornment, social, ceremonial, and possibly other uses. Uses such as these usually have associated beliefs and values (both explicit and implicit) relating to a pervasive general theme that flows throughout traditional Native Hawaiian culture and binds it together. To Native Hawaiians, the natural elements of the physical environment – the land, sea, water, winds, rains, plants, and animals, and their various embodied spiritual aspects – comprise the very foundation of all cultural life and activity – subsistence, social, and ceremonial. To Native Hawaiians, the relationship with these natural elements is one of family and kinship. The latter type of behaviors – practices with more passive behaviors – involves more experiential activities focused on "communing with nature", that is, behaviors relating to spiritual communication and interaction that reaffirm and reinforce familial and kinship relationships with the natural environment.

While TCP claims, as defined above, would certainly fall within the general domain of traditional and customary cultural practice claims, not all traditional and customary cultural practice claims would necessarily qualify as TCP claims. Traditional and customary cultural practice claims subsume a broad range of cultural practices and beliefs associated with a general geographical area or region, rather than a clearly definable property or site ~~for example~~, such as the gathering of marine resources from along a section of shoreline for traditional subsistence or

ceremonial purposes, in contrast to the gathering of a specific marine resource species for a specific use by current generation members of a family that had obtained the same resource from the same recognized site for several generations.

Contemporary, or "neo-traditional," cultural practice claims overlap with neither traditional property claims nor traditional and customary practice claims. Contemporary cultural practice claims would be those made by cultural practitioners relating to current practices or beliefs for which no clear specific historical basis in traditional culture can be clearly established or demonstrated; for example, this might be the conducting of ritual ceremonies of uncertain authenticity at sites or features for which no such prior use can be demonstrated.

The specific purpose of the present CIA study is to assess the potential impacts of the proposed project upon the cultural resources – the practices, features and/or beliefs of Native Hawaiians or any other ethnic group that might be associated with the project area. To accomplish this purpose, several specific objectives were established:

1. Identify any Native Hawaiian or other ethnic group cultural practices currently being conducted by individual cultural practitioners or groups;
2. Collect sufficient information so as to define the general nature, location, and authenticity of any identified cultural practices;
3. Assess the potential impacts of the proposed project upon identified cultural practices; and
4. Recommend appropriate mitigation measures for any potentially adverse impacts upon identified cultural practices.

Thus, the overall goal or objective of the present CIA study was to identify any Native Hawaiian or other cultural practices currently being conducted within or immediately adjacent to the present project area that might potentially be in some manner constrained, restricted, prohibited, or eliminated if the proposed project were to be approved. The types of practices to be identified would be inclusive, that is, claims for all three types of practices – TCP, traditional and customary cultural practices, and contemporary cultural practices – would be identified and considered. More specifically, the objectives of the CIA were to determine the following: (a) if the project area is currently being accessed by Native Hawaiian cultural practitioners for any traditional and customary cultural uses; (b) if the proposed project would have any adverse

impacts upon any identified current native Hawai‘i cultural uses of the area; and (c) what measures might be proposed to mitigate any adverse impacts the proposed project might have upon any identified current Native Hawaiian uses of the area.

4.3.2 Basic Guidance Documents

Several references are available to serve as basic guidance documents for carrying out CIA studies of various scopes and intensities. The principal sources are the following:

1. The OEQC *Guidelines for Assessing Cultural Impacts* (OEQC 1997);
2. *The Native Hawaiian Rights Handbook* (MacKenzie 1991), and more specifically the discussions of traditional and customary rights contained in the two chapters on access rights (Lucas 1991a) and gathering rights (Lucas 1991b);
3. The Report on Native Hawaiian Traditional and Customary Practices Following the Opinion of the Supreme Court of the State of Hawai‘i in Public Access Shoreline Hawaii v. Hawai‘i County Planning Commission prepared by the PASH/Kohanaiki Study Group (1998);
4. The text of several relevant decisions of the Hawai‘i Supreme Court, including the decision commonly referred to as the “PASH decision” (1995), and the more recent decisions in State of Hawai‘i v. Alapa‘i Hanapi (1998) and Ka Pa‘akai o Ka ‘Aina et al. v. Land Use Commission, State of Hawai‘i et al. (2000);
5. The federal regulations of the Advisory Council on Historic Preservation for the National Register of Historic Places (CFR 1981) and the Protection of Historic Properties (CFR 1986);
6. National Register Bulletin No. 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1990); and
7. Recently approved versions of the SHPD administrative rules (effective December 11, 2003), including Chapter 275: Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS (DLNR 2002a), and Chapter 284: Rules Governing Procedures for Historic Preservation Review to Comment on Chapter 6E-42, HRS, Projects (2002b), as well as an earlier draft Chapter 284-Rules Governing Procedures for Ethnographic Inventory Surveys, Treatment of Traditional Cultural Properties, and Historical Data Recovery (DLNR n.d.).

Attempts to address various issues relating to Native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the current OEQC “Guidelines for Assessing Cultural Impacts” (OEQC 1997b).

The relationship of the OEQC guidelines to the State Supreme Court "PASH decision" was clearly stated on the front page of the September 8, 1997 issue of the OEQC bulletin, "*The Environmental Notice,*" when the draft guidelines were first issued for public review and comment:

> For years, a controversy has simmered over developer's responsibility to perform a "Cultural Impact Study" prior to building a project. The recent Supreme Court "PASH" decision reaffirmed the state's duty to protect the gathering rights of native Hawaiians. In light of these events, the Environmental Council has drafted a guidance document to provide clarity on when and how to assess a project's impacts on the cultural practices of host communities.

The most recent attempt to address various issues relating to Native Hawaiian traditional and customary access and land use rights within the State environmental impact review process resulted in the amendment to *Chapter 343 (Haw. Rev. Stat.),* as amended by H~~.~~ouse B~~.~~ill No.2895, H~~.~~D~~.~~1 of the Hawai State Legislature (2000) and approved by the Governor as *Act 50* on April 26, 2000. While no specific administrative rules for the implementation of this amendment have been adopted, it is generally accepted that the ~~*Guidelines*~~ guidelines previously prepared and adopted by the State OEQC (1997) are meant to provide general compliance guidance.

The OEQC guidelines~~*Guidelines*~~ consist of three basic sections. The first section is an introduction ~~which~~ that notes the various statutory and other bases for addressing potential impacts upon cultural resources within the context of the environmental assessment review process, and "...encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area" (OEQC 1997:1). The second section of the guidelines discusses methodological considerations for conducting CIAs, and presents a recommended six-step protocol to be followed by the assessment preparers. The third section of the guidelines outlines eleven topics or "matters" that a cultural assessment should address; these topics basically represent the desired content and organization of a CIA report.

As "guidelines," the OEQC ~~Guidelines~~ guidelines would seem to have neither the specific statutory authority of law, nor the regulatory authority of administrative rules. They represent

general suggestions and recommendations as to how to approach the assessment of potential cultural impacts and provide little or no guidance relative to many important questions, perhaps the most significant of which are listed below:

1. How would project-specific determinations be made as to whether or not a CIA study might even be necessary or appropriate given the specific nature and location of a proposed project?
2. If a CIA study is to be conducted, how does one determine what constitutes an appropriate project-specific level of effort, that is, the general scope of work or objectives for the study, and the specific tasks or activities required to accomplish the scope of work or objectives?
3. What criteria are to be used for determining the credibility and reliability of potential cultural information sources (generally referred to as "informants" or "knowledgeable individuals")?
4. If specific cultural practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be applied for evaluating (a) the descriptive adequacy and (b) the cultural authenticity of the identified practices, beliefs, or features?
5. If specific culturally authentic practices, beliefs, or features are definitely identified as being associated with a project area, what criteria are to be used for assessing the nature and extent of potential impacts of a proposed project on the identified practices, beliefs, or features, that is, "no effect," "no adverse effect," or "adverse effect?"
6. If a project is determined to have potentially adverse impacts upon specific identified culturally authentic practices, beliefs, or features, what criteria are to be used for evaluating the adequacy and appropriateness of alternative potential mitigation actions?
7. Within the purview of what regulatory office or agency would the review and acceptance or rejection of a completed CIA study legitimately fall?
8. What standards or criteria are to be used to evaluate the overall adequacy or acceptability of a completed CIA study?

Consideration of these questions and their implications has direct relevance to the present CIA study. These implications relate most importantly to (a) the level of study effort believed appropriate for the project-specific context, and (b) the rationale adopted for both the study overall, as well as for the identification and evaluation of any identified cultural practice claims, the assessment of potential project-specific impacts, and the formulation of any specific recommendations for further study or other mitigation actions.

Further comment should be made regarding the final three basic guidance documents listed above. In the absence of any formally adopted administrative rule specifically addressing the treatment of TCPs, the SHPD currently utilizes National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1990), as its principal source of guidance for reviewing and evaluating the adequacy and acceptability of TCP study reports prepared in connection with various permit applications for which SHPD regulatory review is required. Bulletin No. 38 provides detailed guidance for the assessment of TCPs within the framework of the National Register significance criteria evaluation process (National Park Service 1990).

The SHPD draft administrative rule relating to ethnographic surveys and TCPs (DLNR n.d.) has existed in finalized draft version since at least early 1997; however, it has never been formally provided for public review, comment, and eventual adoption by the DLNR. The draft rule goes well beyond National Register Bulletin No. 38 in providing detailed guidance for conducting TCP studies, and more specifically for dealing with the identification, evaluation, and documentation of Native Hawaiian TCPs and their associated cultural practices and beliefs.

In the absence of any formally adopted administrative rule specifically addressing the treatment of TCPs, the SHPD can also be said to basically follow the federal regulations of the Advisory Council on Historic Preservation for guidance in the evaluation of significance, as contained in Section 60.4 (“Criteria for evaluation”) of the "National Register of Historic Places” (CFR 1981), and for guidance in the assessment of potential effects, as contained in Section 800.9 (“Criteria of effect and adverse effect”) of the “Protection of Historic Properties” (CFR 1986).

4.3.3 Present Study Scope and Methodology

The scope of work and methodology for the current project is based on the general assumption that the level of study effort appropriate in any project-specific context should involve the consideration of several factors, the most relevant of which are the following: (a) the probable number and significance of known or suspected cultural properties, features, practices, or beliefs within or associated with the specific project area; (b) the potential number of individuals (potential informants) with cultural knowledge of the specific project area; (c) the availability of

historical and cultural information on the specific project area or immediately adjacent lands; (d) the physical size, configuration, and natural and human modification history of the specific project area; and (e) the potential effects of the project on known or expected cultural properties, features, practices, or beliefs within or related to the specific project area.

~~Consideration~~ Considering ~~of~~ these factors within the specific nature and context of the proposed project, it was thought that the most appropriate level of study for an adequate assessment of potential cultural impacts would be a limited assessment study. Based on the location, size, number and quality of sites, this study assumes that (a) potential CIA issues would be moderate, (b) the results of the archaeological survey conducted for the project would confirm both the limited number and scope of cultural resources within or related to the project area, and (c) in the instance that any legitimate CIA issues should arise during the environmental review period, they could be addressed adequately within the framework of the review process (i.e., from Draft to Final EIS).

Consideration of these factors within the specific nature and context of the proposed project indicated that the relatively greater levels of study effort that can be characterized as identification or documentation studies would be inappropriate and excessive. The distinctive characteristics of an identification study are that it would be restricted to (a) the identification of Native Hawaiian or other ethnic group cultural practices, beliefs, properties, features, or exploitable natural resources associated with and/or present within or related to the specific project area that are currently being conducted by and/or known to individual cultural practitioners or groups; and (b) the collection of information reasonably sufficient so as to define the general nature, location, and likely authenticity of identified cultural claims. An identification study would not involve the considerably greater level of study effort – both calendar months and hours of labor – needed to carry out a full documentation study. The distinctive characteristics of the latter, which would commonly be referred to as a full ethnographic or oral history study, would be (a) the collection of detailed information regarding identified Native Hawaiian or other ethnic group cultural practices by means of formal oral history interviews which are usually tape recorded and transcribed, and (b) the analysis and synthesis of all collected data – from interviews, as well as relevant historical documentary and archival research

– within the general cultural-historical context of traditional Native Hawaiian or other ethnic group culture and the defined specific geographical area of a specific project.

The overall rationale guiding the present limited assessment study has been that the level of study effort should be commensurate with the potential of the proposed project for making any adverse impacts upon any Native Hawaiian or other ethnic group cultural practices currently conducted by cultural practitioners within the project area. The study presented in this report is believed to comprise a reasonable approach for the assessment of potential cultural impacts within this specific project area.

4.3.4 CIA Research and Findings

PHRI contracted Cultural Resources Specialist Helen Wong-Smith, M.A., to conduct the CIA study. Ms. Wong-Smith has extensive experience in historical documentary and informant research, having worked for many years as a Historical Researcher/Cultural Resources Specialist for PHRI. She is currently the Hawaiian and Pacific Collection librarian at the UH Hilo. The entire CIA Study report is contained in the PHRI report in Appendix D of this EIS.

The informant research initially involved compiling a list of potential informants for the Keahuolu housing project area (TMK 3-7-4-21:020). Later, the study was expanded to include the reservoir site (TMK 3-7-4-21: Por. 020, Por. 14, Por. 21). The CIA covers both sites. Ms. Wong-Smith contacted informants known through past projects and through inquiries with departments and cultural specialists such as Kepa Maly, Ruby McDonald of the Office of Hawaiian Affairs (OHA), and Keola Lindsey, formerly of the island of Hawai‘i SHPD office. One contact usually led to another until a list of over 30 potential informants was compiled (Table 4-3~~Table 4-3~~). The potential informants were contacted by phone and e-mail and those responsive were interviewed preliminarily to assess their potential ~~to~~ and willingness to provide information. To further assess informants, informants were asked to fill out written forms to answer some preliminary questions such as: Who are in your immediate family? What was your previous occupation and education? What is your family background? What are your residential ties? Do you know of any specific historic/cultural properties, practices, and/or beliefs relevant to the project area? This was followed up with phone conversations. Historical r~~R~~esearcher and

cCultural sSpecialist Helen Wong-Smith was then contracted to conduct further interviews with a few selected individuals who had potential to provide further information, and to provide further documentary information on the Keahuolu project area.

Table 4-3: List of Potential Informants for Keahuolu Ahupua'a

	Name	Status/Expertise	Affiliation
1	Ruby P. Keana'aina McDonald	Native Hawaiian, executive director	OHA, NAHKHAC
2	Elaine Watai	Native Hawaiian	KCA/SAFIS
3	Craig "Bo" Kahui	Native Hawaiian, president of organization	KCAVL
4	Wally Lau	Native Hawaiian, executive director	NPK
5	Reginald Lee	Native Hawaiian	DOCARE
6	Elizabeth Lee	Native Hawaiian, *lauhala* weaving master	
7	Michael Ikeda	Community Building Facilitator IV	QLCC
8	Mahealani Pai	Native Hawaiian, cultural specialist	BHI
9	J. Curtis Tyler III	Native Hawaiian, cultural resources specialist	KCDPSC
10	Geraldine Bell	Native Hawaiian, park superintendent	KHNHP, NAHKHAC
11	Kahu Akahai	Native Hawaiian, *kahu,* minister, pastor	MZCC
12	David Garcia	Counselor	QLCC
13	Clarence Medeiros, Jr.	Native Hawaiian, journeyman mason	
14	Lily Kong	Native Hawaiian	KOONKOK
15	Ulalia Ka'ai-Berman	Native Hawaiian, *kuma hula*	NAHKHAC
16	Taro Fujimori	Native Hawaiian	N/A
17	Zachary Kanuha	Native Hawaiian	N/A
18	Clement "Junior" Kanuha	Native Hawaiian	N/A
19	Raeanne Kahaiali'i	Native Hawaiian	N/A
20	Clarence Rapoza	Native Hawaiian	N/A
21	E. Kalani Flores	Native Hawaiian, *kuma olelo* Hawai'i	HL-HCCW
22	Gail Souza-Save	General knowledge	QLCC
23	Lydia Mahi	General knowledge	KCDPSC, HCEOC
24	Arthur "Uncle Aka" Mahi	Native Hawaiian	N/A
25	Rae Ann (Fujimori) Godden	Native Hawaiian	N/A
26	Gloria Muraki	General knowledge	N/A
27	Violet Leihulu Mamac	General knowledge	N/A
28	Angel Pilago	Native Hawaiian	HCC
29	Kelly Greenwell	General knowledge	N/A
30	Michael Keala Ching	General knowledge	N/A
31	Iris Nalei Napaepae-Kunewa	General knowledge	N/A
32	Dr. Frank Sayre	General knowledge	N/A
33	Robert Kawaiula Branco	General knowledge	N/A

	Name	Status/Expertise	Affiliation
34	Kahu Henry Kanoelani Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
35	Kahu Brian Boshard	Native Hawaiian, *kahu*, minister, pastor	MC
36	Kaʻea Lyons Alapai	Native Hawaiian, *kumu olelo* Hawaiʻi	KAPA, EHES

Notes:

BHI	Bishop Holdings, Inc.
DOCARE	State of Hawaiʻi DLNR Department of Conservation and Resources Enforcement Division
EHES	Ehunuikaimalino Hawaiian Immersion School
HCC	Hawaiʻi County Council
HCEOC	Hawaiʻi County Economic Opportunity Council
HL-HCCW	Hawaiian Lifestyles – West Hawaiʻi Community College
KAPA	Kapa Radio
KCA	Kealakehe Community Association
KCAVL	Kaniohale Comm. Association at the Villages of Laʻi ʻOpua
KCDPSC	Kona Community Development Plan Steering Committee
KHNHP	Kaloko-Honokohau National Historical Park
KOONKOK	Ka ʻOhana O Na Kupuna O Kona
MC	Mokuaikaua Church
NAHKHAC	Na Hoapili o Kaloko Honokohau Advisory Commission
NPK	Neighborhood Place of Kona
MZCC	Mauna Ziona Congregational Church
N/A	Not Available
OHA	Office of Hawaiian Affairs
QLCC	Queen Liliʻuokalani Children's Center
SAFIS	Salvation Army Family Intervention Services

The historical documentary study by Ms. Wong-Smith suggests limited cultural activity within the project area. Most of the events and documentary evidence concerns the more seaward portion of Keahuolu. Texts indicate that the shoreline area was a rich marine resource. The coastal area also included springs and brackish water ponds from which people harvested, among other things, shrimp. Heiau were located near the shore: Kawaluna, ~~Palihiolo~~Pahiliholo, and Halepana. Inland areas were used primarily for agriculture. Planting evidently was widespread and took place wherever there was a little soil. Even rocky areas were planted with crops such as sweet potatoes, which could thrive in small pockets of soil and mulch.

The informant study, despite considerable effort, yielded only limited information. Pili grass (*Heteropogon contortus*) was apparently harvested from the project area at some time in the past. Clarence Medeiros, Jr. states that he continues to gather pilo (*Capparis sandwichiana*) for medicinal uses. Mahealani Pai indicates that the project area contains plants such as alahe'e,

kauila, and uhiuhi, which were important, useful plants in pre-contact times. No informant, however, had knowledge of any other cultural/traditional use of the project area.

4.3.5 Potential Impacts and Mitigation Measures

The cultural impacts to any locale in Hawai‘i are not always readily evident. What might be assessed by Western eyes as “barren land” may be a rich resource to Hawaiians. For example, trails would be highly valued, the land may yield harvesting material like pili grass, or the area may have spiritual aspects having to do with the wind or other natural phenomenon.

Based on previous and current research, permanent prehistoric populations in Keahuolu appear to have been present along the coast. The midlands were used for temporary habitation and were crossed by trails linking the coast to the uplands, and the uplands were used for agricultural cultivation.

The documentary information on Keahuolu indicates several heiau along the coast, along with several probable permanent residential sites with enclosed yards. Sources reveal the preponderance of burials in coastal areas and in particular in sand dunes. Further inland, caves, lava blisters, and other modified features revealed human remains less frequently. Inland, there are sites and features indicative of dryland agriculture, substantiated by Mahele testimonies of kalo, potato, and limited coffee cultivation. Features indicating temporary habitation were also identified. In the upper elevations, there was a substantial increase in rock mounds, particularly faced mounds and modified lava blisters collaborating with the tradition of increased agricultural activities mauka, where the moisture increases. Documentary information indicates Keahuolu was exposed to far less livestock grazing than Kealakehe to the north. The lesser grazing activity increases the likelihood of cultural sites to remain intact or to suffer less degradation.

Reviewing the information presented in CIA – historical documentation, archaeological surveys and research, and oral reminiscences – reveals limited cultural activities in the project area. For Keahuolu, contemporary or continuing cultural practices include gathering of ocean resources and specific plants from the 300-foot elevation seaward. One cultural practitioner has spoken of

the availability and the gathering of pili, and in the literature are general references to features such as the wind. Halepaoʻo, an *ʻopelu koʻa*, is referenced at Pawai.

Based on the findings of this assessment, the Keahuolu Affordable Housing Ppproject development would have limited impact on Hawaiian cultural resources, beliefs, and practices. Care should be taken to preserve the habitat of endemic plants, in addition to preserving access for gathering activities.

The Impacts of the Alternatives on Cultural Resources

ALTERNATIVES	NO IMPACTS	POTENTIAL IMPACTS	ADVERSE IMPACTS	COMMENTS/MITIGATION MEASURES
1. No Action	✓			No ongoing practices were identified relative to the land proposed for the housing area and the reservoir site.
2. Alternative A		✓		Based on the findings of the CIA, the proposed project would have limited impact on Hawaiian cultural resources, beliefs and practices.
3. Alternative B		✓		Based on the findings of the CIA, the proposed project would have limited impact on Hawaiian cultural resources, beliefs and practices.
4. Alternative C		✓		Based on the findings of the CIA, the proposed project would have limited impact on Hawaiian cultural resources, beliefs and practices.

4.4 ROADWAYS AND TRAFFIC

4.4.1 Background

The West Hawaiʻi roadway network in the general vicinity of the project area consists of three principal roadways: Queen Kaʻahumanu Highway and Mamalahoa Highway, each running in a north – south direction, and Palani Road, which serves as the only street connecting the highways in the immediate vicinity. Palani Road runs in an east-west (mauka-makai) direction.

Palani Road forms the southern boundary of the subject property. To improve traffic conditions in the region, Queen Kaʻahumanu Highway, a State arterial highway facility located downslope (west) of the subject property), is being expanded to a four-lane facility in two phases. Phase I of the expansion involves road widening from Henry Street to Kealakehe Parkway. Phase II of the expansion involves road widening of the segment from Kealakehe Parkway to Keahole Airport.

The County Planning Department is proposing, among other projects, three new roadways that would parallel Queen Ka‘ahumanu Highway at various points up the slope. The “mid-level” road of these three proposed roadways is the proposed Ane Keohokalole Highway, which would be located along the subject property’s west boundary. The Ane Keohokalole Highway would provide key access to the Keahuolu Affordable Housing Pproject. Without Ane Keohokalole, vehicular access to the site would be limited to one possible connection to Palani Road and future connections via Keanalehu Drive, Manawale‘a Street, and potentially a future extension of Makala Boulevard through QLT land.

The projected completion date for construction of Keanalehu Drive and Manawale‘a Street to the HHFDC project boundary is 2008. QLT is expected to include the extension of Makala Boulevard to Ane Keohokalole Highway in its future development plans.

4.4.2 Traffic Study Assumptions and Scope

The following is a discussion of existing traffic conditions in the vicinity of the project area and the proposed project’s potential impacts on future traffic conditions. This discussion is based upon a Traffic Impact Analysis Report (TIAR) prepared by Fehr & Peers / Kaku Associates. Appendix F contains the entire report.

The study analyzed the proposed Keahuolu Affordable Housing Pproject which would construct a new mixed-use neighborhood on vacant land in the area northeast of the intersection of Palani Road (SR 190) and Henry Street. The study assessed the three alternative concept plans, as well as the No Action alternative. For purposes of the TIAR, each of the alternative concept plans has identical street and land use patterns, but the plans vary in the overall intensity of development. Each alternative development concept is focused on a mixed-use community center that includes 197,000 square feet of commercial/retail space, 25 acres of neighborhood parks, a seven-acre archeological preserve, a 12-acre site reserved for a school, and between 1,020 and 2,330 housing units.

- Concept A would construct 1,020 dwelling units, including 620 multi-family units and 400 single-family units in increments of 300 dwelling units per year from 2010-2012, and 120 additional dwelling units in 2013 (Table 4-4).

- Concept B would construct 1,840 dwelling units, including 1,240 multi-family units and 600 single-family units in increments of 300 dwelling units per year from 2010-2015, and 40 additional dwelling units in 2016 (Table 4-5).

- Concept C would construct 2,330 multi-family dwelling units in increments of 300 dwelling units from 2010-2016, and 230 additional dwelling units in 2017 (Table 4-6).

Completion of the residential component of the project is anticipated by 2014 under Concept A, by 2017~~5~~ under Concept B, and by 2018~~6~~ under Concept C. Each concept assumes that the entire project would be completed by the end of 2020.

Table 4-4: Alternative Concept Plan A

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	20 / 100		8,700
2014			
2015			
2016			
2017			
2018		100,000	
2019			
2020		97,000	
Total	**1,020**	**197,000**	**8,700**

Table 4-5: Alternative Concept Plan B

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	200 / 100		8,700
2014	200 / 100		
2015	200 / 100		
2016	40 / 0		
2017			
2018		100,000	
2019			
2020		97,000	
Total	**1,840**	**197,000**	**8,700**

Table 4-6: Alternative Concept Plan C

Year	Land Use		
	Residential Units (multifamily)	Commercial/Retail (SF)	School (SF)
2010	300		
2011	300		
2012	300		
2013	300		8,700
2014	300		
2015	300		
2016	300		
2017	230		
2018		100,000	
2019			
2020		97,000	
Total	**2,330**	**197,000**	**8,700**

The study analyzes potential project-related traffic impacts on the roadway system in the vicinity of the proposed project. The study evaluates projected 2020 conditions both with and without the proposed project. By this date, most of the planned streets in the region are expected to be in place based on the report titled *Keahole to Honaunau Regional Circulation Plan* (2006), which was prepared ~~for~~ by the County of Hawai‘i Planning Department and dated August 14, 2006. The following traffic scenarios are analyzed in the study:

- Existing Conditions (2007) – The analysis of existing traffic conditions provides a basis for the remainder of the study. The existing conditions analysis includes an assessment of streets, traffic volumes, and operating conditions.
- Cumulative Base (No Project) Conditions (2020) – The objective of this scenario is to project future traffic growth and operating conditions resulting from regional growth and related projects in the vicinity of the project site, without consideration of traffic generated by the proposed project.
- Cumulative ~~P~~plus Project Conditions (2020) – The objective of this scenario is to project potential impacts of the proposed project on future traffic operating conditions with project traffic added to the cumulative base traffic forecasts in 2020.

The study analyzed the potential project-related traffic impacts under typical weekday A.M. and P.M. peak hour traffic conditions at twelve intersections in the vicinity of the proposed project. The analyzed intersections, illustrated in Figure 4-3~~Figure 43~~, are:

Study Intersections:

1. Henry Street & Queen Ka‘ahumanu Highway (SR 19)
2. Palani Road (SR 190) & Queen Ka‘ahumanu Highway (SR 19)
3. Kamakaeha Avenue & Palani Road (SR 190)
4. Henry Street & Palani Road (SR 190)
5. Future intersection of Palani Road (SR 190) & Minor Site Access Road
6. Queen Ka‘ahumanu Highway (SR 19) & Makala Boulevard
7. Future intersection of Ane Keohokalole Highway & Major Site Access Road
8. Pahiliholo Street & Palani Road (SR 190)

9. Kealakaʻa Street & Palani Road (SR 190)
10. Uluaoa Street & Palani Road (SR 190)
11. Queen Kaʻahumanu Highway (SR 19) & Kealakehe Parkway
12. Kealakehe Parkway & Ane Keohokalole Highway

The effect of the proposed project options on daily traffic volumes was also measured on 10 street segments, also shown in Figure 4-3~~Figure 43~~. New baseline traffic counts were collected at these locations in August 2007, except at study intersections #5 and #7, both of which are future intersections.

Street Segments:

1. Henry Street south of Palani Road (SR 190)
2. Palani Road (SR 190) makai (west) of Henry Street
3. Palani Road (SR 190) mauka (east) of Henry Street
4. Kealakaʻa Street north of Palani Road (SR 190)
5. Uluaoa Street north of Palani Road (SR 190)
6. Queen Kaʻahumanu Highway (SR 19) south of Kealakehe Parkway
7. Kealakehe Parkway makai (west) of Ane Keohokalole Highway
8. Ane Keohokalole Highway south of Kealakehe Parkway
9. Queen Kaʻahumanu Highway (SR 19) north of Kealakehe Parkway
10. Palani Road (SR 190) south of Mamalahoa Highway

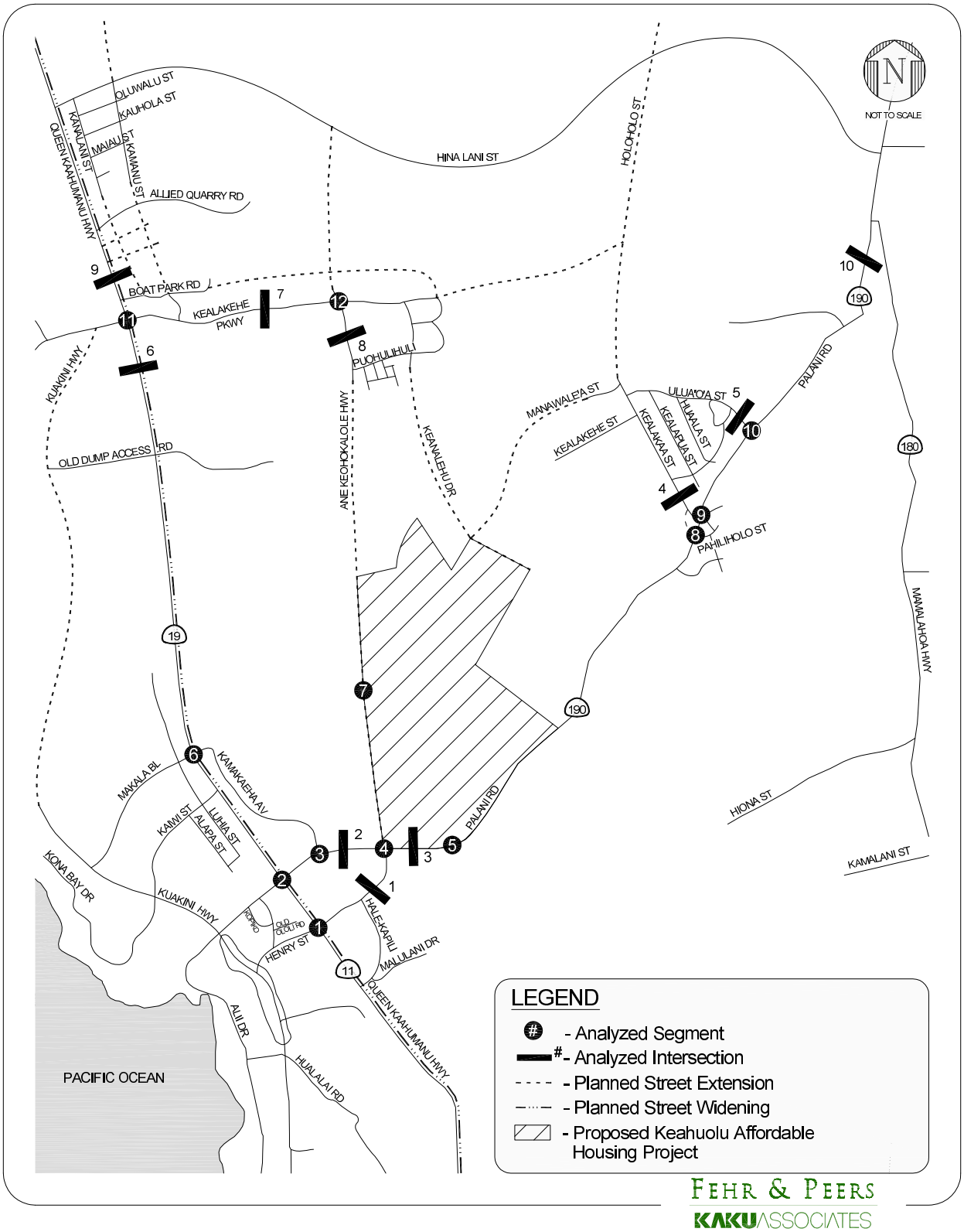


Figure 4-3
TRAFFIC STUDY AREA AND ANALYZED LOCATIONS

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4.4.3 Existing Roadway System Conditions

A comprehensive data collection effort was undertaken to identify existing transportation conditions in the vicinity of the proposed project. The assessment of existing conditions relevant to this study includes an inventory of the street and highway system, traffic volumes on these facilities, and operating conditions at key intersections and street segments.

The study area, as shown in Figure 4-3~~Figure 43~~, is generally bounded by Kealakehe Parkway on the north, Queen Ka'ahumanu Highway (SR 19) on the west (makai), and Palani Road (SR 190) on the southeast. Primary regional access to the area is provided by Queen Ka'ahumanu Highway, which runs north-south approximately one mile makai of the project site, and by Mamalahoa Highway, which runs northeast-southwest approximately two miles mauka of the project site. Henry Street, currently running between Queen Ka'ahumanu Highway and Palani Road, also provides access to the project site. The proposed Ane Keohokalole Highway (Mid-Level Road) will extend Henry Street northward to Hina Lani Street and will serve the project site by providing direct access to Palani Road and Kealakehe Parkway. Diagrams of the existing intersection lane configurations at the ten existing study intersections are provided in Appendix A of the Traffic Report (see Appendix ~~G~~F).

4.4.3.1 Traffic Counts

New weekday peak period intersection turning movement counts were collected between 6:00 A.M. and 9:00 A.M. and between 3:00 P.M. and 6:00 P.M. at the 10 existing study intersections on Tuesday, August 12, Wednesday, August 13, and Thursday, August 14, 2007. Existing weekday peak hour volumes at these intersections are illustrated in Figure 4-4~~Figure 44~~ and the traffic count data sheets are provided in Appendix B of the Traffic Report (see Appendix F).

Twenty four-hour machine counts were conducted at the 10 street segments listed in Section 4.4.2 for analysis of impacts of the proposed project on Tuesday, August 12, Wednesday, August 13, and Thursday, August 14, 2007. The existing daily traffic volume data are available in Appendix B of the Traffic Report (see Appendix F).

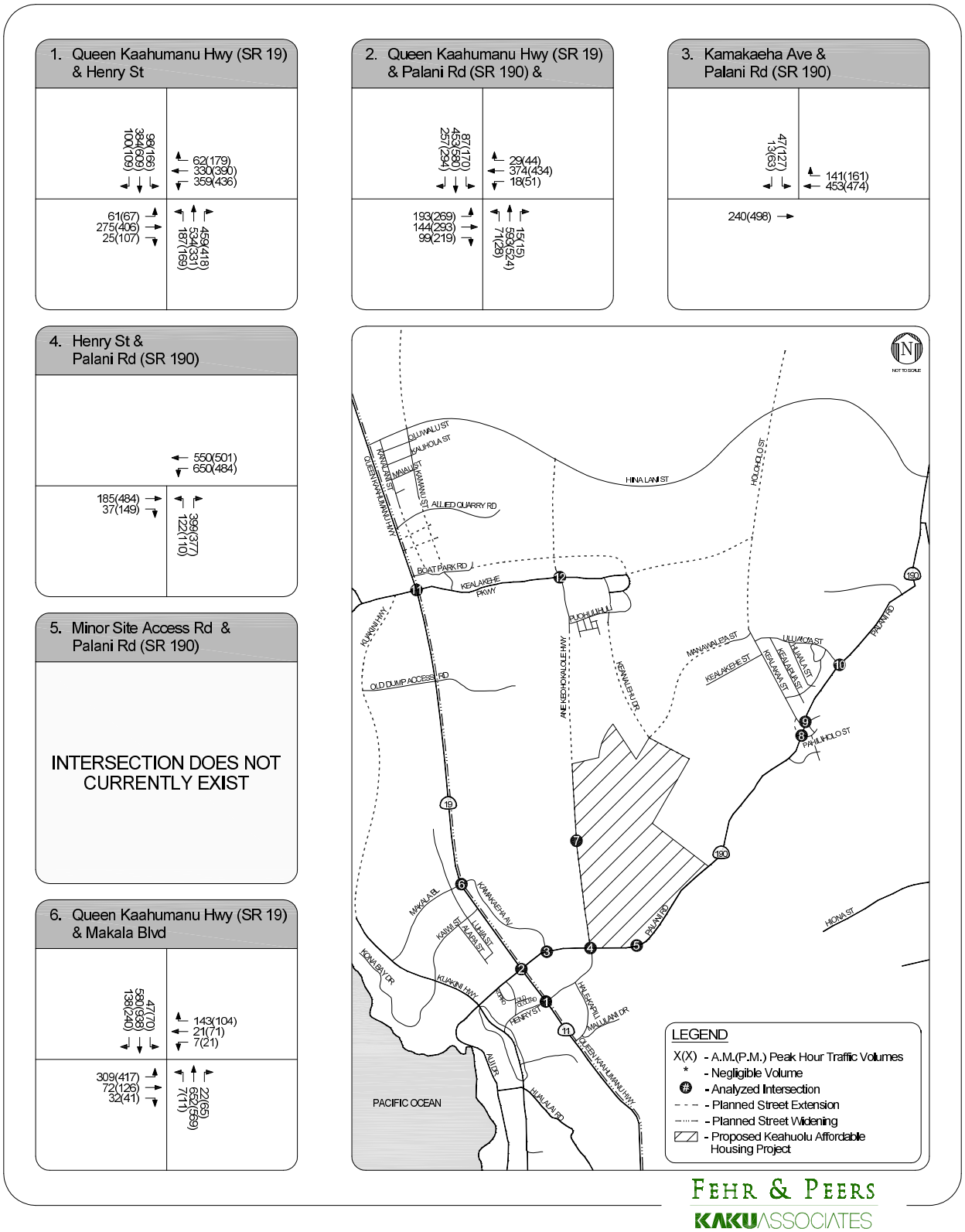

Figure 4-4
EXISTING PEAK HOUR TRAFFIC VOLUMES

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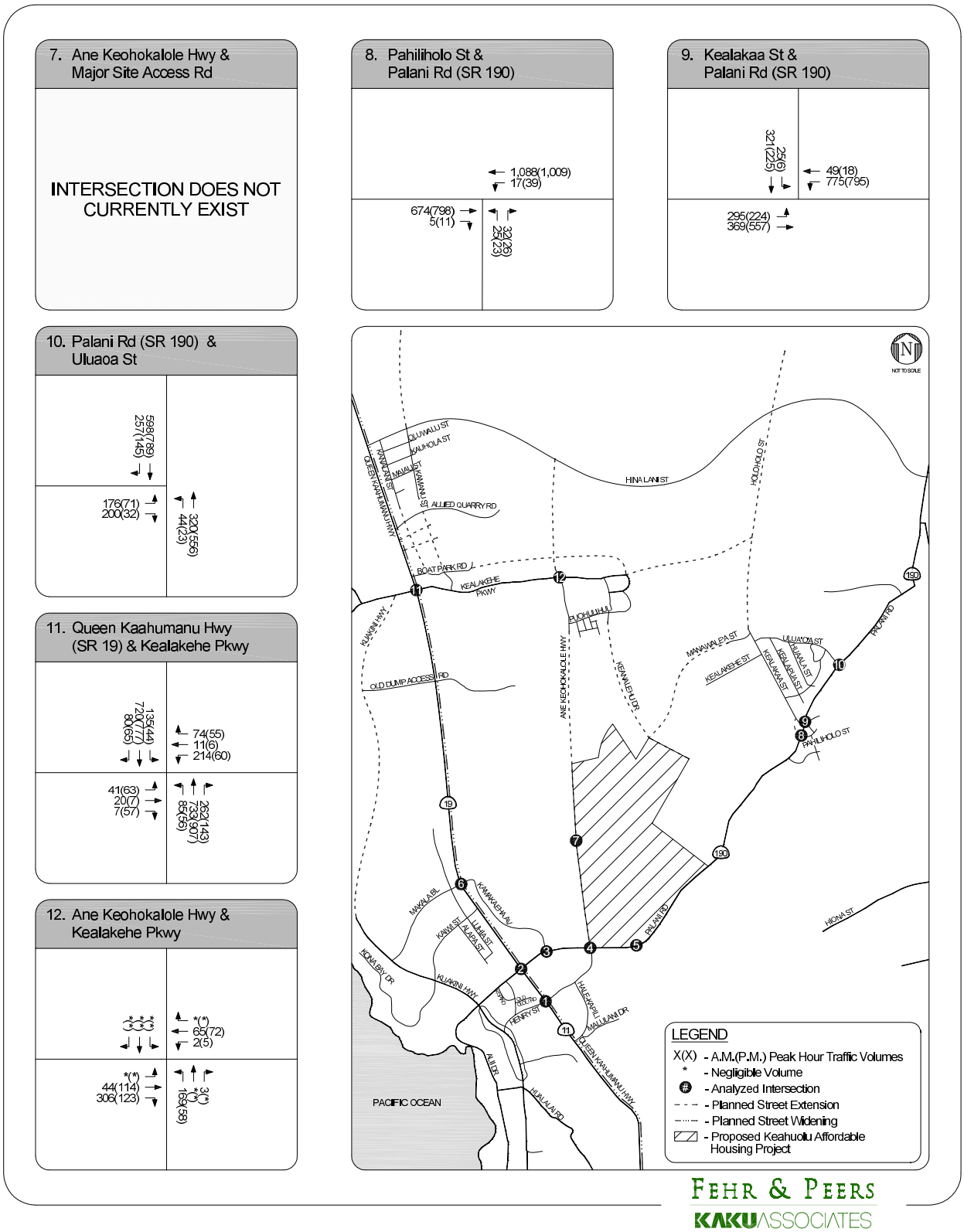

Figure 4-4
EXISTING PEAK HOUR TRAFFIC VOLUMES (continued)

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4.4.3.2 Level of Service Methodology

Level of Service (LOS) is a qualitative measure used to describe the condition of traffic flow ranging from excellent conditions at LOS A to overload conditions at LOS F. LOS definitions for signalized and unsignalized intersections are provided in Table 4-7~~Table 4-7~~ and Table 4-8, respectively. LOS D is considered to be the minimum desirable level of service in this area.

LOS analyses were conducted at each of the existing study intersections to determine their current operating conditions using the operations methodology for signalized intersections and the two-way stop-controlled methodology for unsignalized intersections from the Transportation Research Board's *2000 Highway Capacity Manual.*

Table 4-7: Level of Service Definitions for Signalized Intersections

Level of Service	Volume/Capacity (V/C)	Average Stopped Delay per Vehicle (seconds)*
A	0.000 - 0.600	≤10
B	>0.600 - 0.700	>10 and ≤20
C	>0.700 - 0.800	>20 and ≤35
D	>0.800 - 0.900	>35 and ≤55
E	>0.900 - 1.000	>55 and ≤80
F	> 1.000	>80

Source: *Highway Capacity Manual* (Transportation Research Board, 2000).

Table 4-8: Level of Service Definitions for Unsignalized Intersections

Level of Service	Average Total Delay (seconds/vehicle)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

Source: *Highway Capacity Manual* (Transportation Research Board, 2000).

4.4.3.3 Analysis Results - Existing Peak Hour Intersection Levels of Service

The existing weekday A.M. and P.M. peak hour turning movements depicted in Figure 4-4~~Figure 44~~ were used in conjunction with the LOS methodologies described above to determine existing operating conditions at each study intersection. Detailed LOS calculation worksheets are included in Appendix C of the Traffic Report (see Appendix F).

Table 4-9 summarizes the results of this analysis, including the average control delay and corresponding LOS during the A.M. and P.M. peak hours. Calculated volume-to-capacity (V/C) ratios are also shown in Table 4-9. As indicated in Table 4-9, ~~three~~ two of the 10 existing study intersections, listed below, are operating at LOS E or F during both the A.M. and P.M. peak hours and one of the intersections is operating at LOS E or F during the A.M. peak hours only.~~:~~

Study Intersection:

8. Palani Road (SR 190) & Pahiliholo Street
9. Kealaka‘a Street & Palani Road (SR 190)
10. Uluaoa Street & Palani Road (SR 190)

The other seven existing study intersections are operating at LOS D or better during the A.M. and P.M. peak hours.

Table 4-9: Year 2007 Existing Conditions - Peak Hour Levels of Service

Intersections		Peak Hour	V/C	Del/Veh*	LOS
1	Queen Ka'ahumanu Hwy (SR 19) & Henry St.	A.M. P.M.	0.634 0.626	23 25	C C
2	Queen Ka'ahumanu Hwy (SR 19) & Palani Rd (SR 190)/Alii Dr.	A.M. P.M.	0.777 0.874	26 31	C C
3	Kamakaeha Av & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	15 25	B D
4	Henry St & Palani Rd (SR 190)	A.M. P.M.	0.659 0.804	12 19	B B
5	Project Minor Access & Palani Rd (SR 190) [b]	A.M. P.M.	NA NA	NA NA	NA NA
6	Queen Ka'ahumanu Hwy (SR 19) & Makala Bl	A.M. P.M.	0.748 0.973	23 36	C D
7	Ane Keohokalole Hwy & Major Site Access Road [b]	A.M. P.M.	NA NA	NA NA	NA NA
8	~~Palihiolo~~ Pahiliholo St & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	48 **	E F
9	Kealaka'a St & Palani Rd (SR 190) [a]	A.M. P.M.	NC NC	** 33	F D
10	Palani Rd & Uluaoa St (SR 190) [a]	A.M. P.M.	NC NC	** **	F F
11	Queen Ka'ahumanu Hwy (SR 19) & Kealakehe Hwy	A.M. P.M.	0.742 0.652	20 11	B B
12	Ane Keohokalole Hwy & Kealakehe Hwy [a]	A.M. P.M.	NC NC	12 11	B B

Note:

* Delay indicates average stopped delay per vehicle in seconds for signalized intersections. The worst case vehicular delay is reported for stop-controlled intersections.

** Indicates oversaturated conditions. Delay cannot be calculated.

NA = Not Applicable

NC = Not Calculated

[a] Intersection is controlled by stop signs on the minor approaches.

[b] Future intersection

4.4.4 Future Traffic Conditions without the Project

In order to evaluate the potential impact of traffic generated by the proposed project on the surrounding street system, it was necessary to develop estimates of future traffic conditions in the area both with and without the project.

Future traffic conditions without the proposed project reflect traffic increases due to general regional growth and development, as well as traffic increases generated by other specific developments near the project site. These conditions are referred to as the "cumulative base condition" (i.e., no project conditions). The sum of the cumulative base and project-generated traffic represents the "cumulative plus project" conditions. Development of these future 2020 traffic scenarios conditions is described below.

The cumulative base traffic projections include two elements. The first element is growth in the existing background traffic volumes reflecting the effects of overall regional growth and development in and around the study area, referred to as ambient growth. The second is the traffic generated by specific cumulative projects located in or near the study area.

4.4.4.1 Areawide Traffic Growth and Cumulative Development Projects

Traffic projections were estimated on the basis of actual traffic growth on Queen Ka'ahumanu Highway (SR 19) and Mamalahoa Highway/Palani Road (SR 190) between 1998 and 2004, which shows that peak hour traffic volumes have increased at a simple growth rate of approximately 5 percent per year during the period. That estimate is consistent with the level of growth identified in the *Keahole to Honaunau Regional Circulation Plan* (2006). Accordingly, the 2007 northbound and southbound volumes were increased by 65 percent (5 percent annual simple growth rate x 13 years) through 2020.

Information regarding potential future projects either under construction, planned, or proposed for development within or near the study area was obtained from several sources. Estimated trips from the related projects were assigned to the roadway system based on their anticipated distribution patterns. The geographic distribution of traffic generated by new developments

depends on several factors, such as the type and density of the proposed land uses, the geographic distribution of the population from which employees and/or patrons may be drawn, the geographic distribution of activity centers (employment, commercial, and other) to which residents of proposed residential projects may be drawn, and the location in relation to the surrounding street system.

The resulting cumulative base traffic volumes, representing future conditions without the project for year 2020, are presented in Figure 4-5~~Figure 45~~. These future projections take into account the estimated overall growth in the surrounding area without the addition of traffic generated by the proposed Keahuolu Affordable Housing P~~p~~roject.

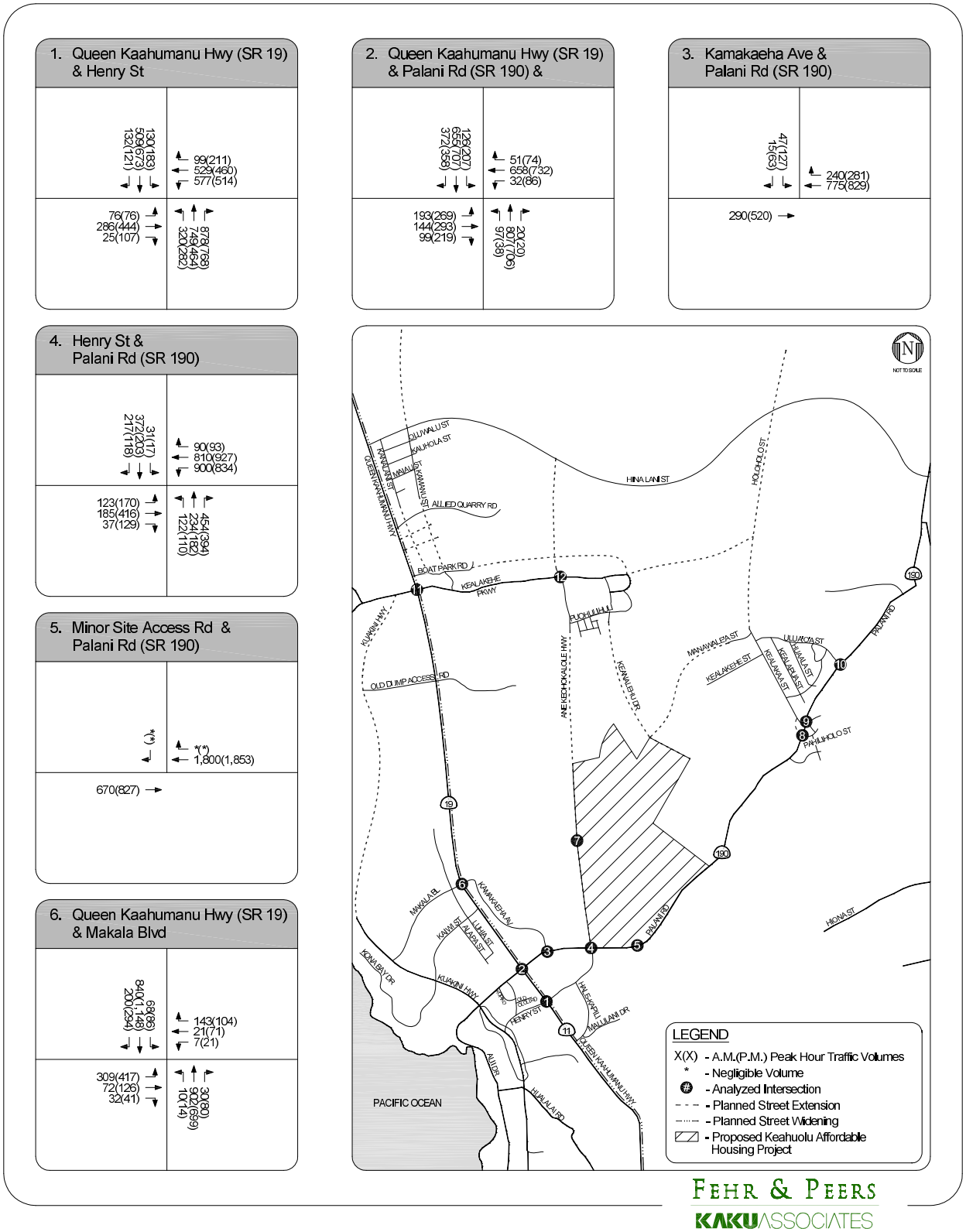

Figure 4-5
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES

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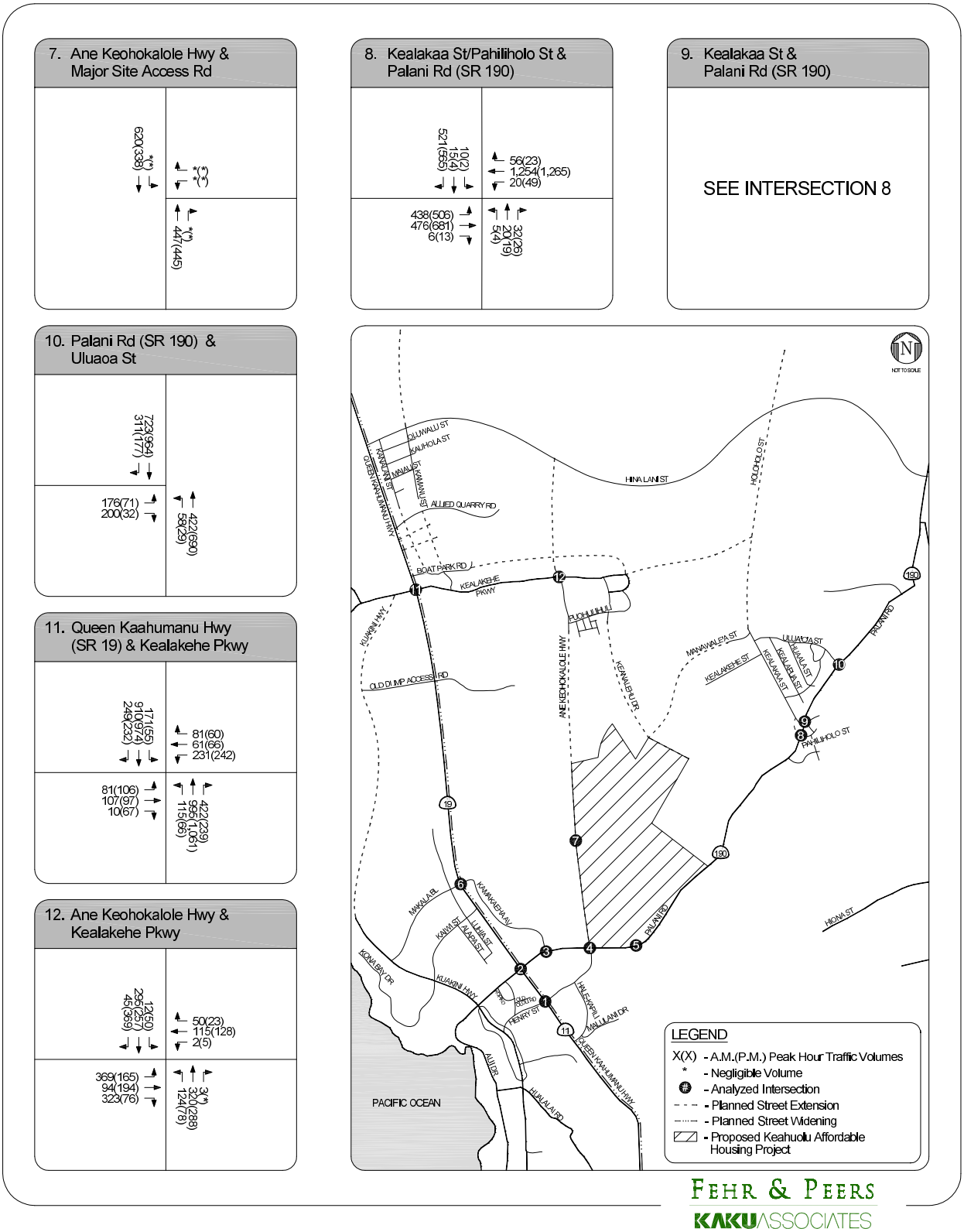

Figure 4-5
CUMULATIVE BASE PEAK HOUR TRAFFIC VOLUMES (continued)

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4.4.4.2 Baseline Street System Improvements

Several key roadway improvements in or near the study area are planned for completion by 2020. These improvements, whether the result of local capital improvement programs or in connection with planned or approved projects, would result in dramatically improved mobility options for residents and visitors and in capacity changes at various locations throughout the study area.

- Queen Ka‘ahumanu Highway – The main arterial highway through Kailua-Kona is being widened from two to four lanes (two in each direction) with a median from Kona International Airport to Henry Street in Kailua.
- Main Street (Kamanu Street) – Kamanu Street will be extended to connect with Kealakehe Parkway and north to the proposed University Drive.
- Ane Keohokalole (Mid-Level Road) – This project will extend Henry Street from Palani Road northward to Hina Lani Street.
- Kealaka‘a Street/Holoholo Street Extension – This planned street would extend Kealaka‘a Street northward to Holoholo Street and the planned Kealakehe Parkway.
- Kuakini Highway – Kuakini Highway will be extended northward to connect to Kealakehe Parkway, forming a new north-south roadway on the makai side of Queen Ka‘ahumanu Highway.
- Intersection of Kealaka‘a Street and Palani Road – Two T-intersections, Kealaka‘a Street & Palani Road and ~~Palihiolo~~ Pahiliholo Street & Palani Road, are being merged into a signalized intersection with additional turn lanes. This will result in the existing intersection of Kealaka‘a Street & Palani Road (Intersection 9) being limited to right turns in, with all other turning movements focused at Pahiliholo Street & Palani Road (Intersection 8). For this reason, only the latter of these locations is analyzed in the future scenarios.
- Keanalehu Drive and Manawale‘a Street – These streets are currently being constructed just north of the project site to create a new mauka-makai connection.

4.4.4.3 Cumulative Base Traffic Volumes w~~W~~ithout the Project

Forecasts of cumulative base traffic volumes were developed by adding the total projected traffic growth to the background existing volumes and distributing it over the future street network. Estimated traffic shifts for the 2020 horizon year were developed based on field observations and current and future land use patterns. Approximately 20 percent of the vehicles traveling through Queen Ka‘ahumanu Highway and Mamalahoa Highway/Palani Road are expected to divert to

the planned new roads described above that will be parallel to these existing highways. The resulting projected traffic volumes at the analyzed intersections, illustrated in Figure 4-5~~Figure 45~~, represent the 2020 cumulative base conditions, i.e., future conditions without the project.

4.4.5 Future Traffic Conditions w~~W~~ith the Project

Development of future traffic projections for the proposed project involved a three-step process. This process included the estimation of project trip generation, trip distribution, and trip assignment.

4.4.5.1 Project Trip Generation

Trip generation rates found in *Trip Generation, 7th Edition* (Institute of Transportation Engineers, 2003) were used to estimate number of trips to and from the proposed project. The trip generation rates used in this study and the estimated new trips generated by the proposed project Concepts A, B, and C are summarized in Table 4-10, Table 4-11~~Table 4-11~~, and Table 4-12~~Table 4-12~~, respectively.

As shown in Table 4-10, Concept A is estimated to generate about 9,953 daily trips, including approximately 1,178 trips during the morning peak hour (631 inbound and 547 outbound) and approximately 1,046 trips during the evening peak hour (543 inbound and 503 outbound).

As shown in Table 4-11~~Table 4-11~~, Concept B is estimated to generate about 16,034 daily trips, including approximately 1,511 trips during the morning peak hour (665 inbound and 846 outbound) and approximately 1,629 trips during the evening peak hour (918 inbound and 711 outbound).

As shown in Table 4-12~~Table 4-12~~, Concept C is estimated to generate about 17,617 daily trips, including approximately 1,580 trips during the morning peak hour (646 inbound and 934 outbound) and approximately 1,695 trips during the evening peak hour (973 inbound and 722 outbound).

Table 4-10: Preliminary Trip Generation Estimates
~~Keahuolu Affordable Housing Project~~ - Concept A [a]

Land Use	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
			Trip Gen	In	Out	Trip Gen	In	Out
Trip Rates [b]								
Single Family Housing	per Dwelling Unit[1]	9.57	0.75	25%	75%	1.01	63%	37%
Apartments	per Dwelling Unit[1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	per 1,000 square feet[2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
			In	Out	Total	In	Out	Total
Single Family Housing	400 DU	3,828	75	225	300	255	149	404
Apartments	620 DU	4,166	63	253	316	250	134	384
Commercial/Retail	197,000 sf	2,169	268	37	305	50	244	294
High School	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT		12,097	732	648	1,380	634	594	1,228
Less: Internal Capture [d]		*-2,144*	*-101*	*-101*	*-202*	*-91*	*-91*	*-182*
Net New Trips		9,953	631	547	1,178	543	503	1,046

Notes:

[1] Dwelling Unit = DU

[2] 1,000 square feet = ksf

[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii*, Belt Collins Hawaii Ltd., June 2007.

[b] Source: *Trip Generation, 7th Edition*, Institute of Transportation Engineers (ITE), 2003.

[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.

[d] Internal trip capture estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition*, ITE, 2004.

Table 4-11: Preliminary Trip Generation Estimates
~~Keahuolu Affordable Housing Project~~ - Concept B [a]

Land Use	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
			Trip Gen	In	Out	Trip Gen	In	Out
Trip Rates [b]								
Single Family Housing	per Dwelling Unit[1]	9.57	0.75	25%	75%	1.01	63%	37%
Apartments	per Dwelling Unit[1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	per 1,000 square feet[2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
			In	Out	Total	In	Out	Total
Single Family Housing	600 DU	5,742	113	338	450	382	224	606
Apartments	1,240 DU	8,333	126	506	632	500	269	769
Commercial/Retail	197,000 sf	2,169	268	37	305	50	244	294
High School	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT		18,178	833	1,014	1,846	1,011	804	1,815
Less: Internal Capture [d]		*-2,144*	*-168*	*-168*	*-335*	*-93*	*-93*	*-186*
Net New Trips		16,034	665	846	1,511	918	711	1,629

Notes:

[1] Dwelling Unit = DU

[2] 1,000 square feet = ksf

[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii,* Belt Collins Hawaii Ltd., June 2007.

[b] Source: *Trip Generation, 7th Edition*, Institute of Transportation Engineers (ITE), 2003.

[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.

[d] Internal trip capture estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition*, ITE, 2004.

Table 4-12: Preliminary Trip Generation Estimates
~~Keahuolu Affordable Housing Project~~ - Concept C [a]

Land Use	Rate	Daily	A.M. Peak Hour			P.M. Peak Hour		
			Trip Gen	In	Out	Trip Gen	In	Out
Trip Rates [b]								
Apartments	per Dwelling Unit[1]	6.72	0.51	20%	80%	0.62	65%	35%
Commercial/Retail	per 1,000 square feet[2]	11.01	1.55	88%	12%	1.49	17%	83%
High School	per ksf	12.89	3.06	71%	29%	0.97	54%	46%

Land Use	Size	Daily	A.M. Peak Hour			P.M. Peak Hour		
			In	Out	Total	In	Out	Total
Apartments	2,330 DU	15,658	238	950	1,188	939	506	1,445
Commercial/Retail	197,000 sf	2,169	268	37	305	50	244	294
High School	150 ksf [c]	1,934	326	133	459	79	67	146
TOTAL PROJECT		19,761	832	1,120	1,952	1,068	817	1,885
Less: Internal Capture [d]		*-2,144*	*-186*	*-186*	*-372*	*-95*	*-95*	*-190*
Net New Trips		17,617	646	934	1,580	973	722	1,695

Notes:

[1] Dwelling Unit = DU

[2] 1,000 square feet = ksf

[a] Source: *Keahuolu Affordable Housing Project Master Plan, Kailua-Kona, Hawaii,* Belt Collins Hawaii Ltd., June 2007.

[b] Source: *Trip Generation, 7th Edition*, Institute of Transportation Engineers (ITE), 2003.

[c] Assume that approximately 30% of the total school site (12 acres) is occupied by building area.

[d] Internal trip capture estimates were based on methodology described in *Trip Generation Handbook, 2nd Edition*, ITE, 2004.

4.4.5.2 Project Trip Distribution and Trip Assignment

Factors considered in the development of the project trip distribution include a review of historic traffic volume data in the area, observations of existing traffic patterns and discussions with residents, the geographic distribution of employment and commercial activity in the vicinity, and the proposed street extension program described in the *Keahole to Honaunau Regional Circulation Plan* (2006). Based on these factors, the following trip distribution pattern was estimated for the project-generated traffic, as illustrated in Figure 4-6~~Figure 46~~:

- Northwest 40%
- Northeast 20%
- Southwest 40%

The project trip assignment took into account the roadway network anticipated to be in place by 2020, when the project would be fully built out. Figure 4-7~~Figure 47~~, Figure 4-8~~Figure 48~~, and Figure 4-9~~Figure 49~~ illustrate the assignment of new project-related traffic at each study intersection under the three housing concept alternatives.

4.4.5.3 Cumulative Plus Project Traffic Volumes

The project-generated traffic volumes were added to the cumulative base traffic projections to develop the cumulative plus project traffic (*Future w~~W~~ith Project*) forecasts for 2020. Figure 4-10~~Figure 410~~, Figure 4-11~~Figure 411~~, and Figure 4-12~~Figure 412~~ illustrate the projected cumulative plus project A.M. and P.M. peak hour traffic volumes at each of the 12 study intersections under the three housing concept alternatives. Appendix A of the Traffic Report depicts the anticipated future lane configurations at the study intersections, including assumptions regarding the future intersections of Palani Road (SR 190) & Minor Site Access Road, Ane Keohokalole Highway & Major Site Access Road, and the north leg of Henry Street & Palani Road (see Appendix F).

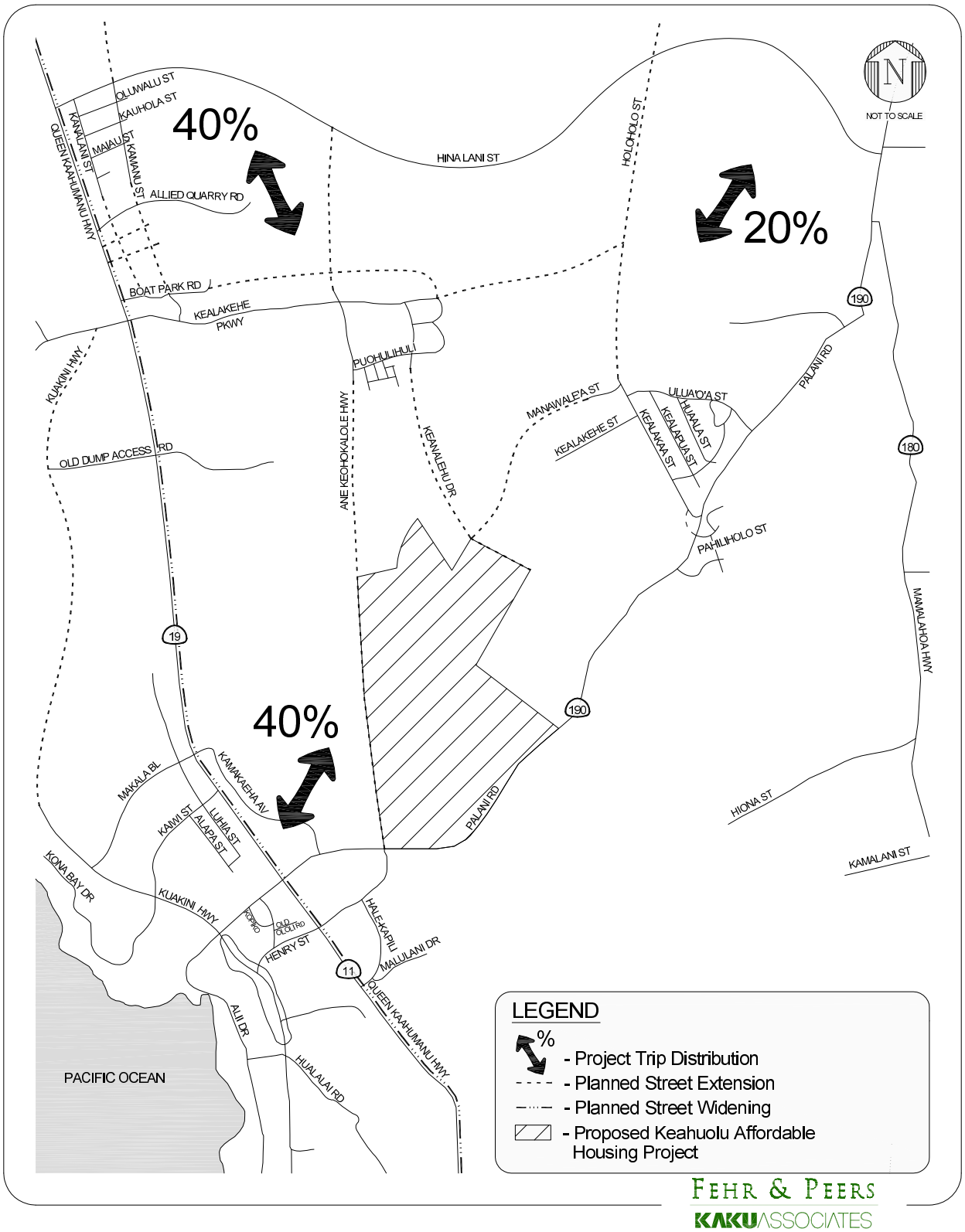

Figure 4-6
PROJECT TRIP DISTRIBUTION

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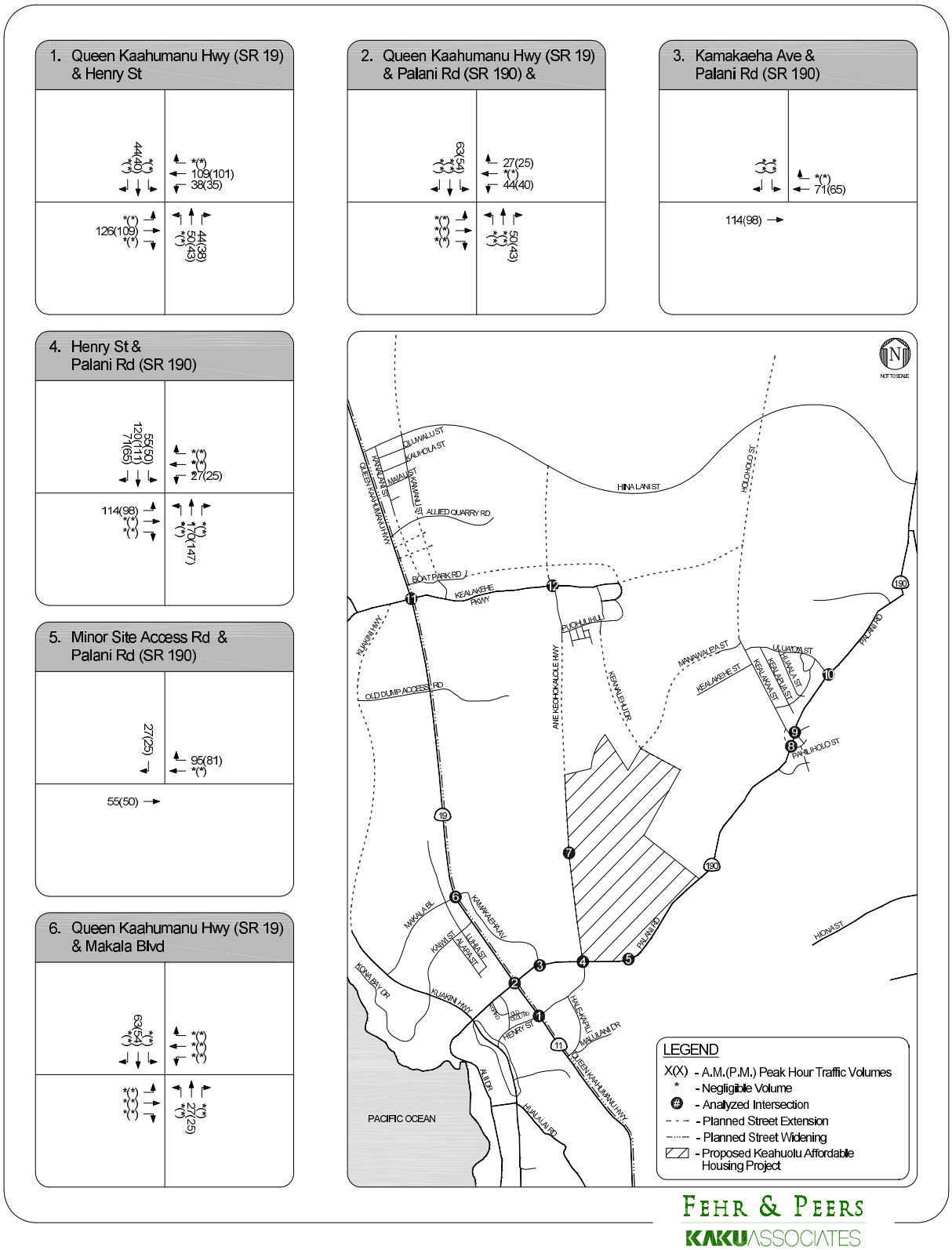

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Figure 4-7
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT A

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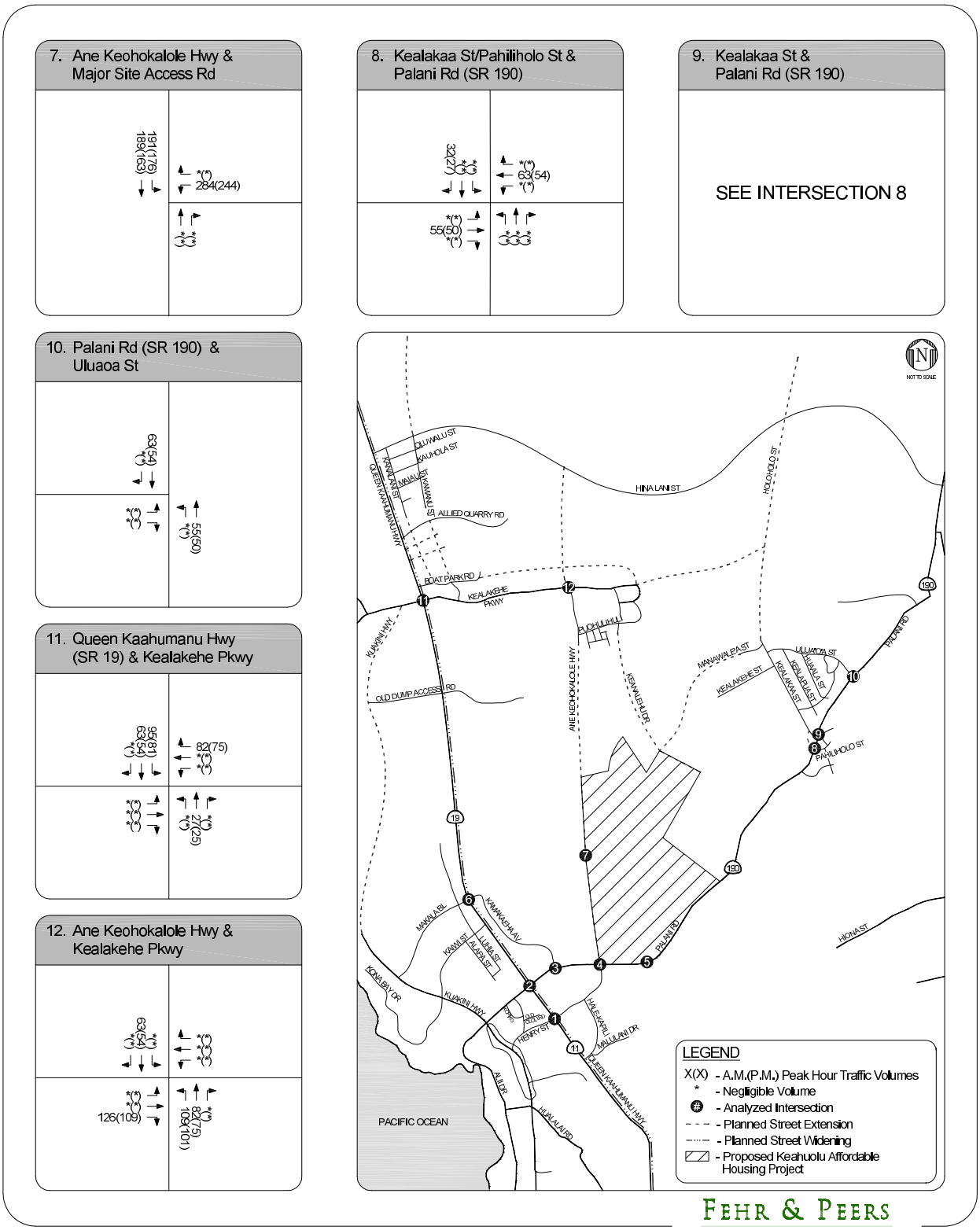

Figure 4-7
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT A (continued)

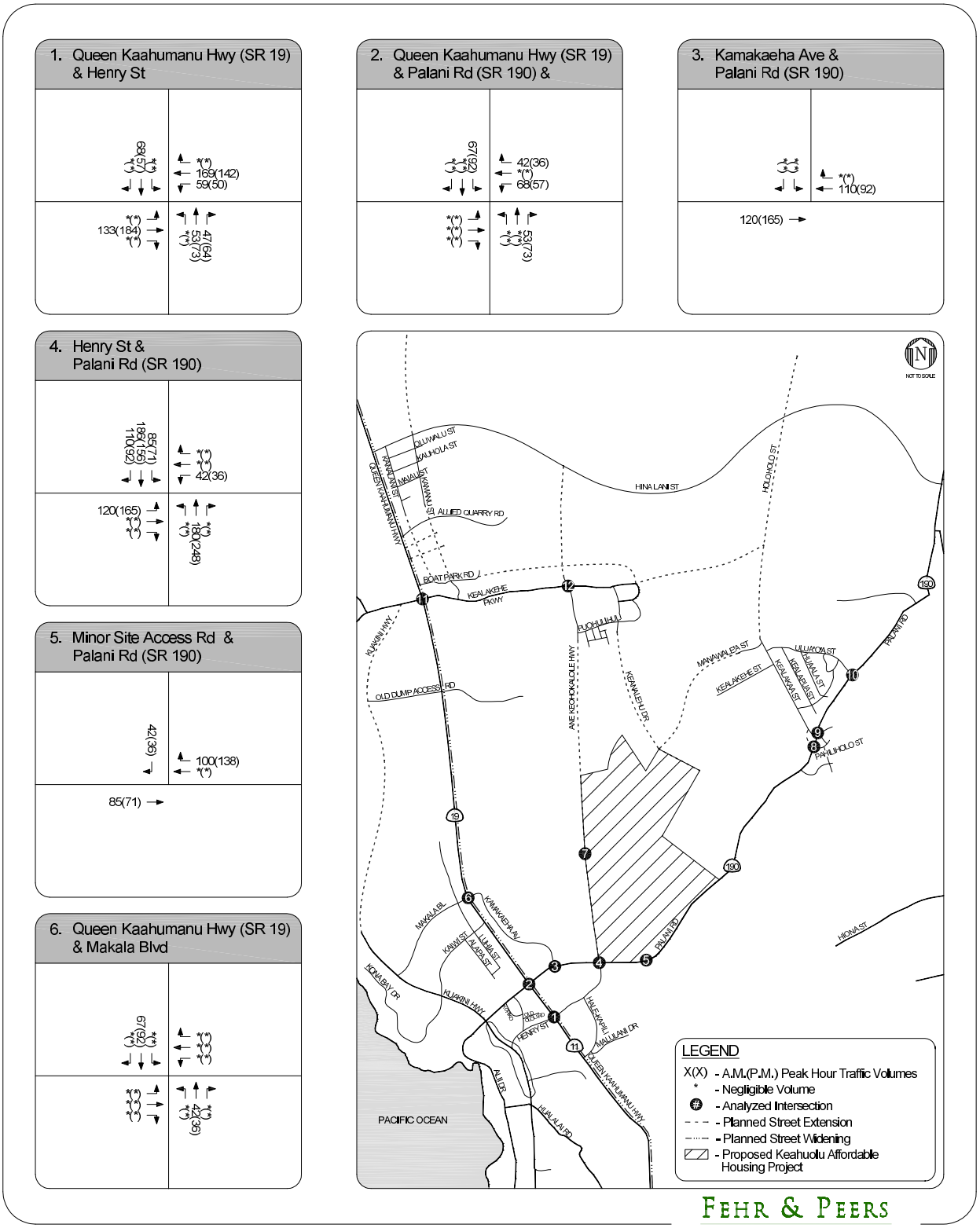

Figure 4-8
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT B

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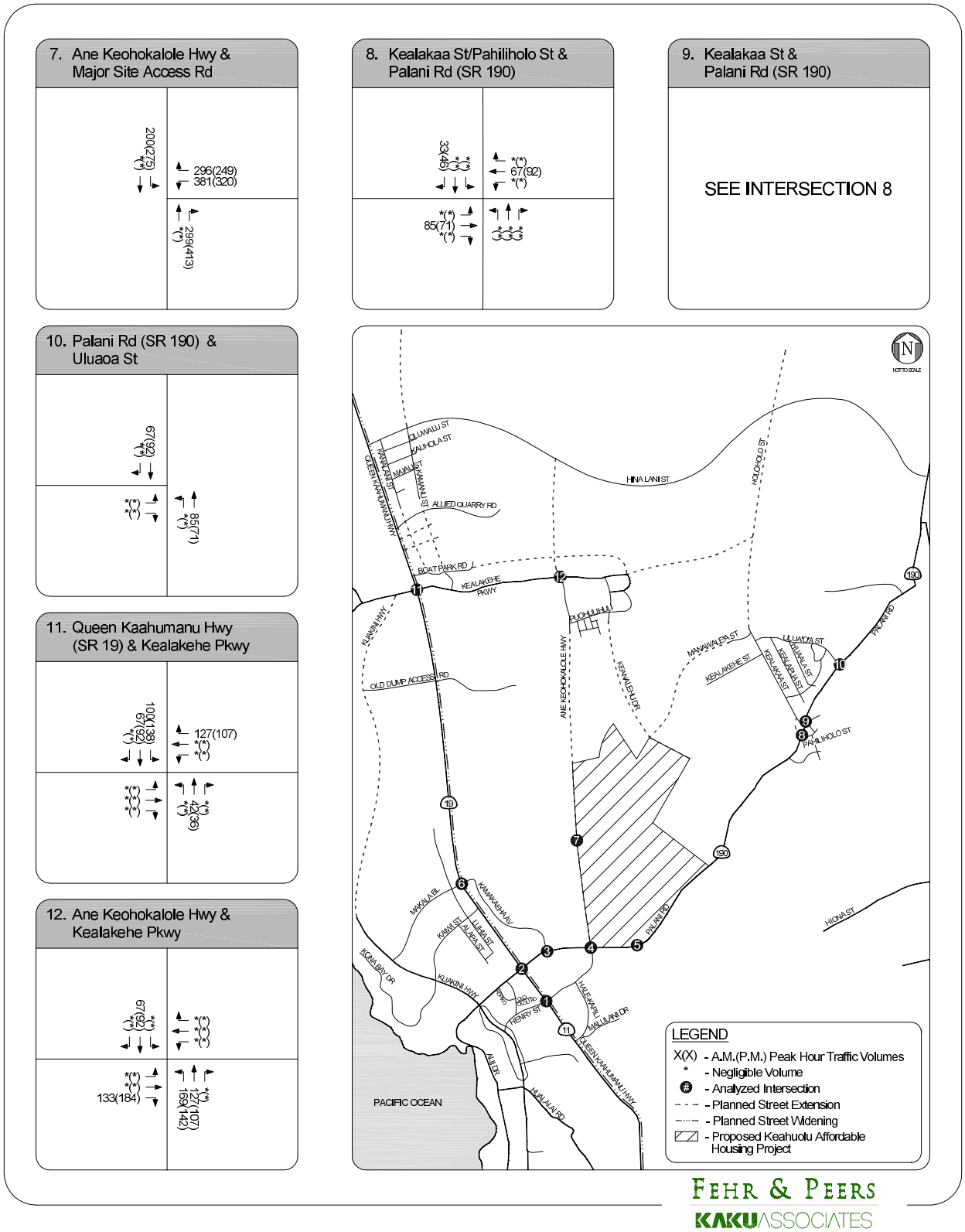

Figure 4-8
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT B (continued)

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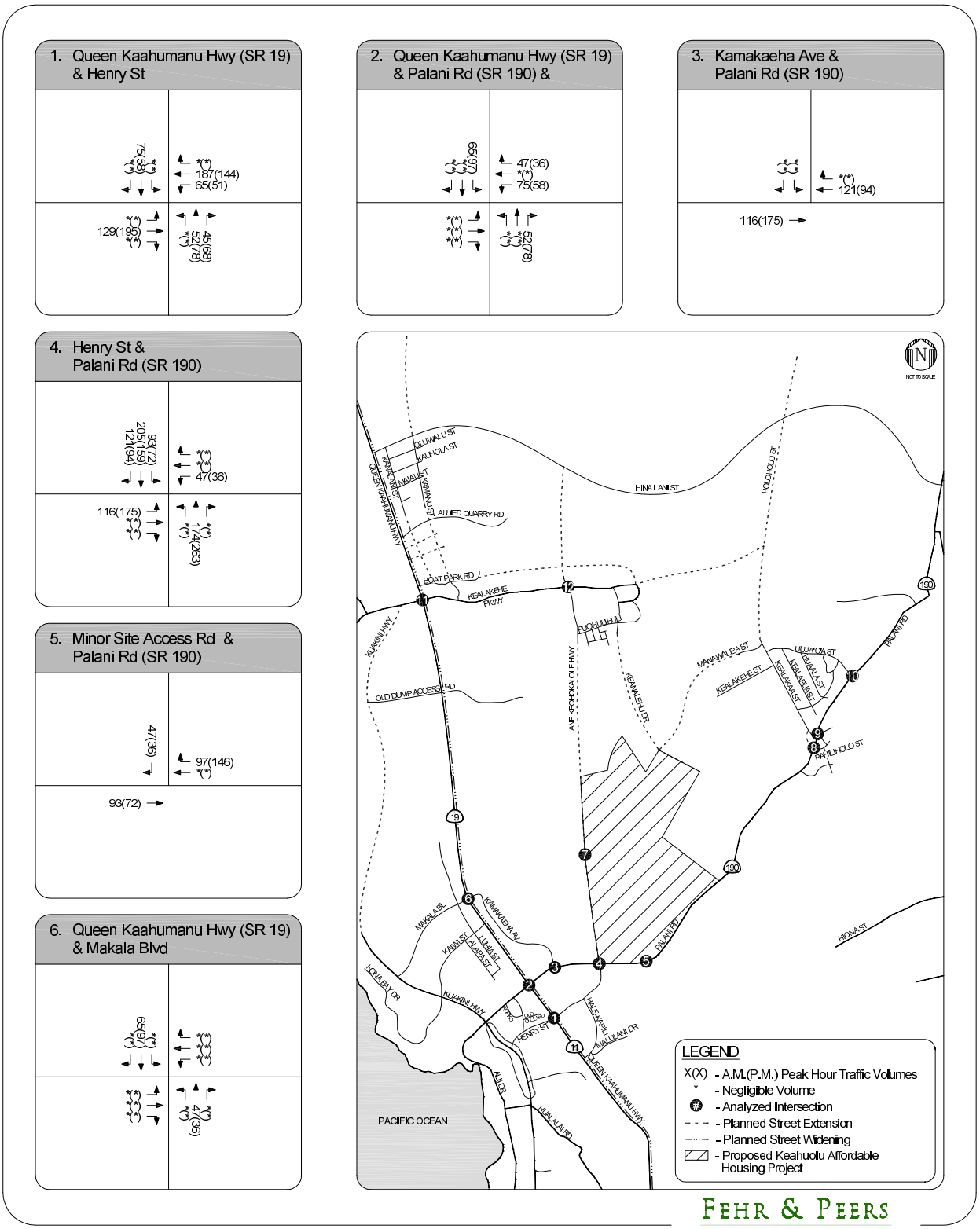

Figure 4-9
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT C

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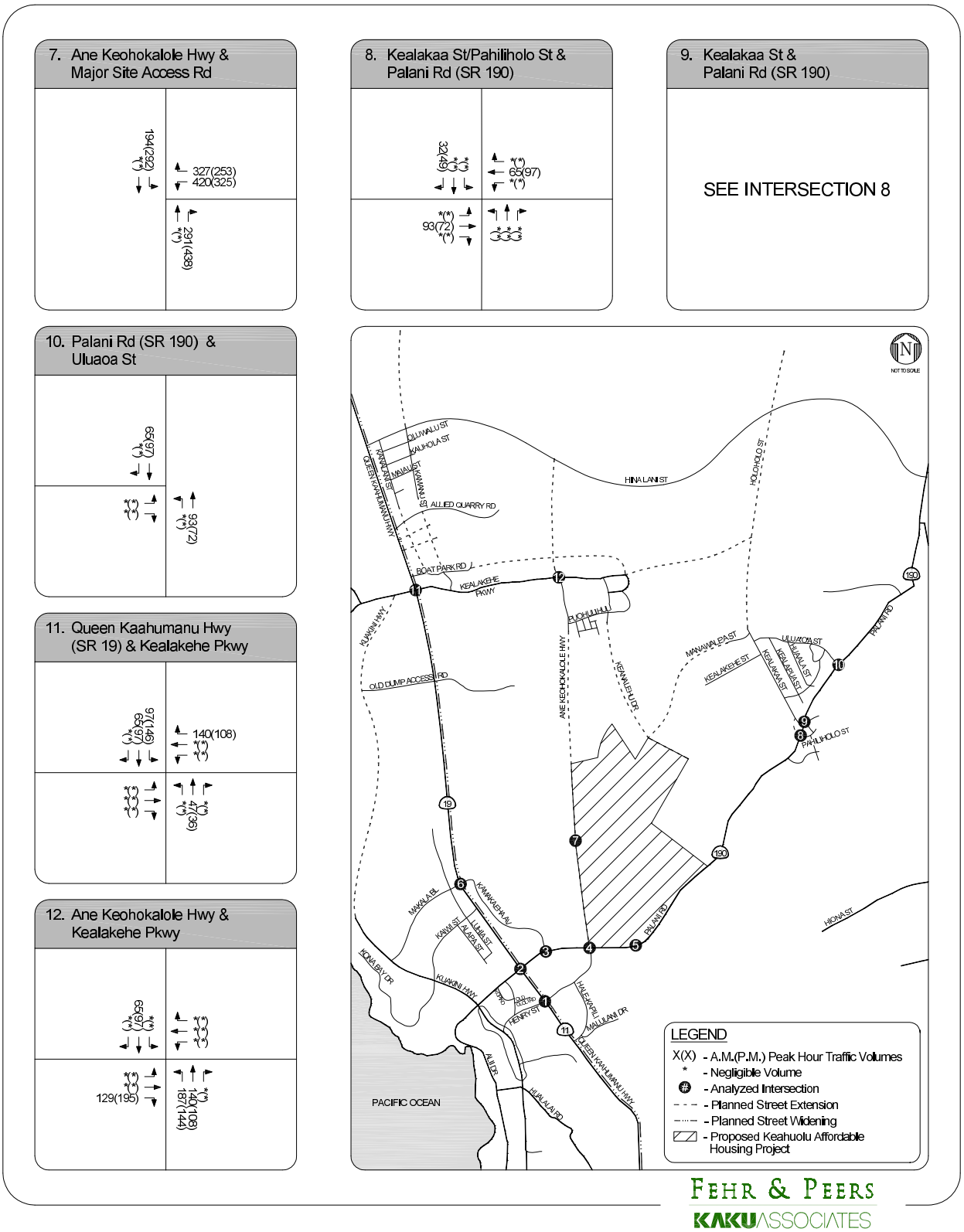

Figure 4-9
PROJECT ONLY PEAK HOUR TRAFFIC VOLUMES—CONCEPT C (continued)

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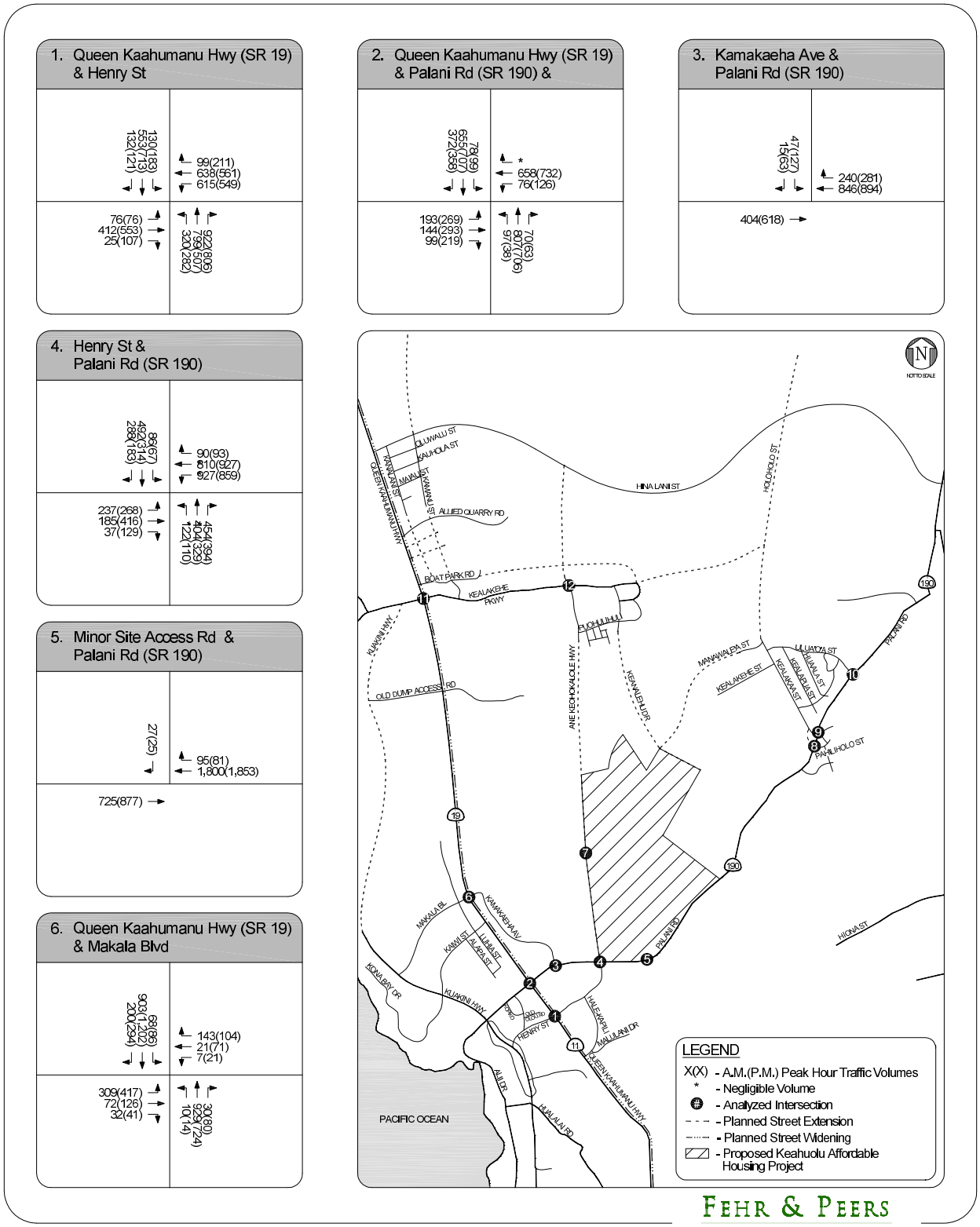

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Figure 4-10
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES—CONCEPT A

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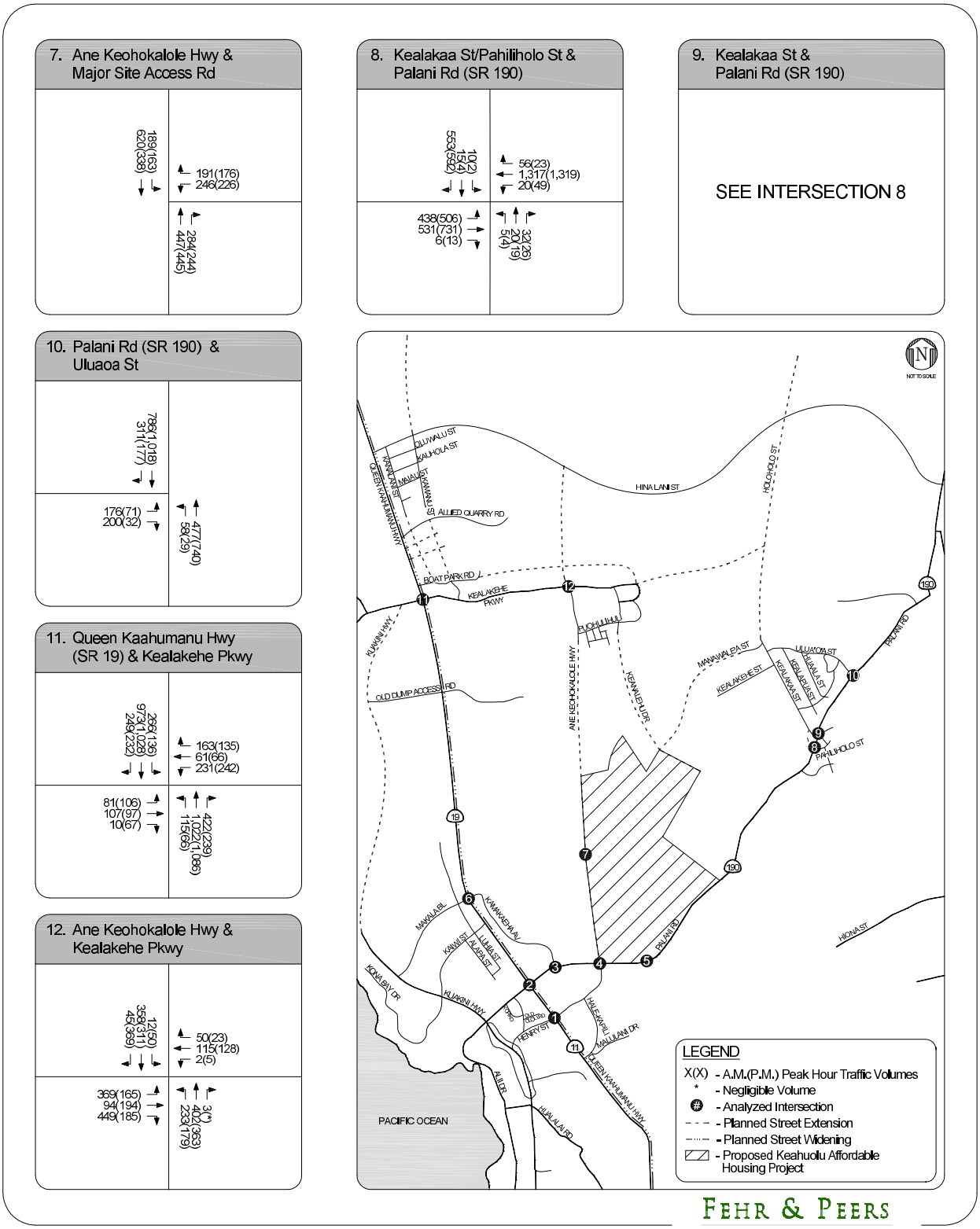

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Figure 4-10
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES—CONCEPT A (continued)

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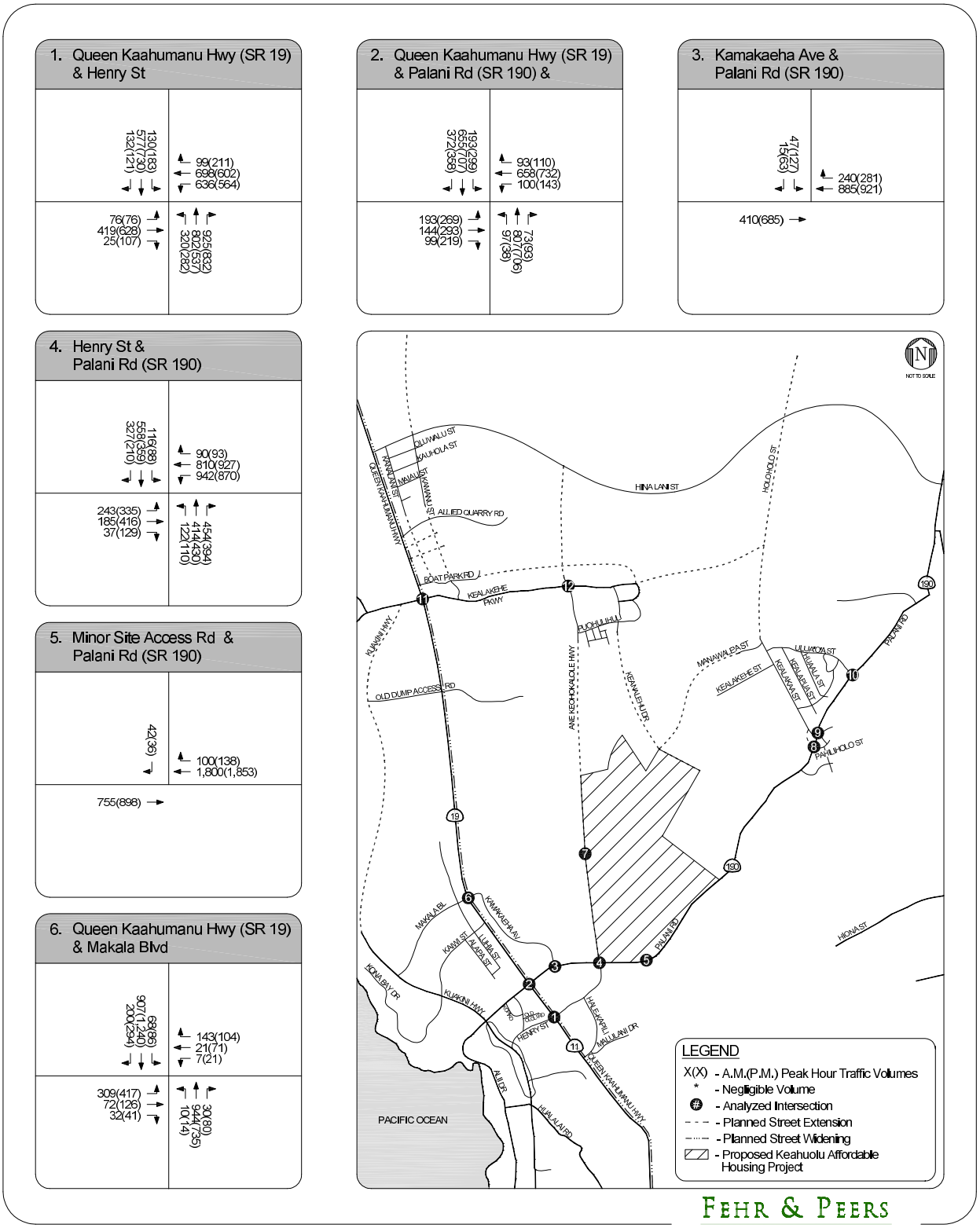

Figure 4-11
CUMULATIVE PLUS PROJECT PEAK HOUR TRAFFIC VOLUMES—CONCEPT B

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