# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# FINAL ENVIRONMENTAL ASSESSMENT

**Submitted Pursuant to Chapter 343, Hawai‘i Revised Statutes (HRS)**

**University of Hawai‘i at Hilo**

**June 2011**

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Tax Map Key Number: (3rd) 2-4-001:122 (por.) and 173

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CLASS OF ACTION:

Use of State Land
Use of State Funds

This document is prepared pursuant to:
the Hawai‘i Environmental Protection Act,
Chapter 343, Hawai‘i Revised Statutes (HRS), and
Title 11, Chapter 200, Hawai‘i Department of Health Administrative Rules (HAR)

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## SUMMARY

The University of Hawai‘i at Hilo (UH Hilo) plans to drill an exploratory water well on UH Hilo land above Komohana Street, north of the Puainako Street Extension. Construction of the exploratory well will involve clearing, grubbing and minor grading of the site for the well pad and access road to the well site. Well construction will include drilling, casing, testing, and disinfecting the well. If the exploratory well phase is successful, the well will be outfitted for production. Conversion to a production well will add a production pump (currently expected to be rated at 1,750 gallons per minute) and related appurtenances, a 16-inch transmission waterline to connect to an existing 1.0 million gallon water tank reservoir, control building, electrical work, a 12-foot wide access road, and well site landscaping and fencing. Once construction for the production well phase is completed, it will be dedicated to the Hawai‘i County Department of Water Supply (DWS), per an intergovernmental agreement between the DWS and UH Hilo currently being developed. The new UH Hilo well is intended to develop a maximum of 2.5 million gallons per day (mgd) and an average of 1.66 mgd of groundwater.

This project is necessary to meet UH Hilo’s future growth, including buildings for the Ka Haka ‘Ula O Ke‘elikōlani College of Hawaiian Language buildings, the College of Pharmacy, and student housing. The well and associated facilities are a critical step in allowing UH Hilo to proceed with its orderly growth, which benefits students, the Big Island community, and the entire State of Hawai‘i. The project site has no valuable natural, historical or cultural resources. No streams or water features are present or would be affected, and the use is compatible with nearby land uses.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| BMP | Best Management Practice |
| CWRM | Hawai‘i State Commission on Water Resource Management |
| DHHL | Department of Hawaiian Home Lands |
| DLNR | Hawai‘i State Department of Land and Natural Resources |
| DWS | Hawai‘i County Department of Water Supply |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| ESA | Environmental Site Assessment |
| FIRM | Flood Insurance Rate Map |
| FONSI | Finding of No Significant Impact |
| gpd | Gallons per day |
| gpm | Gallons per minute |
| HCWUDPU | Hawai‘i County Water Use and Development Plan Update |
| HDOH | Hawai‘i State Department of Health |
| HAR | Hawai‘i Administrative Rules |
| HEPA | Hawai‘i Environmental Policy Act |
| HCGP | Hawai‘i County General Plan |
| HRS | Hawai‘i Revised Statutes |
| IWS | Individual Wastewater System |
| MCL | Maximum Contaminant Level |
| MG | Million gallons |
| mgd | Million gallons per day |
| mg/L | Milligrams per liter |
| msl | Mean sea level |
| OEQC | Hawai‘i State Office of Environmental Quality Control |
| SFHA | Special Flood Hazard Area |
| SHPD/O | State Historic Preservation Division/Officer |
| SMA | Special Management Area |
| UH | University of Hawai‘i |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USNRCS | U.S. Natural Resources Conservation Service |

# 1 PROJECT LOCATION, DESCRIPTION AND ALTERNATIVES

## 1.1 Project Location, Description and Purpose and Need

*Project Location and Description*

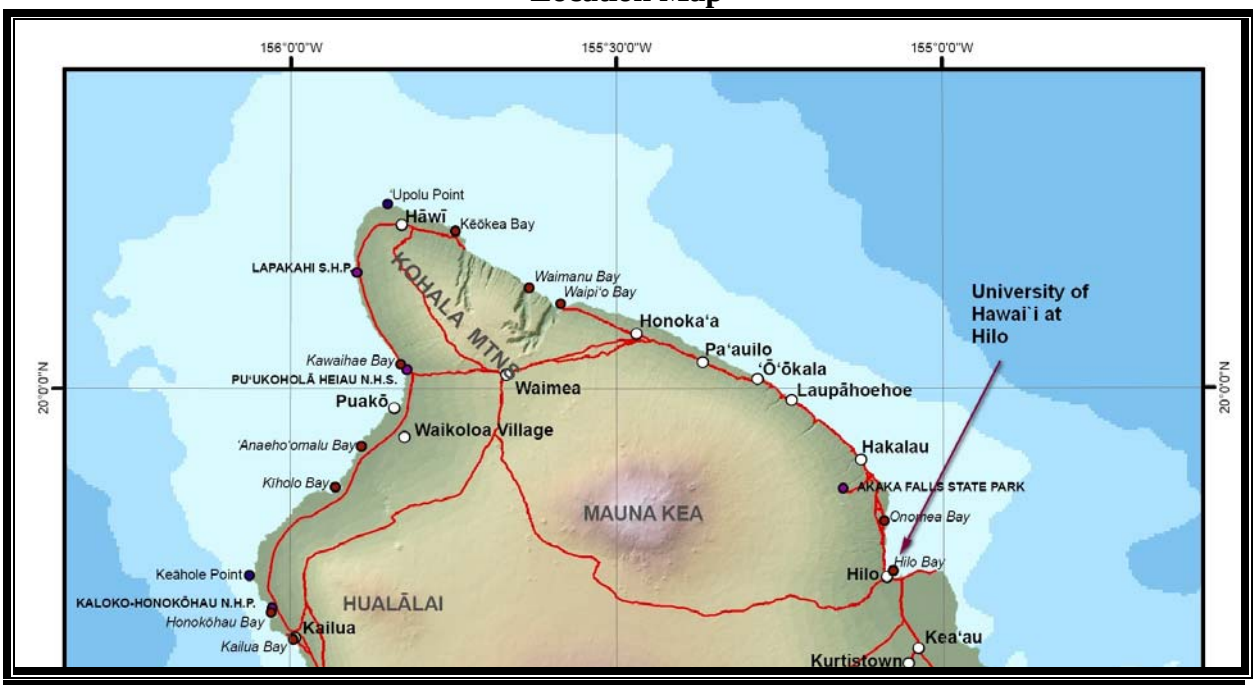
The University of Hawaiʻi at Hilo (UH Hilo) plans to drill an exploratory water well on UH Hilo land above Komohana Street, north of the Puainako Extension (Figures 1-4). Construction of the exploratory well will involve clearing, grubbing and minor grading for the well pad and access road to the well site. Well construction will include drilling, casing, testing, and disinfecting the well. If the exploratory well phase is successful, the well will be outfitted for production. Conversion to a production well will add a production pump (currently expected to be rated at 1,750 gallons per minute) and related appurtenances, a 16-inch transmission waterline, control building, electrical work, 12-foot wide access roads, and well site landscaping and fencing. Once construction for the production well phase is completed, it will be dedicated to the Hawaiʻi County Department of Water Supply (DWS), per an intergovernmental agreement between the DWS and UH Hilo currently being developed. The new UH Hilo well is intended to develop a maximum of 2.5 million gallons per day (mgd) and an average of 1.66 mgd of groundwater.

The well will be located at an elevation of 410 feet above sea level on a portion of TMK 2-4-001:122 (which is State land comprising 267.030 acres that is planned for University uses) on the north side of the Puainako Extension. The 16-inch transmission waterline will convey the water from the well via a 560-foot long pipeline to the DWS's existing 1.0 MG (million gallon) water storage tank on the south side of the Puainako Extension. Currently, this tank is supplied from existing wells in Piʻihonua and provides drinking water and fire protection to the UH Hilo campus and the University Park. The tank is located on TMK 2-4001:173, a 2.663-acre parcel owned by the State of Hawaiʻi and under Executive Order to the DWS. The budget for the project, which will be funded by the University of Hawaiʻi, is approximately $3.5 million, an estimate that will be refined through final design. After the EA is complete and permits are granted, UH will finish design and select a contractor for construction, which is scheduled for completion in 2015.

*Project Background and Purpose and Need*

This project is necessary to meet UH Hilo's future growth, which is currently constrained by the DWS's requirement for additional water source. Projects in early or advanced stages of planning or design include buildings for the Ka Haka ʻUla O Keʻelikōlani College of Hawaiian Language and the College of Pharmacy, as well as astronomical observatory base facilities at the University Research and Technology Park and a variety of new student housing and classroom facilities needed to accommodate the steady growth of enrollment. The well and associated facilities are a critical step in allowing UH Hilo to proceed with its orderly growth, which benefits students, the Big Island community, and the entire State of Hawaiʻi.

**Figure 1-1**
**Location Map**



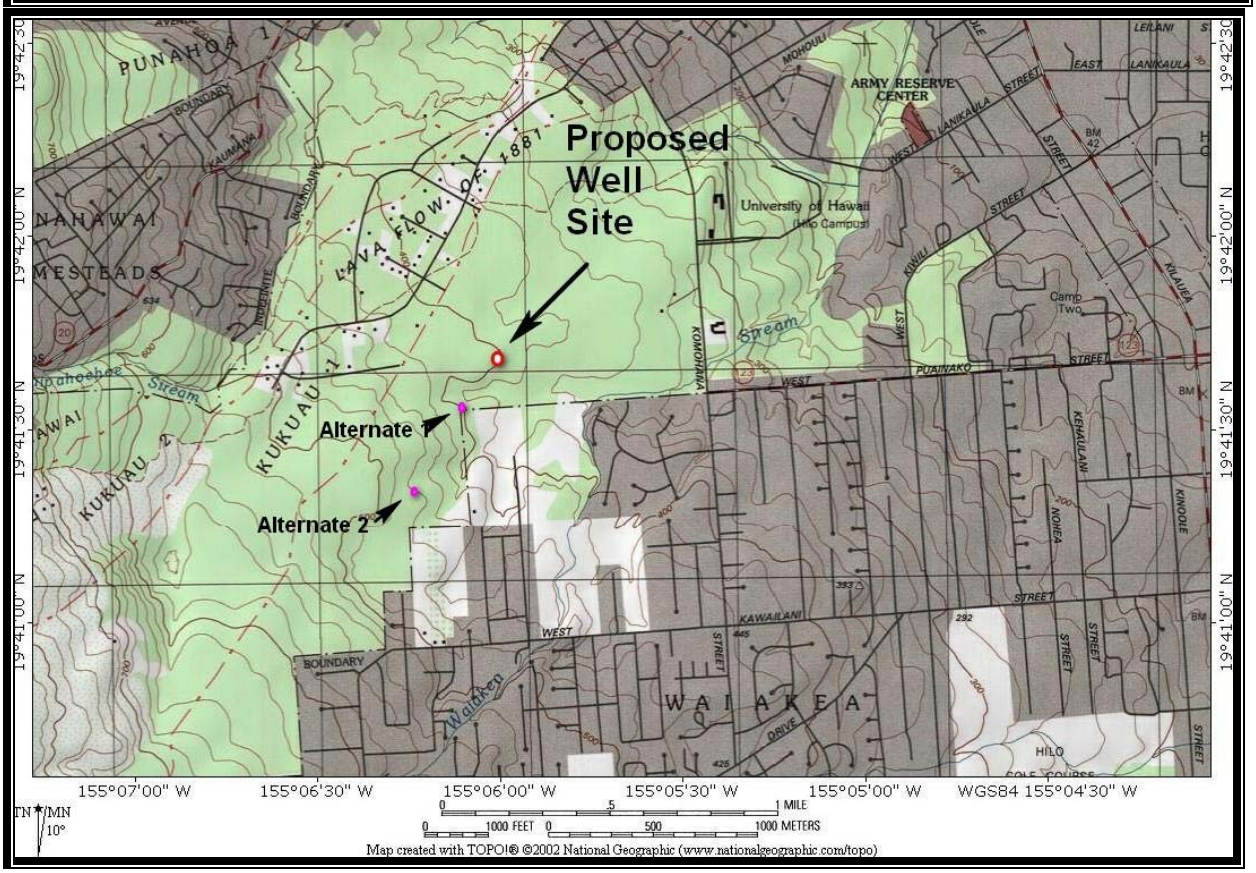
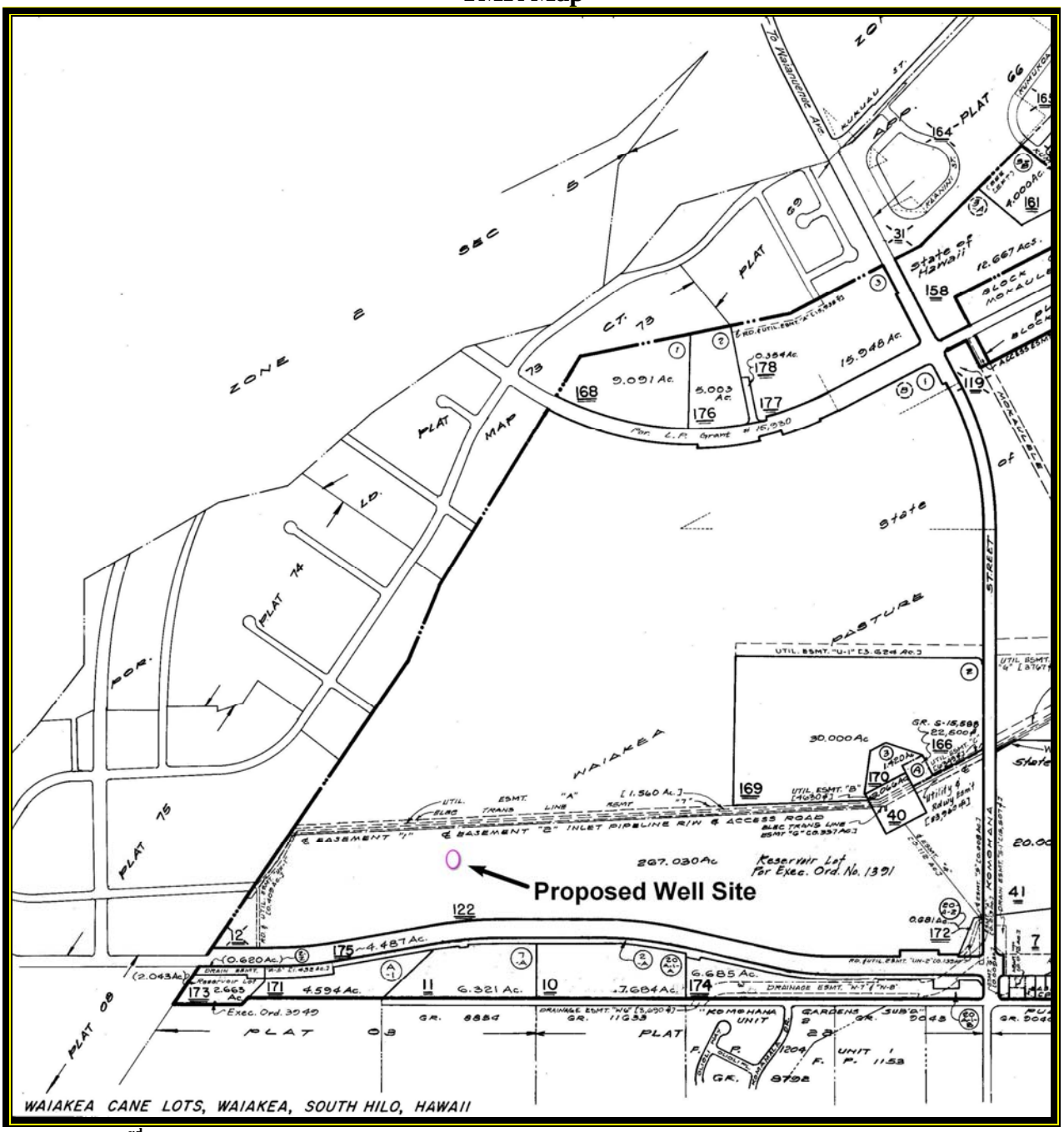



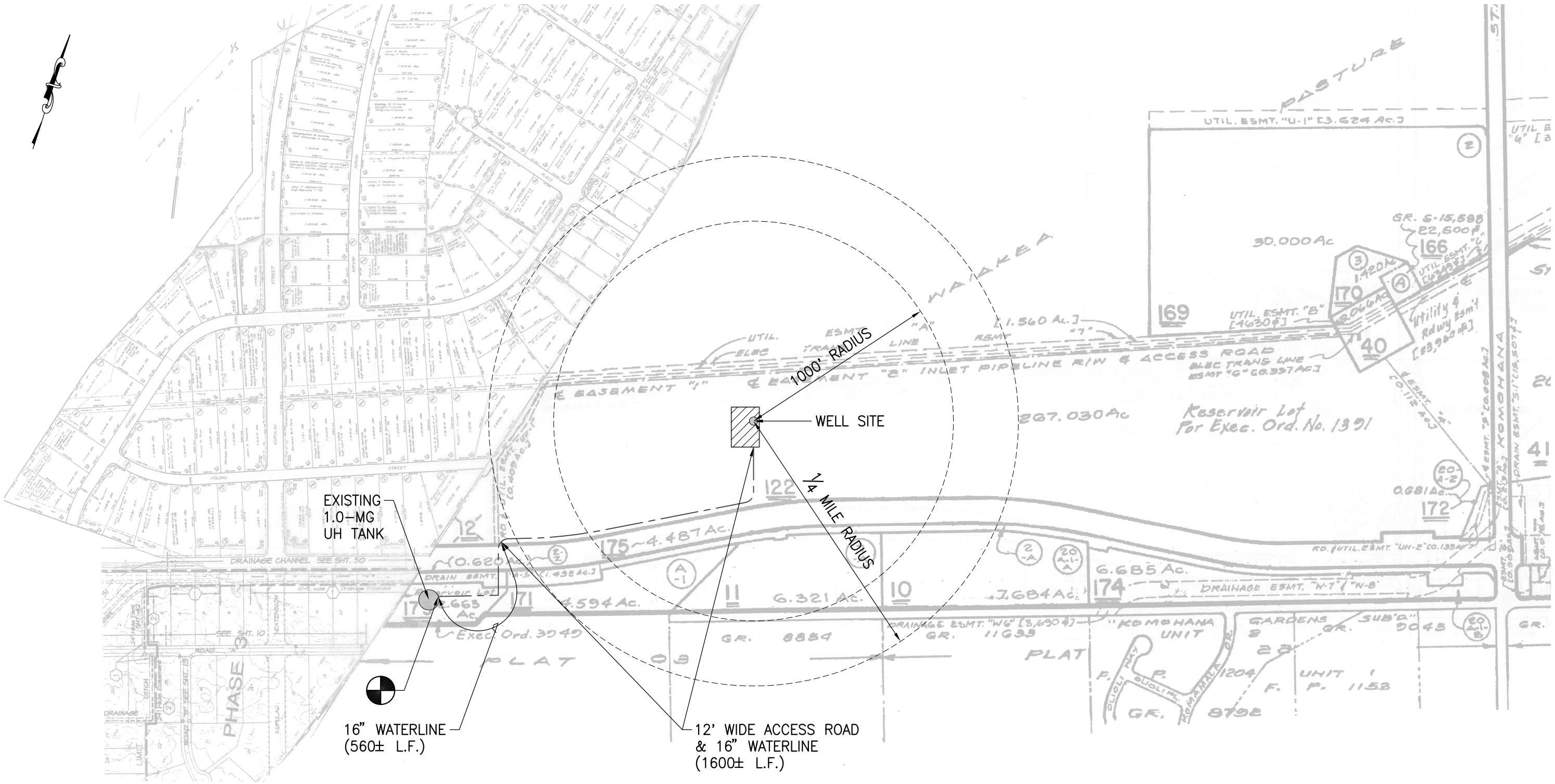
**Figure 1-2**
**TMK Map**




**Portion 3rd. 2-4-001. Source: Hawai'i County Real Property Tax Maps. Some labels removed or added**

**Figure 1-3 Project Site Photos**

**1-3a, top: Site for Future Well; 1-3b, bottom: Pipeline Route along Puainako Extension (approx. 50 feet right of edge of shoulder) and 1.0 mg Reservoir**




LEGEND:

POINT OF CONNECTION

# OVERALL SITE PLAN

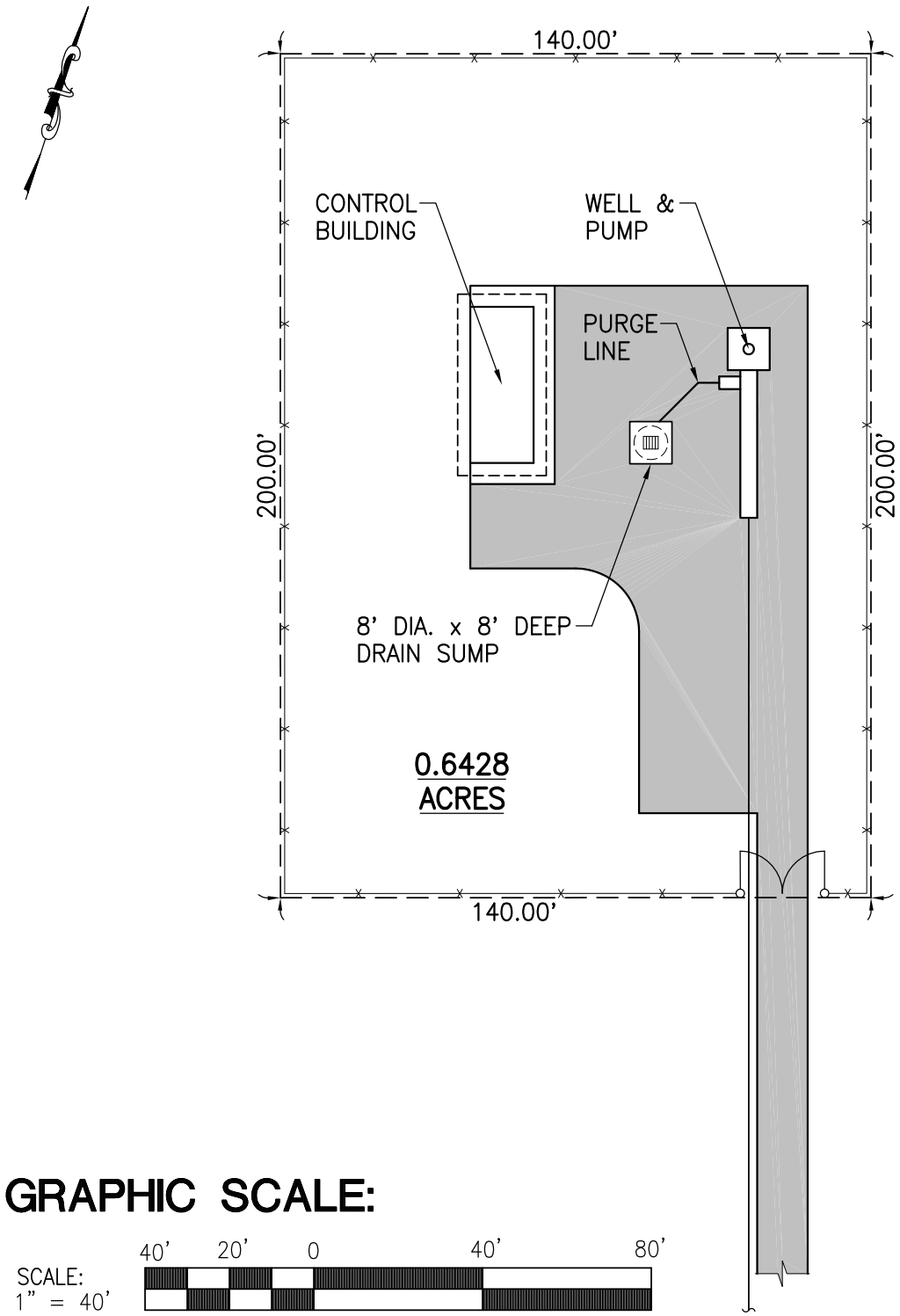
SCALE: 1"=500'

GRAPHIC SCALE:

500' 250' 0 500' 1000'

SCALE:
1" = 500'

FIGURE 1-4a




# WELL SITE - GENERAL ARRANGEMENT PLAN

SCALE: 1"=40'

**FIGURE 1-4b**

The well will also benefit the DWS and its customers by supplementing sources in the existing Hilo Water System. The new well would provide the DWS with an alternate water source located outside of the Pi‘ihonua well field. It would provide an alternate source for the DWS 1.0-MG reservoir on the Puainako Extension in the event of a break in the water transmission line from the Pi‘ihonua Wells that currently supply water to this reservoir. Furthermore, the well would provide an important water source addition to the Hilo Water System in the event a pump failure should occur in any of the Pi‘ihonua Wells. This proposed well can help to relieve the "stress" in supplying water to the system with one or more of the Pi‘ihonua wells down. The project would substantially improve the operational flexibility and reliability of the Hilo Water System.

## 1.2 Alternatives Considered

### 1.2.1 Alternative Water Well Sites

UH Hilo investigated various properties in the Waiākea area near UH Hilo that could feasibly be developed for a water well according to several criteria:

1. *Land ownership and ease and expense of acquisition*. Since the well and supporting facilities will be dedicated to the DWS, the land must be transferred to the DWS through executive order for State-owned property, or deeded fee-simple if privately owned. Of the two ownership options, it was deemed preferable to seek a location that was on State-owned land. The most ideal would be property owned and controlled by the University
2. *Hydrogeologic and elevational suitability.* Sites in the general elevation of the existing Pi‘ihonua wells would likely overlie high-level groundwater capable of pumping 2 to 3 million gallons per day but would be low enough in elevation to minimize pumping costs.
3. *Presence nearby of necessary infrastructure available to support the well site.* This includes water tank reservoirs, roads, pipelines, and electricity.
4. *Sufficient distance from neighboring properties where development is planned.* Currently, the State Department of Health requires a 1,000-foot clearance between an existing drinking water well and a new septic system, and a quarter-mile clearance for a new injection well. Municipal wells require careful siting to avoid constraining other planned uses.
5. *Sufficient distance from existing sources of contamination septic systems, injections wells, and contaminated sites.* Whenever a well is planned within 1,000 feet of a septic system or one-quarter mile of an injection well, the Department of Health and the DWS are concerned with any potential contamination to the proposed well via improper wastewater treatment and disposal from any nearby source.
6. *Elevational compatibility with the existing DWS water tank.* The well water would be pumped to an existing DWS water tank on the Puainako Extension. In order for the well to be hydraulically compatible with the water tank, the well should be located at or below the 460-foot elevation, which is the floor elevation of the tank.

Three sites that satisfied all or most of the criteria were located (see Figure 1-1). These were evaluated on the above criteria, and each well site location was found to have its advantages and disadvantages. All the sites selected were on State land, and Alternative 3 was on University land. Each site alternative met the elevational requirement, but Alternative 2 had to be moved closer to adjacent private properties to be at the proper elevation. All were in relatively close proximity to the DWS tank off of the Puainako Extension. Every alternative had a radius from currently developed properties of at least 1,000 feet, with Alternative 3 having the largest such radius (1,300 feet) and also the greatest potential to restrict septic systems and injection wells, since most land within 1,000 feet (and all such land directly *mauka*) is under UH Hilo control. Alternative 1 held a distinct advantage in terms of length of access road and water transmission pipeline in that it was closest to the DWS water tank. HELCO power is not available for any of the well site alternatives, but HELCO power is closest to Alternative 3. Alternatives 1 and 2 are on the same side of the Puainako Extension as the DWS water tank reservoir and unlike Alternative 3would not require crossing Puainako Extension with the water transmission pipeline.

Table 1-1 compares the three alternatives using the six criteria described above. Each alternative was evaluated by the criteria and given a score of poor, good, or best. Alternative 3 had the best overall score based on how well it met the requirements of these criteria, and it is the alternative that was advanced for study in this EA. The site is well suited to the proposed use with no known environmental or other concerns. As there are no reasonable alternatives that do not have substantial disadvantages relative to the project site, no other sites, including Alternatives 1 and 2, have been advanced for study in this Environmental Assessment.

**Table 1-1**
**Initial Alternative Well Sites Comparison**

| Well Site Alternative | Criteria | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Good | Good | Best | Poor | Good | Good |
| 2 | Good | Good | Good | Poor | Poor | Good |
| 3 | Best | Good | Good | Best | Best | Good |
| Recommended Well Site Alternative No. 3 | | | | | | |

### 1.2.2 Surface Water, Catchment, Wastewater Re-Use, and Desalination

Due to the high permeability of the Mauna Loa lava flows, there are no perennial streams in the Waiākea area of Hilo, although permanent springs and streams are present just a few miles west on Mauna Kea surfaces, including Wailuku Stream and its tributaries. However, surface water is more susceptible to contamination and droughts, and the U.S. Environmental Protection Agency requires that it be treated. Therefore, DWS is working to replace all existing surface water sources with groundwater, and all new sources of potable water in the County is groundwater.

Rainfall catchment is used in many parts of Hawai‘i County; in fact it is the common water system for residents of parts of Puna, South Kona, Ka‘u and Kaumana City in Hilo, where County water service is not available. There are also three public water systems using rainwater catchment on Hawai‘i Island, all in the Puna District, serving Kilauea Military Camp, Hawai‘i Volcanoes National Park and the Kulani Facility. Although catchment does provide a potable water source of last resort, it has many drawbacks, including high maintenance costs and susceptibility to microbiological and chemical contamination. Sources of contaminants vary from dead animals in the storage tank to materials eroded or leached from roofs, gutters and paint. The State Department of Health (DOH) recommends using catchment water for non-consumptive needs and obtaining drinking or cooking water from regulated public water systems and/or purchased bottled drinking water. In the case of urban Hilo, the abundant aquifer resources combined with the efficient transmission networks that relatively compact development makes possible render consideration of the far more problematic catchment system moot. UH Hilo has a policy of LEED Silver Certification for all projects, and water conservation measures are an essential part of the design of each new project.

Wastewater re-use can be an important source of water, particularly for irrigation, although treatment expense may elevate the cost of the water beyond the budget of agricultural users. In situations with critical water shortages, the cost of treated wastewater can be borne by municipal users, who then are able to utilize surface water or groundwater that would otherwise be used for irrigation. There are currently several wastewater reclamation facilities, mostly in North Kona. Notable examples are the He‘eia facility, which provides irrigation for the Kona and Ali‘i Country Club Golf Course, and a facility at Kona International Airport that provides landscaping irrigation. The He‘eia facility produces water that is treated to R-2 level, classified as disinfected secondary treated water, which has some restrictions on its irrigation use, while the airport facility produces R-1 or tertiary treated water, which is approved for spray irrigation without restrictions. In general, the effluent is utilized by plants and evapotranspires, avoiding significant penetration to the groundwater table. This reuse benefits agriculture and water resources. It is expected that in the future, increasingly extensive use will be made of treated wastewater for irrigation uses. In rainy Hilo, where there are only limited irrigation needs and a relatively inexpensive and environmentally sustainable source of groundwater, such systems are not considered cost-effective or environmentally necessary.

Similarly, DWS and other agencies concerned with developing and utilizing water on the Big Island consider desalination, an energy-intensive and expensive process, to be unjustified for cost reasons on the island of Hawai‘i and unnecessary to consider when better options exist. However, new technologies for desalination are being developed and the economic barriers may eventually disappear as the production costs come down, and this technology may soon be appropriate and practical for certain isolated, dry areas.

### 1.2.3 Optimize Distribution of Existing Potable/Non-Potable Supplies

This project increases the amount of potable water available for the Hilo Water System, where such water is sometimes used for non-potable purposes including agriculture, but due to the high rainfall of Hilo irrigation is not a substantial part of the total use. Neither the State nor County operate irrigation water systems in Hilo. Implementing a new, parallel non-potable source, storage and distribution system extending throughout the Hilo Water System is not a practical or necessary alternative.

### 1.2.4 Conservation/Demand Side Strategies Alternative

According to agency officials, current conservation activities at the DWS include the following:

- *100 percent customer metering*. All customer accounts are metered.
- *Meter repair/replacement programs*. Testing, repair and replacement of water meters are done on a systematic basis.
- *Water analysis/reports*. The difference between metered source production and metered sales to consumers is monitored to determine whether a leak detection program is justified.
- *Leak detection programs*. The DWS is implementing investigations and repair for suspected sections of leaking pipelines.
- *Tank overflow controls/alarms*. These facilities prevent system losses from overflows.
- *Voluntary water restriction notices*. The DWS requests voluntary water conservation during dry periods and emergency water outages.
- *Public education outreach/education programs*. Exhibits in trade shows, the County fair, and public schools, among other venues, allow the DWS to share information about the potable water system and water conservation.

These conservation programs have reduced and will continue to reduce the per-capita growth of future water demand. In particular, an island-wide reduction in non-metered water use continues to be realized. Rather than an alternative to developing new sources, water conservation is seen by DWS as an integral and ever-increasing part of its strategy to provide safe, affordable and reliable water service to the island of Hawai‘i in a sustainable and financially secure manner.

### 1.2.5 No Action Alternative

The No Action Alternative would result in no on-ground impacts in the proposed well pad, access road and pipeline areas. Unless explicitly mentioned, discussion of impacts and mitigation relates to the Build Alternative only. However, it should be noted that the No Action Alternative would deprive UH Hilo of a source of water for its expansion plans and would not provide the DWS with the degree of water system flexibility, reliability and capacity that it requires. It would also continue the increasing DWS reliance on water from existing wells in Pi‘ihonua.

### 1.2.6 Selection of Project Alternative

UH Hilo has determined that the most rational and efficient strategy for dealing with the need for a reliable supply for its campus properties is to construct a water well and integrate it with the DWS system. Initial discussions between UH Hilo and the DWS indicate that the proposed well would be an effective component of its system to help meet demand and provide the DWS with an alternate water source located outside of the Pi‘ihonua well field, increasing the operational flexibility and reliability of the Hilo Water System. An intergovernmental agreement is now in development. The decision to advance this alternative was based on the presumed successful yield and good water quality, the lack of impact on aquifer sustainability, the utility to both UH Hilo and the DWS, and the fact that no alternative sources (such as catchment, wastewater reuse, or desalination) would provide a practical or economical source of potable water in this service area.

## 1.3 Consistency with Government Plans and Policies

The project is highly consistent with government plans and policies, which in general call for water systems that meet the needs of residents, support planned growth, and minimize environmental degradation. The following sections discuss consistency with key plans.

### 1.3.1 Hawai‘i State Plan

The Hawai‘i State Plan was adopted in 1978. It was revised in 1986 and again in 1991 (Hawai‘i Revised Statutes, Chapter 226, as amended). The Plan establishes a set of goals, objectives and policies that are meant to guide the State’s long-run growth and development activities. The proposed project is consistent with State goals and objectives that call for increases in employment, income and job choices, and a growing, diversified economic base extending to the neighbor islands.

The sections of the Hawai‘i State Plan most relevant to the proposed project are centered on the theme of facility systems. The following objectives and policies are taken from the section dealing with water development.

- Objective a): Planning for the State’s facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational and other needs within resource capacities.
- Objective b: To achieve the facility systems water objective, it shall be the policy of this State to:
  - (1) Coordinate development of land use activities with existing and potential water supply.
  - (2) Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.

(3) Reclaim and encourage the productive use of runoff water and wastewater discharges.
(4) Assist in improving the quality, efficiency, service and storage capabilities of water systems for domestic and agricultural use.
(5) Support water supply services to areas experiencing critical water problems.
(6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.

The proposed project supports all relevant objectives and policies of the Hawai‘i State Plan related to water facilities.

### 1.3.2 Hawai‘i Water Plan

The *Hawai‘i Water Plan* includes plans dealing with water resource protection, water quality, and development plans related to each individual county, to State projects, and to agricultural water systems. The most relevant plans for this discussion are the *Hawai‘i State Water Resources Development Plan* (Hawai‘i DLNR 1980), the *Water Resources Protection Plan* (Hawai‘i State CWRM 1992), the *State Water Projects Plan, Volume 2, Island of Hawai‘i* (Hawai‘i State Commission on Water Resources Management 2003) and the individual water use and development plans prepared for each county.

The purpose of the *Hawai‘i State Water Resources Development Plan* is to set forth specific objectives, policies, programs and projects to guide the State and county governments. In summary, this plan presents guidelines for development of water resources for municipal, agricultural and industrial requirements; preservation of ecological, recreational, and aesthetic values and quality; and regulation of the use of water to assure adequate supplies for the future. The proposed project would develop a municipal water source in a rational manner to improve drinking water quality, assure adequate water for planned growth and would not adversely affect ecological, recreational or aesthetic values. The project is thus consistent with the basic guidelines of the plan.

In particular, the following objectives are noteworthy:

Objective A. Assure adequate municipal water supplies for planned urban growth.
Objective B. Support long-range municipal water supply planning by the counties.
Objective C. Promote municipal water conservation.
Objective D. Improve drinking water quality.
Objective E. Upgrade rural water systems.

The proposed project supports or is not inconsistent with each objective of the plan.

The *Water Resources Protection Plan* inventoried the water resources of the State, determined their sustainable yields based on available data, and recommended means of conserving and augmenting these resources. As discussed in Section 3.1.2, because there is no recognized current or foreseeable threat of exceeding sustainable levels of withdrawal from the Hilo Aquifer System, it has not been declared a Groundwater Management Area by the State Commission on Water Resources Management, and no aquifer impacts are expected.

The *State Water Projects Plan, Volume 2, Island of Hawai‘i* (SWPP) (Hawai‘i State CWRM 2003) provides a framework for the planning and implementation of water development strategy for future State projects. The SWPP recognizes the need for a number of projects involving potable and nonpotable water in the Hilo area, primarily with the University of Hawai‘i and school buildings, but also involving Department of Hawaiian Home Lands, airport expansion, harbor improvements, and baseyard expansions (Ibid. Table 4.1). All told, the demand of new State projects to the year 2020 on sources within the Northeast Mauna Loa Sector (which includes both Hilo and the larger Kea‘au Aquifer System) in 2003 was anticipated to be 3.69 mgd. Much of that demand has already been met (e.g., the Hilo Judiciary Building) and is included in current DWS pumpage. However, new sources are necessary, especially for development of UH Hilo, and the project, which would provide up to 2.5 mgd, is highly consistent with this plan.

### 1.3.3 Hawai‘i County Water Use and Development Plan

The *Hawai‘i County Water Use and Development Plan* (HCWUDP) (Hawai‘i County DWS 1989) is the most recent Hawai‘i County water plan to be formally adopted by DWS and CWRM. A draft update to the plan was prepared in 2006 and a final version of the update is currently being finalized. The Plan is meant to aid CWRM in granting permits for water use and designating water management areas, as well as serving as a reference document of current and future water resource conditions. The HCWUDP includes an inventory of existing water uses and developments by hydrologic units, addresses future land uses and related water needs, and is consistent with State and County land and water policies. This plan also guides the DWS in future operations and to identify the improvements and facilities required to continue to provide safe, affordable and reliable water service to the island of Hawai‘i in a sustainable and financially secure manner.

The draft *Hawai‘i County Water Use and Development Plan Update* provides scenarios of low, medium, and high growth rates and estimates the public water needs for regions of the island for various years in the future. Common to all scenarios in each region is a steadily increasing demand for water. The Northeast Mauna Loa Aquifer Sector currently has the highest water usage on the island, but due to the high rainfall, it also has the highest sustainable yield. Development of groundwater sources may continue as land development demands dictate. The detriment is the excess cost of production, not loss of a limited supply of sources. The plan calculated that if all land uses currently envisioned within the Northeast Mauna Loa Aquifer

Sector under the General Plan's Land Use Pattern Allocation Guide Map were to be developed, a process which might take a century or more to occur, water demand would be a 203 mgd under the highest use scenario, compared to a sustainable yield of 740 mgd. The recommendation for this sector area was to improve the efficiency of the DWS Hilo Water System; loss of source water through leakage is suspected. The proposed project is consistent with the HCWUDPU in that it provides an additional source of water for growth in demand over the next 15 years.

### 1.3.4 Hawai'i County General Plan

The *General Plan* for the County of Hawai'i is the document expressing the broad goals and policies for the long-range development of the Island of Hawai'i. The latest plan was adopted by ordinance in 2005. The *General Plan* is organized into thirteen elements, with policies, objectives, standards, and principles for each. There are also discussions of the specific applicability of each element to the nine judicial districts comprising the County of Hawai'i. Below are pertinent Goals, Objectives, Policies and Standards, and Courses of Action sections related to Water Systems Development, followed by a discussion of conformance. In addition, the most relevant sections of aspects of the General Plan are briefly discussed.

#### 1.3.4.1 General Plan and Water Systems

**POLICIES**

**(a)** Water system improvements shall correlate with the County's desired land use development pattern.
**(b)** All water systems shall be designed and built to Department of Water Supply standards.
**(c)** Improve and replace inadequate systems.
**(d)** Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.
**(e)** Water system improvements should be first installed in areas that have established needs and characteristics, such as occupied dwellings, agricultural operations and other uses, or in areas adjacent to them if there is need for urban expansion.
**(f)** A coordinated effort by County, State and private interests shall be developed to identify sources of additional water supply and be implemented to ensure the development of sufficient quantities of water for existing and future needs of high growth areas and agricultural production.
**(g)** The fire prevention systems shall be coordinated with water distribution systems in order to ensure water supplies for fire protection purposes.
**(h)** Develop and adopt standards for individual water catchment units.
**(i)** Cooperate with the State Department of Health to develop standards and/or guidelines for the construction and use of rainwater catchment systems to minimize the intrusion of any chemical and microbiological contaminants.

**(j)** Cooperate with appropriate State and Federal agencies and the private sector to develop, improve and expand agricultural water systems in appropriate areas on the island.
**(k)** Promote the use of ground water sources to meet State Department of Health water quality standards.
**(l)** Continue to participate in the United States Geological Survey's exploratory well drilling program.
**(m)** Seek State and Federal funds to assist in financing projects to bring the County into compliance with the Safe Drinking Water Act.
**(n)** Develop and adopt a water master plan that will consider water yield, present and future demand, alternative sources of water, guidelines and policies for the issuing of water commitments.
**(o)** Expand programs to provide for agricultural irrigation water.

**STANDARD**

**(a)** Public and private water systems shall meet the requirements of the Department of Water Supply and the Subdivision Control Code.

**COURSES OF ACTION FOR SOUTH HILO**

**(a)** Continue to implement water system maintenance and improvement programs in order to provide the city with a dependable and consistently safe drinking water supply.
**(b)** Investigate groundwater sources in the upper Waiākea Uka, Kaieie Mauka, Kulaimano, Saddle Road, and Honomu areas.
**(c)** Further investigate future ground water resources.
**(d)** Replace existing surface sources with groundwater sources to meet State Department of Health standards.

Discussion: The proposed project is completely consistent with all elements of the General Plan dealing with water systems. In particular, it would correlate with the County's desired growth pattern by servicing areas already identified for urban and rural growth, with established needs and characteristics. The project would be designed and built to DWS standards. As discussed in Section 3.1.2 below, the project is not expected to deplete aquifers or to contaminate them from natural and man-made sources. The project involves promotion of the use of groundwater sources (as opposed to surface water) to meet State Department of Health water quality standards. Finally, it provides a new source for Hilo. Implementation of the proposed project would not conflict with any goals, policies or courses of action, and would, in fact, contribute to their fulfillment.

#### 1.3.4.2 Other Selected Elements of General Plan

**ECONOMIC GOALS**

**(d)** Provide an economic environment that allows new, expanded, or improved economic opportunities that are compatible with the County's cultural, natural and social environment.

**ENVIRONMENTAL QUALITY POLICIES**

**(a)** Take positive action to further maintain the quality of the environment for residents both in the present and in the future.

**ENVIRONMENTAL QUALITY STANDARDS**

**(a)** Pollution shall be prevented, abated, and controlled at levels that will protect and preserve the public health and well being, through the enforcement of appropriate Federal, State and County standards.
**(b)** Incorporate environmental quality controls either as standards in appropriate ordinances or as conditions of approval.

**HISTORIC SITES GOALS**

**(a)** Protect, restore, and enhance the sites, buildings, and objects of significant historical and cultural importance to Hawaii.

**HISTORIC SITES POLICIES**

**(c)** Require both public and private developers of land to provide historical and archaeological surveys and cultural assessments, where appropriate, prior to the clearing or development of land when there are indications that the land under consideration has historical significance.
**(d)** Public access to significant historic sites and objects shall be acquired, where appropriate.

**AGRICULTURAL LAND GOALS**

**(a)** Identify, protect and maintain important agriculture lands on the island of Hawaii.
**(b)** Preserve the agricultural character of the island.

**FLOOD CONTROL AND DRAINAGE GOALS**

**(c)** Control pollution.
**(d)** Prevent damage from inundation.
**(e)** Reduce surface water and sediment runoff

**FLOOD CONTROL AND DRAINAGE POLICIES**

**(g)** Development-generated runoff shall be disposed of in a manner acceptable to the Department of Public Works and in compliance with all State and Federal laws.

**FLOOD CONTROL AND DRAINAGE STANDARDS**

**(b)** Applicable standards and regulations of Chapter 27, "Flood Control," of the Hawaii County Code.
**(c)** Applicable standards and regulations of the Federal Emergency Management Agency (FEMA).
**(d)** Applicable standards and regulations of Chapter 10, "Erosion and Sedimentation Control," of the Hawaii County Code.

**NATURAL BEAUTY GOALS**

**(a)** Protect, preserve and enhance the quality of areas endowed with natural beauty, including the quality of coastal scenic resources.
**(b)** Protect scenic vistas and view planes from becoming obstructed.

**NATURAL BEAUTY POLICIES**

**(h)** Protect the views of areas endowed with natural beauty by carefully considering the effects of proposed construction during all land use reviews.
**(i)** Do not allow incompatible construction in areas of natural beauty.

**NATURAL RESOURCES AND SHORELINES GOALS**

**(a)** Protect and conserve the natural resources of the County of Hawaii from undue exploitation, encroachment and damage.
**(f)** Ensure that alterations to existing land forms and vegetation, except crops, and construction of structures cause minimum adverse effect to water resources, and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of earthquake.

Discussion: The project is consistent with these aspects of the General Plan. It will encourage economic opportunities that are compatible with the County's cultural, natural and social environment, the quality of which will be maintained. Historic sites or agricultural lands will not be adversely impacted. The improvements will be properly sited on the property to avoid encroachment into the flood zone or any other adverse drainage impact. Finally, the natural beauty and natural resources of the Hilo area will not be adversely affected directly or indirectly by the proposed project, given standard expected conditions of land use approvals and permitting.

# 2 ENVIRONMENTAL ASSESSMENT PROCESS

The project involves the use of State of Hawai‘i funds and land and therefore requires compliance with Chapter 343, Hawai‘i Revised Statutes (HRS), the Hawai‘i Environmental Policy Act (HEPA). The University of Hawai‘i at Hilo is both the proposing and approving agency for this Environmental Assessment (EA).

This EA process is being conducted in accordance with Chapter 343 of the Hawai‘i Revised Statutes (HRS). This law, along with its implementing regulations, Title 11, Chapter 200, of the Hawai‘i Administrative Rules (HAR), is the basis for the environmental impact process in the State of Hawai‘i. According to Chapter 343, an EA is prepared to determine impacts associated with an action, to develop mitigation measures for adverse impacts, and to determine whether any of the impacts are significant according to thirteen specific criteria.

Part 4 of this document states the finding (anticipated in the Draft EA) that no significant impacts are expected to occur; Part 5 lists each criterion and presents the findings by the University of Hawai‘i at Hilo. In the EA process, if the approving agency determines after considering comments to the Draft EA that no significant impacts would likely occur, then the agency issues a Finding of No Significant Impact (FONSI), and the action is permitted to occur. If the agency concludes that significant impacts are expected to occur as a result of the proposed action, then an Environmental Impact Statement (EIS) is prepared.

# 3 ENVIRONMENTAL SETTING AND IMPACTS

This section describes the existing social, economic, cultural, and environmental conditions surrounding the proposed project along with the probable impacts of the proposed action and mitigation measures designed to reduce or eliminate adverse environmental impacts. As discussed above in Section 1.2.5, the No Action Alternative would be disadvantageous for UH Hilo and the DWS, but it would not result in any on-ground impacts in the proposed well pad, access road and pipeline areas. Therefore, unless explicitly mentioned, discussion of impacts and mitigation relates to the Build Alternative only.

The area upon which the proposed well pad, access road and pipeline would be built is referred to throughout this EA as the *project site*. The term *project area* is more flexibly used to describe the general Hilo area.

## 3.1 Physical Environment

### 3.1.1 Climate, Surface Geology and Hazards

*Existing Environment*

Geologically, the site is located on the flanks of Mauna Loa volcano, near the boundary between surface lava flows that occurred from 5,000 to 10,000 years before the present located to the south and newer flows that occurred between 1,500 and 750 years before the present (Wolfe and Morris 1996) further to the north. Small areas of younger flows are also present in the area, along the northern boundary of the lot containing the project site. Soil is only just beginning to develop in this area, where the surface is classified by the U.S. Natural Resources Conservation Service (formerly Soil Conservation Service) as rLW, or lava flows, pahoehoe (U.S. Soil Conservation Service 1973).

The project site is rated Lava Flow Hazard Zone 3 on a scale of ascending risk from 9 to 1 (Heliker 1990:23). The relatively high hazard risk is based on the fact Mauna Loa is an active volcano. Volcanic Hazard Zone 3 areas have had up to 5 percent of their land area covered by lava or ash flows since the year 1800, and between 15 and 75 percent of the areas have been covered in the past 750 years. The 1881 lava flow penetrated the area now occupied by much of the upper part of the Hilo and the UH Hilo campus, including the area about a mile east of the project site near Mohouli Street.

In terms of seismic risk, the entire Island of Hawai‘i is rated Zone 4 Seismic Hazard (Uniform Building Code, Appendix Chapter 25, Section 2518). Zone 4 areas are at risk from major earthquake damage, especially to structures that are poorly designed or built.

*Impacts and Mitigation Measures*

In general, geologic conditions impose no overriding constraints on the project, and it is not imprudent to construct in terms of geological hazard. The University of Hawai‘i recognizes that most of the surface of Hawai‘i Island is subject to eventual lava inundation, and that water system infrastructure in places such as Hilo face risk. Given the considerable investment in the existing campus, close to the community that it serves, UH Hilo has determined that it is economically and environmentally sensible to invest in water system infrastructure, despite the eventual risk of lava flows. Project design will take the seismic setting into account, and no mitigation measures are expected to be required.

### 3.1.2 Groundwater Hydrology

*Existing Environment*

Hydrogeological Setting

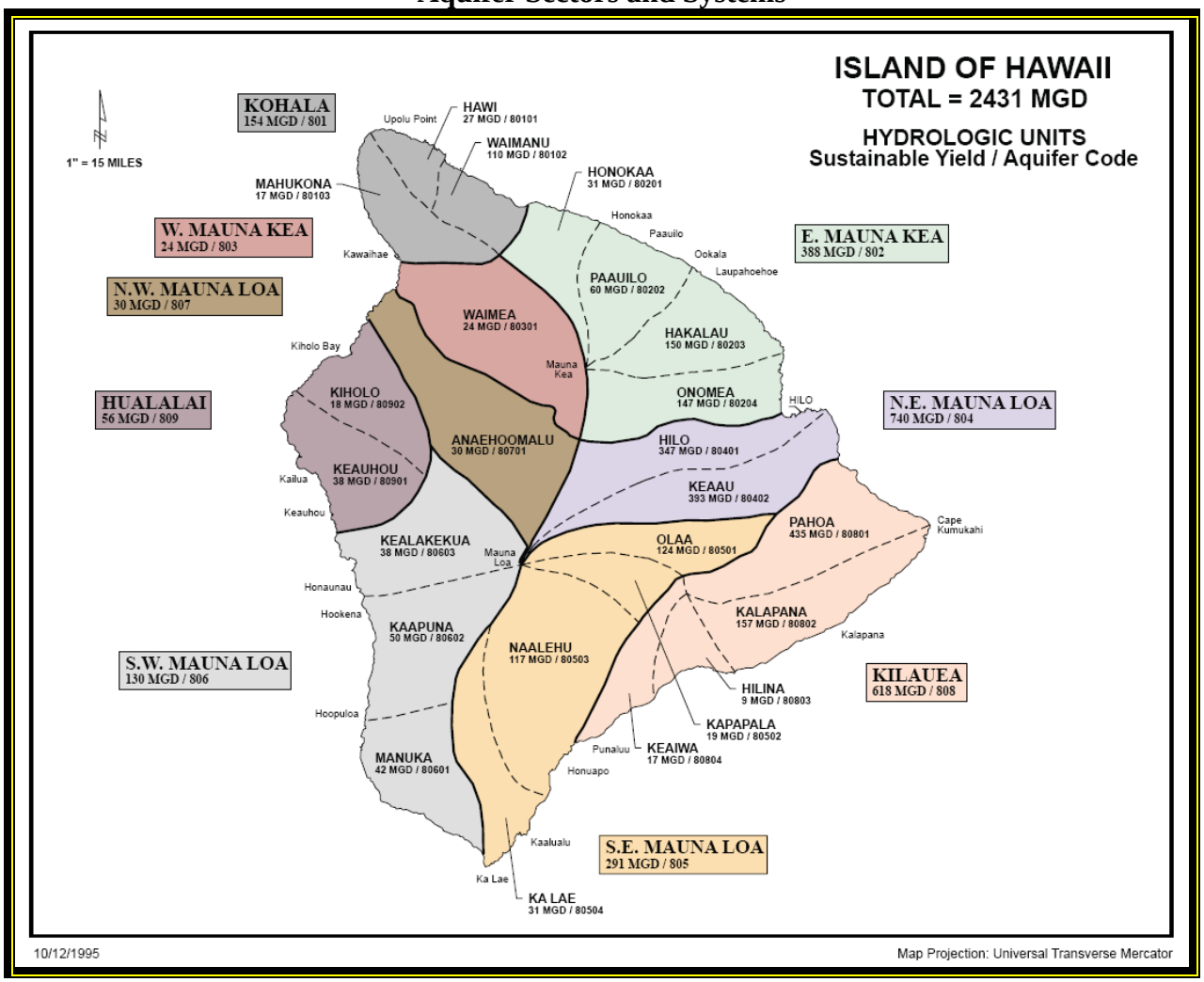
No designated Principal or Sole-Source aquifers are located nearby or would be affected (Source: *Designated Sole Source Aquifers in EPA Region IX*, www.epa.gov/safewater/swp/ssa/reg9.html. U.S. Environmental Protection Agency web page, checked January 2011). There are no State Wellhead Protection Plans in force in or near the well site.

The State Commission on Water Resource Management (CWRM) classification of aquifers locates this part of Hilo as being in the Hilo Aquifer System (80401) of the Northeast Mauna Loa Sector. The surface boundary of this aquifer is shown in Figure 3-1.

Precipitation that is not lost through evapotranspiration or runoff into the ocean percolates into the ground to collect in the aquifers before slowly making its way to the sea. As streams in Hawai‘i are generally flashy or even ephemeral, underground water is the most reliable source of water supply, because there is less daily or seasonal change in water tables. Most water is maintained in the basal freshwater lens that “floats” on the salt-water permeated rock below, but in some locations, such as on the slopes of the Hualālai and Mauna Loa volcanoes, substantial quantities of “high-level” water are known to occur. The new UH Hilo well would develop groundwater from basaltic lava flows originating from Mauna Loa. These buried lava flows comprise both pahoehoe and ‘a‘a, and because they are geologically young, they never became weathered and are very permeable.

The recharge area for the 193.73-square mile Hilo Aquifer System is assumed to consist of essentially the surface area contained within the boundaries of the aquifer system. The Hilo Aquifer System has average annual rainfall varying from less than 20 inches near the summit of Mauna Loa to more than 230 inches 10 miles above Hilo. In general, the area averages well over 100 inches per year. As computed by the CWRM, groundwater recharge is limited to the contribution of rainfall. It

**Figure 3-1**
**Aquifer Sectors and Systems**




Source: Hawaii State Commission on Water Resources Management
http://hawaii.gov/dlnr/cwrm/mapsillustrations/gwhawaii.pdf

does not include the contribution of fog drip, which studies have determined to be a considerable amount. CWRM estimates that there is a mean daily recharge rate from rainfall of 793 mgd, and the sustainable yield for the aquifer system is 347 mgd.

Existing Wells and Current Estimated Water Use

CWRM maintains a database of wells that provides information on, among other aspects, the aquifer identity, user identity, installed capacity, chloride content and function. The database does not provide information on current pumpage, which instead is logged in a separate database and is derived from reports from individual well operators. Because not all well operators report their use

in a timely manner, pumpage data may not be complete or up to date. Owing to security concerns after September 11, 2001, these databases are no longer accessible to the public and data must be requested from CWRM. The information provided below is based on databases maintained by CWRM, by information contained in the Draft *Hawai'i County Water Use and Development Plan Update*, and information obtained from the Department of Water Supply and hydrology consultants.

The Hilo Aquifer System currently contains wells of various types, including municipal, agricultural, industrial, observation, and unused. Thirty-two wells are listed in the CWRM database (see Appendix 3 for well names, locations and characteristics). According to information reported by well owners to the CWRM from 2000 to 2009, the average pumpage in the Hilo Aquifer system was about 42 mgd (less than 15 percent of sustainable yield) with the majority of the pumpage from the HELCO cooling wells. Department of Water Supply pumpage for the same period was between 2.5 to 6 mgd.

Existing Drinking Water Quality

The Hawai'i DWS regularly conducts microbiological analysis and contracts for extensive chemical testing in order to comply with U.S. Environmental Protection Agency (EPA) and Hawai'i State Department of Health standards. Table 3-1 depicts the contaminants tested for and the frequency of testing.

The current sources of water for the Hilo Water System are Panaewa Well Nos. 1, 2 and 3, Pi'ihonua Well Nos. A, B, and C, and Saddle Road Well A, all of which are groundwater sources. The source(s) used on any given day may change depending on the supply and demand. Annual Water Quality reports from the Hilo system for the latest full year available, 2009 (see Appendix 2), indicate that the system was compliant with all current State of Hawai'i and U.S. Environmental Protection Agency drinking water standards. Specifically, no violations were recorded for radioactive, inorganic, organic or lead and copper contaminants, with all contaminants generally far below Maximum Contaminant Levels (MCLs). However, the Hilo Water System temporarily violated a drinking water standard in January of 2009. Saddle Road Well A was out of service for repairs from January 14 to March 12, 2009. The 'Ōla'a Flume Spring source was temporarily activated to service the area that Saddle Road Well A normally serves. The 'Ōla'a Flume Spring is groundwater under the influence of surface water source, and it is thus required to meet specified disinfection standards. In order to ensure proper disinfection, water from the 'Ōla'a Flume Spring source must be in contact with chlorine for a minimum amount of time. On January 15 and 16, 2009, this did not occur. The DWS incurred a violation for January because the disinfection levels were lower than the required amounts on two days in the month of January. This situation was rectified.

**Table 3-1**
**Summary of Current Water Quality Monitoring Requirements**

| **CONSTITUENT** | | |
|---|---|---|
| Bacteriological | Distribution system | Monthly; number of samples dependent on population served within distribution system |
| Carbamate, Nitrate, Metals, Inorganic, THM / HAA5 VOC, SOC8, Glyphosate EDB / DBCP / TCP | Entry point to distribution AND/OR Well Head (Location is dependent on contaminant being sampled for. SDWB will specify.) | Quarterly. |
| Asbestos | Source/distribution along AC pipe | First 3-year compliance period of 9-year cycle |
| Nitrate EDB / DBCP / TCP Metals, SOC8, VOC | Entry point to distribution AND/OR Well Head (Location is dependent on contaminant being sampled for. SDWB will specify.) | Annually |
| Lead and copper | Customer taps | For systems that have passed, once every three years. For systems that have failed, then once every six months until system passes, then once every three years thereafter. |
| Reduced Monitoring for Populations<=3300: Metals / VOC (ALL Groundwater sources; ALL Populations) SOC8, EDB / DBCP / TCP Glyphosate, Carbamate Herbicides | Entry point to distribution AND/OR Well Head (Location is dependent on contaminant being sampled for. SDWB will specify.) | Once every 3 years (R1/1) |
| Reduced Monitoring for Populations >3300: SOC8, EDB / DBCP / TCP Glyphosate, Carbamate Herbicides | Entry point to distribution AND/OR Well Head (Location is dependent on contaminant being sampled for. SDWB will specify.) | Twice every 3 years. |
| Radionuclides | Source | Once every 5 years. |

Source: Hawai‘i County Department of Water Supply. SDWB = Hawai‘i State Department of Health, Safe Drinking Water Branch.

Other Planned Uses in Aquifers and Issues of Concern

The January 2011 issue of the *Water Resource Bulletin*, issued by CWRM, listed only one well that was under construction for Hilo, a University of Hawai‘i Pilot Well for scientific purposes that was drilled in 1998 but not classified as completed. Aside from the proposed UH Hilo well, no new municipal or significant other wells are known to be in planning or construction in Hilo.

As discussed in Section 1.3.2 above, the *State Water Projects Plan, Volume 2, Island of Hawai‘i* (SWPP) (Hawai‘i State CWRM 2003) calculated the total demand of new State projects to the year 2020 on sources within the Northeast Mauna Loa Sector (which includes both Hilo and the larger Kea‘au Aquifer System) in 2003 at 3.69 mgd. Some of that demand has already been met (e.g., the Hilo Judiciary Building) and is included in current DWS pumpage. However, much of the new demand is derived from UH Hilo needs and represents additional draws on the Hilo Aquifer System.

*Impacts and Mitigation Measures*

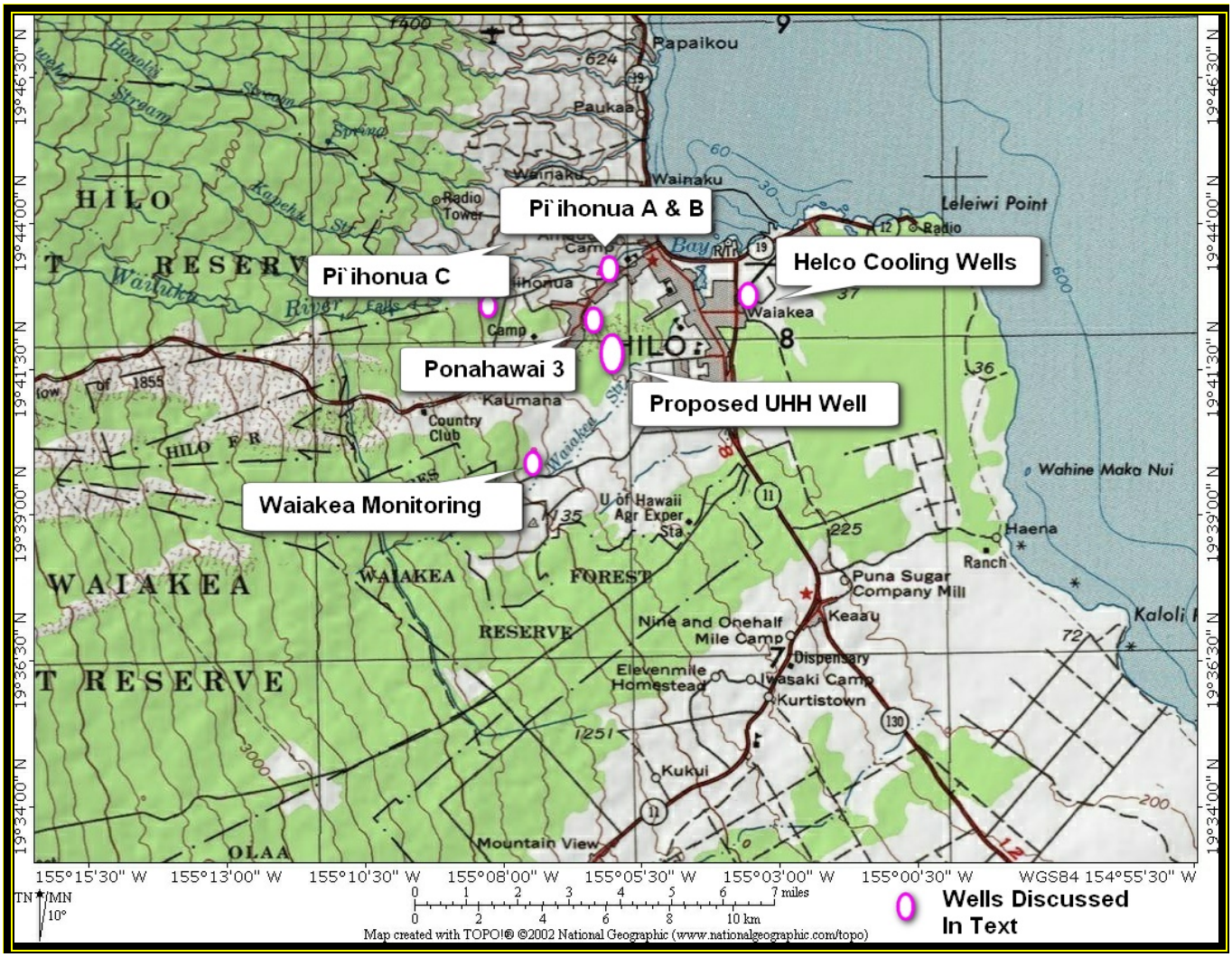
Hydrologic Impacts: Expected Water Resources and Effects on Sustainable Yield

Older wells in the Hilo Aquifer System were drilled close to the coast, at ground elevations less than 100 feet above mean sea level (msl). These wells exhibited typical basal groundwater conditions where the fresh groundwater floats on top of the denser saltwater. A Ghyben-Herzberg lens is formed, and the theoretical relationship is that for every foot of fresh water above sea level it is balanced by 40 feet below sea level. The 12 HELCO wells (4203-01-12), for example, have water levels that vary between 6 and 9 feet above msl (CWRM well database). Assuming an average water level of 7 feet above msl, the theoretical thickness of the lens is 41 times 7 feet or 287 feet. In terms of elevation, the 50 percent seawater/freshwater concentration mid-point is 280 feet below sea level. The region above the mid-point is called the transition zone. The top of the transition zone is defined as two-percent seawater concentration. The thickness of the transition zone varies, though in the Hilo area, it is assumed to be thin due to the tremendous amount of groundwater flux. The bottom elevations of these HELCO wells vary from 14 to 535 feet below msl. When the wells were drilled in the early 1960s the chlorides were low. Large capacity pumps cause a phenomenon known as *upconing* of the underlying seawater over time, which means a rise of all the transition zone and lower layers of the aquifer in a cone around a particular well.

The DWS started drilling wells at higher ground elevations in 1973. Pi‘ihonua Well A (4306-01) drilled at elevation 278 feet above msl and encountered a water level of 42± feet above msl. The nearby Pi‘ihonua Well B (4306-02) also had a similar water level. Ponohawai 3 Well (4206-01), drilled in 1993 at ground elevation 465 feet above msl, hit water at 243 feet above msl. Pi‘ihonua Well C (4208-01), drilled in 1995 at a ground elevation of 975 feet above msl, found water at 264± feet above msl. Figure 3-6 shows the locations of these wells, the proposed UH Hilo well, and the general location of the HELCO wells.

As discussed in Appendix 3, hydrologists believe that the high groundwater levels in these wells preclude the possibility of seawater intrusion or contact with seawater. The bottom elevations for all these high-level wells are range between 57 and 157 feet below msl. The usual cause for abundant high-level groundwater is a geologic structure such as volcanic dikes. Well capacity in areas of volcanic dikes is limited because low-permeability dikes become “no-flow” boundaries. A pumping well’s drawdown cone expands outward, and when a dike is reached, the drawdown greatly increases. The DWS wells are not limited by this problem. The cause for the high-level water at

**Figure 3-2**
**Location of Selected Wells in Hilo**




ground elevations greater than 200 feet above msl could be large f groundwater flux through the aquifer system. Even though the individual lava flows range in permeability, the bulk permeability of the basaltic lava flows may be causing groundwater to "back up" inland from the coast.

The quantity of water desired from the new UH Hilo well equates to a maximum daily demand of 2.5 mgd (1,750± gpm) over a 24-hour period. With an installed pump capacity of 1,750 gpm, a standard 16-hour pump day would produce an average daily amount of 1.66 mgd. Although there are no other wells in close proximity to the UH Hilo well site, hydrologists presume that the water level in the new UH Hilo well will be comparable to the high-level wells at or near the same ground elevations. When the well is drilled, hydrologists will undertake measurements regarding the static head in order to precisely adjust the lengths of solid casing and perforated casing. For the sake of

design, the assumed water level will be 200 feet above msl, and to accommodate a 1,750 gpm pump, the well casing diameter will be 20 inches. Appendix 3 provides a draft cross-section of the well that will be provided to CWRM in the well application form. The assumed depth of the well is 500 feet (bottom elevation is 91 feet below msl). The final length of the solid casing and perforated casing will depend upon the static head. Depending upon drilling results, drillers may need to drill open hole below the perforated casing to provide more exposed aquifer.

The expected average daily pumpage of 1.66 mgd would have negligible effects in terms of the aquifer's sustainable yield, which is 347 mgd, with current pumping from other wells only totaling 42 mgd. Considering the relatively modest growth rate in Hilo and the low level of anticipated long-term State needs (as discussed above, this total is only 3.69 mgd, the University component of which would actually be met by the proposed well itself), there is no risk of exceeding or approaching even a quarter of the sustainable use of the aquifer within the foreseeable future.

Hydrologic Impacts: Effects on Nearby Wells

The nearest production well to the proposed UH Hilo well is Ponahawai 3, more than a mile across the slope to the north. Given the water level discontinuities and the very substantial spacing between wells, any significant impact by use of the proposed UH Hilo well on other wells is highly unlikely.

Water Quality

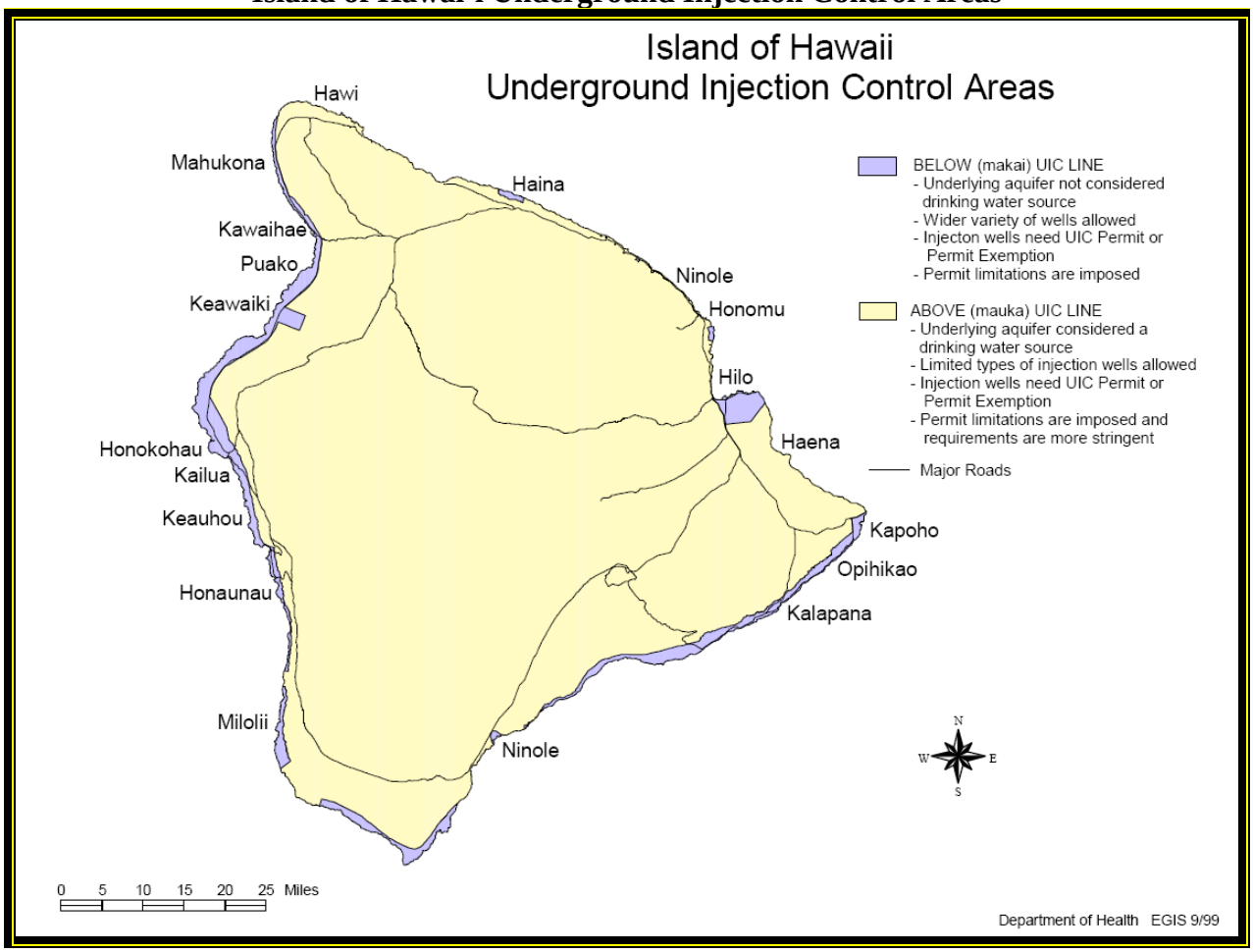
Since this area of *mauka* Hilo has no municipal sewer service, every residence in the area has an Individual Wastewater System (IWS) – more likely a cesspool than a septic tank. There are a number of residences in the Sunrise Estates subdivision within 2,000 feet of the well site, and some are as close as 1,500 feet (see Figure 1 for location of subdivision). *Mauka* of Sunrise Estates are a number of similarly unsewered locations.

Hawai‘i Administrative Rules (HAR) require that a new IWS be a minimum of 1,000 feet from a potable water well. However, the converse is not true, i.e., it is not required to locate a potable well 1,000 feet from an existing IWS. Nevertheless, whenever a well is located within 1,000 feet of an IWS, the Department of Health and the DWS are concerned with any potential contamination to the proposed well via improper wastewater treatment and disposal from any nearby source. The geological context is important, and it is also necessary to have mechanisms in place to check water quality periodically to ensure protection of public health.

The Underground Injection Control (UIC) line in the Waiākea area of Hilo is located *makai* of Kilauea Avenue, about two miles *makai* of the well (Figure 3-3). The well site and its recharge area are thus *mauka* of the UIC line, where underlying aquifers are considered drinking water sources and injection wells may be prohibited and if permitted are subject to stringent requirements to ensure they do not contaminate aquifers. The Department of Health prohibits injections wells closer than one-quarter mile to municipal water well.

**Figure 3-3**

**Island of Hawai`i Underground Injection Control Areas**




The aquifer below the well site is presumed to be about 209 ~~350~~ feet below the surface and even deeper in the well's recharge area upgradient. Although there is a history of sugar cane agriculture in the early 20th century, and individual wastewater systems are present over 1,000 feet from the well on the upgradient side, the lack of industrial, commercial agricultural or dense residential land use upgradient, as well as the underlying geology and the depth to the aquifer, indicate that the possibility for aquifer contamination is slight. Since the well will be fully grouted to a significant depth, no surface or near-surface contamination of the groundwater aquifer is expected to occur beyond that of pre-development conditions. DWS periodically performs comprehensive and stringent tests of well water quality to ensure that public health is protected. Considering the depth of the well and the lack of past or current potential sources of contamination, good water quality is expected from the exploratory well. Water quality tests will verify this, and only if the water meets standards will the well be incorporated in the DWS water system.

In the future, the Department of Health may prohibit injection wells and prohibit or require enhanced treatment for IWS within 1,000 feet of the well. Because all land within a 1,000-foot radius is under State of Hawai‘i control (see radii on Figure 1-4a) and designated for University use, UH Hilo can plan its wastewater system (which would be through municipal sewer) and drainage system to avoid such impacts within 1,000 feet. UH Hilo is aware of the planning constraint around the proposed water well and will incorporate it in all Master Plans.

In summary, the area near the proposed well appears to be reasonably free of any major source of contaminants. No Individual Wastewater Systems or injection wells are present or likely to be constructed within 1,000 feet of the well. The water from the production well will be tested by a qualified laboratory to ensure the water quality meets the potable water source requirements of the Hawai‘i State Department of Health, which tests for a variety of organic and volatile compounds and total and fecal coliform, among other parameters. The well and the system to which it connects will be in full compliance with all requirements of the Safe Drinking Water Act, (42 U.S.C §300H-3[e]).

The project will be designed in accordance with the “Water System Standards, Department of Water Supply, County of Hawai‘i, 2002”. The design will be coordinated with the appropriate County and State agencies. Given the proper design and appropriate agency coordination, there will be negligible hazard to the public or the natural environment, including impacts on water quality.

### 3.1.3 Floodplains, Drainage and Surface Water Quality

*Existing Environment*

The average annual rainfall in the Hilo area of between 120 and 200 inches (UH Hilo 1998) generates substantial runoff in some locations. However, the Flood Insurance Rate Maps (FIRM) FM1551660880C (9/16/88) show that the project site, which is located on fairly recent lava that drains rapidly, is in Flood Zone X, outside the 100-year floodplain. No known areas of local (non-stream related) flooding are present on or near the project site. The Waiākea Drainage, an intermittent and largely channelized stream that drains much of southern Hilo, is located about a mile south of the project site.

*Impacts and Mitigation Measures*

Construction of the project well pad, access road and transmission waterline, along with any subsequent construction of the control building and associated features, will add minimally to the area of impermeable surface and will not adversely affect drainage. In any project, uncontrolled excess sediment from soil erosion during and after excavation and construction has the potential to impact natural watercourses, water quality and flooding potential. Contaminants associated with heavy equipment and other sources during construction have the potential to impact ground water if not mitigated effectively.

Provisions will be made during the construction grading and earthwork to minimize soil erosion and off-site sediment transport. A Pollution Control Plan and a Stormwater Pollution Prevention Plan will be implemented to ensure that the proposed improvements do not cause drainage or water quality impacts. Best Management Practices (BMPs) such as standard soil erosion and sediment control shall be implemented. These may include measures such as the following:

- Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion;
- Utilizing soil erosion protective materials such as mulch or geotextiles on areas where soils have a high potential for erosion until permanent vegetation is in place;
- Planting vegetation as soon as grading operations permit to minimize the amount of time soils are exposed to possible erosion; and
- Building sedimentation basins to collect sediment that might enter runoff waters.
- Installing silt fences along the downstream perimeter of any disturbed areas to collect sediment from stormwater runoff.

The project will be regulated through review and approval by the Hawai‘i County Department of Public Works (DPW) to ensure compliance with standards related to storm runoff containment.

### 3.1.4 Climate and Air Quality

*Existing Environment*

The project site is located near the Puainako Extension at an elevation of 410 feet above sea level. Average annual rainfall at the project site is about 150 inches (UH Hilo 1998). The average maximum temperature is approximately 80 degrees F, with an average minimum of 65 degrees.

*Impacts and Mitigation Measures*

The proposed project will not produce any permanent substantial air quality impacts. Access road improvements have the potential to produce very localized and temporary fugitive dust emissions, although the moist, highly vegetated landscape is not prone to production of dust. There are no dust-sensitive land uses nearby. Nevertheless, a dust control plan will be implemented for construction activities with potential to generate substantial dust. The elements of the plan may include some or all of the following:

- Watering of active work areas;
- Cleaning adjacent paved roads affected by construction;
- Covering of open-bodied trucks carrying soil or rock;
- Limiting area to be disturbed at any given time;
- Mulching or stabilizing disturbed inactive areas with geotextile; and
- Paving and landscaping as soon as practical in the construction schedule.

### 3.1.5 Noise and Scenic Value

*Existing Environment*

Noise may be defined as unwanted sound. Evaluation of noise requires a consideration of loudness at various pitches. Loudness is measured in units called decibels (dB). Levels over 70 dB are considered unpleasant by most individuals; levels under 50 dB are perceived as acceptably quiet. Noise levels on the site are low and are derived mainly from the vehicle traffic on the Puainako Extension and some distant residential activities.

The proposed well pad is over 1,000 feet from residences and other sensitive uses. The well pad site is not visible from any nearby road vantage and lacks intrinsic scenic value.

*Impacts and Mitigation Measures*

Construction will elevate noise levels during short periods over the course of several months. Due to the site's isolation from sensitive uses, no construction noise mitigation requirements are needed.

As far as permanent impacts, if the exploratory phase is successful the well will be outfitted with a vertical turbine lineshaft pump. The motor will not be structurally baffled and will produce noise of 81 dB on the well pad. This sound level is considered "annoying" if experienced by at the edge of a residence (*Source: U.S. Department of Transportation Policy and Procedure Memorandum 90-2*). The control building will also be equipped with alarms that will be connected to the DWS's SCADA system. Thus, the well will produce noise. However, noise degrades rapidly with distance, and within 60 feet the sound level would be at 55 dB, the level inside a normal department store. At the distance of the nearest residences – 1,000 feet – the well will not be audible. If the area is developed densely for University uses in the future, the pump can be baffled to reduce noise.

The well pad site and access road/pipeline would essentially be concealed from view from uphill, downhill and cross-slope vantages because of topography and vegetation. In the long-term, the area is expected to be urbanized as part of the expansion of UH Hilo and the well pad will be concealed with landscaping. No scenic impacts would occur.

## 3.2 Biological Environment

*Existing Environment*

The project site contains the natural vegetation of recent lava flows, which are dominated by *'ohi'a* (*Metrosideros polymorpha*) and *uluhe* (*Dicranopteris linearis*) (Gagne and Cuddihy 1990). No streams, ponds or wetlands are present in the area affected by the proposed project. The vegetation is moderately to heavily invaded by melastoma (*Melastoma candidum*) and strawberry guava (*Psidium cattleianum*). Aside from *uluhe* and *'ohi'a*, only a few common native fern, vine, sedge, herb and shrub species are present. Table 3-2 lists species noted on the project site.

**Table 3-2. Plant Species Detected on Project Site**

| Scientific Name | Family | Common Name | Life Form | Status* |
|---|---|---|---|---|
| *Ageratum conyzoides* | Asteraceae | Ageratum | Herb | A |
| *Ageratum houstonianum* | Asteraceae | Ageratum | Herb | A |
| *Alistonia macrophylla* | Apocynaceae | Alistonia | Tree | A |
| *Andropogon virginicus* | Poaceae | Broomsedge | Herb | A |
| *Arundina graminifolia* | Orchidaceae | Bamboo orchid | Herb | A |
| *Blechnum appendiculatum* | Blechnaceae | Blechnum | Fern | A |
| *Brachiaria mutica* | Poaceae | California grass | Herb | A |
| *Chamaecrista nictitans* | Fabaceae | Partridge pea | Herb | A |
| *Chamaesyce hypericifolia* | Euphorbiaceae | Graceful spurge | Herb | A |
| *Christella cyatheoides* | Thelypteridaceae | Kikawaio | Fern | E |
| *Citharexylum caudatum* | Verbenaceae | Citharexylum | Tree | A |
| *Clidemia hirta* | Melastomataceae | Koster's curse | Herb | A |
| *Cocculus trilobus* | Menispermaceae | Huehue | Vine | I |
| *Conyza bonariensis* | Asteraceae | Hairy horseweed | Herb | A |
| *Cordyline fruticosa* | Agavaceae | Ti | Shrub | A |
| *Crotalaria assamica* | Fabaceae | Crotalaria | Herb | A |
| *Crotalaria micans* | Fabaceae | Crotalaria | Herb | A |
| *Crotalaria sp.* | Fabaceae | Crotalaria | Herb | A |
| *Cuphea carthagenensis* | Lythraceae | Colombian Cuphea | Herb | A |
| *Desmodium sandwicense* | Fabaceae | Spanish Clover | Herb | A |
| *Desmodium triflorum* | Fabaceae | Desmodium | Herb | A |
| *Dicranopteris linearis* | Gleicheniaceae | Uluhe | Fern | I |
| *Emilia fosbergii* | Asteraceae | Pualele | Herb | A |
| *Emilia sonchifolia* | Asteraceae | Flora's paintbrush | Herb | A |
| *Epidendrum x obrienianum* | Orchidaceae | Baby orchid | Herb | A |
| *Eucalyptus sp.* | Myrtaceae | Eucalyptus | Tree | A |
| *Hippobroma longiflora* | Campanulaceae | Star of Bethlehem | Herb | A |
| *Hyptis pectinata* | Lamiaceae | Comb hyptis | Shrub | A |
| *Ipomoea indica* | Convolvulaceae | Ipomoea | Vine | I |
| *Lantana camara* | Verbenaceae | Lantana | Herb | A |
| *Lepisorus thunbergianus* | Polypodiaceae | 'Ekaha | Fern | I |
| *Lygodium japonicum* | Schizaeaceae | Japanese climbing fern | Fern | A |
| *Melastoma sp.* | Melastomataceae | Melastoma | Shrub | A |
| *Melinis minutiflora* | Poaceae | Molasses grass | Herb | A |
| *Melochia umbellata* | Sterculiaceae | Melochia | Tree | A |
| *Metrosideros polymorpha* | Myrtaceae | 'Ohi'a | Tree | E |
| *Mimosa pudica* | Fabaceae | Sleeping grass | Herb | A |
| *Nephrolepis exaltata* | Nephrolepidaceae | Sword fern | Fern | I |
| *Nephrolepis multiflora* | Nephrolepidaceae | Sword fern | Fern | A |
| *Panicum maximum* | Poaceae | Guinea grass | Herb | A |
| *Paraserianthes falcataria* | Fabaceae | Albizia | Tree | A |
| *Paspalum conjugatum* | Poaceae | Hilo grass | Herb | A |
| *Phyllanthus debilis* | Euphorbiaceae | Niruri | Herb | A |

| Table 3-2, continued | | | | |
|---|---|---|---|---|
| Scientific Name | Family | Common Name | Life Form | Status* |
| *Phymatosorus grossus* | Polypodiaceae | Maile scented fern | Fern | A |
| *Pityrogramma calomelanos* | Pteridaceae | Silver fern | Fern | A |
| *Pluchea symphytifolia* | Asteraceae | Sourbush | Shrub | A |
| *Polygala paniculata* | Polygalaceae | Milkwort | Herb | A |
| *Polygonum capitatum* | Polygonaceae | Polygonum | Herb | A |
| *Psidium cattleianum* | Myrtaceae | Strawberry guava | Tree | A |
| *Psilotum nudum* | Psilotaceae | Moa | Fern Ally | I |
| *Pteris vittata* | Pteridaceae | Cliff brake | Fern | A |
| *Rhus sandwicensis* | Anacardiaceae | Neneleau | Shrub | E |
| *Rhynchelytrum repens* | Poaceae | Natal grass | Herb | A |
| *Rhynchospora caduca* | Cyperaceae | Rhynchospora | Herb | A |
| *Rubus rosifolius* | Rosaceae | Thimbleberry | Herb | A |
| *Sacciolepis indica* | Poaceae | Glenwood grass | Herb | A |
| *Schefflera actinophylla* | Araliaceae | Octopus tree | Tree | A |
| *Schizachyrium condesatum* | Poaceae | Beardgrass | Herb | A |
| *Scleria testacea* | Cyperaceae | Scleria | Herb | I |
| *Stachytarpheta jamaicensis* | Verbenaceae | Owi | Herb | A |
| *Trema orientalis* | Ulmaceae | Gunpowder tree | Tree | A |
| *Waltheria indica* | Sterculiaceae | ‘Uhaloa | Herb | I |

*A=Alien E=Endemic I=Indigenous END=Federal and State Listed Endangered

Although the 10 to 25-foot tall trees on the project are too short to offer nesting habitat for the Hawaiian Hawk or *‘Io* (*Buteo solitarius*), this endangered bird is forages widely around forested and even urban areas of the island of Hawai‘i and likely forages here as well.

Additionally, it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*) and the threatened Newell’s Shearwater (*Puffinus auricularis newelli*) over-fly the project area between the months of May and November. Hawaiian Petrels were formerly common on the Island of Hawai‘i. This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea, as well as at the mid-to-high elevations of Hualālai and in the Kohala Mountains. It has within recent historic times been reduced to relict breeding colonies in a few locations. Hawaiian Petrels were first listed as an endangered species by the U.S. Fish and Wildlife Service (USFWS) in 1967 and by the State of Hawai‘i in 1973. Newell’s Shearwaters were also once common on the Island of Hawai‘i. This species breeds on Kaua‘i, Hawai‘i, and Moloka‘i. Newell’s Shearwater populations have dropped precipitously since the 1880s (Banko 1980, Day et al., 2003). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially *uluhe* fern. Newell’s Shearwater was listed as a threatened species by the USFWS in 1975 and by the State of Hawai‘i in 1973.

Biologists believe that the leading cause of death for both these species in Hawai‘i is predation by alien mammals at the nesting colonies, followed by collision with man-made structures. Exterior lighting disorients these night-flying seabirds, especially fledglings, as they make their way from land to sea during the summer and fall. When disoriented, seabirds often collide with manmade structures and, if not killed outright, the dazed or injured birds are easy targets for feral mammals. There is no suitable nesting habitat within the project area for these birds.

Aside from the Hawaiian Hawk, few species of native forest birds would be expected on the project site due to its low elevation (400 feet above sea level) and lack of key native plants except short, scattered *‘ohi‘a*, although the Hawai‘i ‘Amakihi (*Hemignathus virens virens*) might occasionally be present.

The short-stature vegetation may offer some limited habitat to Hawai‘i’s only land mammal, the endangered *‘ope‘ape‘a* or Hawaiian hoary bat (*Lasiurus cinereus semotus*).

*Impacts and Mitigation Measures*

The clearing and use of the project site is not expected to induce any adverse botanical impacts. Although the forest is dominated by several common native species, it is becoming increasingly invaded and would within several decades be almost exclusively non-native. To minimize impacts to the endangered Hawaiian hoary bat, initial clearing of the project site should avoid removal or trimming of woody plants taller than 15 feet from May 15 through August 15 each year. This period is the most vulnerable time in the bat birthing and pup rearing season, and refraining from vegetation removal or trimming is recognized as appropriate by the U.S. Fish and Wildlife Service. Under the assumption that no tower or unshielded exterior lighting will be involved in the development of the water system infrastructure, there should be no impact to listed seabirds.

## 3.3 Socioeconomic

### 3.3.1 Land Use, Social Factors and Community Identity

*Existing Environment*

The project site is a portion of TMK 2-4-001:122, a 267.030-acre lot owned by the University of Hawai‘i (State of Hawai‘i). The existing water tank to which the well would be connected is on TMK 2-4-001:173, a 2.663-acre lot owned by the State of Hawai‘i and utilized by the DWS under Executive Order 3949. According to the Hawai‘i County Planning Department, the project site is within the State Land Use Agricultural District and the County Zoning on the property is Agricultural (A-1a for Lot 122, and A-1a and A-3a for Lot 173). It is designated on the County General Plan Land Use Designation Maps (LUPAG) as University ~~Rural~~ for Lot 122, and a combination of Rural and Low Density Urban for Lot 173. The site is not within the Special Management Area. The facility is a public use that is a permitted use on these properties requiring Plan Approval prior to obtaining a building permit.

Table 3-3 shows the population and socioeconomic characteristics of both Hawai‘i County and Hilo.

**Table 3-3**
**Selected Socioeconomic Characteristics**

| CHARACTERISTIC | ISLAND OF HAWAI‘I | HILO |
|---|---|---|
| Total Population | 148,677 | 40,759 |
| Percent Caucasian | 31.5 | 17.1 |
| Percent Asian | 26.7 | 38.3 |
| Percent Hawaiian | 9.7 | 13.1 |
| Percent Two or More Races | 28.4 | 29.7 |
| Median Age (Years) | 38.6 | 38.6 |
| Percent Under 18 Years | 26.1 | 24.7 |
| Percent Over 65 Years | 13.5 | 16.7 |
| Percent Households with Children | 21.3 | 36.1 |
| Average Household Size | 2.75 | 2.7 |
| Percent Housing Vacant | 15.5 | 9.0 |

Source: U.S. Bureau of the Census. May 2001. *Profiles of General Demographic Characteristics, 2000 Census of Population and Housing, Hawai‘i.* (U.S. Census Bureau Web Page).

*Impacts and Mitigation Measures*

The project would not cause relocation of residences, businesses, community facilities, farms or other activities. In the long term, project impacts to the social environment may be regarded as largely beneficial, because the project would improve the quality, quantity and reliability of potable water for the University of Hawai‘i at Hilo and the DWS Hilo Water System which serves all of Hilo. All water projects require consideration for the secondary effects of growth induction; this topic is covered in Section 3.4.

### 3.3.2 Public Facilities and Utilities

*Utilities*

The well and supporting facilities will require electrical power. This will be provided by the Hawai‘i Electric Light Company (HELCO) via existing overhead lines on the Puainako Extension adjacent to the access road. The power demands of the well pump, control building and reservoir will not adversely affect the ability of HELCO to provide power.

*Roadways*

Access to the well site for construction and maintenance will be via the proposed 12-foot wide access road off of the Puainako Extension and Puloku Street (see Figure 4a). UH Hilo will coordinate with the State Department of Transportation and the County Department of Public Works to obtain a permit to work within the Puainako Extension and Puloku Street rights-of-way. After construction, the gated road will be used by the DWS on an infrequent basis for well maintenance. Ultimately, as the land is developed for University use, access to the well will likely be through internal roadways.

### 3.3.3 Cultural and Archaeological Resources

*Cultural Background and Resources*

The traditional cultural value of the project site was assessed by determining whether it supports any traditional gathering uses, is vital for access to traditional cultural sites, or has other important symbolic associations for native Hawaiians or other cultural groups.

The project site is located in the *ahupua‘a* of Waiākea in the district of South Hilo. The earliest historical knowledge of Hilo comes from legends written by Samuel Kamakau (1961) of the 16th century chief ‘Umi-a-Liloa (son of Liloa), who at that time ruled the entire island of Hawai‘i. Descendants of Umi and his sister-wife were referred to as “Kona” chiefs, controlling Ka‘ū, Kona, and Kohala, while descendants of Umi and his Maui wife were “Hilo” chiefs, controlling Hāmākua, Hilo, and Puna (Kelly 1981:1). According to Kamakau (1961), both sides fought over control of the island, desiring access to resources such as feathers, *māmaki* tapa, and canoes on the Hilo side, and *wauke* tapa and warm lands and waters on the Kona side (Kelly 1981:3).

Sometime near the end of the 16th century or early in the 17th century, the lands of Hilo were divided into *ahupua‘a,* which today retain their original names (Kelly 1981:3). These include the *ahupua‘a* of Pu‘u‘eo, Pi‘ihonua, Punahoa, Pōnohawai, Kūkūau, and Waiākea. The design of these land divisions was such that residents could have access to all that they needed to live, with ocean resources at the coast, and agricultural and forest resources in the interior. However, only Pi‘ihonua and Waiākea provided access to the full range of resources stretching from the sea up to 6,000 feet along the slopes of Mauna Kea (Kelly 1981:5).

Historical accounts place the current study area in an “upland agricultural zone” (McEldowney 1979), which consisted of scattered huts amidst garden plots created through what McEldowney described “shifting agriculture.” As Isabella Bird recorded upon arriving in Hilo in 1873:

> “Above Hilo, broad lands sweeping up cloudwards, with their sugar cane, kalo, melons, pine-apples, and banana groves suggest the boundless liberality of Nature” (Bird 1964:38).

Handy and Handy (1972) also described the general region as an agricultural area:

> "On the lava strewn plain of Waiākea and on the slopes between Waiākea and Wailuku River, dry taro was formerly planted wherever there was enough soil. There were forest plantations in Panaewa and in all the lower fern-forest zone above Hilo town along the course of the Wailuku River" (Handy and Handy 1972:539).

Maly (1996) referred to a 1922 article from the Hawaiian Language newspaper, *Ka Nupepa Kū'oku'a*, where planting on pāhoehoe lava flats was described:

> "There are pāhoehoe lava beds walled in by the ancestors in which sweet potatoes and sugar cane were planted and they are still growing today. Not only one or two but several times forty (mau ka'au) of them. The house sites are still there, not one or two but several times four hundred in the woods of the Panaewa. Our indigenous bananas are growing wild, these were planted by the hands of our ancestors" (Maly 1996:A-2).

The *ahupua'a* of Waiākea is a very large land division that includes all land in and near UH-Hilo as well as the land *mauka* and *makai*. As part of an archaeological assessment study, Maly (1996) conducted historical research for the lands of Wainaku, Pōnohawai, Waiākea, and Pi'ihonua, some of which is cited in a 2003 Archaeological Inventory Survey of TMK 2-4-001:122 by Scientific Consultant Services, which is found in Appendix 4 and summarized below. He discusses the significance of the use of the Hawaiian word *wai* in the place names: Waiākea, Pōnohawai, Wainaku, and Wailuku (River). According to Maly, the word *wai* (water) has strong metaphorical associations with the Hawaiian concept of wealth (*waiwai*), stressing its cultural importance (Maly 1996:A-2). In this context, the importance of Hilo can be better understood, with its copious streams that fed taro pondfields and its numerous fishponds.

Waiākea, along with Punahoa and Pi'ihonua, were held by Kamehameha I until the time of his death in 1819, at which time his holdings, including Waiākea, were passed down to his son, Liholiho. Following the *Māhele,* the population of Hilo grew and the scattered upland habitations gave way to sugar cultivation (McEldowney 1979:37).

The *ahupua'a* of Waiākea became Crown Lands during the Mahele of 1848. In the following years, 25 land claims were awarded. The awards were all small in size, and 24 went to native claimants. No Land Commission awards were made within the project area (Maly 1996, as cited in SCS 2003).

By 1905, according to Thrum (1923) the Hawaii Mill Company had 10 miles of cane flumes and produced twenty-five tons of sugar per day. In 1920 Hawaii Mill Company was taken over by the Hilo Sugar Company (Kelly 1981). Commercial sugar production lasted in Waiākea until the mid-twentieth century, at which time many of the fields were converted to pasturage associated with cattle ranching.

Following the *Māhele*, Kamehameha IV leased large portions of Waiākea to outside interests for pasture and sugarcane cultivation (Moniz 1992). In 1861 S. Kipi leased the Crown Lands of Waiākea for the rate of $600 dollars a year to be used as pasture land for five years (Kelly et al. 1981; Maly 1996). In 1874 the first lease for sugarcane cultivation in Waiākea was granted to Rufus A. Lyman for a term of 25 years. The lease granted him all the privileges of the land including the use of the fishponds and the cutting of firewood (Maly 1996). This lease was eventually transferred to the Waiākea Mill Company, founded by Alexander Young and Theo H. Davis, and the Waiākea sugar plantation was established in 1879. The Waiākea Mill Company started with about 350 acres of cultivated lands they had acquired from Lyman. In 1888 the company acquired a 30-year lease that increased their land holdings in Waiākea Ahupuaʻa. When the lease ran out in 1918, the acreage under cultivation had increased to nearly 7,000; but without a lease the *ahupuaʻa* fell under the homesteading laws, which required the government to lease the land to individual growers. Waiākea Mill Company was expected to grind the crop for the independent growers under a contract that gave the company 40% of the proceeds from the sale of the refined sugar. During its 68 years of operation, the Waiākea Mill Company was a major force in shaping the economic and social growth of Hilo, and certainly left its mark on both the cultural and physical landscapes of the area. The productive areas were interconnected with a plantation railroad system connecting fields with the mill at Wailoa Stream.

Research conducted by Kepa Maly in 1996 indicates the use of much of the project area for sugar cultivation. Contractual and legal problems, combined with a declining sugar market and the devastating *tsunami* of 1946, led the Waiākea Mill Company to cease operation in 1947, and offer its property under General Lease 2741 to private cultivators for the purpose of growing cane (Maly 1996). Although it was classified as "poor" due to shallow, very wet soils, Waiākea Plantations's Lot 20-A, located near that southeastern border of the property that contains the project site, along the current Puainako Extension, was part of a sugar cane field (the project site itself was not). Fairview Dairy acquired lots 11 through Lot 20-A, located in the eastern and southeastern portion of this property, at public auction under General Lease 3333 for pasture use. That lease was transferred to William Kamaʻu Sr. in 1959 for the purposes of pasturing cattle and horses (SCS 2003). The remaining majority of the property comprised a portion of a single government parcel (including the current project site) known as "Waiākea Pasture Land," which, covered under General Lease 2751, was leased to Kazuo Miyasaki in 1939 for dairy cattle pasturage. The lease passed to John Matson in 1942. During World War II, the property under Lease 2751 was used for training by the U.S. Army Corps (Maly 1996). By 1946, the Army was clearing the property of barbed wire, unexploded ordnance, three Quonset buildings and two latrines (SCS 2003).

*Cultural Resources*

No caves, springs, *puʻu*, native forest groves, gathering resources or other natural features are present on or near the project site. The vegetation is somewhat disturbed and contains only a few common native species, not the quality and quantity or resources that would be important for native gathering. As discussed below, no archaeological remains reflecting cultural history or supporting

cultural values appear to be present. Based on historical research, botanical reconnaissance and inquiries with potentially knowledgeable informants (including the Office of Hawaiian Affairs), it would appear that no known valuable natural, cultural or historical resources are present on the project site. The project site does not support any traditional resource uses, nor are there any Hawaiian customary and traditional rights or practices known to be associated with the property.

*Cultural Resources: Impacts and Mitigation Measures*

As it currently appears that no resources or practices of a potential traditional cultural nature (i.e., landform, vegetation, etc.) appear to be present on or near the project site, and there is no evidence of any traditional gathering uses or other cultural practices, the proposed construction and maintenance of the well, access road and pipeline would not likely impact any culturally valued resources or cultural practices. Although there are no indications so far from literature review or consultation with the State Historic Preservation Division, the Office of Hawaiian Affairs, or local residents knowledgeable about Hawaiian cultural practices that there are any traditional cultural properties or practices on the project site, various parties including the Office of Hawaiian Affairs and State Historic Preservation Division were supplied a copy of the Draft EA in order to help finalize this finding. No party reviewing the Draft EA supplied any cultural information.

*Archaeological Resources: Existing Environment*

As noted previously, an archaeological inventory survey of the large property containing the project site was conducted by Scientific Consultant Services. The survey is included as Appendix 4 and is summarized below.

The archaeological inventory study involved a pedestrian survey of the property containing the project site. All sites and features were located, mapped, described, drawn at appropriate scales, and photographed. Limited subsurface testing was conducted at sites where warranted. The survey revealed 80 features in 17 sites, including three previously identified sites. The majority of the sites within the property were interpreted to be related to historic sugar cane cultivation, ranching, or military activities; none of the sites was interpreted as being pre-Contact in nature. None of the sites found were within 1,500 feet of the project site, i.e., the limited area of the property that would be occupied by the well site, access road, or pipeline.

*Archaeological Resources: Impacts and Mitigation Measures*

By letters of November 17 and December 20, 2004, the State Historic Preservation Division concurred with the findings of the survey, including the finding of no historic properties on the project site (see end of Appendix 4 for letter). In the unlikely event that archaeological resources are encountered during future development activities within the project site, work in the immediate area of the discovery will be halted and DLNR-SHPD contacted as outlined in Hawai‘i Administrative Rules 13§13-275-12.

## 3.4 Growth-Inducing, Cumulative and Secondary Impacts

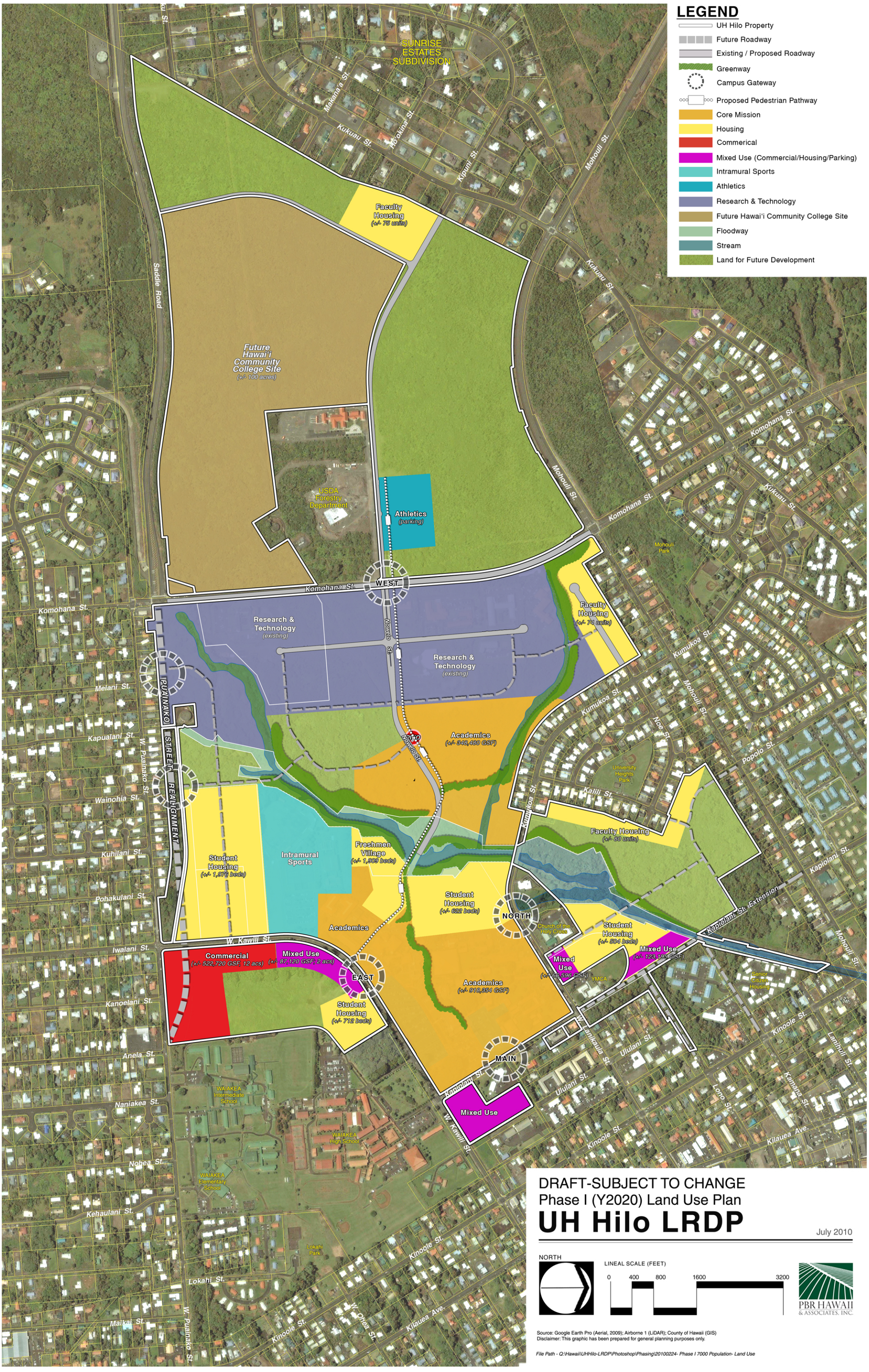
### 3.4.1 Secondary and Growth Inducing Impacts

Infrastructure expansion projects – whether highways, sewage treatment plants, school construction, or water supply – can induce secondary physical and social impacts that are only indirectly related to the project. Few if any secondary impacts are expected. A subset of secondary impacts are growth-inducing impacts. Some infrastructure projects induce unplanned development, substantially accelerate planned development, encourage shifts in growth from other areas in the region, or intensify growth beyond the levels anticipated and planned for without the project.

The proposed increase to the water supply in the Hilo Water System is in response to two needs, that of increasing general water system flexibility, and more importantly, the specific water capacity needs for the growth of UH Hilo. In terms of the general system, the Hilo Water System has enough capacity to accommodate most new construction such as individual homes or small subdivisions without a requirement for additional source. Such growth is therefore currently unconstrained by source deficiencies, whereas larger developments, if any are proposed in Hilo, have the wherewithal to develop their own sources and then dedicate them to the DWS. Consequently, the additional source is unlikely to generate or accelerate any substantial new non-University growth that otherwise would not occur. Furthermore, any such developments must conform to zoning and the General Plan.

Figure 3-4 is a preliminary preferred Master Plan developed by UH Hilo as part of a visioning process. Although by no means finalized, this exploration of what the campus may look like in 2020 (by which time the goal is to increase enrollment from 4,100 to 7,000 students) and beyond has allowed UH Hilo to organize its planning and expansion efforts. This plan is a good first-order approximation of the areas and nature of growth that at least partially depend on development of a water source.

Aside from infilling and minor expansion into the neighborhoods in the *makai* areas of the 115-acre main campus, the major emphasis is use of the nearly 500 acres of land *mauka* or just *makai* of Komohana Street for faculty housing, the relocation of Hawai‘i Community College, parking, and unspecified future growth. Such growth has been anticipated or even specifically planned for through: 1) dedication of the land by the State of Hawai‘i for University uses, mostly related to UH Hilo and 2) the designation of University Use in the Hawai‘i County General Plan. As such, it is important to note that the orderly growth of the UH Hilo campus is not induced, but rather planned growth. However, as individual projects develop, EAs for site specific concerns such as archaeology, biology and hazardous materials, cumulative impacts, as well as more neighborhood-wide impacts such as traffic, will be developed to identify develop specific mitigation measures to protect environmental and community resources.


LEGEND
UH Hilo Property
Future Roadway
Existing / Proposed Roadway
Greenway
Campus Gateway
Proposed Pedestrian Pathway
Core Mission
Housing
Commerical
Mixed Use (Commercial/Housing/Parking)
Intramural Sports
Athletics
Research & Technology
Future Hawai'i Community College Site
Floodway
Stream
Land for Future Development
SUNRISE ESTATES SUBDIVISION
Faculty Housing (+/- 76 units)
Future Hawai'i Community College Site (+/- 100 acres)
USDA Forestry Department
Athletics (parking)
WEST
Research & Technology (existing)
Research & Technology (existing)
Faculty Housing (+/- 74 units)
Academics (+/- 348,480 GSF)
Student Housing (+/- 1,976 beds)
Intramural Sports
Freshmen Village (+/- 1,909 beds)
Faculty Housing (+/- 80 units)
Student Housing (+/- 622 beds)
NORTH
Academics
Student Housing (+/- 504 beds)
Mixed Use (+/- 123,195 GSF)
Mixed Use (+/- 66,996 GSF)
Commercial (+/- 522,720 GSF, 12 acs)
Mixed Use (+/- 87,120 GSF, 2 acs)
EAST
Academics (+/- 918,354 GSF)
Student Housing (+/- 712 beds)
MAIN
Mixed Use
Saddle Road
Komohana St.
Kukuau St.
Mohouli St.
Makana'a St.
Ho'okina St.
Kipuni St.
Nowelo St.
Kumukoa St.
Popolo St.
Kaliili St.
Noe St.
Kapiolani St.
Kapiolani St. Extension
W. Kawili St.
Kinoole St.
Melani St.
Kapualani St.
Wainohia St.
Kuhilani St.
Pohakulani St.
Iwalani St.
Kanoelani St.
Anela St.
Naniakea St.
Nohea St.
Kehaulani St.
Maikai St.
Lokahi St.
W. Puainako St.
IPUAINAKO STREET REALIGNMENT
W. Kanikeaula St.
Ululani St.
Lono St.
Kamana St.
Laniniuli St.
Kilauea Ave.
W. Onea St.
Mohouli Park
University Heights Park
Church of the Holy Cross
YMCA
Senior Citizen Housing
WAIAKEA Intermediate School
WAIAKEA High School
WAIAKEA Elementary School
Lokahi Park
DRAFT-SUBJECT TO CHANGE
Phase I (Y2020) Land Use Plan
UH Hilo LRDP
July 2010
NORTH
LINEAL SCALE (FEET)
0 400 800 1600 3200
PBR HAWAII & ASSOCIATES, INC.
Source: Google Earth Pro (Aerial, 2009); Airborne 1 (LiDAR); County of Hawaii (GIS)
Disclaimer: This graphic has been prepared for general planning purposes only.
File Path - Q:\Hawaii\UHHilo-LRDP\Photoshop\Phasing\20100224- Phase I 7000 Population- Land Use

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### 3.4.2 Cumulative Impacts

Cumulative impacts result when implementation of several projects that individually have limited impacts combine to produce more severe impacts or conflicts in mitigation measures. The potential for adverse cumulative effects from induced or subsequent growth is covered in the previous section. Most of the adverse effects of the project are related to construction and are temporary – minor disturbance to air quality, traffic, noise and visual quality– and thus very limited in severity, nature and scale. However, there are a number of construction projects occurring nearby within a three-year timeframe that could generate similar construction impacts, with which these very minor and temporary effects could accumulate. This interaction thus requires attention. According to current schedules, most of the construction activity on the UH Hilo Well project site would occur during 2012 to 2013, although final outfitting of the production well might not occur until 2015.

Most nearby projects appear to be related to new buildings on or near the UH Hilo campus. UH Hilo projects currently underway include the almost completed Science and Technology Building. Planned for the near future are new buildings for the Ka Haka ʻUla O Keʻelikōlani College of Hawaiian Language (whose $23,800,000 Phase I includes a complex of three buildings for offices, classrooms, and pre-school facilities) and the College of Pharmacy. UH Hilo is also planning student housing expansion through new or renovated complexes. Non-UH Hilo projects are the Puainako Street Widening, Thirty Meter Telescope base facilities, the Kapiolani Street Extension, the 12-bed, single-story Hospice of Hilo residential facility, the Hilo Hillside subdivision and the possible relocation of Hawaiʻi Community College. Table 3-4 summarizes these projects and their potential interaction with the UH Hilo Well.

**Table 3-4**
**Projects with Potential for Cumulative Impacts**

| Project | Construction Timing | Location Relative to Well | Interaction Potential |
|---|---|---|---|
| College of Pharmacy | 2011-2015 | Nowelo Street, 3,000 feet NE | Low, due to distance, although both projects may have traffic on Puainako Street |
| Puainako Street Widening | Not funded or scheduled | Puainako Street, 2,800 feet E | Low, due to timing, but both projects would have traffic on Puainako Street |
| TMT base facilities | 2013-2015 | Nowelo Street, 3,000 feet NE | Low, due to distance and timing. |
| Hawaiʻi Community College relocation | Not funded or scheduled | In same property | None, due to timing. Project would depend on completion of well. |
| Science and Technology building | Complete in 2011 | 1.1 miles NE | None, due to timing, as project would be complete before well began. |
| College of Hawaiian Language | 2011-2013 | 3,300 feet NE | Low, due to distance, although both projects may have traffic on Puainako Street |
| Hospice of Hilo Residential Center | 2011-2012 | 1.5 miles NE | Very low, due to distance and scale of 12-bed project |
| Kapiolani Street Extension | Uncertain | 1.2 miles NE | Low, due to distance and timing uncertainty. |
| UH Hilo Student Housing | 2011-2016 | 1.2 miles NE | Low, due to distance. |
| Hilo Hillside Estates Residential Subdivision | 2011-2012 | 0.1 mile W | Low, due to timing; infrastructure for 56-lot project done before well begins; home building may overlap |

More uncertain in nature, timing or location is the China-U.S. Center (or an updated equivalent of this 2005 public-private partnership), which proposed student housing, commercial, conference and hotel rooms on 33 acres just across the main campus entrance on Kawili Street. Similarly uncertain is the Events Center, 22,600-square-foot structure that was originally planned adjacent to the Athletic Complex to provide an auditorium for performances and meetings.

In summary, most of these projects are located at least a mile from the project site, outside the area that would involve any potential to contribute dust, noise or similar construction impacts that might accumulate with similar impacts from the proposed water well project. Minor impacts to traffic on Puainako Street or the Puainako Extension could occur, but these could be mitigated through traffic control plans and construction timing that would be specified as construction managers neared the start date and examined the schedules of other, concurrent projects. Some other projects are fairly uncertain or will not likely overlap in terms of timing. There is little or no chance for adverse interactions or cumulative effects during construction.

## 3.5 Required Permits and Approvals

Several permits and approvals would be required to implement this project. They are listed here under their granting agencies.

*Hawai'i State Commission on Water Resources*

1. Well Construction Permit
2. Pump Installation Permit

*Hawai'i State Department of Health*

1. Approval of Preliminary Engineering Report
2. National Pollutant Discharge Elimination System Permit

*Hawai'i Planning Department*

1. Plan Approval

# 4 COMMENTS AND COORDINATION

## 4.1 Agencies and Organizations Contacted

The following agencies received a letter inviting their participation in the preparation of the Environmental Assessment.

*County of Hawai'i*

- Planning Department
- Public Works Department
- County Council
- Environmental Management Department
- Water Supply Department
- Police Department
- Fire Department

*State of Hawai'i*

- Department of Health
- Office of Hawaiian Affairs, Honolulu Office
- State Historic Preservation Division

Copies of correspondence from agencies with substantive comments during the preparation of the EA are included in Appendix 1a and are cited in appropriate sections of the text of this EA. Appendix1b contains written comments on the Draft EA and the responses to these comments. Various places in the EA have been modified to reflect input received in the comment letters; additional or modified non-procedural text is denoted by double underlines, as in this paragraph.

# 5 LIST OF DOCUMENT PREPARERS

This Environmental Assessment was prepared for the University of Hawai‘i at Hilo by Ron Terry, Ph.D., of Geometrician Associates, in coordination with Terry Nago, P.E., of Okahara and Associates. An archaeological inventory survey from Scientific Consultant Services prepared in 2003 for the property containing the project site was also utilized for this document.

# 6 STATE OF HAWAI‘I ENVIRONMENTAL ASSESSMENT FINDINGS

Section 11-200-12 of the State Administrative Rules sets forth the criteria by which the significance of environmental impacts shall be evaluated. The following discussion paraphrases these criteria individually and evaluates the project's relation to each.

1. *The project will not involve an irrevocable commitment or loss or destruction of any natural or cultural resources*. The well pad, access road and pipeline route are within a forest that is substantially invaded by invasive species and contains a limited number of common native species. No water bodies are present and no significant natural resources will be irrevocably committed or lost. The State Historic Preservation Division concurred with the determination that no effect to historic properties will occur.

2. *The project will not curtail the range of beneficial uses of the environment*. Future beneficial uses of the environment will in general be maintained by the proposed project. Sufficient water will remain, well within the sustainable yield of the aquifer, to promote other beneficial withdrawals of groundwater in the Hilo region.

3. *The project will not conflict with the State's long-term environmental policies*. The State's long-term environmental policies are set forth in Chapter 344, HRS. The broad goals of this policy are to conserve natural resources and enhance the quality of life. A number of specific guidelines support these goals. The project's goals of providing potable water to support adequate supply and orderly development of planned growth while working with resource agencies to conserve natural resources, including other beneficial uses of groundwater, satisfies the State's environmental policies.

4. *The project will not substantially affect the economic or social welfare of the community or State*. The improvements will benefit the social and economic welfare of Hawai‘i by improving the potable water supply system in Hilo and specifically UH Hilo.

5. *The project does not substantially affect public health in any detrimental way*. No adverse effects to public health are anticipated. Public health will be benefited by improving the potable water supply system for Hilo and specifically UH Hilo.

6. *The project will not involve substantial secondary impacts, such as population changes or effects on public facilities*. No adverse secondary effects are expected. The project will not enable development in itself, but will instead assure adequate supply of an improved source of water to existing customers and will foster the orderly expansion of UH Hilo, serving growth that has explicitly been specified in the Hawai‘i County General Plan.

7. *The project will not involve a substantial degradation of environmental quality*. The implementation of best management practices for all construction will ensure that the project will not degrade environmental quality in any substantial way.

8. *The project will not substantially affect any rare, threatened or endangered species of flora or fauna or habitat*. No endangered species of flora or fauna are known to exist on the project site or would be affected in any way by the project.

9. *The project is not one which is individually limited but cumulatively may have considerable effect upon the environment or involves a commitment for larger actions*. The adverse impacts of the project are limited to temporary and largely mitigable construction-phase impacts to erosion, sedimentation, dust, noise and visual resources. Those construction projects in the general area that will likely be occurring simultaneously are sufficiently distant from the project site so that construction-phase impacts are very unlikely to accumulate.

10. *The project will not detrimentally affect air or water quality or ambient noise levels.* The project will have negligible effects in terms of water quality, air quality and noise.

11. *The project will not affect or will likely be damaged as a result of being located within an environmentally sensitive area such as flood plains, tsunami zones, erosion-prone areas, geologically hazardous lands, estuaries, fresh waters or coastal waters*. No floodplains, tsunami zones, geologically hazardous areas, or other such sensitive land is involved in the area planned for development.

12. *The project will not substantially affect scenic vistas and viewplanes identified in county or state plans or studies.* No protected viewplanes will be impacted by the project, which will have no adverse scenic effects.

13. *The project will not require substantial energy consumption*. Some, but not substantial, input of energy is required for the construction of the facilities and the operation of the pump.

Based on the findings below, and upon consideration of comments to the Draft EA, the University of Hawai‘i at Hilo has determined that the Proposed Action will not significantly alter the environment, as impacts will be minimal, and has therefore issued a Finding of No Significant Impact (FONSI).

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# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# ENVIRONMENTAL ASSESSMENT

## Appendix 1a
## Responses to Early Consultation Letter

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**William P. Kenoi**
*Mayor*

**Harry S. Kubojiri**
*Police Chief*

**Paul K. Ferreira**
*Deputy Police Chief*

# County of Hawaii

**POLICE DEPARTMENT**
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-8865

December 2, 2010

Mr. Ron Terry, Principal
Geometrician Associates
P. O. Box 396
Hilo, HI 96721

Dear Mr. Terry:

**Subject: Early Consultation for Environmental Assessment for Proposed UH-Hilo Water Well, Island of Hawai'i, TMK (3rd) 2-4-001:122 and 173**

Staff, upon reviewing the documents provided and the map of the area, does not anticipate any significant impact to traffic and/or other public safety concerns.

Thank you for allowing us the opportunity to comment.

If you have any questions or concerns, please contact Captain Robert Wagner, Commander of the South Hilo District, at (808) 961-2214.

Sincerely,

DEREK D. PACHECO
ASSISTANT POLICE CHIEF
AREA I OPERATIONS BUREAU

RW/lli

**William P. Kenoi**
*Mayor*

**William T. Takaba**
*Managing Director*

**Frank J. DeMarco, P.E.**
*Director*

**Ivan M. Torigoe**
*Deputy Director*

# County of Hawai'i

**DEPARTMENT OF ENVIRONMENTAL MANAGEMENT**
**25 Aupuni Street • Hilo, Hawai'i 96720**
(808) 961-8083 · Fax (808) 961-8086
http://co.hawaii.hi.us/directory/dir_envmng.htm

December 6, 2010

Mr. Ron Terry
Principal
GEOMETRICIAN ASSOCIATES, LLC
P. O. Box 396
Hilo, HI 96721

RE: Early Consultation for Environmental Assessment for Proposed UH-Hilo Water Well, Island of Hawai'i, TMK: 2-4-001:122 and 173

Dear Mr. Terry,

We have no comments to offer on the subject project.

Thank you for allowing us to review and comment on this project.

Sincerely,

Frank DeMarco

Frank J. DeMarco, P.E.
DIRECTOR

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

DIRECTOR OF HEALTH

**STATE OF HAWAII**
**DEPARTMENT OF HEALTH**
**SAFE DRINKING WATER BRANCH**
919 Ala Moana Boulevard, Room 308
Honolulu, Hawaii 96814

In reply, please refer to:
File: SDWB

December 6, 2010

Mr. Ron Terry
Geometrician Associates
P.O. Box 396
Hilo, Hawaii 96721

Dear Mr. Terry:

SUBJECT: EARLY CONSULTATION FOR ENVIRONMENTAL ASSESSMENT
PROPOSED UH-HILO WATER WELL,
ISLAND OF HAWAI`I, TMK: (3RD) 2-4-001:122 AND 173

The Safe Drinking Water Branch (SDWB) has received the subject letter, dated November 27, 2010, and has the following comments:

1. The project proposed for the University of Hawai`i at Hilo is to drill an exploratory well, and if successful, outfit the well for production. The completed production well will be dedicated to the Hawai`i County Department of Water Supply to supplement existing sources in the Hilo (PWS 101) water system.

2. This well qualifies as a source that serves a regulated public water system. Federal and state regulations define a public water system as a system that serves 25 or more individuals at least 60 days per year or has at least 15 service connections. All public water system owners and operators are required to comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 20, "Rules Relating to Potable Water Systems."

3. Projects that propose development of new sources of potable water serving or proposed to serve a public water system must comply with the terms of HAR 11-20-29, entitled "Use of New Sources of Raw Water for Public Water Systems." This section requires that all new public water system sources be approved by the Director of Health prior to its

use. Such approval is based primarily upon the submission of a satisfactory engineering report, which addresses the requirements set in HAR Section 11-20-29.

The engineering report must identify all potential sources of contamination and evaluate alternative control measures, which could be implemented to reduce or eliminate the potential for contamination, including treatment of the water source. In addition, water quality analyses for all regulated contaminants, performed by a laboratory certified by the State Laboratories Division of the state of Hawaii, must be submitted as part of the report to demonstrate compliance with all drinking water standards. Additional parameters may be required by the Director for this submittal or additional tests required upon his or her review of the information submitted.

4. All public water system sources must undergo a source water assessment, which will delineate a source water protection area. This process is preliminary to the creation of a source water protection plan for that source and activities which will take place to protect the drinking water source.

If there are any questions, please call Jennifer Nikaido at 586-4258.

Sincerely,

MICHAEL MIYAHIRA, P.E., ACTING CHIEF
Safe Drinking Water Branch
Environmental Management Division

JN:cb

c: Ms. Theresa McGeehan-Takiue, East Hawaii EHS

**William P. Kenoi**
*Mayor*

**Darryl J. Oliveira**
*Fire Chief*

**Glen P. I. Honda**
*Deputy Fire Chief*

# County of Hawai'i

**HAWAI'I FIRE DEPARTMENT**
**25 Aupuni Street • Suite 2501 • Hilo, Hawai'i 96720**
**(808) 932-2900 • Fax (808) 932-2928**

December 9, 2010

Mr. Ron Terry
Geometrician Associates
PO Box 396
Hilo, HI 96721

Dear Mr. Terry,

SUBJECT: EARLY CONSULTATION FOR ENVIRONMENTAL ASSESSMENT FOR UH-HILO WATER WELL
TMK: (3RD) 2-4-001:122 and 173

The Hawai'i Fire Department does not have any comments to offer at this time regarding the above-referenced early consultation on Environmental Assessment.

Thank you for the opportunity to comment. A copy or Notice of Availability of Environmental Assessment is not needed when completed.

Sincerely,

DARRYL OLIVEIRA
Fire Chief

GA:lc

PHONE (808) 594-1888

FAX (808) 594-1865

**STATE OF HAWAI'I**
**OFFICE OF HAWAIIAN AFFAIRS**
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD10/5418

December 13, 2010

Ron Terry
Geometrician Associates
P.O. Box 396
Hilo, Hawai'i 96721

**Re: Pre- Draft Environmental Assessment**
**University of Hawai'i at Hilo Water Well**
**Hilo, Island of Hawai'i**

Aloha e Ron Terry,

The Office of Hawaiian Affairs (OHA) is in receipt of your November 27, 2010 request for comments ahead of on a draft environment assessment (DEA) to support the construction and operation of an exploratory well site proposed by the University of Hawai'i-Hilo (UHH). If exploration is successful, the well will be outfitted for production and then dedicated to the County of Hawai'i-Department of Water Supply.

OHA has no specific comments at this time. We look forward to reviewing the DEA. Thank you for initiating consultation at this early stage. Should you have any questions or concerns, please contact Keola Lindsey at 594-0244 or keolal@oha.org.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Chief Executive Officer

C: OHA- East Hawai'i Community Resources Coordinator

William P. Kenoi
*Mayor*

BJ Leithead Todd
*Director*

Margaret K. Masunaga
*Deputy*

# County of Hawai'i

**PLANNING DEPARTMENT**
Aupuni Center • 101 Pauahi Street, Suite 3 • Hilo, Hawai'i 96720
Phone (808) 961-8288 • Fax (808) 961-8742

January 3, 2011

Mr. Ron Terry
Geometrician Associates
P.O. Box 396
Hilo, HI 96721

Dear Mr. Terry:

**SUBJECT: Early Consultation for Draft Environmental Assessment**
**Project: University of Hawai'i at Hilo (UHH) Water Well**
**TMK: (3) 2-4-001:122 and 173; Waiākea, South Hilo, Hawai'i**

Thank you for your letter dated November 27, 2010 requesting comments from this office regarding the preparation of a Draft Environmental Assessment (DEA). The University of Hawai'i at Hilo (UHH) plans to drill an exploratory well on UHH lands. Construction of the exploratory well will involve clearing, grubbing and minor grading of the site for the well pad and access road to the well site.

The project site consists of a 267.03 acre parcel and a 2.663 acre parcel on the UHH lands above Komohana Street. The subject properties are zoned A-1a (Agricultural-1 acre minimum lot size). The properties are situated within the State Land Use Agricultural district. In addition, according to the County of Hawai'i General Plan 2005 (amended December 2006), the subject properties are designated as University by the Land Use Pattern Allocation Guide. The subject area is not within the Special Management Area (SMA).

If the exploratory well is successful, the University proposes to outfit the well for production. According to Chapter 25 of the Hawai'i County Code, *any substation used by a public or private utility for the purpose of furnishing telephone, gas, electricity, water, sewer, radio, or television shall be a permitted use in any district provided that the use is not hazardous or dangerous to the surrounding area and the director has issued plan approval for such use.* Therefore, plan approval will be required for any future planned improvements to the property.

We have no further comments to offer, at this time. However, please keep us informed and provide our department with a copy of the Final Environmental Assessment for our records.

If you have any questions or if you need further assistance, please feel free to contact Bethany Morrison of this office at 961-8138.

Sincerely,

BJ LEITHEAD TODD
Planning Director

BJM:cs
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# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# ENVIRONMENTAL ASSESSMENT

## Appendix 1b
## Comments to Draft EA and Responses

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NEIL ABERCROMBIE
GOVERNOR OF HAWAII

GARY HOOSER
DIRECTOR

**STATE OF HAWAII**
**OFFICE OF ENVIRONMENTAL QUALITY CONTROL**
235 SOUTH BERETANIA STREET, SUITE 702
HONOLULU, HI 96813

March 24, 2011

Ron Terry
Geometrician Associates
PO Box 396
Hilo, HI 96721

Dear Mr. Terry:

Subject: University of Hawaii at Hilo, Water Well, Draft Environmental Assessment

Thank you for the opportunity to comment on the subject draft environmental assessment. The University of Hawaii at Hilo (UH Hilo) plans to drill an exploratory water well on UH Hilo land above Komohana Street, north of the Puainako Street Extension. If the exploratory well phase is successful, the well will be outfitted for production and dedicated to the Hawaii County Department of Water Supply. It will develop a maximum of 2.5 million gallons per day. The Office of Environmental Quality Control has no comments at this time.

If you have any questions, please call Rebecca Alakai at 586-4185.

Sincerely,

Rebecca Alakai

Rebecca Alakai
Senior Planner

geometrician
ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 969-7090 PO Box 396 Hilo Hawai'i 96721 rterry@hawaii.rr.com

May 9, 2011

Rebecca Alakai, Senior Planner
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu HI 96813

Dear Ms. Alakai:

**Subject: Comment to Draft Environmental Assessment for UH-Hilo Water Well, TMK (3rd) 2-4-001:122 (por.) and 173, Hilo, Island of Hawai'i**

Thank you for the comment letter dated March 24, 2011, in which you stated that your agency had no further comments at this time. We very much appreciate your review of the document. If you have any questions about the EA, please contact me at (808) 969-7090.

Sincerely,

Ron Terry

Ron Terry, Principal
Geometrician Associates

Cc: Terry Nago and Lo-li Chih

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
INTERIM DIRECTOR OF HEALTH

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

In reply, please refer to:
File:
SDWB

March 24, 2011

Mr. Ron Terry
Geometrician Associates
P.O. Box 396
Hilo, Hawaii 96721

Dear Mr. Terry:

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT
PROPOSED UH-HILO WATER WELL,
SOUTH HILO, ISLAND OF HAWAI`I,
TMK: (3RD) 2-4-001: 122(POR.) AND 173

The Safe Drinking Water Branch (SDWB) has reviewed the subject document and has no comments.

If there are any questions, please call Jennifer Nikaido at (808) 586-4258.

Sincerely,

Joanna Seto

JOANNA L. SETO, P.E, CHIEF
Safe Drinking Water Branch
Environmental Management Division

JN:slm

c: Lo-li Chih
University of Hawaii at Hilo
Facilities Planning and Construction Office
200 W. Kawili Street
Hilo, Hawaii 96720-4091

geometrician
ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 969-7090 PO Box 396 Hilo Hawai'i 96721 rterry@hawaii.rr.com

May 9, 2011

Joanna L. Seto, P.E., Chief.
Hawai'i State DOH Safe Drinking Water Branch
P.O. Box 3378
Honolulu HI 96801-3378

Dear Ms. Seto:

**Subject: Comment to Draft Environmental Assessment for UH-Hilo Water Well, TMK (3rd) 2-4-001:122 (por.) and 173, Hilo, Island of Hawai'i**

Thank you for your comment letter on the Draft EA dated March 24, 2011, in which you stated that your agency had no further comments at this time. We very much appreciate your review of the document. If you have any questions about the EA, please contact me at (808) 969-7090.

Sincerely,

Ron Terry

Ron Terry, Principal
Geometrician Associates

Cc: Terry Nago and Lo-li Chih

**William P. Kenoi**
*Mayor*

**Bobby Jean Leithead Todd**
*Planning Director*

**Margaret K. Masunaga**
*Deputy Planning Director*

County of Hawaii
**PLANNING DEPARTMENT**
Aupuni Center • 101 Pauahi Street, Suite 3 • Hilo, Hawaii 96720
Phone (808) 961-8288 • Fax (808) 961-8742

April 20, 2011

Mr. Ron Terry
Geometrician Associates
P.O. Box 396
Hilo, HI 96721

Dear Mr. Terry:

**SUBJECT: Review of Draft Environmental Assessment**
**Project: University of Hawai'i at Hilo (UHH) Water Well**
**TMK: (3) 2-4-001:122 and 173; Waiākea, South Hilo, Hawai'i**

Thank you for your letter received on March 23, 2011 requesting comments from this office regarding the Draft Environmental Assessment (DEA) for the University of Hawai'i at Hilo Water Well. The University of Hawai'i at Hilo (UHH) plans to drill an exploratory well on UHH lands. Construction of the exploratory well will involve clearing, grubbing and minor grading of the site for the well pad and access road to the well site.

The project site consists of a 267.03 acre parcel and a 2.663 acre parcel on the UHH lands above Komohana Street. The subject properties are zoned A-1a and A-3a (Agricultural). The properties are situated within the State Land Use Agricultural district. In addition, according to the County of Hawai'i General Plan 2005 (amended December 2006), the subject properties are designated as University by the Land Use Pattern Allocation Guide. The subject area is not within the Special Management Area (SMA).

If the exploratory well is successful, the University proposes to outfit the well for production. According to Chapter 25 of the Hawai'i County Code, *any substation used by a public or private utility for the purpose of furnishing telephone, gas, electricity, water, sewer, radio, or television shall be a permitted use in any district provided that the use is not hazardous or dangerous to the surrounding area and the director has issued plan approval for such use.* Therefore, plan approval will be required for any future planned improvements to the property.

Please revise ***Section 3.3.1 Land Use, Social Factors and Community Identity*** to reflect the correct Land Use Pattern Allocation Guide University designation for parcel 122.

We have no further comments to offer, at this time. However, please provide our department with a copy of the Final Environmental Assessment for our records

If you have any questions or if you need further assistance, please feel free to contact Bethany Morrison of this office at 961-8138.

Sincerely,

for BJ LEITHEAD TODD
Planning Director

BJM:bjm
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geometrician
ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 969-7090 PO Box 396 Hilo Hawai'i 96721 rterry@hawaii.rr.com

May 9, 2011

Bobby Jean Leithead-Todd, Director
Hawai‘i County Planning Department
101 Aupuni Street, Suite 3
Hilo HI 96720

Dear Ms. Leithead-Todd:

**Subject: Comment to Draft Environmental Assessment for UH-Hilo Water Well, TMK (3rd) 2-4-001:122 (por.) and 173, Hilo, Island of Hawai‘i**

Thank you for the comment letter dated April 20, 2011, in which you confirmed most of the land use designations and permit/approval requirements contained in the Draft EA. We note your correction of the LUPAG designation for Parcel 122, which has been changed in the Final EA.

We very much appreciate your review of the document. If you have any questions about the EA, please contact me at (808) 969-7090.

Sincerely,

Ron Terry

Ron Terry, Principal
Geometrician Associates

Cc: Terry Nago and Lo-li Chih

Water Resources Research Center
**Environmental Center**

UNIVERSITY of HAWAI'I
MĀNOA

April 21, 2011
EA: 00324

Lo-li Chih, Director
Facilities Planning and Construction Office
University of Hawaii at Hilo
200 W. Kawili Street
Hilo, HI 96720

Dear Mr. Chih,

Draft Environmental Assessment
University of Hawaii at Hilo Water Well

The University of Hawaii at Hilo (UH-Hilo) proposes to construct a water well for dedication to the Hawaii County Department of Water Supply that would yield up to 2.5 million gallons per day of groundwater to support UH-Hilo's future growth.

This review of UH-Hilo's Draft Environmental Assessment (Draft EA) is a service activity of the Environmental Center to help determine and maintain the optimum quality of the environment. It is not intended to represent the official views of the University of Hawaii. The objectives of our review process are to enhance environmental consciousness, encourage cooperation and coordination, and facilitate public participation. These comments were drafted with the assistance of Robert Whittier, Geology & Geophysics, UH-Manoa, and David Penn, Environmental Center.

**General Comments**

The Draft EA provided much valuable information for our research efforts, and our review focused on the hydrogeologic description and the contamination risk analysis. Based on our ongoing research, we have a few specific comments regarding potential water quality impacts and site specific hydrogeology.

1. We plotted the proposed well location in relation to that of potentially contaminating activities contained in the Source Water Assessment Program database for the island of Hawaii. Consistent with the Draft EA we found no cesspools or septic systems located within 1000 feet of the wellhead. However, there are numerous such facilities above the probable groundwater flow path that leads to the well. Past sugar cane cultivation also occurred above this probable groundwater flow path. Therefore, agricultural contaminants leaching from the

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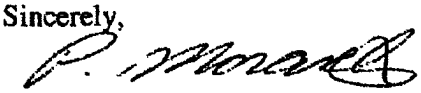
soil could be a source of contamination. The potential sources of contamination listed above should be considered.

2. The quantity is not great enough to pose a severe threat of contamination. However, they should be included in the post-construction engineering report for this water well.
3. On page 3-9 the assumed vertical distance from the ground surface to the water table is 350 feet. Based on a ground elevation of 409 feet above sea level (Appendix 3, page 1) and the groundwater elevation at nearby wells, the depth to groundwater is probably less than 200 feet.
4. It is interesting to note that the well data provided shows that wells with a higher groundwater elevation have a lower specific capacity (pumping rate divided by drawdown). This suggests a significantly lower aquifer permeability in the vicinity of the proposed well location as compared to wells near the coast (refer to the Draft EA, Appendix 3 – Appendix CWRM Well Database).

Thank you for the opportunity to comment on this Draft Environmental Assessment (DEA). When the Final EA is distributed, please send one printed copy to the Environmental Center.

Sincerely,



Philip Moravcik
Water Resources Research Center

cc: State of Hawaii Office of Environmental Quality Control (OEQC)
Chittaranjan Ray, Interim Director, Water Resources Research Center, UH Manoa
Ron Terry, Geometrician Associates LLC
Robert Whittier
David Penn

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May 9, 2011

Phillip Moravcik
Water Resources Research Center
Environmental Center
University of Hawaii, Mānoa
2500 Dole Street, Annex 19
Honolulu HI 96822

Dear Mr. Moravcik:

**Subject: Comment to Draft Environmental Assessment for UH-Hilo Water Well, TMK (3rd) 2-4-001:122 (por.) and 173, Hilo, Island of Hawai'i**

Thank you for your comment letter dated April 21, 2011, on the Draft EA. In answer to your specific comments:

1-2. *Sources of contamination*. There is at least some potential for contamination from sugar cane agriculture (which ceased in this particular area in the 1940s) and from cesspools and septic systems outside the 1,000-foot range. The concerns you mentioned are certainly important to UHH and have been added to the Final EA. These contaminants will be listed in the post-construction engineering report. It is important to note that the well will be constructed with the annular space fully grouted from the ground surface to the top of the screen. This will provide the best level of protection against contamination from these sources. To date, they have not been an issue in other wells in the Hilo area, even though these wells have a greater density of individual wastewater system upgradient and larger areas of sugar cane that persisted later into the 20th century, when the use of pesticides became more widespread. DWS periodically performs comprehensive and stringent tests of well water quality to ensure that public health is protected. Considering the depth of the well and the lack of past or current potential sources of contamination, good water quality is expected from the exploratory well. Water quality tests will verify this, and only if the water meets standards will the well be incorporated in the DWS water system. During well operation, in the unlikely event contamination beyond the maximum contaminant level is found, the DWS will follow the necessary protocol as directed by the State Department of Health Safe Drinking Water Branch.

3. *Vertical distance from the ground surface to the water table*. The distance has been corrected to 209 feet, as the presumed groundwater table is 200 feet above msl and the elevation at the well site is +/-409 feet above msl.

4. *Relationship between with higher groundwater elevation and lower specific capacity*. Glenn Bauer, the hydrologist for the project, has considered your comment and provided the following response: "It is possible that aquifer has a lower permeability in the high level zone. It could also mean that turbulent flow around the well bore is higher, therefore creating slightly greater drawdowns. However, the amount of exposed aquifer (screen and open hole) in some high level wells is small when compared to the solid casing lengths. We should be able to pump the water quantity necessary for the project with minimal drawdown. The open hole can be adjusted later (see Fig. 3 of my report)."

We very much appreciate your thorough and thoughtful review of our document and your concern for insuring safe drinking water. If you have any questions about the EA, please contact me at (808) 969-7090.

Sincerely,

Ron Terry, Principal
Geometrician Associates

Cc: Terry Nago and Lo-li Chih

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# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# ENVIRONMENTAL ASSESSMENT

## Appendix 2
## Annual Water Quality Report, South Hilo System, Year 2009

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## Sources of drinking water

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

•Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

•Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

•Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

•Organic chemical contaminants, including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

•Radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the Environmental Protection Agency (EPA) prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

## Source Water Assessment Program

In 2004, the preliminary source water assessment report was released. The purpose of the source water assessment report is to enable the public and decision-makers to make well-founded decisions for the protection and preservation of our drinking water. The source water assessment report identifies the potential contaminating activities for each source of water.

In the report, Hilo Water System sources are potentially vulnerable to contaminants associated with the following activities: roads, septic tanks, cesspools, sewer lines, injection wells, residential parcel, cultivated agriculture, and sugarcane. Note: the list of potential contaminating activities has not necessarily been associated with anything found in the water. For more information, please contact Keith Okamoto, P.E., at 961-8670.

## Is my water safe?

Yes it is. Last year, as in years past, your tap water met all U.S. Environmental Protection Agency (EPA) and State drinking water health standards. The Department of Water Supply vigilantly safeguards its water supplies and once again we are proud to report that your system has complied with all drinking water standards.

## Why are there contaminants in my drinking water?

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline 1-(800) 426-4791. If you have any questions regarding this Water Quality Report, please call Keith Okamoto, P.E., at 961-8670.

## Do I need to take special precautions?

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline at 1-(800) 426-4791 .

## How can I get involved?

The Water Board meets the fourth Tuesday of every month. Call for the time and location of the meeting.

**You Can Contact Us at the Following Numbers:**

| | |
|---|---|
| **Administration/Finance/General** | **(808) 961-8050** |
| **Billing/Customer Service** | **(808) 961-8060** |
| **Engineering** | **(808) 961-8070** |
| **Emergencies & Field Operations** | **(808) 961-8790** |
| **Water Quality** | **(808) 961-8670** |


Department of Water Supply
345 Kekūanaō'a Street, Suite #20
Hilo, Hawai'i 96720



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*The Department of Water Supply is an equal opportunity provider and employer.*

# 2009 Hilo Water System Annual Water Quality Report

county of Hawai'i

Department of Water Supply

# Hilo System Water Quality Data Tables

The table below lists the drinking water contaminants that we detected during the calendar year of this report. The presence of contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from testing done in the calendar year of the report. The EPA or the State requires us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though representative, are more than one year old.

## Regulated Contaminants

| | | | Pana'ewa Wells 1,2,3 | | | Pi'ihonua Well C | | | Pana'ewa Wells 1,2,3/ Pi'ihonua Wells A,B | | | Pi'ihonua Wells A,B | | | Saddle Road Well A | | | 'Ōla'a Flume Spring | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contaminants (units) | MCL | MCLG | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Violation | Typical Source of Contaminant |
| **Microbiological Contaminants** | | | | | | | | | | | | | | | | | | | | | | |
| Turbidity (NTU)* | TT = 5 NTU | N/A | N/A | N/A | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | Highest monthly average = 0.126 | | 2009 | No | Soil runoff. |
| *Turbidity is a measure of the cloudiness of the water. We monitor it because it is a good indicator of the quality of the water. High turbidity can hinder the effectiveness of disinfectants. | | | | | | | | | | | | | | | | | | | | | | |
| **Inorganic Contaminants** | | | | | | | | | | | | | | | | | | | | | | |
| Fluoride (ppm) | 4 | 4 | ND | N/A | 2009 | ND | N/A | 2009 | ND | ND - ND | 2009 | ND | N/A | 2009 | 0.21 | ND - 0.22 | 2009 | 0.05 | N/A | 2007 | No | Erosion of natural deposits. |
| Nitrate (ppm) | 10 | 10 | ND | N/A | 2009 | 0.30 | N/A | 2009 | 0.38 | ND - 0.38 | 2009 | 0.38 | N/A | 2009 | 0.36 | 0.30 - 0.41 | 2009 | 0.19 | N/A | 2007 | No | Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits. |
| **Disinfection By-Products** | | | | | | | | | | | | | | | | | | | | | | |
| Haloacetic acids (HAA5) (ppb) | 60 | N/A | 1.08 | ND - 1.20 | 2009 | 1.05 | ND - 1.30 | 2009 | 1.08 | ND - 1.20 | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | No | Byproduct of drinking water disinfection. |
| Total Trihalomethanes (TTHMs) (ppb) | 80 | N/A | ND | ND - ND | 2009 | 1.00 | ND - 1.00 | 2009 | ND | ND - ND | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | N/A | N/A | 2009 | No | Byproduct of drinking water disinfection. |

Haloacetic Acids or "HAA5" means the sum of the concentration of the haloacetic acids (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid).
Total Trihalomethanes or "TTHM" means the sum of the concentration of the trihalomethane compounds [trichloromethane (chloroform), dibromochloromethane, bromodichloromethane, and tribromomethane (bromoform)].

## Sodium (Not Regulated by State or Federal Government)

| | | | Pana'ewa Wells 1,2,3 | | | Pi'ihonua Well C | | | Pana'ewa Wells 1,2,3/ Pi'ihonua Wells A,B | | | Pi'ihonua Wells A,B | | | Saddle Road Well A | | | 'Ōla'a Flume Spring | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contaminants (units) | MCL | MCLG | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Level Found | Range of Detections | Sample Date | Violation | Typical Source of Contaminant |
| **Inorganic Contaminants** | | | | | | | | | | | | | | | | | | | | | | |
| Sodium (ppm) | N/A | none | 5.4 | N/A | 2008 | 7.0 | N/A | 2008 | 8.2 | 5.4 - 8.2 | 2008 | 8.2 | N/A | 2008 | 9.5 | 7.0 - 9.5 | 2008 | 2.5 | 2.5 - 2.5 | 2002 | No | Erosion of naturally occurring deposits; saltwater intrusion. |

## Lead and Copper Rule Compliance

| | | | Hilo Water System | | | | |
|---|---|---|---|---|---|---|---|
| Contaminant (units) | AL | MCLG | Level Found | # of sites > AL | Sample Date | Violation | Typical Source of Contaminant |
| Copper (ppm) | 1.3 | 1.3 | 0.06 | 0/36 | 2007 | No | Corrosion of household plumbing systems; erosion of natural deposits. |

## Key definitions of terms used in this report

- **MCLG** = Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk for health. MCLGs allow for a margin of safety.
- **MCL** = Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
- **TT** = Treatment Technique: A required process intended to reduce the level of a contaminant in drinking water.
- **NTU** = Nephelometric Turbidity Units: This is a measure of the suspended material in water.
- **AL** = Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.
- **ND** = Not Detected: If a contaminant is not measured at or above its minimum detection limit, it is reported as Not Detected - detection limits are available upon request.
- **ppm** = Parts per million. One ppm corresponds to a single penny in $10,000 or one minute in two years.
- **ppb** = Parts per billion. One ppb corresponds to a single penny in $10,000,000 or about one minute in two thousand years.
- **N/A** = not applicable

## Sodium in drinking water

There is no State or Federal maximum contaminant level for sodium. Although required, monitoring for sodium is performed primarily to gather information for the consumers, the Safe Drinking Water Branch, and the Department of Water Supply.

The EPA Drinking Water Advisory recommends that the sodium concentration in drinking water not exceed a range of 30 to 60 ppm because of the possible adverse effects on taste at higher concentrations. For persons on a sodium-restricted diet, sodium concentrations greater than 120 ppm could be problematic.

If you are on a sodium-restricted diet, you should consult your physician about the level of sodium in the drinking water.

## Giardia

*Giardia* is a protozoan, or one-celled organism that causes intestinal problems in humans. This organism, which originates from animals, can be transmitted by drinking water. It produces a cyst, or dormant stage that is resistant to low levels of chlorine. For this reason, while the 'Ōla'a Flume Spring source was in use, the Department monitored the chlorine levels on a 24-hour basis to ensure that an adequate chlorine level was maintained.

## Drinking Water Standard Violation in January 2009

The Hilo Water System violated a drinking water standard in January of 2009. Saddle Road Well "A" was down for repairs from January 14 to March 12, 2009. The 'Ō'laa Flume Spring source was temporarily activated to service the area that Saddle Road Well "A" normally serves.

The 'Ō'laa Flume Spring source, as a groundwater under the influence of surface water source, is required to meet specified disinfection standards. In order to ensure proper disinfection, water from the 'Ō'laa Flume Spring source must be in contact with chlorine for a minimum amount of time. On January 15 and 16, 2009, this did not occur. The DWS incurred a violation for January because the disinfection levels were lower than the required amounts on two days in the month of January.

Although chlorine quickly kills most bacteria, it is less effective against organisms such as viruses and parasites. For this reason, water needs to mix with chlorine for a longer period of time to kill such organisms.

*Inadequately treated water may transmit disease-causing organisms. These organisms include bacteria, viruses, and parasites, which can cause symptoms such as nausea, cramps, diarrhea and associated headaches.*

These symptoms, however, are not only caused by organisms in drinking water. If you experience any of these symptoms and they persist, you may want to seek medical advice.

## Lead and drinking water

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing and not usually from the source water. The Department of Water Supply is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may choose to have your water tested by contacting private laboratories that are certified by the State for doing drinking water analyses. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

## Where does my water come from?

The sources of water that are normally used for the Hilo Water System are Pana'ewa Well Nos. 1, 2 and 3, Pi'ihonua Well Nos. A, B, and C, and Saddle Road Well "A" (all of which are groundwater sources). These source(s) may change depending on the supply and demand.

From January 14 to March 12 of 2009, Saddle Road Well "A" was down for repairs. 'Ō'laa Flume Spring (which is a groundwater under the influence of surface water source) was used as an emergency source during that time.

# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# ENVIRONMENTAL ASSESSMENT

## Appendix 3
## Hydrology Memorandum

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December 7, 2010

MEMORANDUM

TO: Terrance Nago, P.E., Okahara & Associates, Inc.

FROM: Glenn Bauer, Mink & Yuen, Inc.

SUBJECT: University of Hawaii Hilo Well Design and Capacity

The purpose of this memorandum is to discuss the well design and the capacity for the proposed new University of Hawaii Hilo (UHH) well site located near the Hilo campus off of the new Puainako Extension road. The December 1, 2010 site visit provided an opportunity to see the well's location in conjunction with other wells in the area. The NAD83 datum coordinates for the site as determined by a Garmin 60Cx GPS are: 19°41′42.9″/155°6′1.9″ ±12 ft. The surveyor calculated the elevation of the well (top of a rebar driven into the ground) at 409.69 ft., msl. See Figure 1.

The new UHH well is intended to develop a maximum of 2.5 million gallons per day (mgd) of groundwater from basaltic lava flows originating from Mauna Loa. These lavas are comprised of both pahoehoe and aa, and because they are geologically young, they are not weathered and are very permeable.

The Commission on Water Resource Management (CWRM) manages the groundwater resources in the state. This is done by dividing the islands up into Aquifer Sectors and Aquifer Systems. Aquifer Sectors are geologic structural boundaries, such as the geological unconformity between Mauna Kea and Mauna Loa, whereas the aquifer systems are within the sectors and are hydraulically connected.

The Hilo area south of the Wailuku River is defined by CWRM as the Northeast Mauna Loa Sector. This sector is subdivided into the Hilo and Keaau Aquifer Systems. The Hilo Aquifer System, where the UHH well is located, has an area of 193.73 $mi^2$ and an estimated mean daily recharge rate from rainfall of 793 mgd. The CWRM estimated sustainable yield for the aquifer system is 347 mgd. Similarly, the hydraulically connected Keaau Aquifer System has an average daily recharge rate of 898 mgd and an estimated sustainable yield of 393 mgd (George A. L. Yuen & Assoc. 1990; CWRM, 2008). This is a tremendous amount of groundwater moving through the systems, and the water not pumped out of the ground, discharges as basal springs at the coast.

From 2000 to 2009, the average pumpage in the Hilo Aquifer system was about 42 mgd, the majority of the pumpage is from the HELCO cooling wells. Department of Water Supply pumpage for the same period was between 2.5 to 6 mgd (CWRM pumpage database).

Water Levels

The older wells in the Hilo Aquifer System were drilled close to the coast, at ground elevations less than 100 ft., msl. These wells exhibited typical basal groundwater conditions where the fresh groundwater floats on top of the denser saltwater. A Ghyben-Herzberg lens is formed, and the theoretical relationship is that for every foot of fresh water above sea level it is balanced by 40 feet below sea level. The twelve HELCO wells (4203-01-12) for example have water levels that vary between 6 and 9 ft., msl (CWRM well database). Assuming an average water level of 7 ft., msl, the theoretical thickness of the lens is 41 x 7 feet or 287 feet. In terms of elevation, the 50 percent seawater/freshwater concentration mid-point is 280 feet below sea level. The region above the mid-point is called the transition zone. The top of the transition zone is defined as 2 percent seawater concentration. The thickness of the transition zone varies, though in the Hilo area, it is assumed to be thin due to the tremendous amount of groundwater flux. The bottom elevations of the wells vary from -14 to -535 ft., msl. When the wells were drilled in the early 1960's the chlorides were low. Large capacity pumps will cause upconing of the underlying seawater over time.

Hawaii DWS started drilling wells at higher ground elevations in 1973. Piihonua Well A (4306-01) drilled at elevation 278 ft., msl, encountered a water level of 42± ft., msl. The nearby Piihonua Well B (4306-02) also had a similar water level. A well known as Ponohawai 3 (4206-01), drilled in 1993 at ground elevation 465 ft., msl hit water at 243 ft., msl. Piihonua Well C (4208-01) drilled in 1995 at ground elevation of 975 ft., msl found water at 264± ft., msl. Figure 2 shows the locations of these wells, the new UHH well (yellow dot), and the general location of the HELCO wells.

It is safe to say that the high groundwater levels in these wells preclude the possibility of seawater intrusion or contact with seawater. The bottom elevations for all of these high-level wells are range between -57 and -157 ft., msl.

The usual cause for abundant high-level groundwater is due to a geologic structure such as volcanic dikes. Well capacity in areas of volcanic dikes is limited because low-permeability dikes become "no flow" boundaries. A pumping well's

drawdown cone expands outward, and when a dike is reached, the drawdown increases significantly. The Hawaii DWS wells are not limited by this problem.

The cause for the high-level water at ground elevations greater than 200 ft., msl could be due to the tremendous amount of groundwater flux moving through aquifer system. Even though the individual lava flows range in permeability, the bulk permeability of the basaltic lava flows may be such as causing groundwater to "back up" inland from the coast.

UHH Well Design and Capacity

The quantity of water desired by the new UHH well would meet a maximum daily demand of 2.5 mgd (1,750± gpm) over a 24-hour period. With an installed pump capacity of 1,750 gpm, a standard 16-hour pump day would produce an average daily amount of 1.66 mgd. It is assumed that the water level in the new UHH well will be comparable to the high-level wells at or near the same ground elevations even though there are no wells in close proximity to the well site (see Figure 2). When the well is drilled careful measurements regarding the static head must be done, as adjustments to the lengths of solid casing and perforated casing need to be made.

For the sake of design, the assumed water level will be 200 ft., msl, and to accommodate a 1,750 gpm pump, the well's diameter will be 20 inches ID. Figure 3 is the cross-section used by CWRM in the well application form. The assumed depth of the well is 500 feet (bottom elevation is -91 ft., msl). The final length of the solid casing and perforated casing will depend upon the static head. Figure 3 shows the solid casing extending 91 feet into the saturated zone. If the static head is lower, then the length of the solid casing will be greater. This may have to be adjusted in the field. Assuming the pump test does not show the well to be performing adequately, we may have to drill open hole below the perforated casing to provide more exposed aquifer.

I have attached as an appendix to this memorandum a printout of the CWRM well database for the Hilo Aquifer System. I highlighted the high-level Piihonua wells and the Ponohawai well. Also highlighted is one of the HELCO basal wells shown in Figure 2. The well database shows the variability of well design for the wells developing high-level groundwater.

If the well encounters basal groundwater with water levels of less than 20 ft., msl, then the casing length would be adjusted to sea level (409 feet) and the perforated casing would go to quarter of the thickness of the freshwater lens. Therefore, if the

water level is 10 ft., msl, then the bottom elevation would be set by CWRM standards using the formula: 10 – (41 x 10)/4 or -92.5 ft., msl. It may be difficult to develop 2.5 mgd from one source without causing the upconing of the underlying saline water over time.

Figure 1

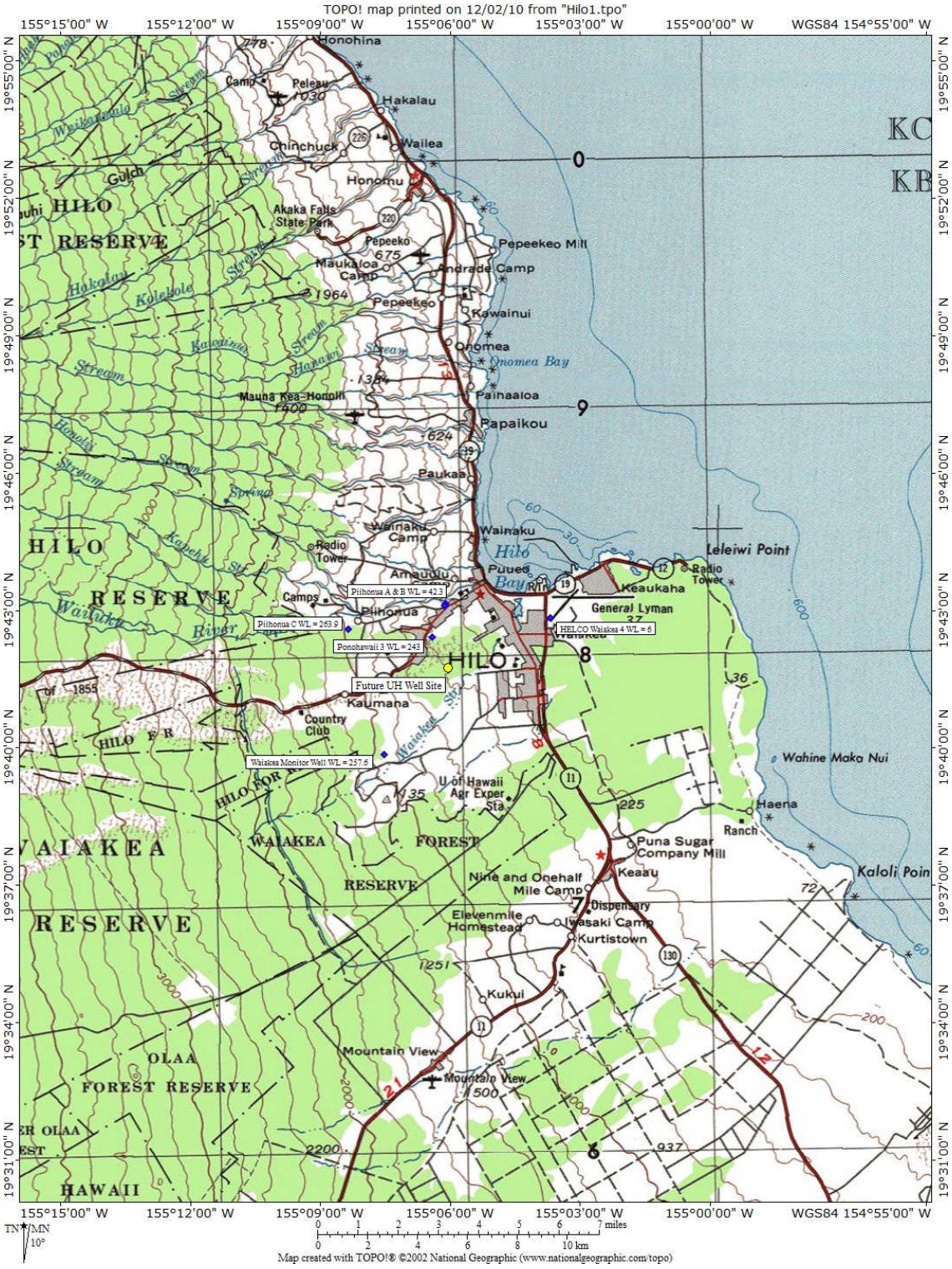
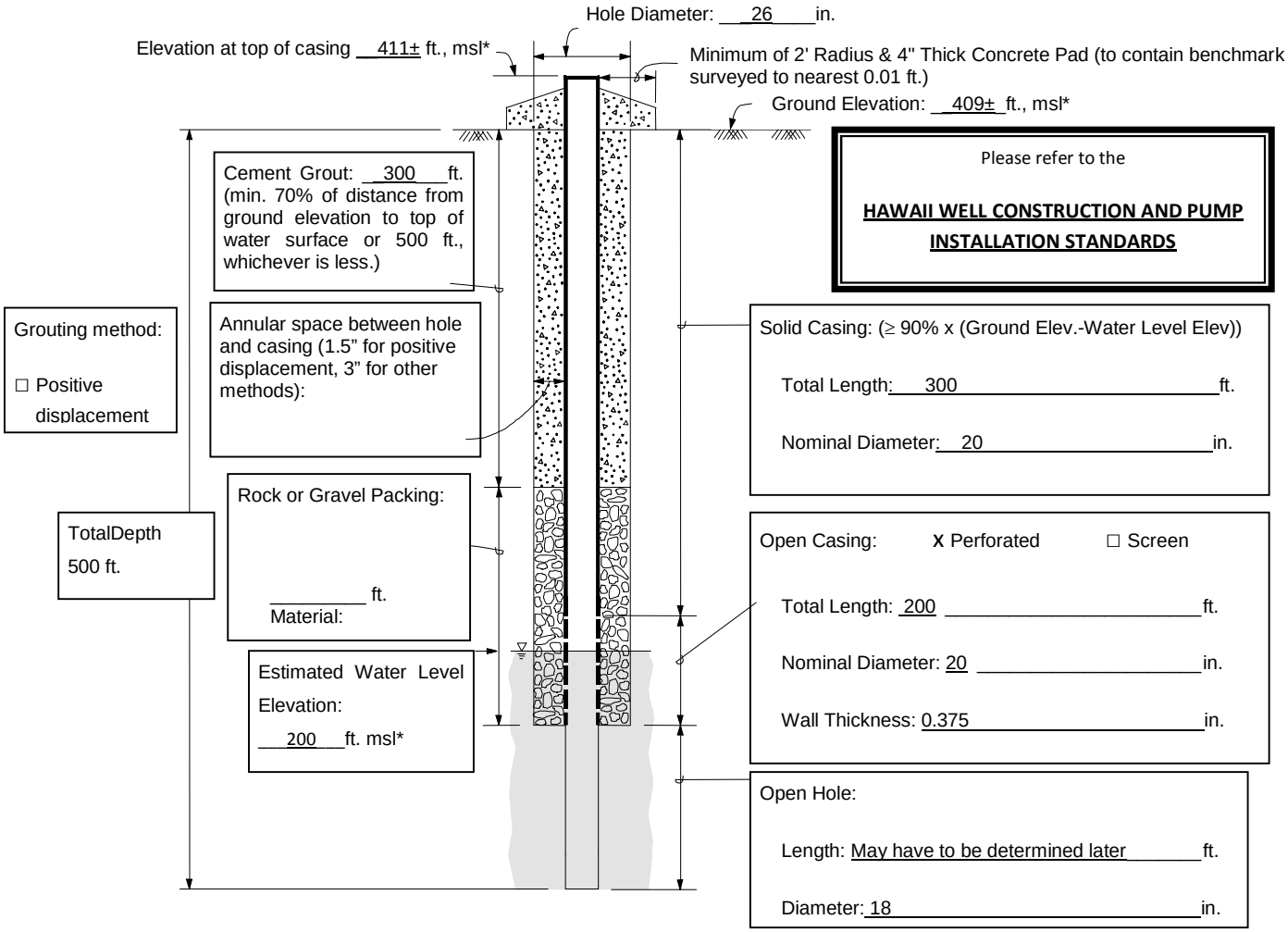

TOPO! map printed on 12/02/10 from "Hilo1.tpo"
155°15'00" W
155°12'00" W
155°09'00" W
155°06'00" W
155°03'00" W
155°00'00" W
WGS84 154°55'00" W
19°55'00" N
19°52'00" N
19°49'00" N
19°46'00" N
19°43'00" N
19°40'00" N
19°37'00" N
19°34'00" N
19°31'00" N
Honohina
Camp
Peleau
Hakalau
Chinchuck
Wailea
Honomu
Akaka Falls State Park
Pepeekeo
Maukaloa Camp
Pepeekeo Mill
Andrade Camp
Pepeekeo
Kawainui
Onomea
Onomea Bay
Paihaaloa
Mauna Kea-Honoli
Papaikou
Paukaa
Wainaku Camp
Wainaku
Radio Tower
Hilo Bay
Puueo
Leleiwi Point
Keaukaha
General Lyman
Amauulu
Camps
Piihonua A & B WL = 42.3
Piihonua
Piihonua C WL = 263.9
Ponohawaii 3 WL = 243
HELCO Waiakea 4 WL = 6
HILO
Future UH Well Site
Kaumana
Country Club
Waiakea Monitor Well WL = 257.6
U of Hawaii Agr Exper Sta
Wahine Mako Nui
Haena
Ranch
Puna Sugar Company Mill
Keaau
Nine and Onehalf Mile Camp
Dispensary
Elevenmile Homestead
Iwasaki Camp
Kurtistown
Kaloli Poin
Kukui
Mountain View
HILO RESERVE
WAIAKEA FOREST RESERVE
OLAA FOREST RESERVE
HAWAII
TN
MN
10°
0 1 2 3 4 5 6 7 miles
0 2 4 6 8 10 km
Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

Figure 2

Figure 3

**PROPOSED WELL SECTION** *(Please attach schematic if different from diagram provided below)*




* The approximate elevation must be referenced to mean sea level (msl) at the time of application filing. Final elevations of well components shall be submitted in the Well Completion/Well Abandonment reports and referenced to a benchmark which has been established by a surveyor licensed by the State.

→

References:

Commission on Water Resource Management, 2008, Hawaii Water Resources Protection Plan: 12 sections and appendices. Can be found online at: (http://hawaii.gov/dlnr/cwrm/planning_wrpp.htm

George A. L. Yuen and Associates, 1990, State Water Resources Protection Plan, Vol. II, Appendix: prepared for the State Water Resources Management Commission, Dept. of Land and Natural Resources, State of Hawaii, 233 p.

# APPENDIX

## CWRM WELL DATABASE

| Well No. | Well Name | Aquifer Code | Owner/User | Year Drilled | Coordinates Latitude | Coordinates Longitude | Physical Data Type | Case Dia. in. | Total Depth ft. | Elevations in feet (msl) Ground | Bottom Solid Casing | Bottom Perf Casing | Bottom of Hole | Static Head | Initial Cl mg/l | Initial Temp °F | Specific Capacity | Pump Test Results Installed Capacity T mgd | Use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ISLAND | | | | | | | | | | | | | | | | | | | |
| CODE | 8 | | | | | | | | | | | | | | | | | | |
| 3903-01 | PACRC-P 3 | 80401 | University of Hawaii Hilo | -2005 | 193901 | 1550248 | PER | 12 | 275 | 241 | 1 | -29 | -34 | 15.46 | | 18.7 | | .396 | AGRAQ |
| 4007-01 | Waiakea Monitor | 80401 | Okahara & Assc | 1991 | 194002 | 1550742 | ROT | 7 | 955 | 915 | 903 | -40 | -40 | 257.6 | | 19.0 | 84 | | OBS |
| 4010-01 | Kaumana | 80401 | U S G S | 1995 | 194035 | 1551023 | ROT | 4 | 1397 | 1796 | 1154 | 399 | 399 | 996.8 | | | | | OBS |
| 4110-01 | Saddle Road A | 80401 | Hawaii DWS | 1998 | 194105 | 1551058 | ROT | 20 | 1400 | 1910 | 810 | 610 | 510 | 950.6 | | | | 1.008 | MUNCO |
| 4202-01 | Hilo Airport 1 | 80401 | HIARNG | 1944 | 194248 | 1550245 | PER | 16 | 76 | 59 | 44 | | -17 | 4 | | | 64 | | UNU |
| 4202-02 | Hilo Airport 2 | 80401 | HIARNG | 1944 | 194240 | 1550252 | PER | | 55 | 71 | 56 | | 16 | 5 | | | 1000 | | UNU |
| 4203-01 | Waiakea TH 1 | 80401 | HELCO | 1960 | 194228 | 1550353 | | 5 | 54 | 40 | | | -14 | 6.7 | 4 | 21.1 | 36 | | UNU |
| 4203-02 | Waiakea TH 2 | 80401 | HELCO | 1960 | 194223 | 1550352 | | 5 | 55 | 41 | | | -14 | 9.1 | 6 | 21.1 | 83 | | UNU |
| 4203-03 | Waiakea TH 3 | 80401 | HELCO | 1960 | 194230 | 1550348 | | 5 | 56 | 41 | | | -15 | 5.8 | 4 | 21.1 | 250 | | OTH |
| 4203-04 | Waiakea 4 | 80401 | HELCO | 1961 | 194222 | 1550351 | PER | 16 | 201 | 47 | -13 | | -154 | 7.06 | 22 | 20.0 | 12500 | | NSLD |
| 4203-05 | Hill Unit 5A | 80401 | HELCO | 1965 | 194222 | 1550350 | | 29 | 200 | 50 | -4 | | -150 | | | 20.0 | | 6.480 | NDEL |
| 4203-06 | Hill Unit 5B | 80401 | HELCO | 1965 | 194223 | 1550349 | | 29 | 200 | 50 | -4 | | -150 | 6.5 | | 19.9 | 1000 | 6.480 | NDEL |
| 4203-07 | Hill Unit 5C | 80401 | HELCO | 1965 | 194224 | 1550350 | | 29 | 585 | 50 | -150 | | -535 | | | | | 6.480 | NDEL |
| 4203-08 | Kanoelehua Disp | 80401 | HELCO | 1965 | 194228 | 1550350 | DUG | 192 | 33 | 39 | 31 | | 6 | | | | | | OTH |
| 4203-09 | Hill Unit 6A | 80401 | HELCO | 1974 | 194223 | 1550347 | ROT | 32 | 210 | 55 | | | -155 | 6 | | | | 9.000 | NDEL |
| 4203-10 | Hill Unit 6B | 80401 | HELCO | 1973 | 194222 | 1550347 | ROT | 32 | 210 | 55 | -20 | | -155 | 6 | | 20.0 | 1743 | 9.000 | NDEL |
| 4203-11 | Hill Unit 6C | 80401 | HELCO | 1974 | 194223 | 1550346 | DUG | 72 | 20 | 43 | | | 23 | 6 | | | 1349 | | OTH |
| 4203-12 | Helco Kan 6-4 | 80401 | HELCO | 1974 | 194222 | 1550346 | ROT | 30 | 210 | 49 | -31 | | -161 | 6 | | | 60000 | 9.000 | NDEL |
| 4203-13 | Glover Quarry A | 80401 | Jas W Glover Ltd | 1948 | 194244 | 1550344 | DUG | 72 | 25 | 23 | | | -2 | | | | | .864 | NDMI |
| 4203-14 | Glover Quarry B | 80401 | Jas W Glover Ltd | 1948 | 194245 | 1550342 | DUG | 72 | 25 | 23 | | | -2 | | | | | .504 | NDMI |
| 4203-15 | Waiakea | 80401 | Hawaiian Host | 1987 | 194216 | 1550336 | PER | 8 | 130 | 81 | 1 | -19 | -49 | 8.75 | | 19.4 | | | IND |
| 4204-01 | Waiakea Village | 80401 | Hawn Rsrt Vill | 1971 | 194258 | 1550434 | PER | 14 | 35 | | | | | | | | 521 | 1.008 | IND |

| | | | | | Coordinates | | Physical Data | | | Elevations in feet (msl) | | | | | Initial | | | | Pump Test Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well No. | Well Name | Aquifer Code | Owner/User | Year Drilled | Latitude | Longitude | Type | Case Dia. in. | Total Depth ft. | Ground | Bottom Solid Casing | Bottom Perf Casing | Bottom of Hole | Static Head | Cl mg/l | Temp °F | Specific Capacity | T | Installed Capacity mgd | Use |
| 4206-01 | Ponohawai 3 | 80401 | Isf Develop Co | 1993 | 194236 | 1550635 | PER | 12 | 465 | 380 | 0 | -20 | -85 | 243 | | | | | | UNU |
| 4208-01 | Piihonua C | 80401 | Hawaii DWS | 1995 | 194247 | 1550832 | PER | 20 | 1032 | 975 | 3 | -57 | -57 | 263.9 | | 17.2 | 93 | 6E+04 | 3.024 | MUNCO |
| 4211-01 | Olaa Flume Tun | 80401 | Hawaii DWS | | 194201 | 1551115 | TUN | | | 1960 | | | | 1960 | | | | | | UNCO |
| 4304-01 | Shipman 1A, 1B | 80401 | HELCO | 1943 | 194337 | 1550418 | | 54 | 20 | 12 | | | -8 | | | | | | 7.776 | NDEL |
| 4304-02 | Shipman 2 | 80401 | HELCO | 1957 | 194337 | 1550418 | DUG | 84 | 26 | 10 | | | -16 | | | | | | 9.504 | UNU |
| 4304-03 | Shipman 3 | 80401 | HELCO | 1971 | 194337 | 1550418 | DUG | | 20 | 10 | | | -10 | | | | | | 9.504 | NDEL |
| 4304-04 | Shipman 4A, 4B | 80401 | HELCO | 1970 | 194337 | 1550418 | DUG | | 20 | 10 | | | -10 | | | | | | 12.672 | NDEL |
| 4306-01 | Piihonua A | 80401 | Hawaii DWS | 1973 | 194318 | 1550618 | PER | 18 | 423 | 278 | 68 | | -145 | 42.1 | 2 | 17.8 | 139 | | 3.024 | MUNCO |
| 4306-02 | Piihonua B | 80401 | Hawaii DWS | 1987 | 194320 | 1550617 | PER | 18 | 445 | 278 | -40 | | -167 | 42.3 | 2 | 17.2 | 346 | | 3.024 | MUNCO |
| 4403-01 | PACRC-KSW 1 | 80401 | University of Hawaii-Hilo | 2005 | 194341 | 1550246 | PER | 8 | 405 | 11 | -379 | -389 | -394 | 3.3 | | 21.3 | | | .684 | AGRAQ |
| 4403-02 | PACRC-KFW 2 | 80401 | University of Hawaii-Hilo | 2005 | 194341 | 1550246 | PER | 12 | 23 | 11 | 1 | -9 | -12 | 0.3 | | 19.8 | | | .648 | AGRAQ |

**Total Installed Pump Capacity in Aquifer in mgd** **100.08**
**Total Number of Wells in Aquifer** **33**

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# UH-HILO WATER WELL
# SOUTH HILO, ISLAND OF HAWAI‘I
# STATE OF HAWAI‘I

# ENVIRONMENTAL ASSESSMENT

## Appendix 4
## Archaeological Inventory Survey

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SCS PROJECT 361-2

# AN ARCHAEOLOGICAL INVENTORY SURVEY ON APPROXIMATELY 258 ACRES OF LAND FOR THE UNIVERSITY OF HAWAI`I-HILO *MAUKA* LANDS DEVELOPMENT WAIĀKEA AHUPUA`A, SOUTH HILO DISTRICT, ISLAND OF HAWAI`I, HAWAI`I [TMK: 3-2-4-01:122]


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# INTRODUCTION

## PROJECT AREA DESCRIPTION

At the request of PBR Hawaii, Scientific Consultant Services (SCS), Inc. conducted an Archaeological Inventory Survey of a 258-acre parcel (TMK: 3-2-4-01:122) located in the *ahupua`a* of Waiākea, South Hilo District, Island of Hawai`i (Figures 1 and 2). The project area is situated approximately three kilometers southwest of Hilo Bay and is bounded by the Mohouli Street extension to the north, Komohana Street to the east, the Pū`āinakō Street extension to the south, and by the Sunrise Ridge subdivision to the west. The parcel is being considered for the University of Hawai`i (UH) Hilo Mauka Lands development, a proposed expansion of the Hawaii Community College and the University of Hawai`i Hilo campuses.

## SCOPE OF WORK

The Archaeological Inventory Survey was undertaken in accordance with draft Hawai`i Administrative Rules 13§13-284 and was performed in compliance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports contained in draft Hawai`i Administrative Rules 13§13-276. The investigation included the following procedures:

1.) A 100 percent pedestrian survey of the project area. All sites and features were located, mapped (GIS), described, drawn at appropriate scales, and photographed. Sites were assigned temporary numbers pending State Historic Preservation Division (SHPD) assignment of SIHP site numbers.

2.) Limited subsurface testing was conducted at sites, where warranted, to determine depth, quantity, and context of cultural materials and to obtain samples for radiocarbon dating.

3.) Extensive historical and archaeological archival research was conducted including a search of historic maps, aerial photos, written records, Land Commission Award documents, and State and County Planning Division documents.

4.) Interviews were conducted with community members regarding their recollections of land-use and activities known to have occurred within the study area.

## METHODS

Prior to fieldwork, a search of geological maps, aerial photos, historical maps, historical documents, and archaeological reports was conducted. Extensive archival research and oral interviews were also carried out as part of the Inventory Survey work. The project area was found to exist entirely within known Waiākea Sugar Mill plantation fields and Waiākea Pastureland.

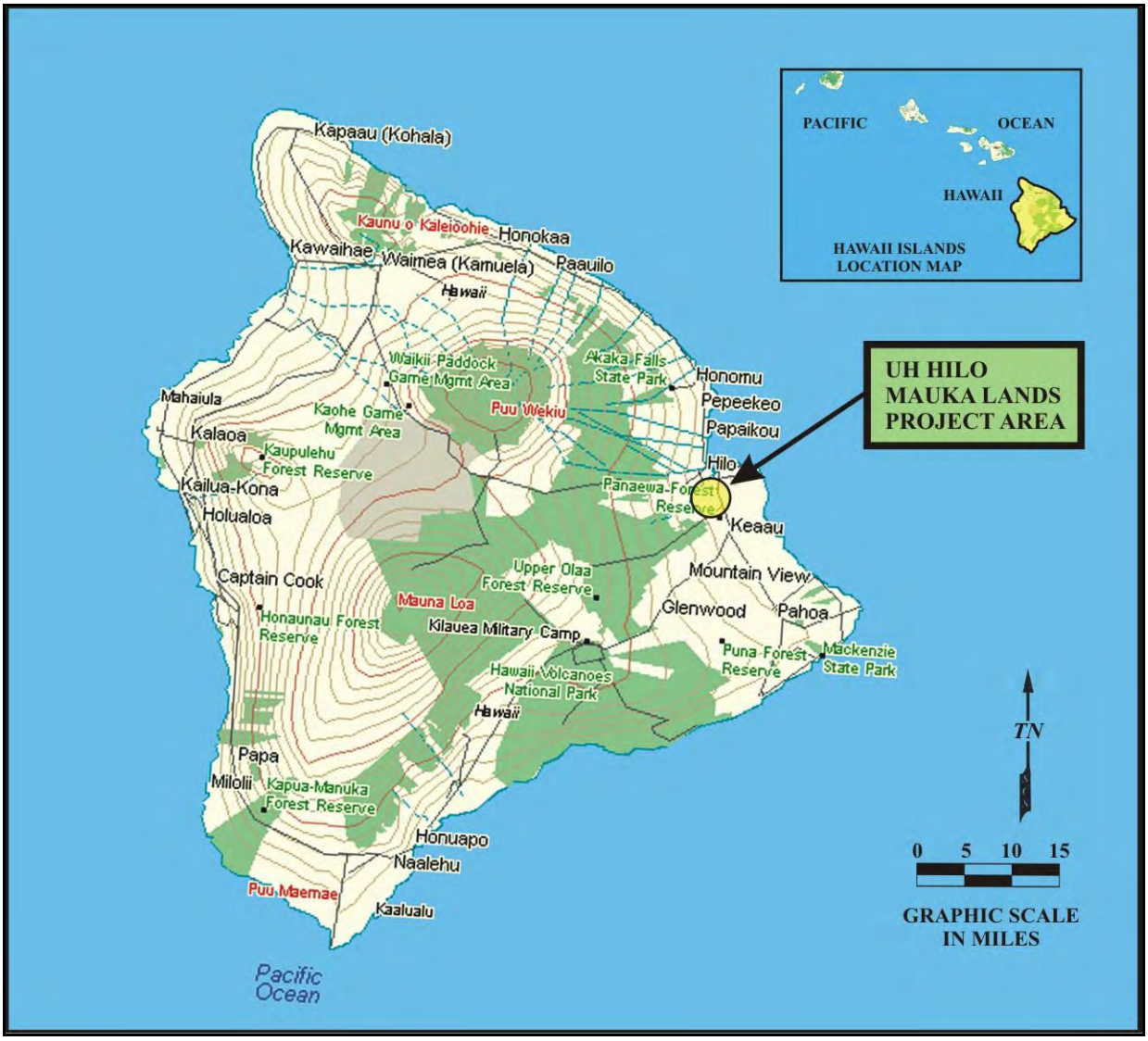


**Figure 1:** Map of Hawai`i Island Showing Project Location.

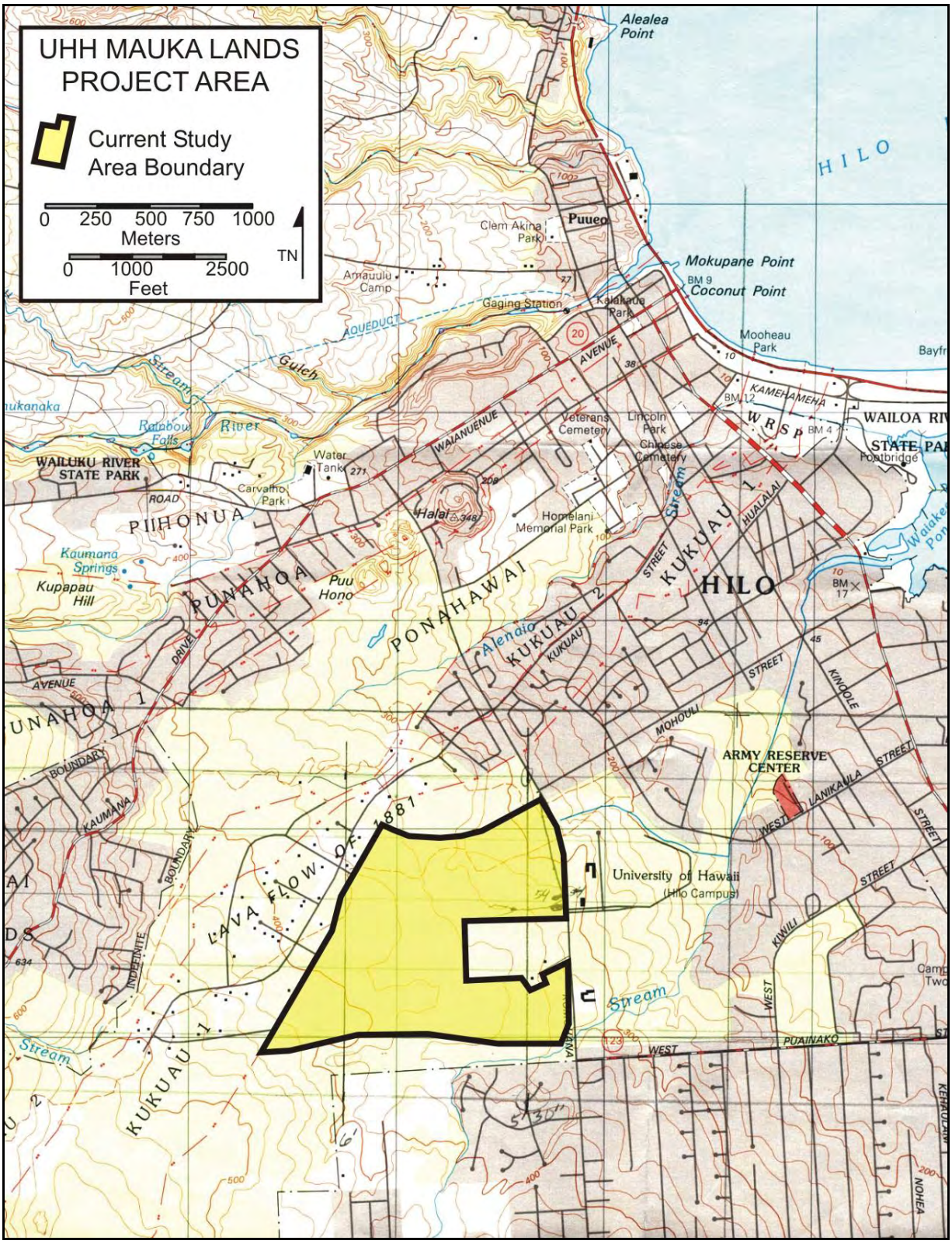


**Figure 2:** Portion of USGS 1995 Hilo Quadrangle Topographical Map, Showing Project Location.

Fieldwork was carried out in May and June 2003 under the direction of Glenn Escott, M.A. Fieldwork was completed in two steps; a preliminary reconnaissance was completed and was followed by an Inventory Survey. During the reconnaissance survey, SCS crewmembers were spaced 10 to 15-meters apart and traversed the project area in north-south intervals. Ground visibility was limited in many areas by dense mats of *uluhe* fern (*Dicranopteris linearis*). Interval spacing was reduced to as much as three meters in areas of thick ground cover. All features were surveyed and plotted on a GIS map by Control Point Surveyors of Honolulu. Fieldwork and the Inventory Survey report production were completed under the overall direction of Robert L. Spear, Ph.D. (Principal Investigator).

Sixteen new sites comprised 80 features and were recorded during this archaeological work. Site integrity of three previously-documented sites within the project area (State Inventory of Historic Places [SIHP] Sites 18918, 18919, and 20681) was reassessed during the present study. Inn total, there are 19 sites in the project area. The majority of all sites within the study area were interpreted to be related to historic sugar cane cultivation, ranching, or military activities; none of the sites were interpreted as pre-Contact in nature. Discussions between PBR Hawaii and community groups are presently underway regarding the preservation of cultural and environmental resources contained on the UH Hilo Mauka Lands parcel.

This report contains background information outlining the environmental and cultural contexts of the project area, a presentation of previous archaeological work within the study area and in the immediate vicinity, and current survey expectations based on that previous work. This report also includes an explanation of the archaeological methods used during the project; detailed descriptions of the archaeological resources encountered; interpretation and evaluation of those resources; and treatment recommendations for all of the documented sites along with a discussion of interim protection for those sites recommended for data recovery.

## ENVIRONMENTAL SETTING

### LAVA FLOWS

The UH Hilo Mauka Lands project area consists of a single undeveloped 258-acre parcel [TMK: 3-2-4-01:122] situated on gently sloping to level land at 80 m (300 feet) to 115 m (380 feet) above means sea level (amsl). Three Mauna Loa pāhoehoe flows within the project area dictate soil conditions, drainage, and vegetation (Wolfe and Morris 1996 [Figure 3]) in the area. The oldest flow, dating between 10,000 and 5,000 B.P., occurs along the southern boundary of the project area and is overlain by well-developed deep ash soils. A second flow dating to between 1,500 and 750 B.P. covers the majority of the project area and is overlain in places by

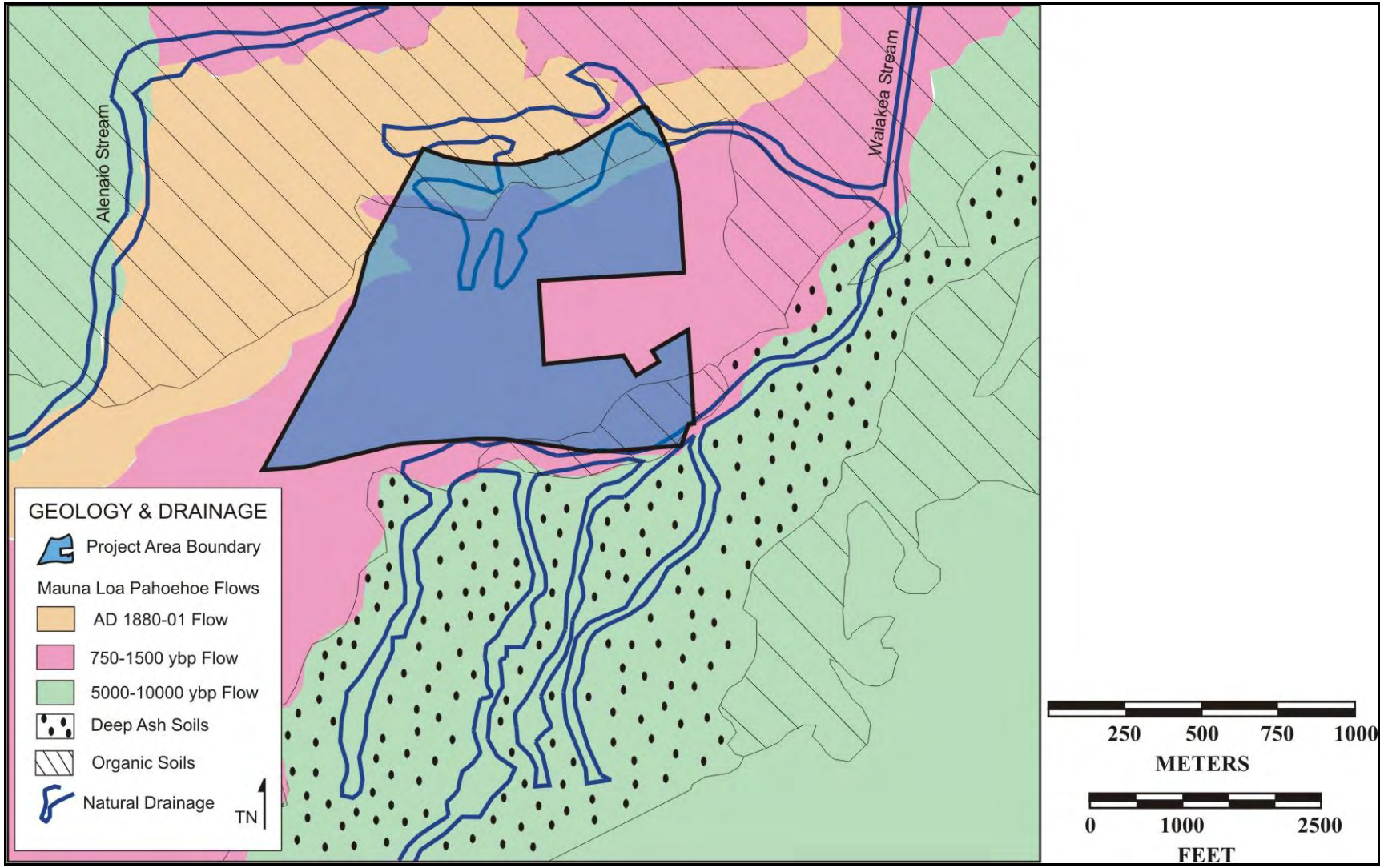


**Figure 3:** Project Area Map Showing Lava Flows, Soil Designations, and Natural Drainage.

thin organic soils. The third is the historic 1880–1881 flow present along the northern edge of the project area and consists of bare *pāhoehoe* overlain in places by a thin layer of organic soil. There are numerous shallow skylights, collapsed pressure blisters, and tree lava molds located on the surface of the 1,500 to 750 B.P. flow.

**SOILS**

Soils in the project area belong to the Pana`ewa very rocky silty clay loam (northern portion of project area) and Keaukaha extremely rocky muck series (along the southern boundary of the project area [Sato 1973]). Both soil types are characterized by poorly suited or unsuited to mechanized-farming (Soil Survey of the Territory of Hawaii 1955). Sugar cane was cultivated (Waiākea Mill Company Lot 20-A) along the southern edge of the project area where deeper pockets of well-developed organic soil exist despite the fact that Lot 20-A soil was classified as "poor" due to its shallow, very wet consistency (cited in Maly 1996:33).

**RAINFALL AND DRAINAGE**

Rainfall in the project area is high, ranging between 330 and 440 centimeters (150 and 200 inches) per year (Kelly *et al*. 1981). Natural drainage in the area runs from southwest to northeast and from west to east (see Figure 3). The majority of runoff affects the northern and southern edge of the project area where ground conditions are often swampy. A portion of the Waiākea Stream may have once flowed across the southeastern corner of the project area but has been diverted into a cement spillway. The central portion of the project area is fairly dry and is not affected by runoff from higher elevations to the west. Residents of Pu`ainako Street claimed that since the construction of neighborhoods (Sunrise Ridge) *mauka* (west) of their property, there has been a major reduction in runoff in their yards (Robert Chow interview).

**VEGETATION**

Plant communities in the wettest areas of the project—the southern, eastern, and northern portions—are dominated by *waivi* (*Psidium cattleianum*) and common guava (*Psidium guajava*). Economically useful plants and tree species, as well as ornamental palms, are often located on or near sites along the southern and eastern edges of the project area. They include red ginger (*Alpinia purpurata*), ti (*Cordyline fruticosa*), *liliko`i* (*Passiflora edulis*), avocado (*Persea americana*), royal palm, *hala* (*Pandanus odoratissimus*), and mango (*mangifera*). The western- and northern-central portions of the project area are dryer and are dominated by *ohi`a* (*Metrosideros polymorpha*), *uluhe* (*Dicranopteris linearis*), and grasses common to open savannas. Vegetation within the vast majority of the project is extremely dense.

Gerrish (2000) divides plant communities in the region of the UH Hilo Mauka Lands project into four groups:

**I. The *Ohi`a* and *Uluhe* (*Metrosideros*/*Dicranopteris*) Fern Forest**

The *ohi`a and uluhe* (*Metrosideros*/*Dicranopteris*) fern forest is the original natural vegetation and is an open forest of *ohi`a* (*Metrosideros polymorpha*) with thick, often impenetrable thickets of *uluhe* (*Dicranopteris linearis*). The fern forest is not a diverse plant community. Native plants such as *`ahaniu* (*Machaerina mariscoides*), *pukiawe* (*Styphelia tameiameiae*), *neneleau* (*Rhus sandwicensis*), *wawai-`iole* (*Lycopodium cernuum*), *hapu`u* (*Cibotium ssp*.), *papala-kepau* (*Pisonia umbellifera*), and *kawa`u* (*Ilex anomala*), and non-indigenous plants such as bamboo orchid (*Arundinia bambusifolia*), melastoma (*Melastoma candidum*), *waivi* (*Psidium cattleianum*), broomsedge (*Andropogon virginicus*), and swordfern ((*Nephrolepsis hirsutula*) are sometimes found dispersed throughout the fern forest.

**II. The Closed *Ohi`a* Forest**

The closed-canopy forest is dominated by three varieties of *ohi`a* (*Metrosideros polymorpha*): *icana*, *glaberrima*, and *macrophylla*. Native plant communities in the closed *ohi`a* forest are more diverse and include *kopiko* (*Pychotria hawaiiense*), *pilo* (*Coprosma sp*.), *hapu`u* (*Cibotium ssp*.), Kahili ginger (*Hedychium gardnerianum*), *ie`ie* (*Freycinetia arborea*), *`ekaha* (*Elaphoglossum lanceolatum*), *wawai-`iole* (*Lycopodium cernuum*), *palai-lau-li`i* (*Spaerocionium lanceolatum*). Introduced tree species include thickets of *waivi* (*Psidium cattleianum*) and common guava (*Psidium guajava*), and occasionally individual African tulip trees (*Spathodea campanulata*), albizia (*Paraserianthes falcataria*), and Alexandria palms (*Archontophoenix alexandrae*).

**III. Savanna**

Savannas of widely scattered trees and grasses are dominant in the central areas of the project that have been cleared for roads and possibly as a by-product of cattle grazing. The most common grasses within the savanna include Wainuku grass (*Panicum repens*), California grass (*Brachiaria mutica*), little bluestem (*Schizachyrium condensatum*), and broomsedge (*Andropogon virginicus*). Several tree species growing in savanna areas include albizia (*Paraserianthes falcataria*), *waivi* (Psidium cattleianum), common guava (*Psidium guajava*), melochia (*Melochia umbellata*), and gunpowder tree (*Trema orientalis*).

**IV. The Mixed *Ohi`a* and *Waiwi* Shrubland**

In many areas of the project with shallow soils, where the original growth has been disturbed or in areas between major plant communities a mixed *ohi`a* and *waiwi* shrubland has

developed. A large area of mixed *ohi`a* and *waiwi* shrubland has developed along the outside edges of the central portion of the project where it forms a boundary with the communities dominated by *waivi* thickets. Plant communities in the mixed *ohi`a* and *waiwi* shrubland often contain members from the other three major plant communities.

## HISTORICAL AND CULTURAL CONTEXTS

Hilo was, by most estimates, one of the first settlements on the Island of Hawai`i and was settled between A.D. 300 and 600. The rich marine resources of Hilo Bay and the gently sloping forests of Mauna Loa and Mauna Kea provided abundant resources. Fresh water was available from the Wailoa and Wailuku rivers and smaller streams such as Waiākea, Waiolama, Pukihae, and `Alenaio.

The UH Hilo Mauka Lands Project is located on and near the former *`ili* (subdivision of an *ahupua`a* )lands of Pū`āinakō, Kāwili, and Mohouli, in the *ahupua`a* of Waiākea, Hilo Hanakāhi `Okana, in the *moku-o-loko* (district) of Hilo (Maly 1996:4–5) (Figure 4). Waiākea Stream flows along the southern edge of the present study area. The *ahupua`a* of Waiākea is large, consists of roughly 95,000 acres, and was regarded as a region of abundant natural resources and numerous fishponds. Waiākea was also an early important political center, notably under chief Kulukulu`a (Kelly *et al*. 1981:3). Kamehameha lived and often returned to his *`ili kūpono* (independent land division where all tributes were paid to the chief of the *`ili* and not the *ahupua`a*) lands of Pi`opi`o in the *ahupua`a* of Waiākea (Figure 5). The *`ili kūpono* lands and its royal fishpond were passed on to his son Liholiho after his death.

### TRADITIONAL SETTLEMENT PATTERNS, SUBSISTENCE, AND LAND-USE

Historical accounts and archaeological/cultural studies pertaining to the *ahupua`a* of Waiākea (Ellis 1963; Bingham 1969; Handy and Handy 1972; Bird 1974; McEldowney 1979; Kelly *et al*. 1981; and Maly 1996) provide a wealth of information on traditional settlement patterns, land-use, and subsistence horticulture of the area. These are synthesized below as they allude to the types of sites that may be encountered in the project area.

Historical accounts of residence patterns, land-use, and subsistence horticulture are believed to be indicative of traditional practices developed long before contact with Europeans (McEldowney 1979). Early accounts describe several distinct environmental regions in Waiākea. From the coast inland five or six miles, scattered subsistence agriculture was evident, followed by a region of tall fern and bracken, flanked at higher elevations by a forest region

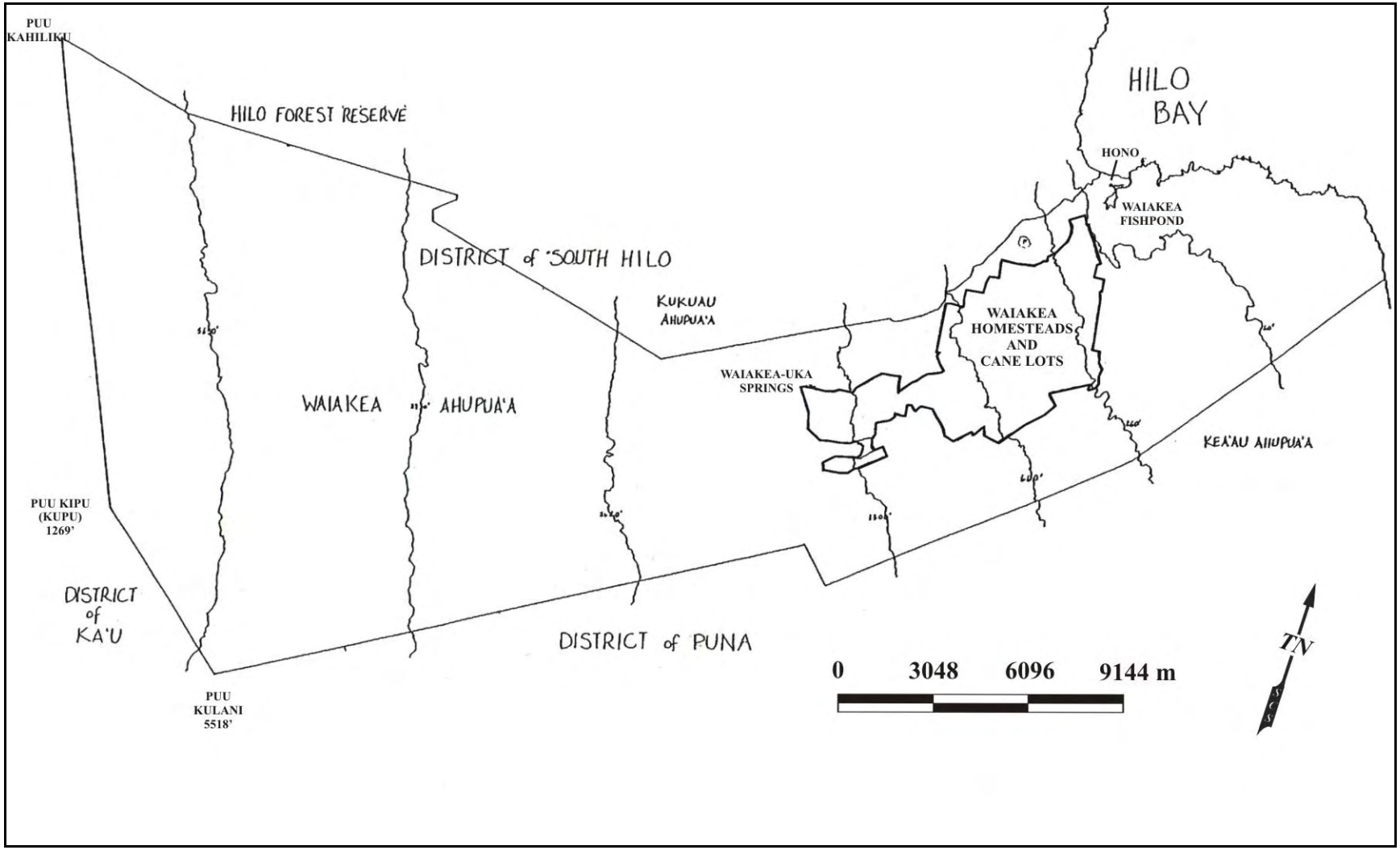


**Figure 4:** *Ahupua`a* of Waiākea (Bush *et al*. 2000).

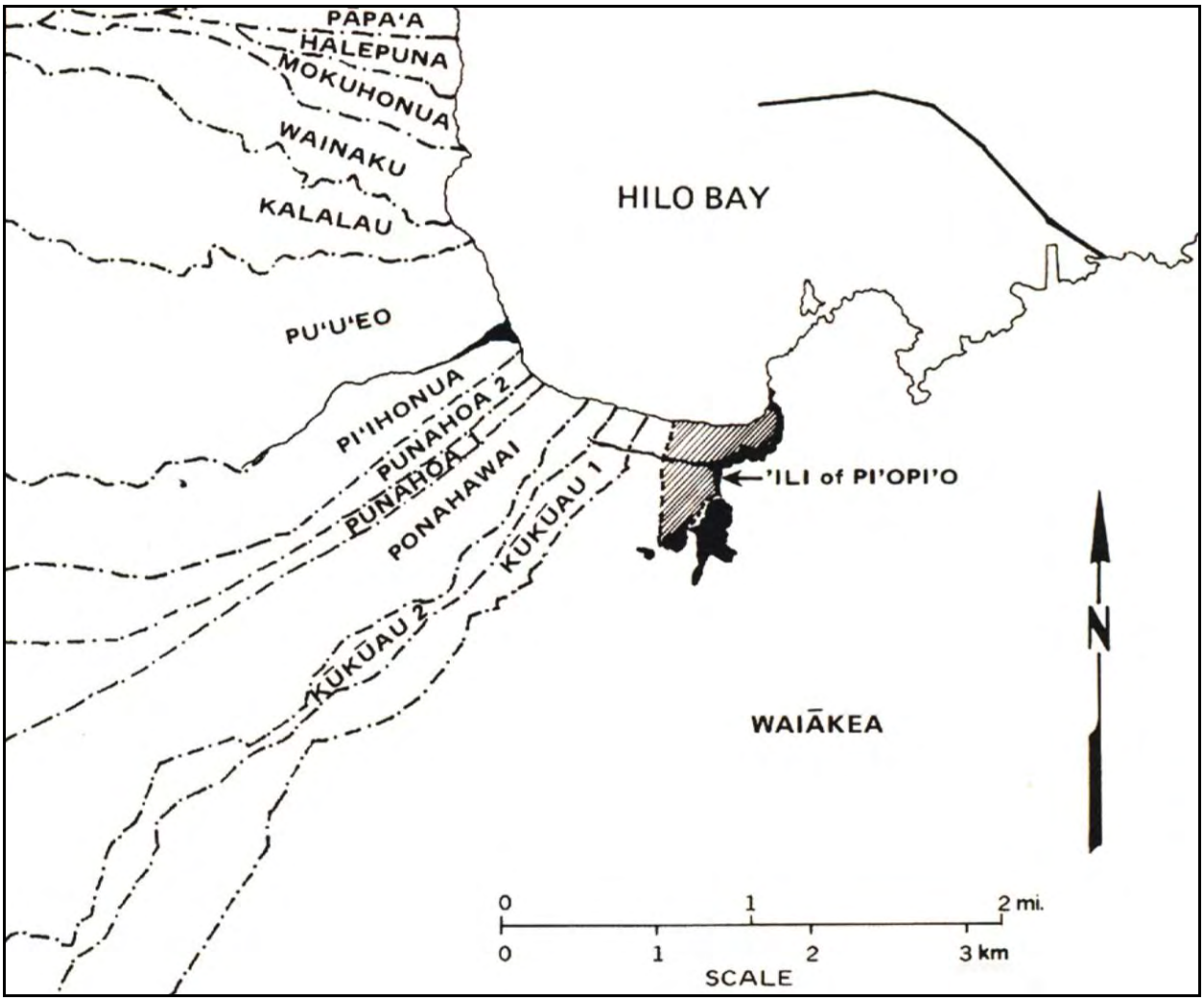


**Figure 5:** *`Ili Kūpono* Lands of Pi`opi`o (Kelly *et al*. 1981).

between 10 and 20 miles wide, beyond which was an expanse of grass and lava (Ellis 1969:403). The American Missionary C.S. Stewart wrote, "the first four miles of the country is open and uneven, and beautifully sprinkled with clumps, groves, and single trees of the bread-fruit, pandanus, and candle tree (Stewart 1970:361–363). The majority of Waiākea`s estimated 2,000 inhabitants (in 1825) lived within this coastal region (Ellis1969:253). Taro, plantains, bananas, coconuts, sweet potatoes, and breadfruit were grown individually or in small garden plots. Fish, pig, dog, and birds were also raised and captured for consumption.

The present study area is located along the upper reaches of the open coastal region and the lower reaches of the tall fern and bracken zone. It is located in McEldowney`s coined "upland agricultural zone" (see Previous Archaeology section) consisting of "scattered huts" amidst "garden "plots" created through "shifting agriculture" (McEldowney 1979:18–19).

Wood, such as *ohi`a* and *koa* for house construction, canoe building, and fires was obtained from this upland agricultural zone, and from the dense forests above (Ellis 1963:236). *Hala* for thatching was also known to be plentiful along the lava flows of eastern Waiākea (Ellis 1917, cited in Kelly *et al*. 1981:20). Of particular interest is a description of bird snaring and mention of banana growing in the area of the present study (Maly 1996:6–8).

## THE *MĀHELE* OF 1848 AND LAND COMMISSION AWARDS

The *ahupua`a* of Waiākea became Crown Lands during the *Māhele* of 1848 and in the following years, twenty-five Land Claims were awarded within the *ahupua`a* of Waiākea (Table 1). The awards were small in area, 24 of which went to native claimants. No Land Commission awards were made within the project area, and all but two were located near the coast. A five-acre parcel was awarded to Keaniho (LCA 2402) approximately one kilometer east of the present study area. The parcel contained a house and three cultivation fields. Keaniho`s parcel bordered *kalo* fields to the west according to testimony given in support of the claim (Maly 1996:22).

**Table 1:** Land Commission Awards in Waiākea Ahupua`a.

| Grantee | LCA | Acreage |
|---|---|---|
| Barenaba | 2327 | 12.25 |
| Halai, L.K. | 1279 | 0.60 |
| Hale | 40004 | 4.25 |
| Kahue | 2663 | 3.75 |
| Kaiana, J.B. | 2281 | 10.25 |
| Kaihenui | 11050-B | 5.19 |
| Kalolo | 1333 | 2.25 |
| Kalua | 8854 | 3.40 |
| Kaluhikaua | 1738 | 2.98 |
| Kamamalu, V. | 7713 | *`Ili `aina* |
| Kamanuhaka | 8803 | 1.02 |
| Kapu | 1-F | 1.60 |
| Kealiko | 11174 | 1.00 |
| Keaniho | 2402 | 5.00 |
| Keawe | 5018 | 0.24 |
| | 10505 | — |
| Kuaio | 4344 | 1.22 |
| Leoi | 9982 | 0.80 |
| Lolo | 4738-B | 1.27 |
| Mahoe | 1-E | 4.46 |
| Moealoha | 4737 | 1.03 |
| Nakai | 4785 | 1.05 |
| Napeahi | 2603 | 1.30 |
| Wahine | 4737-B | 1.01 |
| Wahinealua | 11173 | 2.50 |
| Wahinenohoihilo | 10004 | 1.69 |

## CHANGING RESIDENTIAL AND LAND-USE PATTERNS (1845–1865)

Between 1845 and 1865, traditional land-use and residential patterns underwent a change. In particular, the regular use of Hilo Bay by foreign vessels, the whaling industry, the establishment of missions in the Hilo area, the introduction of the sandalwood trade, the legalization of private land ownership, the introduction of cattle ranching, and the introduction of sugar cane cultivation all brought about changes in settlement patterns and long-established land-use patterns (Kelly *et al*. 1981). Hilo became the center of population and settlements in outlying regions declined or disappeared. While food was still grown for consumption, greater areas of land were continually given over to the specialized cultivation and processing of commercial foodstuffs for export. Sugar cane plantations and industrial facilities were established in areas that were once upland agricultural areas and coastal settlements, respectively.

## WAIĀKEA MILL COMPANY

On July 15, 1861, S. Kipi leased the Crown Land of Waiākea from Kamehameha IV to be used as pastureland for an annual amount of $600 (Kelly *et al.* 1981:89). In 1874, Rufus A. Lyman was granted a 25-year property lease (General Lease 124-A) within Waiākea, encompassing the government pastureland on which the present study area is located (Maly 1996:26). The lease granted him all privileges of land use including the cutting of firewood and the use of fishponds. The newly established Waiākea Mill Company, founded by Alexander Young and Theo H. Davies, acquired Rufus A. Lyman`s General Lease 124-A in 1879 (with an extension of terms until June 1, 1918 [Maly 1996:27]). By the early 1900s, Waiākea plantation was cultivating sugar cane on over 6,000 acres of government land (Kelly *et al*. 1981:89,120).

In 1911, the Waiākea Mill Company applied for a title to several portions of its leased land, but was rejected by the Board of Public Lands. Rather than renew the lease with the Waiākea Mill Company, the government of Hawai`i implemented a plan to sell homestead lots and lease sugar cane lots to the public (Figure 6). By 1919, 2003 acres of land was returned for house lots and 5,300 acres was returned for cane field lease (Maly 1996:27–28). Sugar cane grown on these lots was, by terms of contract, to be processed by the Waiākea Mill Company for a share of the profits. None of the publicly leased government property is located within the present study area.

Waiākea Mill Company plantation Lot 20-A is the only sugar cane field within the current study area and is located along the project`s southern border (Figure 7). Lot 20-A was retained by the Waiākea Mill Company and was classified as “poor” due to shallow, very wet

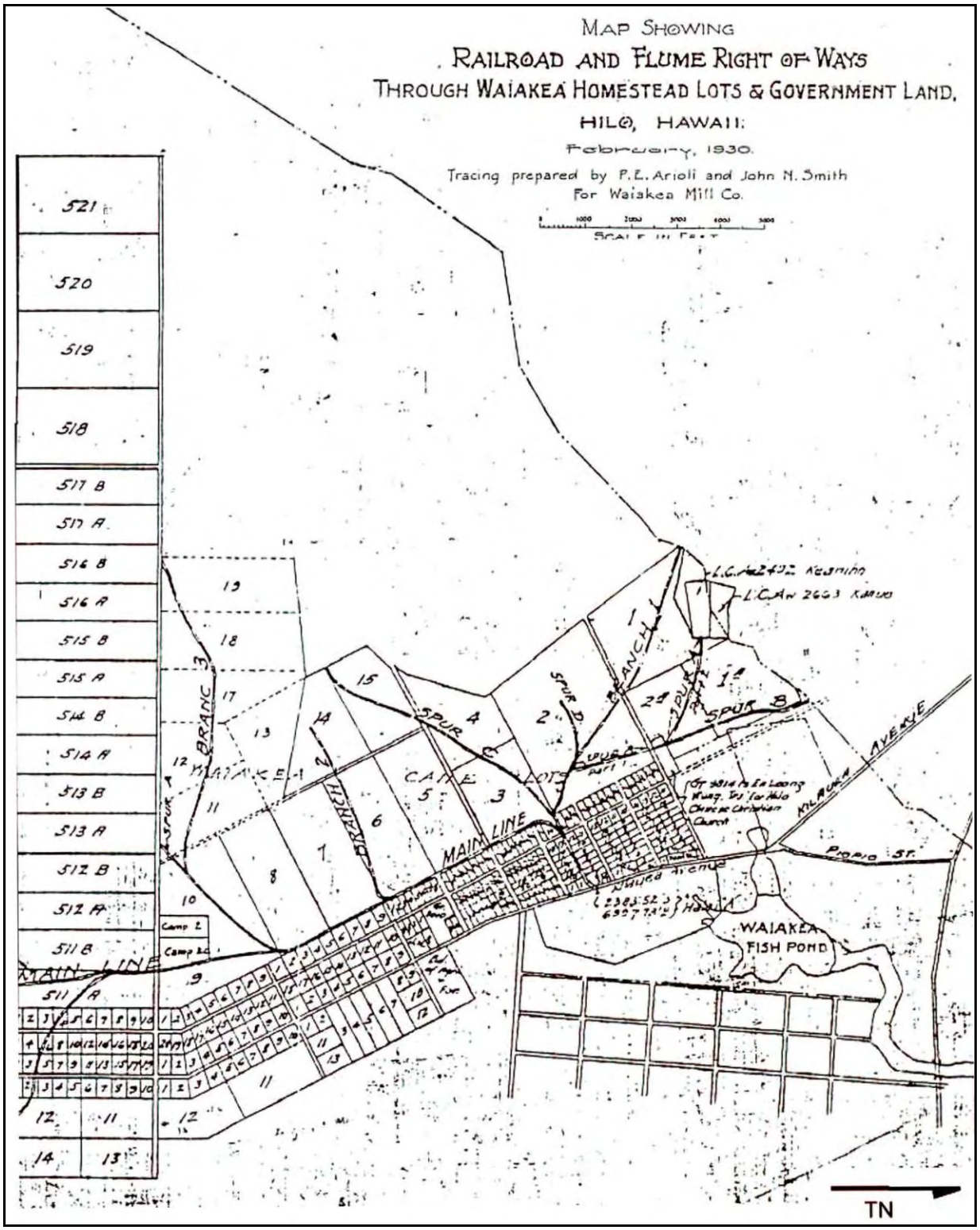


**Figure 6:** Map Showing Portion of Waiākea Homestead Lots and Plantation Fields South and East of the Project Area.

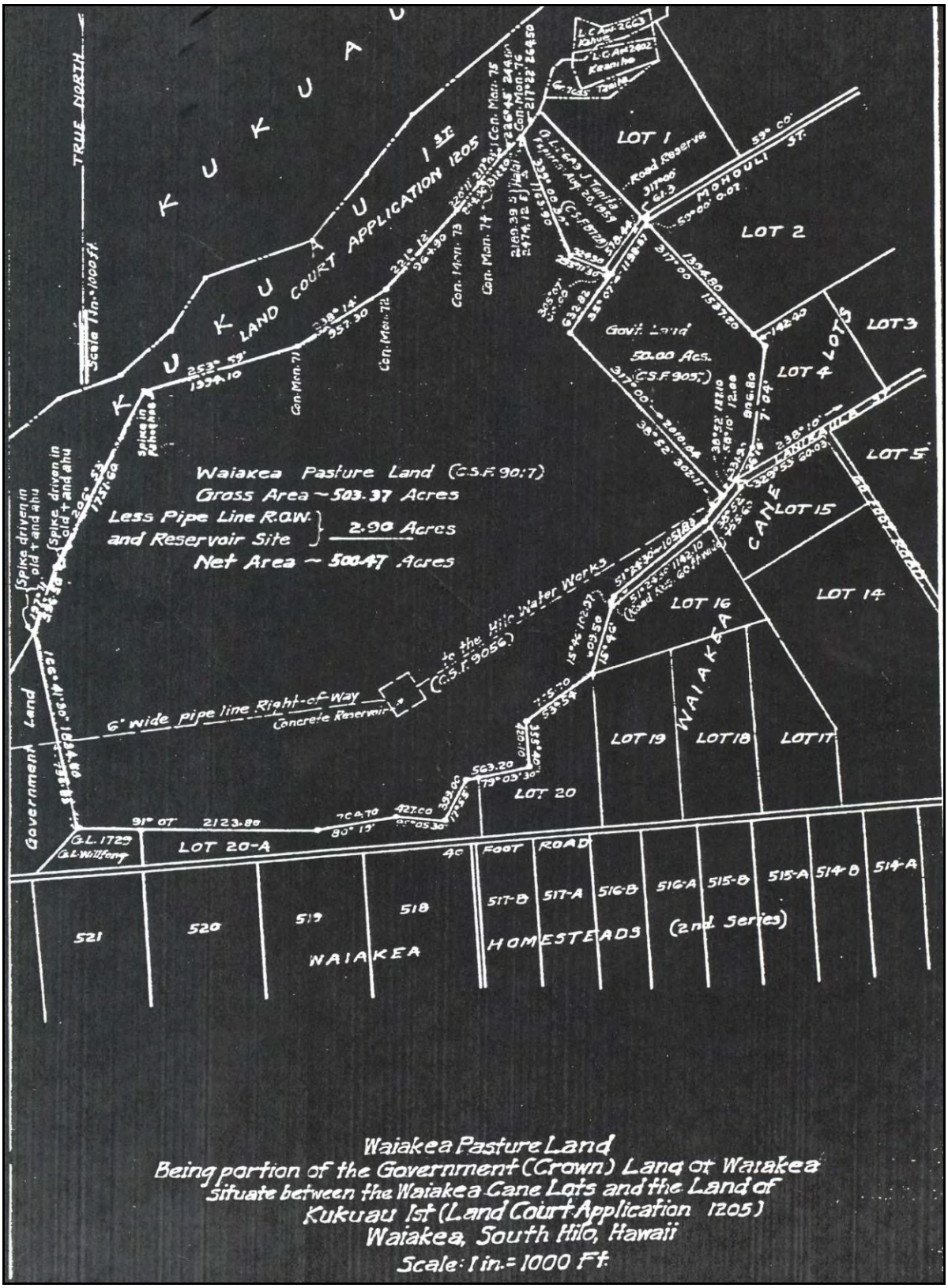


**Figure 7:** Map Showing Waiakea Pasture Land and Waiakea Mill Plantation Lot 20-A.

soils (cited in Maly 1996:33). The Waiākea Mill Company retained the property (General Lease 2741) and as late as 1947 was offering to lease it to private cultivators for the sole purpose of growing sugar cane (Maly 1996:34).

Fairview Dairy acquired a 21-year lease at public auction to Lots 11 through 20-A (General Lease 3333) to be used for pasturing cattle. Fairview Dairy transferred its lease to William Kama`u Sr. in 1959 for the purposes of pasturing cattle and horses. The majority of Lot 20-A is most recently located along the newly-constructed Pu`ainako Street extension.

The largest portion of the study area composed of a single government parcel known as "Waiākea Pasture Land" was leased (approximately 500 acres covered under General Lease 2751) to Kazuo Miyasaki in 1939 as pastureland for his dairy cattle (see Figure 7). The lease then passed to John Matson in 1942. During World War II, the parcel covered under General Lease 2751 and known as "Waiākea Pasture Land" was used for training by the U.S. Army Corps (Maly 1996:34). By 1946, the Army was clearing the property of barbed wire, unexploded ordinance, three Quonset buildings, and two latrines.

## PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

Numerous archaeological investigations have been carried out in the Hilo area and within the *ahupua`a* of Waiākea over the last 95 years. Many of the research projects are located adjacent to or in the immediate vicinity of the current study area. Table 2 summarizes major findings and Figure 8 shows the location of archaeological investigations adjoining the current project area.

**Table 2:** Previous Archaeological Research in Waiākea Ahupua`a and Project Vicinity.

| Reference | Location | Description & Results |
|---|---|---|
| Thrum 1907 | Waiākea Ahupua`a *heiau* sites | List of *heiau* in Waiākea—none located near present project area. |
| Thrum 1908 | Waiākea Ahupua`a | List and description of *heiau* in Waiākea—none located near present project area. |
| Hudson 1932 | East Hawai`i Island | Detailed description of various sites in the Hilo area. |
| McEldowney 1979 | Hilo Bay area | Zonal characteristics—Land-use study. |

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|---|---|---|
| Kelly, Nakamura, and Barrère 1981 | Hilo Bay area | History of Hilo Bay. |
| Smith 1991 | Waiākea Ahupua`a, South Hilo, Hawai`i Island [TMK: 3-2-4-01:7] | List and description of sites on the 4000+B.P. and 1500–750 B.P. lava flows. Inventory survey recommended. |
| Stokes and Dye 1991 | Hawai`i Island | List and description of *heiau* of Hawai`i Island. |
| Smith 1992 | Waiākea Cane Lots, Waiākea Ahupua`a, South Hilo, Hawaii Island [TMK: 3-2-4-56:1] | Numerous cane field features including walls, clearing mounds, a large rectangular enclosure, and c-shaped enclosures. |
| Moniz 1992 | Waiākea Ahupua`a, Hilo Hawai`i | A listing of 1979-1992 Inventory Survey results within Waiākea Ahupua`a that document walls, mounds, platforms, and faced terraces. |
| Hunt 1992 | Lands of Waiākea, Kukuau 1 and 2, and Ponahawai Ahupua`a, South Hilo District, Hawai`i (Puainako Street Extension Project) | Interim Inventory Survey report listing 31 cane field features including walls, clearing mounds, platforms, and faced terraces. |
| Spear 1993 | Pi`ihonua Ahupua`a, South Hilo [TMK: 2-3-32:4] | Inventory Survey report of a 5-acre parcel that documents an historic oven and a trash dump. No further work recommended. |
| Borthwick, Collins, Folk, and Hammatt 1993 | Waiākea Ahupua`a [TMK: 2-4-01:7 and 41] | Inventory Survey of 163 acres of UH property along and east of Komohana Street. Four historic sites associated with sugar cane agriculture documented. No further work recommended. |
| Hunt and McDermott 1994 | Lands of Waiākea, Kukuau 1 and 2, and Ponahawai Ahupua`a, South Hilo District, Hawai`i (Puainako Street Extension Project) | Inventory Survey final report (completion of Hunt 1992) documenting 13 historical sites associated with sugar cane agriculture. |
| Maly, Walker, and Rosendahl 1994 | Lands of Waiākea, South Hilo [TMK: 2-4-57:01] | Inventory Survey of 4.5 acres in the Waiākea Cane Lots documenting four sites associated with historical sugar cane agriculture. Forty-seven features were recorded including walls, clearing mounds, and terraces. One radiocarbon date and |

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|---|---|---|
| | | recovered artifacts suggest prehistoric land-use in the project area. Data recovery recommended. |
| Spear<br>1995 | Lands of Waiākea, South Hilo [TMK: 2-4-57:01] | Data Recovery report of Maly *et al.* (1994) parcel documenting historic sugar cane agricultural features and a few temporary habitations. No further archaeological work recommended. |
| Maly<br>1996 | Waiākea Cane Lots (12, 13, 17, 18, 19, 20 and 20-A, District of South Hilo, Island of Hawai`i | Oral interviews and archival research pertaining to Waiākea Cane Lots. Provides background of pre-Contact land-uses in the area and description of sugar cane agricultural features, their construction, and uses. |
| Robins and Spear<br>1996 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street Realignment/Extension Project) | Inventory Survey of proposed realignment of Puainako Street Extension Corridor documenting 30 new features at 3 sites (Hunt and McDermott 1994), and one new site containing 16 features. Sites and features are associated with historic sugar cane agriculture. |
| Eblé, Denham, and Pantaleo<br>1997 | Lands of Waiākea, Kukuau 1 and 2, and Ponahawai Ahupua`a, South Hilo District, Hawaii (Puainako Street Extension Project) | Supplemental testing of features (six sites) documented in Hunt and McDermott (1994). Features were associated with historic sugar cane agriculture. Recommended preservation of several sites within the project area. |
| Spear<br>1998 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street Realignment/Extension Project) | Reconnaissance-level survey of proposed realignment of Puainako Street Extension Corridor documenting 27 new features associated with historical sugar cane agriculture. Inventory Survey recommended. |
| McGerty and Spear<br>1999 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street | Inventory Survey of Spear (1998) parcel documenting 17 features: 15 historic sugar cane agriculture features and |

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|---|---|---|
| | Realignment/Extension Project) | two features associated with a modern pig farm. All features were added to site 18921. Data Recovery recommended. |
| Dega and Benson 1999 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street Realignment/Extension Project) | Reconnaissance-level survey of proposed realignment of Puainako Street Extension Corridor documenting eight sites containing 18 features including 12 clearing mounds, two platforms, two walls, a rock alignment, and an *`auwai (*drainage ditch). All but the *`auwai* were associated with historic sugar cane cultivation. The *`auwai* was described as a pre-Contact feature likely also utilized in historic cane field agriculture. |
| Dega 2000 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street Realignment/Extension Project) | Inventory Survey of Dega and Benson (1999) parcel documenting eight new features (at Site 18921) associated with sugar cane agriculture. |
| Dega and Spear 2000 | Lands of Waiākea, Kukua 1 and 2, and Ponahawai, South Hilo District, Island of Hawai`i (Puainako Street Realignment/Extension Project) | Preservation Plan for sites 18914, 18915, 18917 and a boulder path/alignment recorded by Eblé *et al.* (1997). |
| Bush, McDermott, and Hammatt 2000 | Lands of Waiākea, South Hilo [TMK: 2-4-01: 122], South Hilo, Hawai`i Island (USDA Pacific Basin Agricultural Center Project) | Inventory Survey of 20 acres along western edge of Komohana Street, and adjacent to east-central portion of current project area. One skylight (site 22080) containing a single human femur documented. Preservation recommended. |
| McDermott and Hammatt 2001 | Lands of Waiākea, South Hilo [TMK: 2-4-01: 122], South Hilo, Hawai`i Island (USDA Pacific Basin Agricultural Center Project) | Inventory Survey of 10 acres adjacent (west) to Bush *et al.* (2000) documenting two historic sites (one feature each), including a modified outcrop and a stone causeway. No further work recommended. |

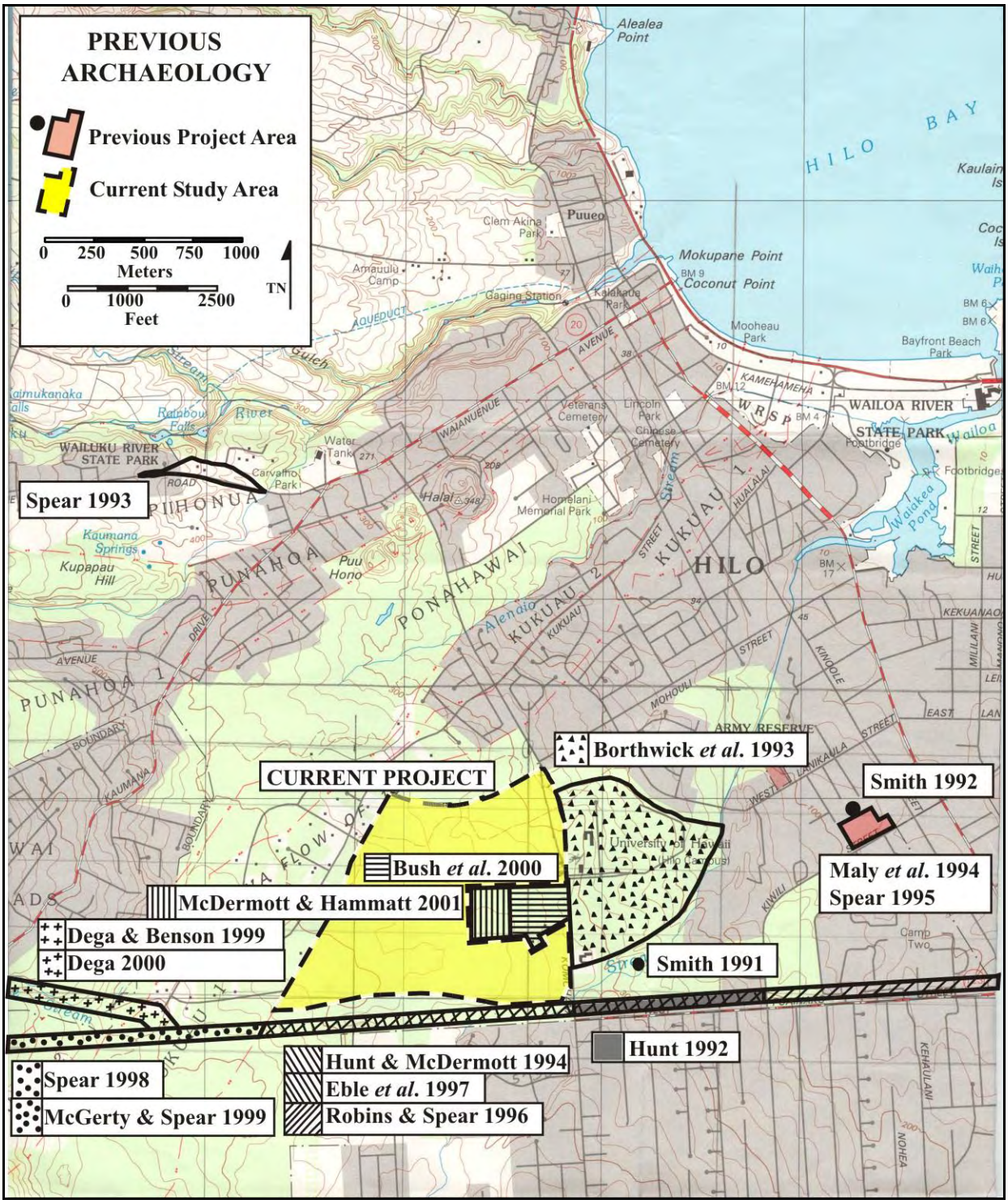


**Figure 8:** Portion of USGS Hilo Quadrangle Topographical Map, Showing Locations of Previous Archaeological Projects in the Vicinity of the UH Hilo Mauka Lands Project.

The archaeological and historical investigations listed are instrumental to understanding broad patterns of land-use in the Hilo area (see McEldowney 1977; Kelly *et al.* 1981; Maly 1996), general trends in the distribution of formal archaeological features in the Hilo area (see Thrum 1907 and 1908; Hudson 1930; Smith 1991; Moniz 1992; Spear 1993), and to formulating archaeological expectations at the UH Hilo Mauka Lands project (see Borthwick *et al.* 1993; Hunt and McDermott 1994; Spear 1995; Robins and Spear 1996; McGerty and Spear 1999; Bush *et al.* 2000; Dega 2000; and McDermott and Hammatt 2001).

## REGIONAL ARCHAEOLOGICAL STUDIES

### MCELDOWNEY (1979)

McEldowney (1979) provides an overview of changing land-use patterns in the Hilo area based on early historic accounts. She proposes that Hawaiians utilized land in accordance with five elevation zones (1979:14). Land-use zones are classified as (I) coastal, (II) upland agricultural, (III) lower forest, (IV) rainforest, and (V) sub alpine, or montane. The inhabitants of Waiākea Ahupua`a had access to resources in all five of McEldowney`s zones.

The present project is situated in the upland agricultural zone (50 to 1,500 feet) described as unwooded grasslands and extensive dryland cultivation plots. McEldowney suggests this region was likely deforested prior to European contact through shifting agricultural practices such as swidden farming. Site types consist of scattered houses adjacent to garden and arboreal plots on older *pāhoehoe* and *`a`ā* flows with well-developed soils. Modified lava tubes and tubes were used for cultural practices were also common in the upland agricultural zone.

### SMITH (1991)

Smith (1991) also comments on site distribution in the *ahupua`a* of Waiākea based on Mauna Loa lava flows, including a portion of the 1880–1881 A.D. *pāhoehoe* flow, a *pāhoehoe* flow dating to 750–1,500 B.P., and a *pāhoehoe* flow dating to 5,000–10,000 B.P. He notes that the majority of sites are located on the older lava flow, which has deeper, more developed soils.

### KELLY *ETAL*. (1991)

Kelly *et al*. (1991) also contributes to a historical understanding of changing land-use patterns following European involvement in the economy of Hawai`i. In particular, they site how the regular use of Hilo Bay by foreign vessels, the whaling industry, the establishment of missions in the Hilo area, the introduction of the sandalwood trade, the legalization of private land ownership, the introduction of cattle ranching, and the introduction of sugar cane cultivation all brought about changes in settlement patterns and long-established land-use patterns. Kelly *et*

*al*. (1991) suggest that Hilo became a population center and settlements in outlying regions declined. While food was still grown for consumption, greater areas of land were continually given over to the specialized cultivation and processing of commercial foodstuffs for export. Eventually, sugar cane plantations and industrial facilities were established in areas that were once upland agricultural areas and coastal settlements.

### THRUM (1907 AND 1908), HUDSON (1932), AND STOKES AND DYE (1991)

Thrum (1907 and 1908), Hudson (1932), and Stokes and Dye (1991) represent early archaeological efforts to document site distribution pertinent to the greater Hilo area. Hudson notes there were already no archaeological sites remaining in the city of Hilo by the early 1930s (Hudson 1932:236). All three authors note the dismantling of well-known *heiau* in the Hilo area (Thrum 1908:240; Hudson 1932:236; Stokes and Dye 1991:152).

## INVESTIGATIONS SPECIFIC TO STUDY AREA

Several recent archaeological and historical investigations completed in the immediate vicinity of the present UH Hilo Mauka Lands project have direct bearing on what types and distribution of sites and features were expected. The majority of these reports (associated with the Pu`ainako Street Extension project) document sites on well-developed ash and organic soils overlaying a Mauna Loa *pāhoehoe* flow dating to 5,000–10,000 B.P. that is also present in the southeast corner of the present study area (see Figure 3). The sites were primarily the remains of sugar cane field clearing and in-field collection and processing architecture. The two most recent reports (Bush *et al*. 2000, McDermott and Hammatt 2001) provide insight into predicting the types of sites located on a *pāhoehoe* flow dating to 750–1,500 B.P. that covers the majority of the UH Hilo Mauka Lands project area.

### HUNT AND MCDERMOTT (1994)

The initial archaeological investigation in the immediate vicinity of the present study area was an Inventory Survey of the Pu`ainako Street Extension within Waiākea, Kūkūau 1 and 2, and Ponahawai Ahupua`a conducted by Hunt and McDermott (1994) in 1992 and 1993. The project area was adjacent to and southeast (*makai*) of the UH Hilo Mauka Lands project. The study entailed historical background research, pedestrian survey, and limited subsurface testing.

The Inventory Survey report documented 13 sites (SIHP Sites 50-10-35-18911 to -18923) comprising 88 individual features (Figure 9). All features were interpreted to date from A.D. 1880 to 1950, and were assumed to be features associated with the cultivation and processing of sugar cane. Five test units were excavated within several features and it was concluded that the

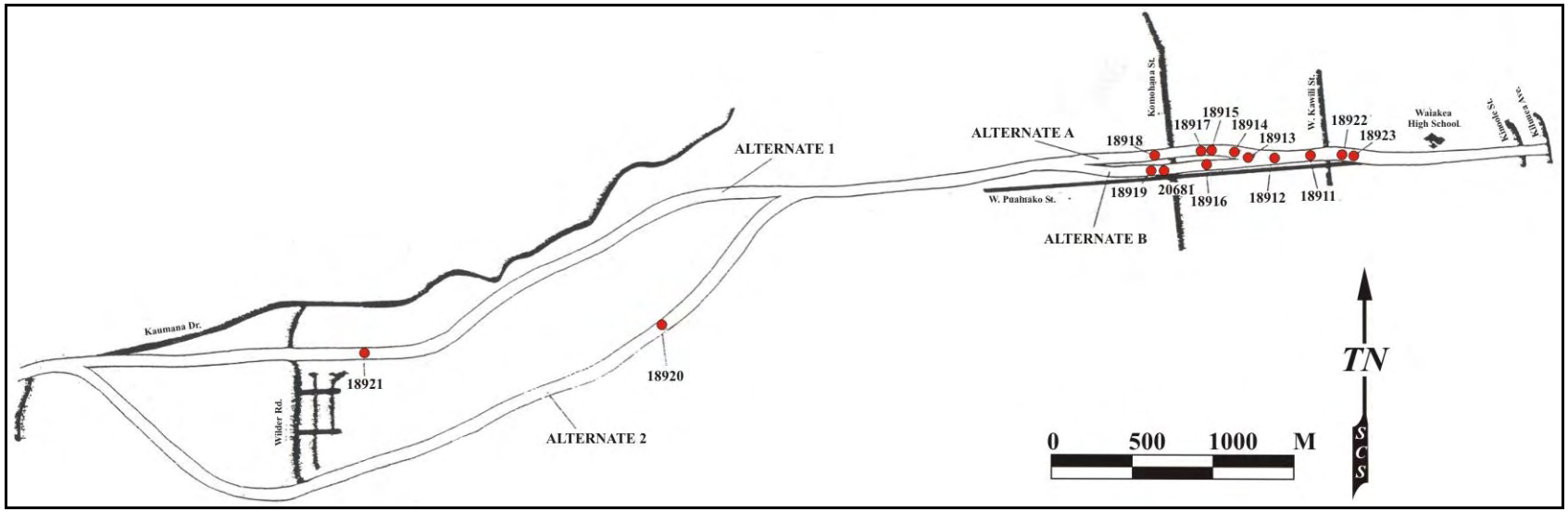


**Figure 9:** Map of Project Areas and Site Locations within the Pu`ainako Street Extension Corridors as Designated by Eble et al. 1997.

lack of prehistoric artifacts and traditional subsurface features within them supported the interpretation that the features were historic in origin (Hunt and McDermott 1994:104). The Inventory Survey report recommended that Data Recovery be implemented at site complexes as additional excavation work "could potentially yield isolated traces of prehistoric use of the area, presumably for dryland agriculture" (Hunt and McDermott 1994:109–113). The report also recommended extensive archival research, a task later undertaken by Maly (1996).

**BORTHWICK, COLLINS, FOLK, AND HAMMATT (1993)**

Cultural Surveys Hawaii conducted an Archaeological Inventory Survey and limited testing on a 163-acre UH Hilo parcel adjacent to and east *makai* of the present study area. The report documents four historic sugar cane cultivation sites (SIHP Sites 18667 through 18670) composed of seven features (one feature contains 25 clearing mounds), including walls, clearing mounds, enclosures, and a remnant sugar cane field. Test units contained no cultural material or traditional Hawaiian feature components confirming their association with more recent sugar cane cultivation. Sites were situated on older *pāhoehoe* flows with well-developed soils. No further work was recommended.

**MALY (1996)**

Kepa Maly`s report combines the results of McEldowney's report (1979) with traditional Hawaiian history, early European accounts, previous archaeological work, and oral histories to document cultural and agricultural practices in Hilo and the *ahupua`a* of Waiākea. The report focuses on Hawaiian settlement and population expansion in the region of the present study area. Of particular interest is the description of bird snaring and mention of banana growing in the area of the present study (Maly 1996:6–8). Maly also documents the effect of sugar cane cultivation (Waiākea Mill Company operations from the 1870s to 1940s) on pre-Contact archaeological remains within the present project area. While some components of early Hawaiian sites might be incorporated in more modern archaeological features, the clearing of fields and the construction of crop collection and processing facilities have dismantled or obscured older archaeological sites (Kenneth Bell in Maly 1996:57). Informants who remembered the Waiākea sugar cane plantation fields stated that features such as stone mounds, ramped platforms, terraces, walls, enclosures, and berms (railway berms) were built in order to facilitate sugar cane cultivation and ranching.

**ROBINS AND SPEAR (1996)**

Following Maly`s (1996) work, SCS (Robins and Spear 1996) conducted an Inventory Survey on a narrow parcel of land adjacent to and south of the present study area (see Figure 9). The project area covered four proposed road alignments for the Pu`ainako Street Extension

project and reflected both an elongation and a lateral expansion of the original road alignment study (Hunt and McDermott 1994) from a 120 foot corridor to 300-foot wide corridor.

The Robins and Spear survey documented the 30 architectural features associated with sites previously reported by Hunt and McDermott (SIHP Sites 18912, 18914, and 18919) as well as 16 additional features that were combined, with features taken by SHPD from SIHP Site 18919 to form a new site (SIHP Site 20681). Robins and Spear (1996:49–52) concluded that all 46 features—representing four sites—were associated with historic sugar cane activities based on the following facts: 1.) all of the sites were located within or adjacent to known sugar cane fields; 2.) all features were representative of formal sugar cane field features; 3.) site structure were comparable to other known plantation sites and is atypical of traditional Hawaiian structures; and 4.) the documented sites contain historic-era artifacts that are specific to sugar plantation or ranching activities. No traditional Hawaiian components of modern features or pre-Contact artifacts were discovered during the Inventory Survey work. Robins and Spear (1996:53–56) recommended Data Recovery for eight sites within the corridor and concurred with SHPD in the preservation of several other sites.

**EBLÉ, DENHAM, AND PANTALEO (1997)**

At the request of the Ho` oikaika Hawaiian Club (HHC), Garcia and Associates (Ganda) conducted supplemental archaeological excavations (reported in Eblé *et al.* 1997) at sites previously identified by Hunt and McDermott (1994 [Figure 10]). The purpose of the additional work was "to aid in the interpretation of site function and chronology, and to ensure that all cultural remains in the area have been sufficiently identified" (Eblé *et al.* 1997:1). The Hunt and McDermott survey had excavated only five units within 88 features and the sponsoring Ho`oikaika group deemed additional excavations necessary to support or refute the report`s site age and function determinations. The supplemental archaeological work performed by Ganda was not considered an official stage in the State of Hawaii historic preservation process but was deemed a supplemental aid to the previous study.

Seven test-units (typically 1.0 m by 1.0 m) were excavated within six sites previously mapped and recorded by Hunt and McDermott (1994). The sites included SIHP Site 18916, 18911, 18912, 18914, 18915, and 18917. The excavation units yielded historic artifacts such as metal and midden. Three samples of wood charcoal were submitted for radiocarbon testing and were dated to pre-Contact (traditional) and early-historic times. The samples were considered problematic since they did not precisely date the architectural structures themselves but were taken from the soil matrix below features and were not associated with any subsurface features such as *`imu* or discrete hearths, for example. The report further concluded that all "intact

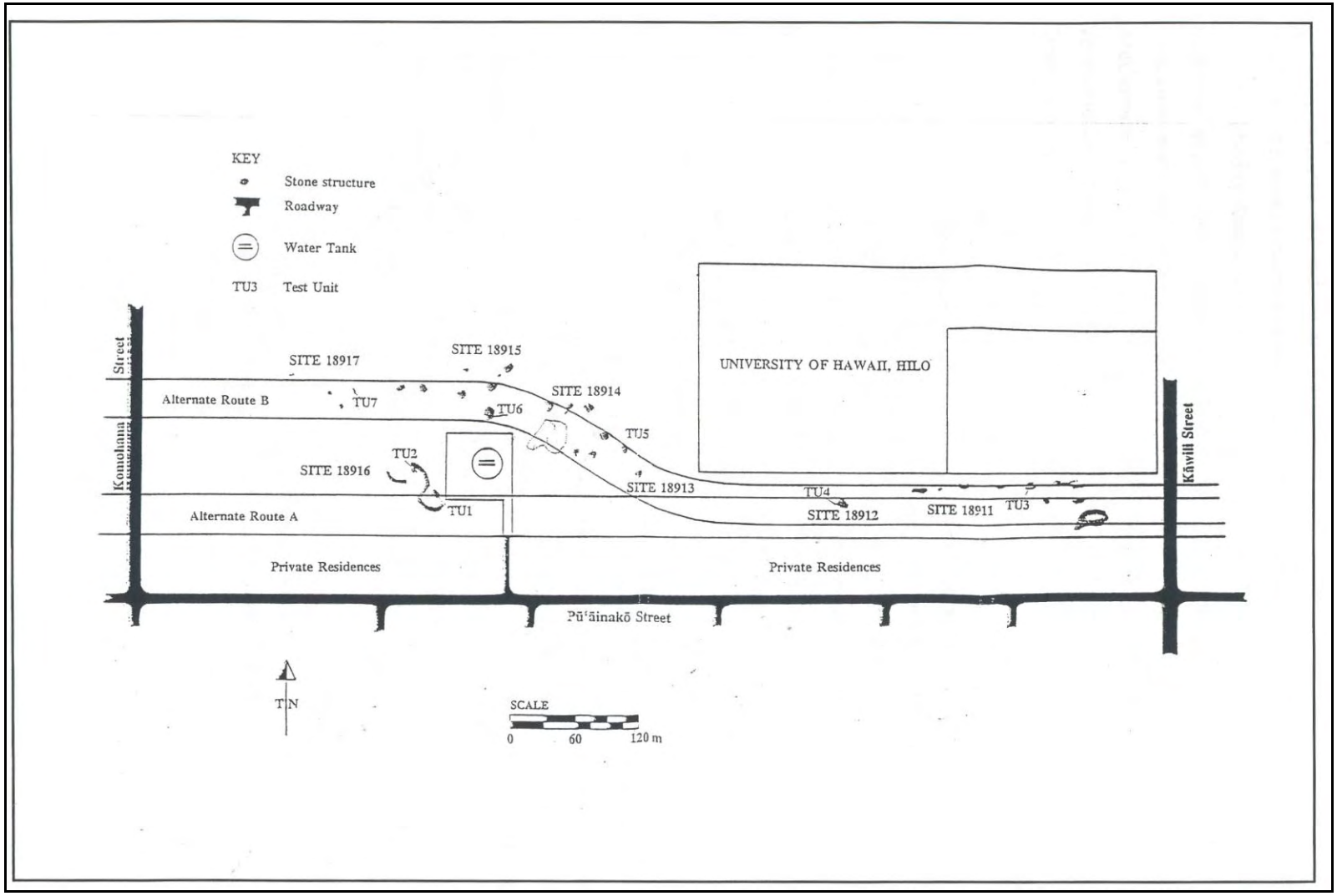


**Figure 10:** Map of Project Area and Excavation Locations within the Pu`ainako Street Extension Corridors as Designated by Eble *et al*. 1997.

evidence of pre-Contact occupation and/or activity in the project area has been disturbed or destroyed as a result of post-Contact period activity" (Eblé *et al.* 1997:53). The archaeological features examined as part of this supplemental project were interpreted to be associated with sugar cane cultivation and processing and reinforced the interpretations offered by Hunt and McDermott (1994), Maly (1996), and Robins and Spear (1996). The supplemental testing report recommended preservation for several sites (Eblé *et al.* 1997:56).

**SPEAR (1998)**

The following year, an archaeological reconnaissance-level investigation was carried out by SCS along the *mauka* portion of the Pu`ainako Street Extension, located to the south of the present study area (Figure 11). While reconnaissance surveys are not recognized by the SHPD as a stage in the historic preservation process, reconnaissance surveys provide a rapid means of assessing the cultural resources within a given project area. A formal report of a reconnaissance survey is not generally submitted to SHPD because the results are usually incorporated into Inventory Survey reports. Twenty-seven features were recorded during the reconnaissance survey and were associated with SIHP Site 18921, previously recorded by Hunt and McDermott (1994). Spear (1998) recommended that an Inventory Survey be conducted.

**MCGERTY AND SPEAR (1999)**

The Inventory Survey work (McGerty and Spear 1999) generated as a result of the previous reconnaissance survey (Spear 1998) was listed as an addendum to the Inventory Survey report completed by Robins and Spear (1996). McGerty and Spear (1999) reidentified the features documented by Spear (1998) and recorded a total of 17 features (Figure 12). The number of features was reduced from 27 to 17 because several of the features documented during the reconnaissance survey were combined into more discrete feature designations or were assessed as not being archaeological features. All 17 features were assigned to SIHP Site 18921. Fifteen of the features were interpreted to be associated with historic sugar cane activities cultivation and processing. The Inventory Survey report notes that SIHP Site 18921 is located on former Waiākea Sugar Company cane fields (Conde and Best 1973:120, cited in McGerty and Spear 1999:23).

Based on information provided in an interview, two features (see Features 1 and 11) were likely remnants of a modern pasture or a pig farm. The Inventory Survey report (McGerty and Spear 1999:25) concurred with Hunt and McDermott (1994:112) that the site was significant under Criterion D and they consequentially recommended a Data Recovery investigation.

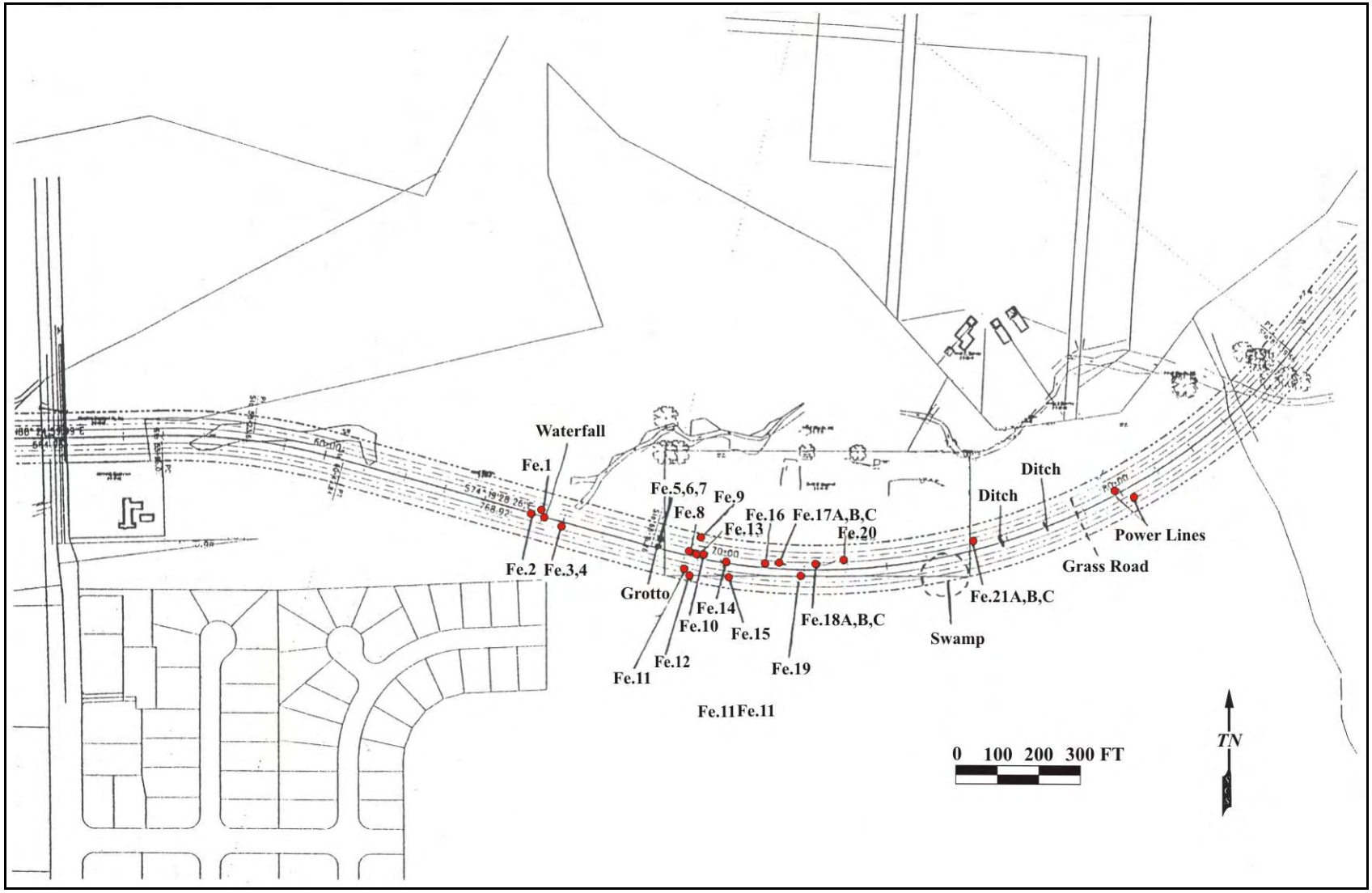


**Figure 11:** Map of Reconnaissance Survey Project Area and Identified Sites within the Pu`ainako Street Extension Corridors.

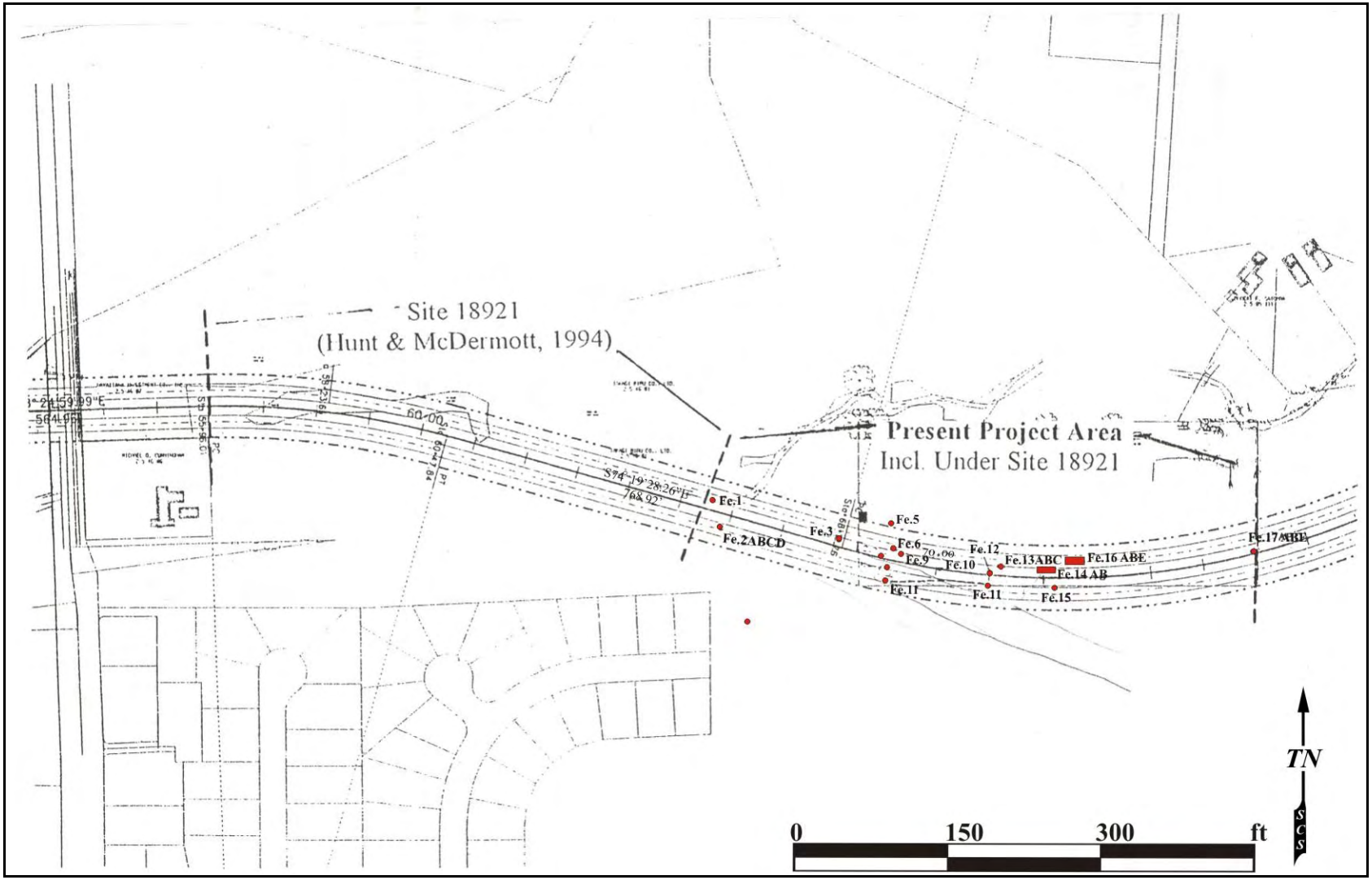


**Figure 12:** Map of Inventory Survey Project Area and Identified Sites Within the Pu`ainako Street Extension Corridors as Designated by McGerty and Spear (1999).

**DEGA AND BENSON (1999)**

In August 1999, SCS conducted a reconnaissance-level survey (Dega and Benson 1999) adjacent to and southwest of the UH Hilo Mauka lands project (Figure 13). The survey was performed within a short, expanded section of the highway (western end) occurring just to the south and partially overlapping the reconnaissance survey area documented in Spear (1998), and the Inventory Survey work reported in McGerty and Spear (1999). The project area was approximately 1.6 kilometers long (east-west) and 100 meters wide (north-south) and was situated from 0.40 km to 2.50 km south of Kaumana Drive at the study corridor`s western and eastern termini.

Eight archaeological sites were identified within the western border of the project area. Eighteen features were documented including 12 rock mounds, two platforms, two walls, one alignment, and one stone-lined *`auwai*, or water channel. Seventeen features were interpreted to be related to historic sugar cane cultivation and processing, a similar interpretation to that presented previously (Hunt and McDermott 1994, Robins and Spear 1996, McGerty and Spear 1999).

One feature, a rock-lined *`auwai*, was thought to be traditional (pre-Contact). The *`auwai* was situated parallel to and between several rock mounds associated with sugar cane cultivation but is suggestive of a traditional water channel because its width (0.80 m) is much smaller than channels typically used for sugar cane field irrigation. Secondly, the gravity-fed system was lined with small cobbles and not metal, as is commonly used in the construction of sugar cane water channels. Thirdly, the channel itself was not deep (average 0.10 m below rock surface) and had not been maintained for some time. Finally, the channel emptied onto a small alluvial plain that would have been well suited to small-scale irrigated taro cultivation. The Dega and Benson (1999) reconnaissance survey report recommended Inventory Survey work be carried out, including test-excavations within and near the *`auwai* feature.

**DEGA (2000)**

SCS conducted an Inventory Survey to complete the reconnaissance-level survey reported by Dega and Benson (1999) at SIHP Site 18921 (see Figure 13). Eight features were documented, two previously recorded by Spear (1998) and Dega and Benson (1999) during the reconnaissance surveys. Features included walls, clearing mounds, rock alignments, a platform, and a stone-lined *`auwai*. Four stratigraphic trenches were mechanically excavated in and around the *`auwai* feature. Trenches were typically 1.80 meters wide and totaled 17 meters in length. The *`auwai* was reinterpreted as an historical sugar cane field irrigation ditch due to a

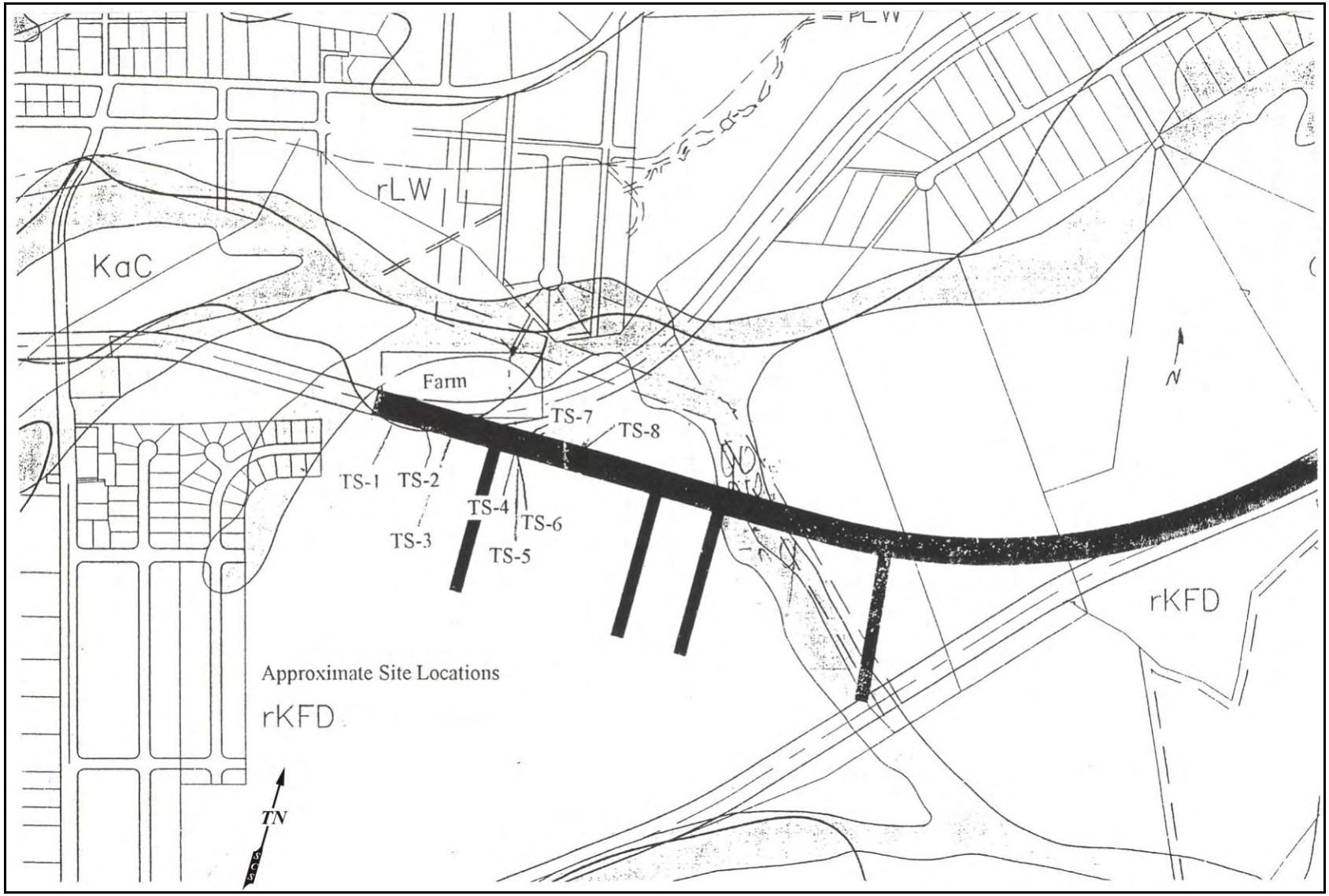


**Figure 13:** Map of Inventory Survey Project Area and Identified Sites within the Pu`ainako Street Extension Corridors as Designated by Dega and Benson 1999.

lack of stones lining its bottom as is common in traditional Hawaiian *`auwai*. No evidence was found to substantiate the presence of *lo`i* (wetland agricultural terraces) associated with the irrigation ditch.

**BUSH, MCDERMOTT, AND HAMMATT (2000)**

Cultural Surveys Hawaii carried out an Inventory Survey of a 20-acre parcel for the proposed USDA Pacific Basin Research Center (Figure 14). The project was located on a parcel along the western-central edge of the UH Hilo Mauka Lands project area on a Mauna Loa *pāhoehoe* lava flow dating between 750 and 1,500 B.P.. A single human femur was located in an overhang of a lava tube within a shallow skylight. The site (SIHP Site 22080) was designated a burial and recommended for preservation.

**MCDERMOTT AND HAMMATT (2001)**

Cultural Surveys Hawaii carried out an additional Inventory Survey of a 10-acre parcel (adjacent to and west of the 2000 study area) for the proposed USDA Pacific Basin Research Center (see Figure 14). The project was also located along the western-central edge of the UH Hilo Mauka Lands project area on a Mauna Loa *pāhoehoe* lava flow dated between 750 and 1,500 B.P. Two post-Contact sites composed of two features were documented. SIHP Site 22734 consisted of a modified outcrop and SIHP Site 22735 consisted of a stacked stone causeway. No further work was recommended at either site.

## EXPECTED ARCHAEOLOGICAL PATTERNS

Based on previous archaeological studies, geological studies, historical research, interviews, and County Planning Department records, site distribution and type can be predicted to fall into two major zonal types: sugar cane cultivation and processing sites (along the southern boundary of the project area) and historic period ranching activities (within the remaining portion of the project area).

**PREHISTORIC SITES**

Historical accounts of Waiākea Ahupua`a describe the region surrounding the present project as unwooded grasslands consisting of extensive dryland cultivation plots. McEldowney suggested this region was likely deforested prior to European contact through shifting agricultural practices such as swidden farming. Site types would consist of scattered houses sites adjacent to garden and arboreal plots on older *pāhoehoe* and *`a`ā* flows with well-developed soils. Modified lava tubes and tubes used for cultural practices were also expected to be found in

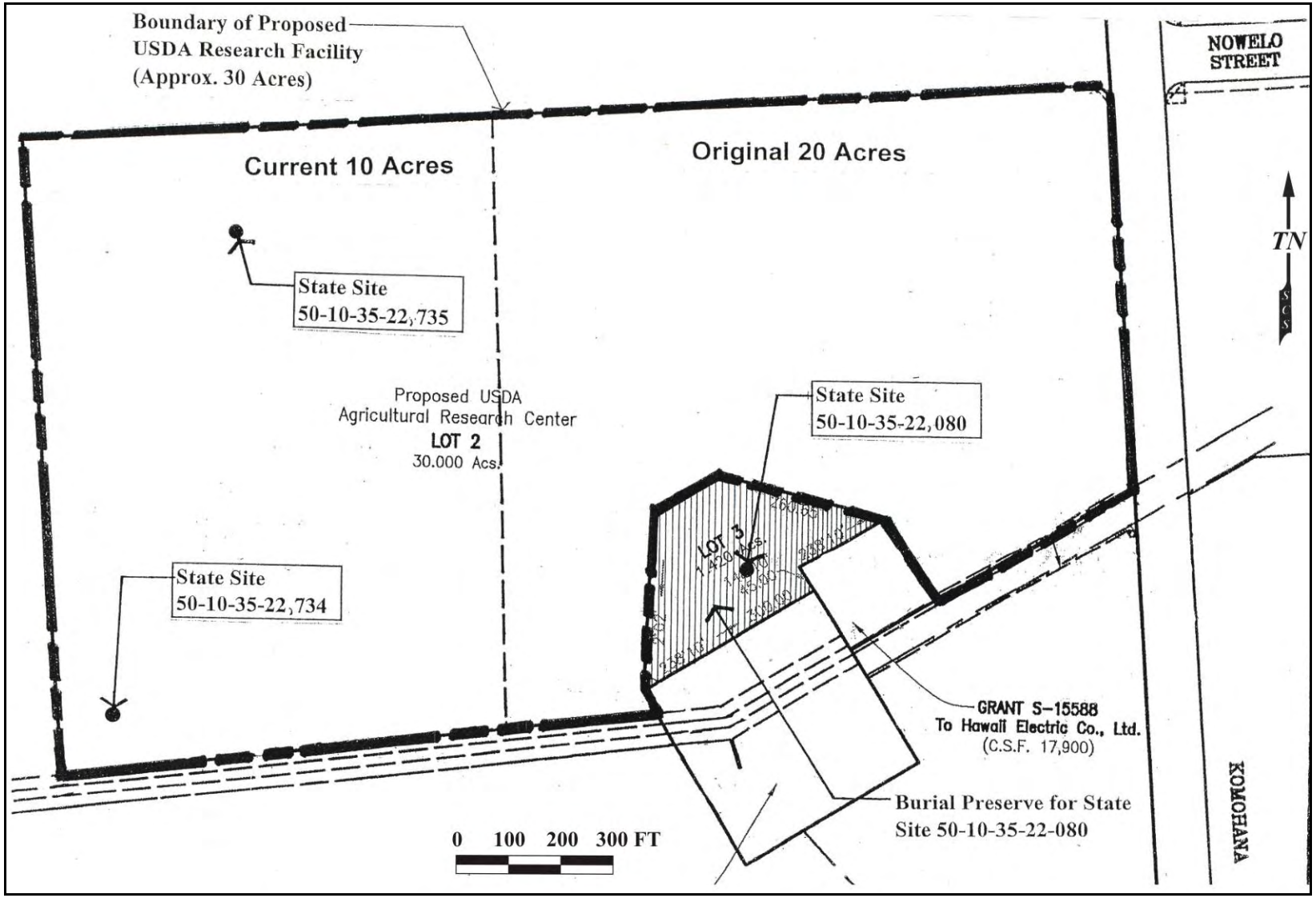


**Figure 14:** Map of Inventory Survey Project Area and Identified Sites within the USDA Research Center Parcel as Designated by McDermott and Hammatt 2001.

this upland agricultural zone. A single human femur located in an overhang within a shallow skylight (SIHP Site 22080) was discovered adjacent to the current study area (Bush *et al.* 2000).

## SUGAR CANE CULTIVATION SITES

According to Smith (1991), the majority of sites in the region are located on the older lava flow, along the southern boundary of the project area. Archaeological investigations and historical documentation have shown that the predominant site type in this area is associated with Waiākea Mill Company plantation fields. Pre-Contact sites are infrequently documented and were likely dismantled or obscured by cane field clearing (Maly 1996). It is expected that sugar cane field features will be encountered along the southern and southeastern boundary of the project area in an area formerly designated as Waiākea Mill plantation Lot 20-A (see Figure 7). The southeast corner of the project area likely contains water diversion and catchment features because it is situated in a low basin near a primary runoff that once flowed into the Waiākea Stream, and because water was necessary for irrigating sugar cane and for preparing field pesticides and herbicides.

## RANCHING AND MILITARY SITES

The majority of the project area is situated on a more recent lava flows (1,500 to 750 B.P. and the historic 1880–1881 flow) along the northern edge of the project area. Soils on these two flows are thin and scattered and are poorly suited for traditional or modern agriculture. While traditional pre-Contact horticultural practices (*i.e.*, planting in pockets of soil in bedrock depressions and mulching with rocks) may have been practiced in the area, it is expected that they will be infrequently encountered. Arboreal agriculture is not expected in the thin soils. If traditional agriculture was not practiced in the area, it is unlikely that temporary habitation and associated features will be located in the central and northern portions of the project area. It is primarily expected that sites related to historic-period ranching and military training (pertaining to General Lease 2741) will be encountered (see Figure 7).

## TRANSPORTATION ROUTES AND SITE LOCATION

It is also expected that the majority of historic-period sites will be located along the eastern and southern edges of the project area because of transportation routes. Historic maps of the area show Mohouli Street and Pu`ainako Street as the only two points of access to this undeveloped area. It is known that a trail (Maly 1996) and several dirt roads (Robert Steamy Chow interview) ran between these two streets, under and *mauka* Komohana Street. Two separate dirt roads are evident in aerial photos of the project area (taken in the years 1950, 1952, and 1964), both along the southern edge of the study area. Portions of the trail and dirt roads may be encountered within the study area parcel.

## RESULTS OF FIELDWORK

Sixteen new sites comprising 80 features were recorded in the course of this archaeological work. Site integrity of three previously documented sites within the project area (SIHP Sites 18918, 18919, and 20681) was reassessed during the present study (Figure 15). In total, there are 19 sites in the project area. The majority of all sites within the study area were interpreted to be related to historic sugar cane cultivation, ranching, or military activities. None of the sites were interpreted as pre-Contact.

## SITES LOCATED ALONG THE EAST EDGE OF THE PROJECT AREA

### SITE 50-10-35-24233

Site 24233 is a rock alignment located three to five meters *mauka* of Komohana Street and 10 meters south of a Helco power line road, at an elevation of 98 meters (320 feet) amsl (Figure 16). The site is situated in a dense *waivi* thicket growing on a thin mantle of soil in an uneven and sloping area with numerous bedrock outcrops. Site 24233 consists of two features (Features A and B).

### Site 24233, Feature A

Feature A is a rock alignment measuring 30 meters long (173º/253º), 1 to 2 meters wide, and averages 0.40 meters in height. It is constructed of piled angular and subangular *pāhoehoe* cobbles and boulders, with no evidence of stacking or facing. There are four large albezia trees along the *makai* edge of the feature at intervals of approximately 4 meters. The alignment likely delineates a remnant portion of trail, the continuance of which has been removed by the construction of Komohana Street and the Helco power line road. The trail surface is now overgrown and it is not certain if the trail was located *mauka* or *makai* of the alignment. The feature has been altered by a recent flood event and is in fair condition.

### Site 24233, Feature B

Feature B is a *pāhoehoe* cobble and boulder concentration situated in a shallow basin adjacent to a modern drainage tunnel under Komohana Street, and is two meters south of Site 24233 (see Figure 16). The cobble and boulder concentration measures 8 meters long (179º/359º), 6.7 meters wide, is even with the ground surface, and is not well sorted or level. Feature B is likely associated with trail Site 24233 and allowed passage over the low swampy terrain in this area. An albezia and two small mango trees are located adjacent to and *makai* the site. The site has been altered by the construction of Komohana Street and appears to be in fair condition

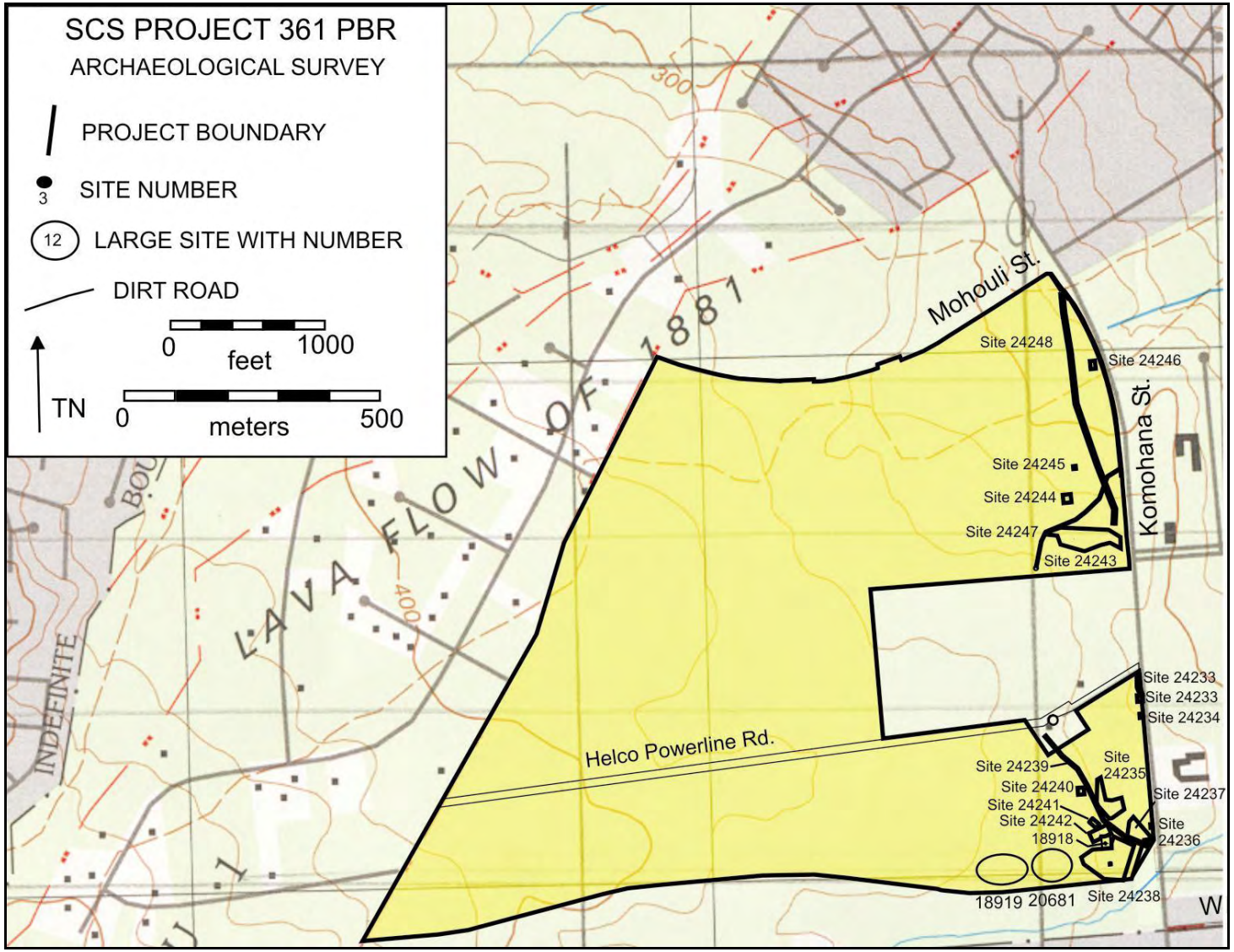


**Figure 15:** Portion of USGS Hilo Quadrangle Topographical Map, Showing Sites Located on the UH Hilo *Mauka* Lands Project Area.

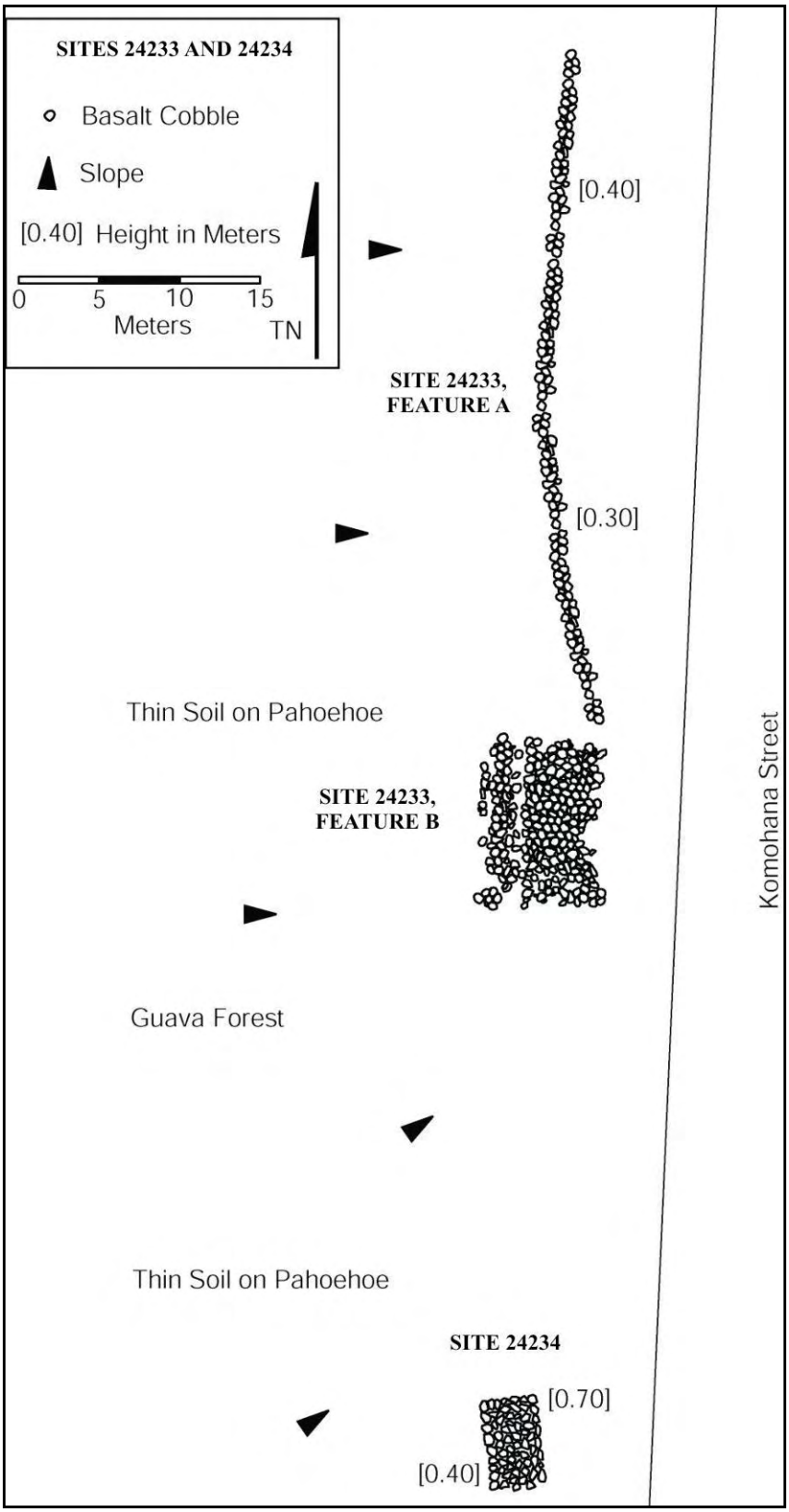


**Figure 16:** Map Showing Locations of Sites 24233 and 24234.

is located on a bedrock outcrop in an area of eastern sloping *waivi* forest and *uluhe* fern. The rock mound is constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders, and measures 4 meters long (170º/350º), 3 meters wide, and from 0.40 to 0.70 meters in height. The rock mound is faced on its west, north, and east sides and was stacked three to four courses high. The south side of the mound appears to be disturbed. The feature is likely a clearing mound associated with historic sugar cane fields documented adjacent to and east of Site 24234 in Borthwick *et al*. (1993). The feature is slightly altered, is in fair condition, and is similar in form to numerous clearing mounds documented in several reports completed in the immediate vicinity.

## SITES LOCATED IN THE SOUTHEAST CORNER OF THE PROJECT AREA

Sites located in the southeastern corner of the project area (Figure 17) are associated with sugar cane agriculture and are likely remnant portions of Waiākea Mill plantation Lot 20-A (see Figure 7). They consist of numerous field-clearing mounds, all of which are constructed on or up against the sides of bedrock outcrops.

### SITE 50-10-35-18918

State Site 50-10-35-18918 is located approximately 75 meters northwest of the southeast corner of the project area, between Site 24238 and 11, and west of dirt road Site 24239, at an elevation of 340 feet (105 m) amsl, and occupies an area of steeply sloping *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare *pāhoehoe* and bedrock outcrops (see Figure 17). Several royal palms are located on the site. The site was originally recorded by Hunt and McDermott (1994) and was later reassessed in Robins and Spear (1996). Hunt and McDermott interpreted the site's four features (Feature A through D) as clearing mounds and an enclosure associated with pastureland. It is evident from a reevaluation during the present study that SIHP Site 50-10-35-18918 is associated with Sites 4, 7, and 11 and are part of the northwestern corner of historic sugar cane fields, likely Waiākea Mill Company plantation Lot 20-A.

### Site 18918, Feature A

Feature A is a clearing mound constructed of basalt cobbles and boulders stacked on a *pāhoehoe* outcrop. The feature measures 3.2 m long (north/south), 1.0 m wide, and is from 0.6 to 1.0 m in height. The feature is slightly collapsed and is in fair condition.

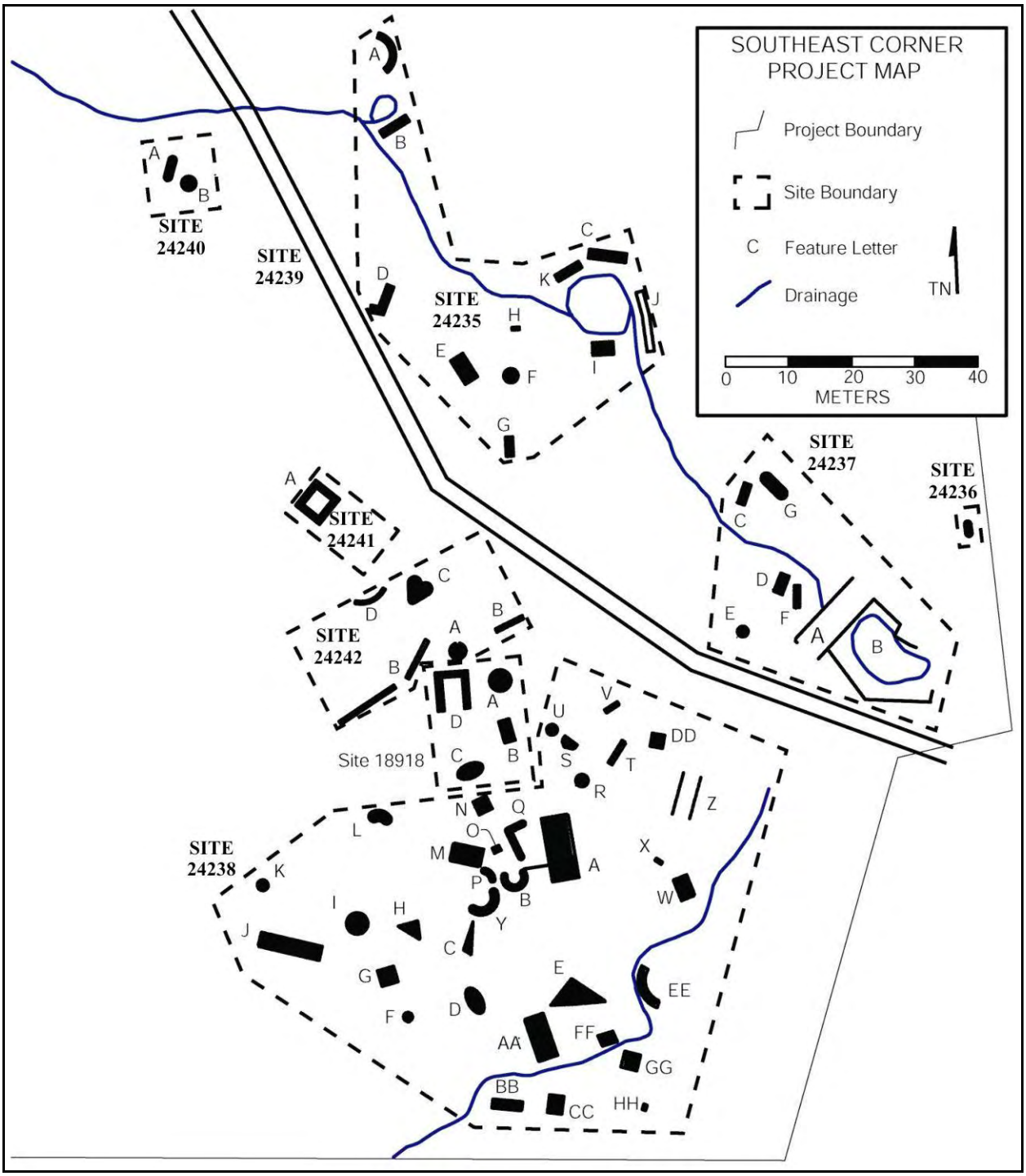


**Figure 17:** Map Showing Locations of Sites in Southeastern Corner of Project Area.

**Site 18918, Feature B**

Feature B is a clearing mound constructed of basalt cobbles and boulders stacked on a *pāhoehoe* outcrop. The feature measures 3.2 m long (north/south), 1.0 m wide, and is from 0.6 to 1.0 m in height. The feature is slightly collapsed and is in fair condition.

**Site 18918, Feature C**

Feature C is an oval clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located in the southwest corner of the site, measures 4.0 meters long (70º/250º), 2.70 meters wide across center, and ranges from 0.80 to 1.60 meters in height (. The sides are very well faced and the top surface is level. It is apparent in the construction that an outer ring was first built and then center filled with piled *pāhoehoe* cobbles and boulders. The feature appears unaltered and is in good condition.

**Site 18918, Feature D**

Feature D is an L-shaped modified outcrop constructed of basalt boulders stacked on a *pāhoehoe* outcrop to form a U-shaped enclosure. The interior of the feature measures 2.0 m long (north/south), 1.5 m wide, and is a maximum of 1.1 m in height. The walls average 0.8 m in thickness and are well faced on the interior. Feature D likely functioned as a clearing mound and perhaps storage of some kind. The feature is slightly collapsed and is in fair condition.

**SITE 50-10-35-18919**

The following site description follows Robbins and Spear (1996). Site 18919 is located in the southeast corner of the project area at approximately 340 ft amsl. The site consists of 58 component features, including 36 features (Feature A through "JJ") previously recorded during the Hunt and McDermott 1992 survey and 22 features (Feature 11 through 32) recorded during the Robbins and Spear (1996) survey. There is a gap in the numbering sequence of the newly identified feature designations, because 16 features (Feature 1-10 and 33-38) were originally considered to be associated with Site 18919. In accordance with the SHPD's request, these 16 features (Feature 1-10 and 33-38) are now regarded as a separate site (Site 20681). The feature number designations were retained to facilitate the relocation of these sites' features since each structure was labeled as such in the field. The site area is characterized by an undulating *pāhoehoe* lava surface with intermittent soil-filled depressions. Vegetation is generally dense with some forested areas providing more open canopies.

In total, the features of Site 18919 consist of 29 modified outcrops, 18 mounds, seven retaining walls, two terraces, and two platforms. The majority of these features are built on or

against outcrop exposures and the differing architectural types range in shapes, from linear to circular and all variations in between, including rectangular platforms.

The site features vary in shape and size and they commonly modify exposed outcrop. A common architectural feature type of the site consisted of modifications that appeared to block openings to lava tubes, blisters or potential overhang shelters. Several of these feature types were carefully dismantled during both the 1992 and present project surveys, but none of these explorations identified any sizable openings that would have been appropriate for human use (e.g. shelters).

Several features were also tested during the Hunt and McDermott survey primarily to determine the age and function of the site and to examine cultural deposits if present. The testing included nine individual feature excavations. The testing indicated that the stone structures were loosely constructed (lacking "internal structure" - meaning stacking or substantiality) and lacked any associated prehistoric cultural deposits. A wire observed in the wall construction of Feature E suggests that it was constructed during the historic period. Site 189191 is interpreted as being associated with historic cane agriculture. The site structures were likely the resulting waste piles from clearing sugar cane fields close by.

**SITE 50-10-35-20681**

The following site description follows Robbins and Spear (1996). Site 20681is located in the southeast corner of the project area at approximately 340 ft amsl, and includes 16 features (Feature 1-10 and 33-38). There is a gap in the numbering sequence of the feature designations of Site 20681 because the site was originally recorded" as being part of Site 18919 (see Site 18919 description).

The site area is characterized by an undulating *pāhoehoe* lava and soil surface that slopes downward moderately to the southeast. The site is bounded by a ridge ascending to the west and by a seasonally dry runoff gulch to the southeast. Site 18919 is located to the west of the site on top of the ridge. Vegetation is generally dense with some forested areas providing more open canopies.

Of the 16 features recorded at Site 20681, twelve are rock, clearing mounds, two are modified outcrops, and two are retaining walls. Site 20681 is interpreted as being associated with historic cane agriculture. The site structures were likely the resulting waste piles from clearing sugar cane fields close by.

**SITE 50-10-35-24235**

Site 24235 is located in the southeastern corner of the study area, at an elevation of 105 m (340 feet) amsl, and occupies an area of steeply sloping *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare *pāhoehoe* and bedrock outcrops (Figure 18). The site measures approximately 70 meters long, (132º/312º) by 10 to 40 meters wide (42º/222º), and consists of 11 historic sugar cane field features (Features A-J), likely part of Waiākea Mill Company plantation field Lot 20-A. A natural drainage channel crosses the site from a more recent dirt road (Site 24239) located along the northwest edge to the *makai* portion of the site. The channel is modified in two locations (See Features B and J below) to pond water. Water no longer flows through this channel as a result of the construction of the dirt road (Site 24239) and the construction of the Waiākea Stream cement spillway further uphill. Four large, pruned mango trees, several small *hala* trees, and several *ti* plants are located along the channel at the northern edge of the site. A concentration of older *hala* trees is located in a basin at the southeastern corner of the site. Numerous modern beer liquor bottles, beer bottles, and a teacup are located across the site.

**Site 24235, Feature A**

Feature A is located at the northern edge of the site and is a crescent-shaped pile of *pāhoehoe* cobbles and boulders associated with a modern trash pile located along its *makai* (east) edge. The rock pile measures 7.60 meters long (north/south), 1.4 meters wide, and ranges from 0.40 to 0.67 meters in height. No facing or formal stacking is evident in the feature. Refuse at the dump consists of *circa* 1950s liquor, beer, soda, medicine, Purex, Clorox, and food bottles; scrap metal; and an old washing machine. A 1952 license plate was also located within the refuse.

**Site 24235, Feature B**

Feature B is an alignment of *pāhoehoe* cobbles piled in a low spot on a bedrock ridge located roughly 6.00 meters south of Feature A, and measures 3.20 meters long (60º/240º), 1.00 meter wide, and from 0.10 to 0.45 meters in height (Figure 19). The bedrock ridge on which the feature is piled forms a natural basin along the northern edge of the natural drainage channel that crosses the site. Soil within the basin was wet when inspected. The alignment serves to dam a low spot on the bedrock outcrop. The feature appears to be unaltered and is in fair condition.

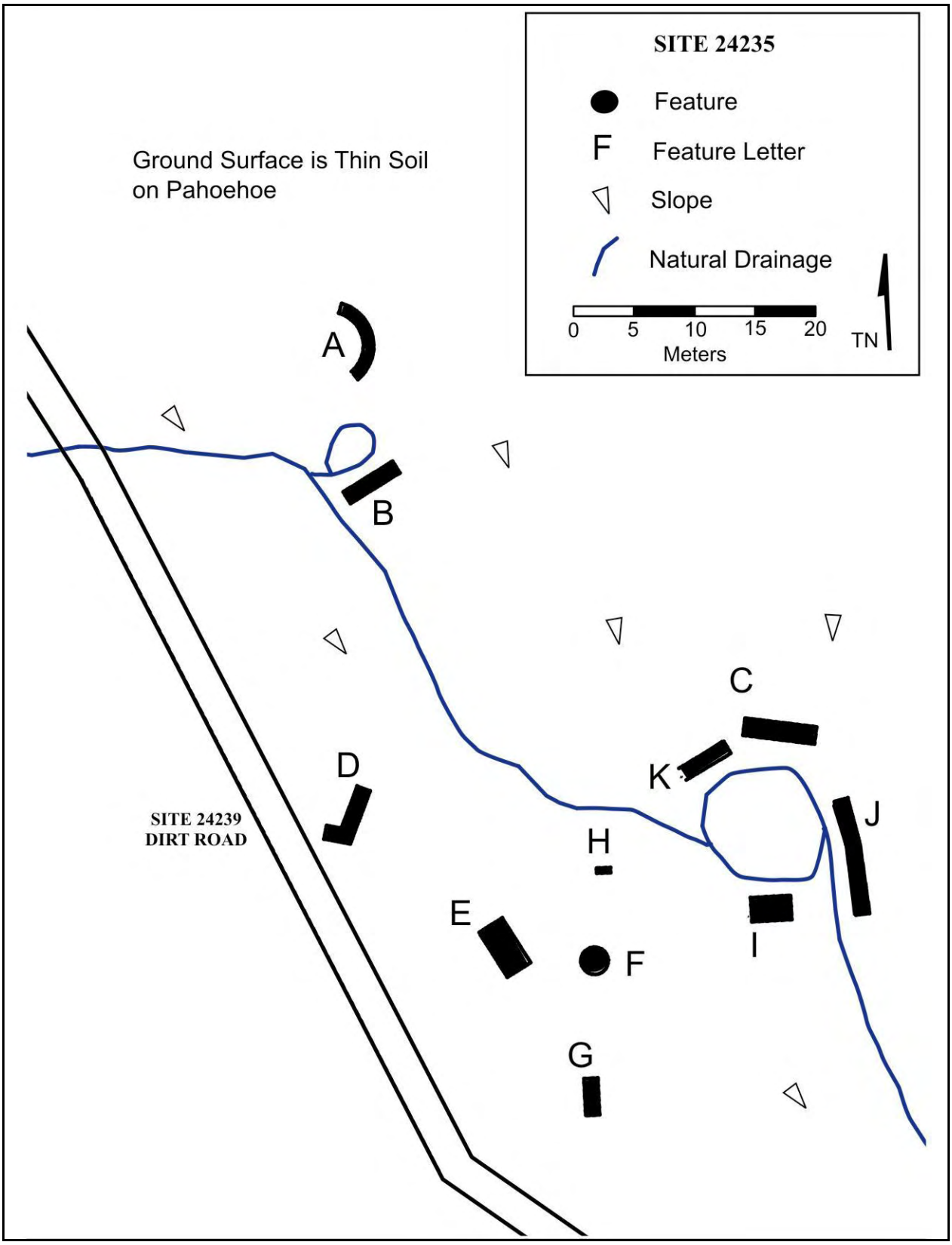


**Figure 18:** Planview Map of Site 24235 Showing Location of Features.

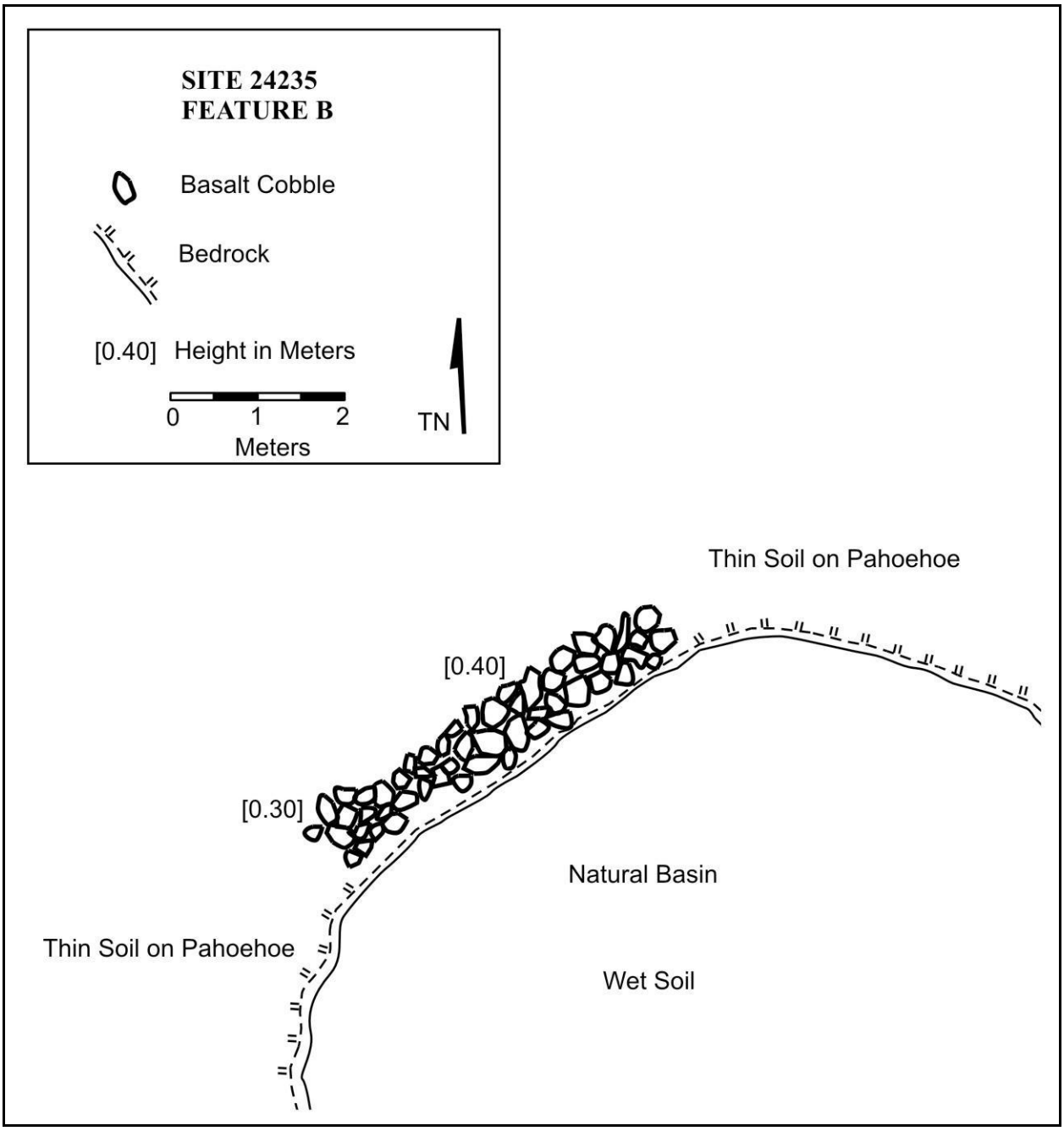


**Figure 19:** Planview of Site 24235, Feature B Rock Alignment.

**Site 24235, Feature C**

Feature C is a level, rectangular clearing mound/terrace located roughly 35.00 meters southeast of Feature A, and measures 6.80 meters long (99º/279º), 1.40 meters wide, and is 1.30 meters in height along its southern face (Figure 20). The feature is constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders, is well-faced along its south side, and is level with the ground surface on the three other sides. The feature is built onto the southern edge of a bedrock cliff situated above a natural basin to the south. The basin has been modified (see Feature J) to collect water. Feature C is likely a clearing mound and work area associated with sugar cane agriculture in the area. The feature appears unaltered and is in good condition.

**Site 24235, Feature D**

Feature D is a rectangular clearing mound constructed of *pāhoehoe* cobbles and boulders located roughly 22 meters south of Feature B, and measures 4.6 meters long (20º/200º), 1.5 meters wide, and averages 0.60 meters along its southeast side (Figure 21). The feature is built onto the southeastern face of a bedrock ledge, is level with the ground surface to the northwest, and is faced on its southeast side. The feature is the result of field clearing, appears unaltered, and is in fair condition.

**Site 24235, Feature E**

Feature E is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 12 meters southeast of Feature D, measures 5.2 meters long (160º/340º), 2.0 meters wide, and averages 0.60 meters in height. The feature is faced, appears unaltered, and is in good condition.

**Site 24235, Feature F**

Feature F is a square clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 3.00 meters east of Feature E, measures 2.30 meters per edge, is 0.37 to 0.67 meters in height, and is well-faced on all sides (Figure 22). The southeast corner of the feature has collapsed, but over all integrity appears to be fair.

**Site 24235, Feature G**

Feature G is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 10.00 meters southeast of Feature E, measures 3.00 meters long (179º/369º), 1.00 meter wide, is 0.37 to 0.67 meters in height, and is well-faced along its western side (Figure 23). The feature is built onto the eastern face of a bedrock ledge and is level with the ground surface to the east. The feature appears unaltered and is in good condition.

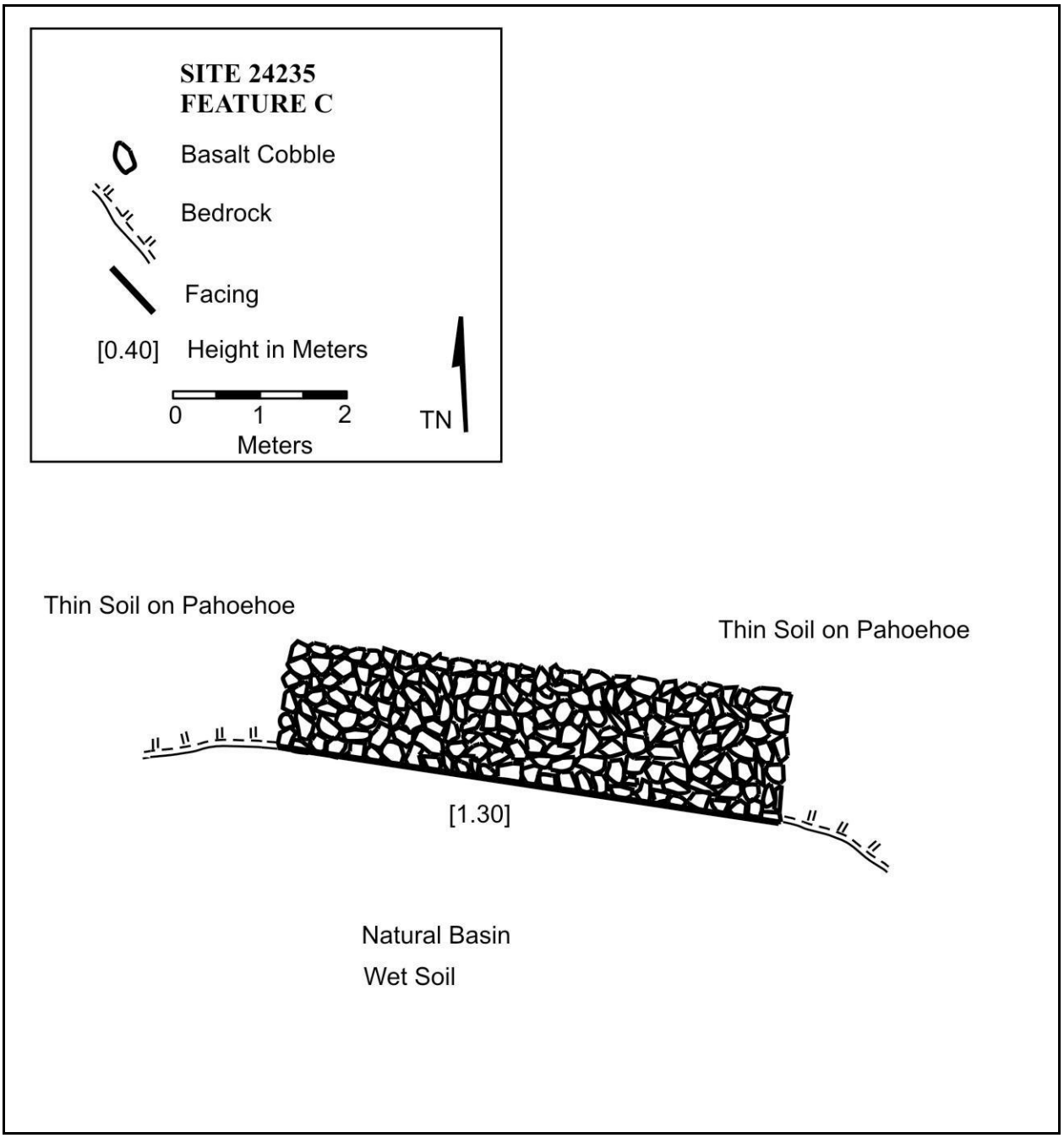


**Figure 20:** Planview of Site 24235, Feature C Clearing Mound.

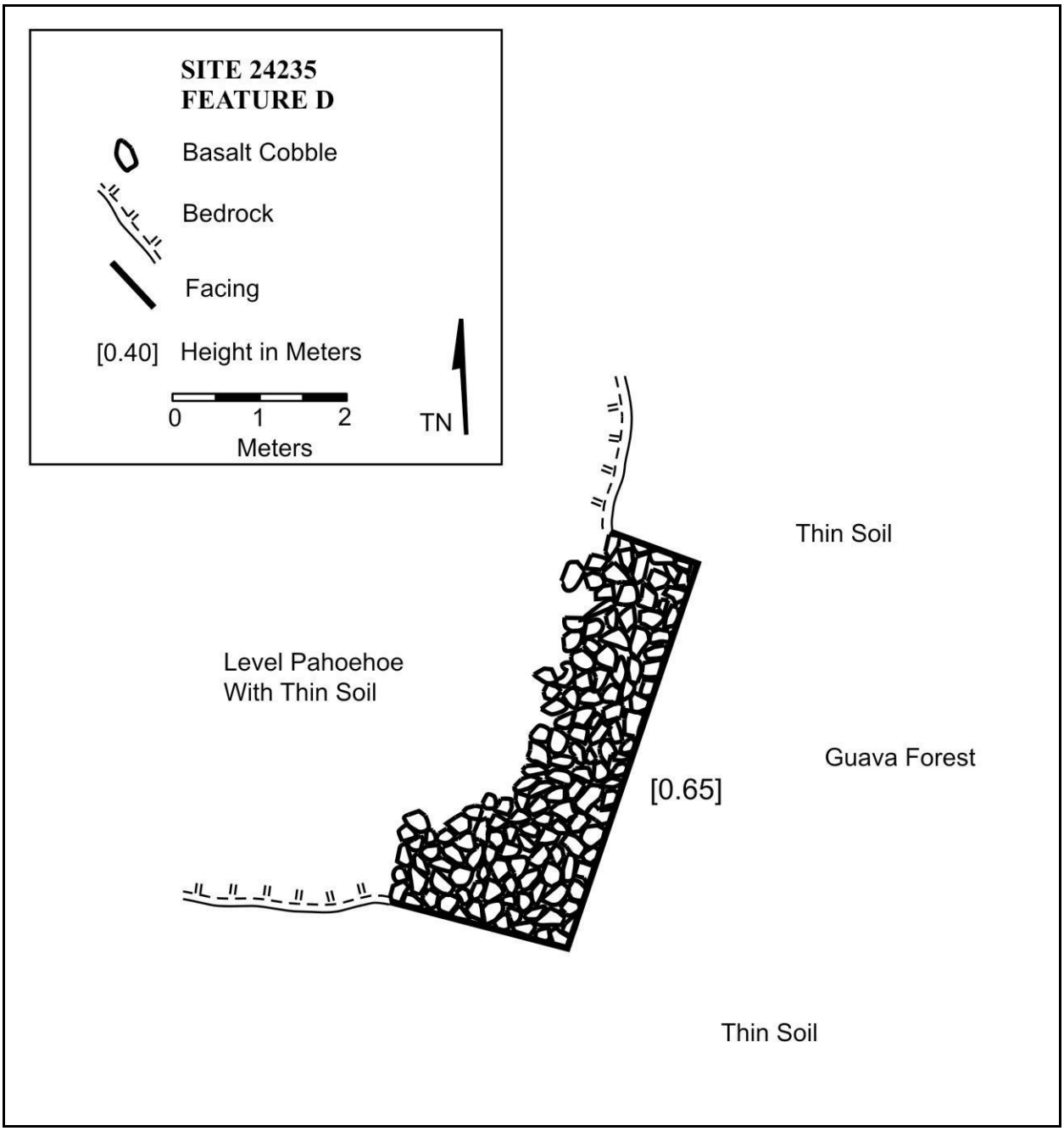


**Figure 21:** Planview of Site 24235, Feature D Clearing Mound**.**

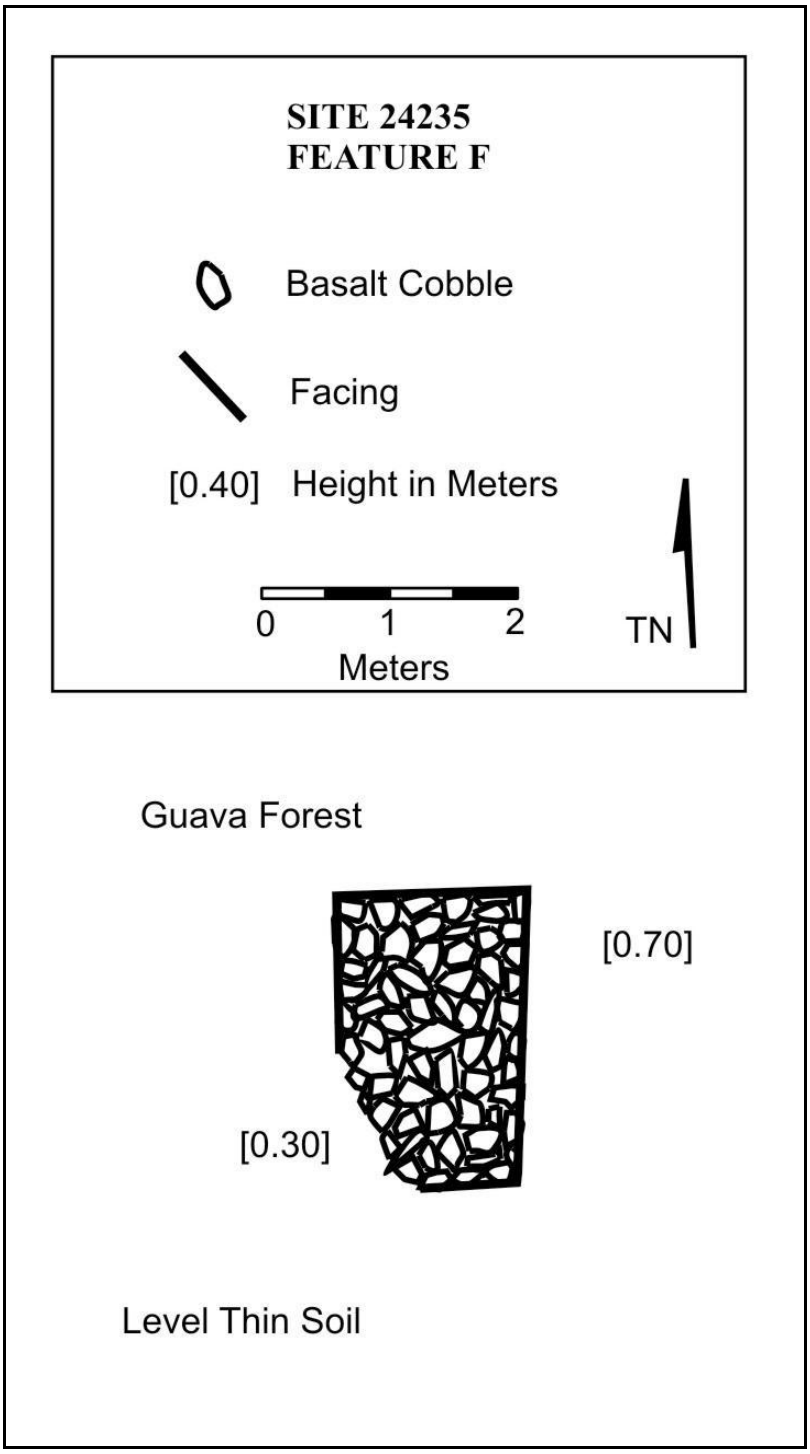


**Figure 22:** Planview of Site 24235, Feature F Clearing Mound.

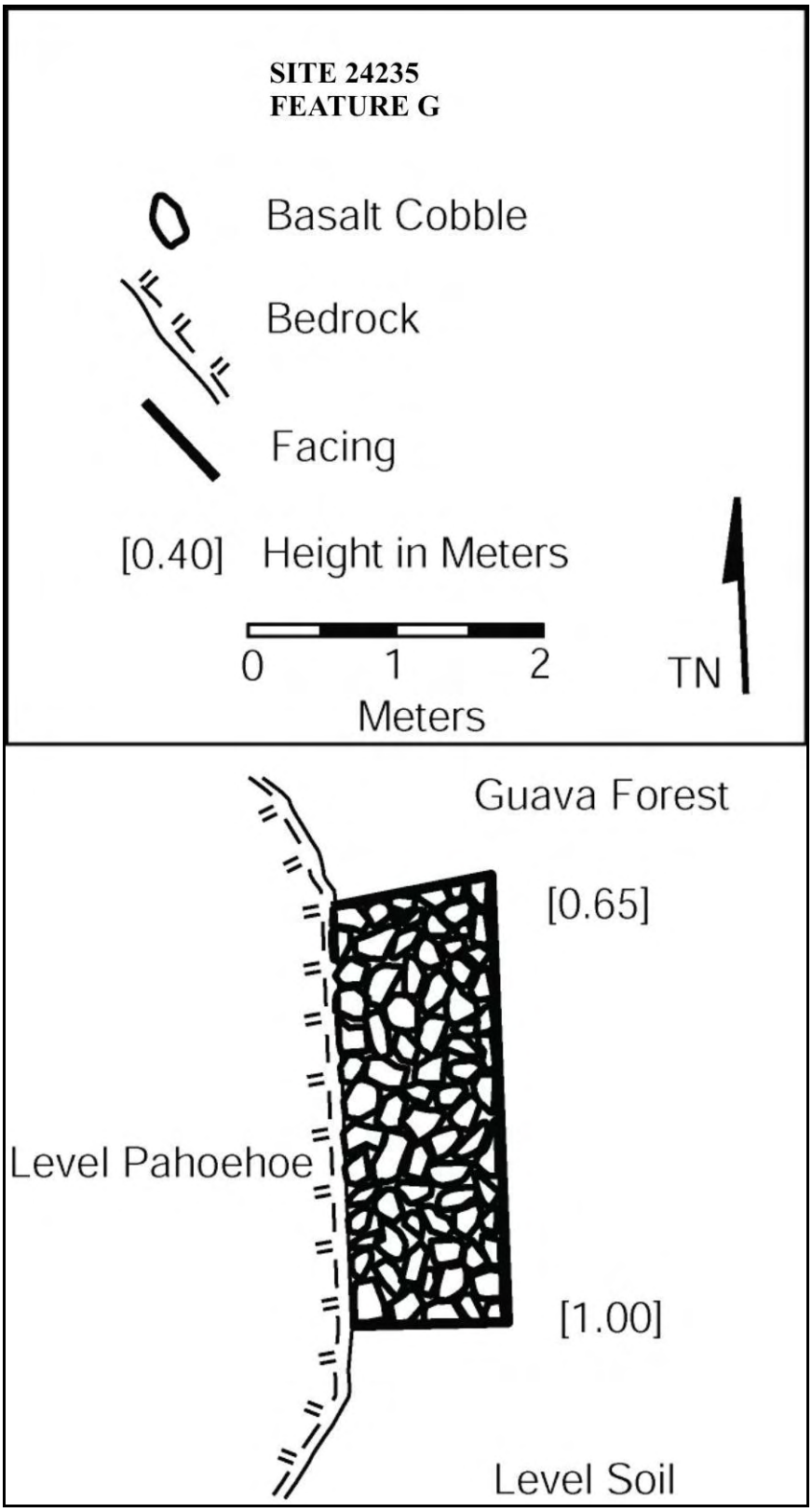


**Figure 23:** Planview of Site 24235, Feature G Clearing Mound.

**Site 24235, Feature H**

Feature H is a rectangular clearing mound constructed of angular and subangular *pāhoehoe* cobbles and boulders stacked on a bedrock outcrop located 5 meters north of Feature F. The feature measures 1.6 meters long (east/west), 0.8 meters wide, is 0.6 to 1.0 meter in height, and is faced on its east side. The feature appears to be unaltered and is in fair condition.

**Site 24235, Feature I**

Feature I is a triangular clearing mound constructed of angular and subangular *pāhoehoe* cobbles and boulders stacked on a bedrock outcrop located 11.00 meters east of Feature H. It measures 2.80 meters long (east/west), 0.97 meters wide, is 0.66 to 1.00 meter in height, and is faced on all side (Figure 24). The feature appears unaltered and is in fair condition.

**Site 24235, Feature J**

Feature J is a rock alignment constructed of angular and subangular *pāhoehoe* cobbles and boulders piled on a bedrock outcrop located 4 meters east of Feature I and measures 9.3 meters long (north/south), 1.0 meter wide, and is from 0.30 to 0.55 meters in height (Figure 25). The bedrock ridge on which the feature is piled forms a natural basin along the eastern edge of the natural water channel that crosses the site. Soil within the basin was wet when inspected. The alignment serves to dam a low spot on the bedrock outcrop. The feature appears to be unaltered and is in fair condition.

**Site 24235, Feature K**

Feature K is a field clearing alignment constructed of angular and subangular *pāhoehoe* cobbles and boulders piled on a bedrock outcrop located 1 meter west of Feature C. It measures 3.9 meters long (59º/239º), 0.78 meters wide, and is from 0.30 to 0.43 meters in height. No facing is evident in the feature. The feature is a result of clearing associated with historic sugar cane agriculture. The feature appears to be unaltered and is in fair condition.

**SITE 50-10-35-24236**

Site 24236 is a single, semicircular rock alignment enclosing a lava tube located in the southeastern corner of the project area and 3.0 meters west of Komohana Street at an elevation of 98.00 meters (320 feet) amsl, and occupies an area of level to gently sloping *waiwi* forest growing on a thin to moderately deep mantle of Keaukaha extremely rocky muck series soil (see Figure 17). The rock alignment is semicircular, measures 2.30 meters long (174º/354º), 0.28 meters wide and is from 0.32 to 0.55 meters in height (Figure 26). The lava tube enclosure measures 2.3 meters in diameter, is 1.3 meters long, pinches off at its interior end, and is devoid of sediment and cultural material (bare lava interior). The feature is associated with a historic

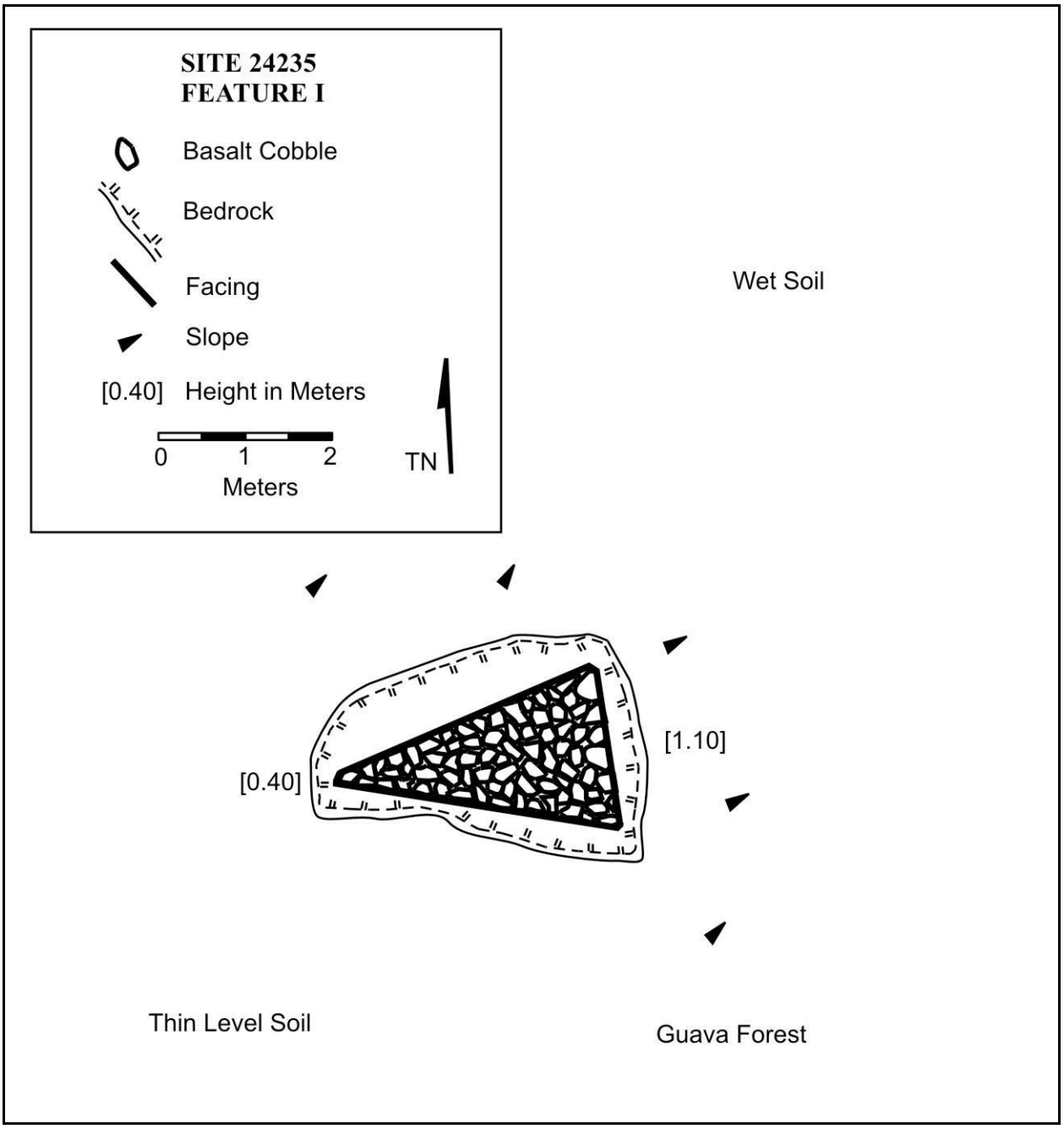


**Figure 24:** Planview of Site 24235, Feature I Clearing Mound.

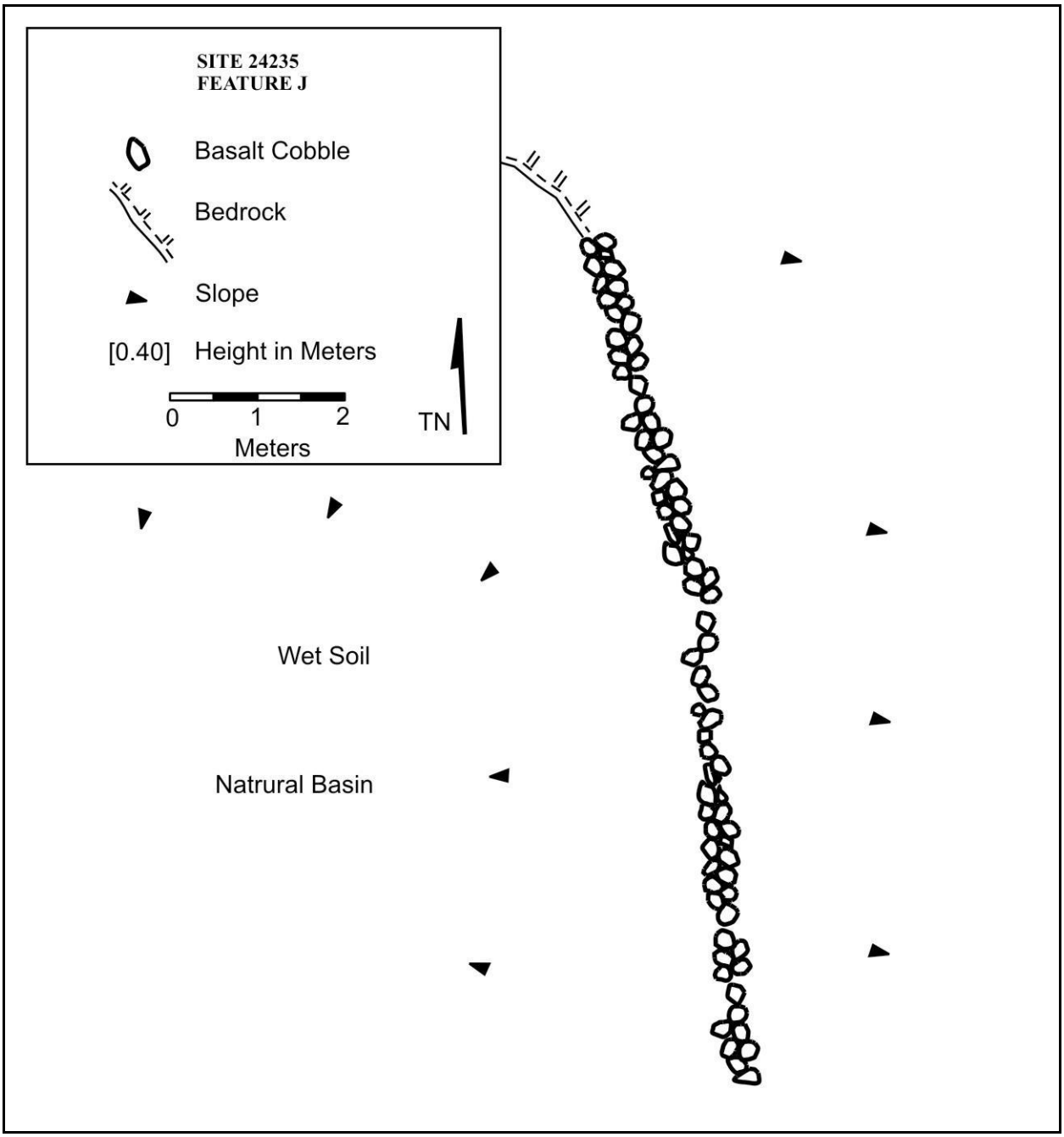


**Figure 25:** Planview of Site 24235, Feature J Clearing Mound.

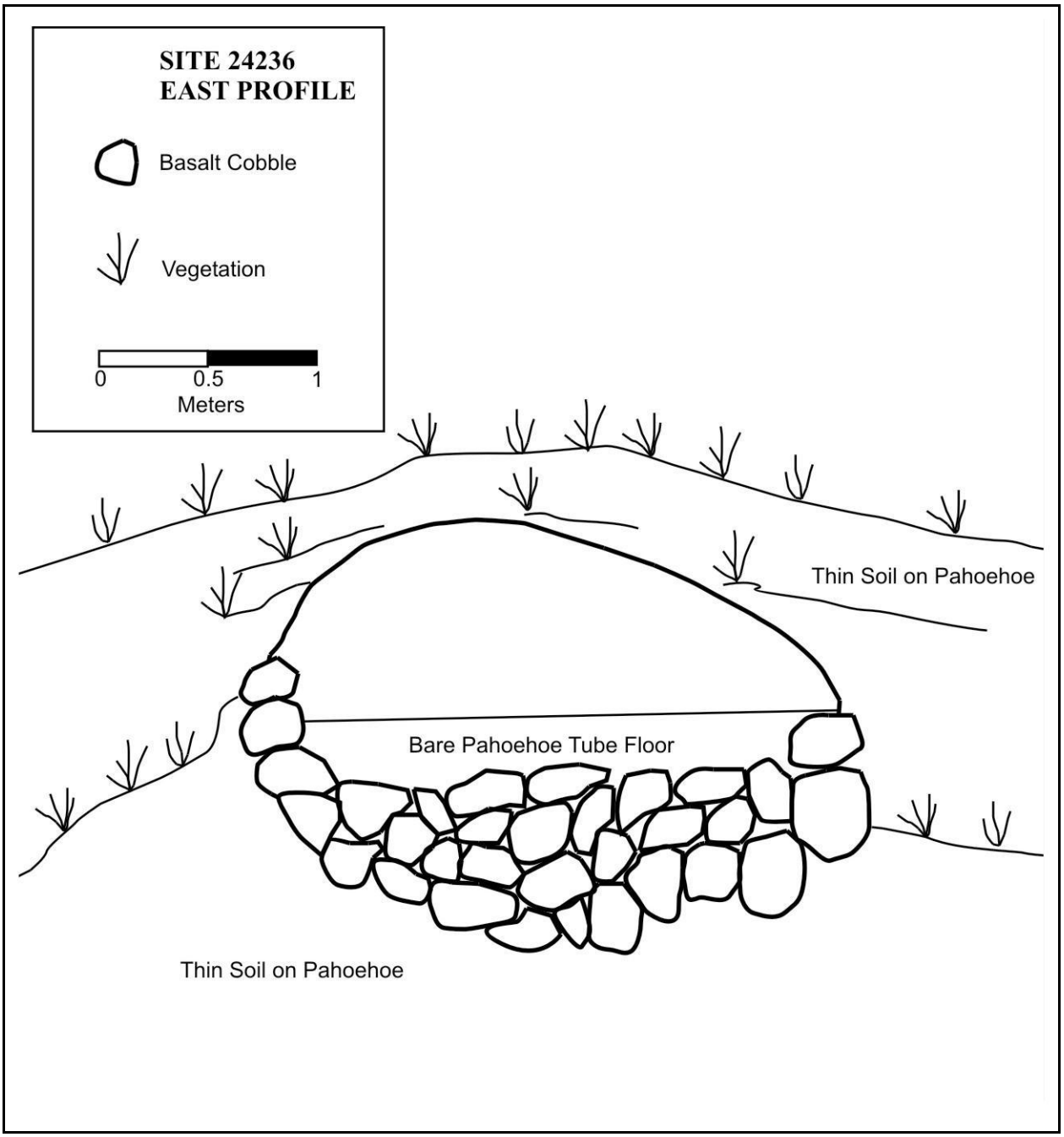


**Figure 26:** Profile of Site 24236 Enclosed Lava Tube.

water catchment complex (Site 24241) located approximately 15 meters to the west. Site 24241 appears unaltered and in good condition.

**SITE 50-10-35-24237**

Site 24237 is located in the southeastern corner of the study area, at an elevation of 320 feet (98 m) amsl, and occupies an area of level to gently sloping *waiwi* forest growing on a thin to moderately deep mantle of Keaukaha extremely rocky muck series soil (Figure 27). The site measures approximately 55 meters long (northwest/southeast), by 18 to 30 meters wide (northeast/southwest) and consists of 7 features (Features A–J), likely part of nearby Waiākea Mill Company plantation field Lot 20-A and Fairview Dairy pasture land. A natural drainage channel enters the site from Site 24235 to the west, and Site 24237 Features A and G (see below) catch the water entering from that channel. Water no longer flows through this channel as a result of the construction of a dirt road (Site 24239) and the construction of the Waiākea Stream cement spillway further uphill. Numerous modern beer bottles, cans, and chunks of cement are located across the site.

**Site 24237, Feature A**

Feature A is a road causeway (Figure 28) constructed of angular and subangular *pāhoehoe* cobbles, boulders, and boulder-sized chunks of flat cement stacked across a low spot in the surrounding ground surface located 20.0 meters west of Komohana Street and 3 meters north of a dirt road (Site 24239). The causeway measures 20.0 meters long (45º/225º), is 4.5 to 5.5 meters wide and is level across the top of its cobble paved surface. The surface is level at both ends of the causeway and is from 0.3 to 1.1 meters above ground surface along its sides. In contrast to the cobble surface, the well-faced sides of the feature are constructed of stacked large angular and subangular *pāhoehoe* boulders. They are stacked from two to four courses high. Water flowing down the natural channel to the northwest likely pooled along the causeway`s northwest side and slowly seeped into a catchment (Feature G) constructed on the causeway`s southeast face.

The causeway was constructed to allow vehicle traffic over this area and is blocked by the more recently constructed dirt road (Site 24239) to its southwest. A small section of the causeway road is located on Site 24238 (Feature CC). No road or trails are evident along the causeway`s northeast terminus; any preexisting road surface is now overgrown. A section of dirt road is visible on an aerial photo taken in 1964 and crosses from Feature A to Komohana Street heading in a northerly direction. The center of the causeway has been altered by the placement

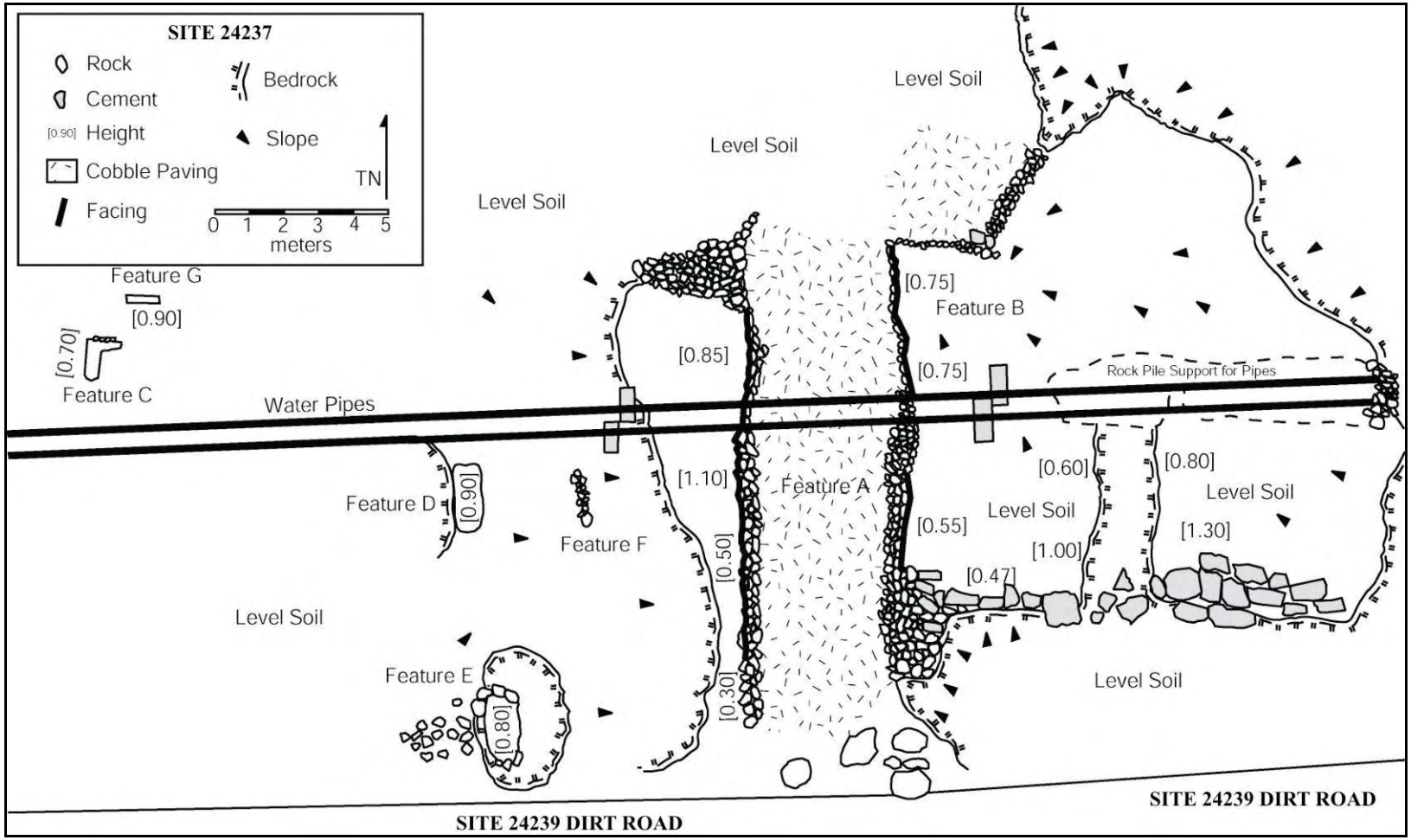


**Figure 27:** Planview of Site 24237 and Features.

**Figure 28:** Photographs of East and West sides of Site 24237, Feature 1 Causeway Looking North.

of two 10-inch water pipes that carry water from a reservoir tank uphill into Hilo. The feature appears otherwise unaltered and is in good condition.

**Site 24237, Feature B**

Feature B is a catchment located on the southeast side of Feature A in a basin measuring approximately 10.00 meters in diameter. The basin is soil filled and formed by Feature A, a crescent shaped raised bedrock outcrop along its south and east edges and, a rock alignment of subangular *pāhoehoe* cobbles and boulders piled along the northern edge. Large Boulder-sized chunks have been discarded over the southern edge of the bedrock outcrop. The rock alignment measures 5.00 meters (east/west), averages 0.50 meters in width (1 to 3 courses), and is 0.25 to 0.40 meters in height (2 to 3 courses). The alignment is cobble paved along its northern edge and forms a low 3.5 meter square two-sided terrace. Feature B is the catchment pool and terrace likely constructed for obtaining water for nearby sugar cane fields and later used to water dairy cattle. The feature appears unaltered and is in fair condition.

**Site 24237, Feature C**

Feature C is an L-shaped trench located 20.00 meters northwest of Feature A, measures 1 meter in length (per segment), is 0.40 to 0.50 meters wide, and is from 0.40 to 0.76 meters deep. The trench appears to be mechanically excavated into the bedrock and is lined with *pāhoehoe* cobbles around its top edge. The bottom of the feature contains a thin layer of sediment on bedrock. The feature likely functioned as a water catchment. The feature appears unaltered and is in fair condition.

**Site 24237, Feature D**

Feature C is a rectangular trench located 6 meters northwest of Feature A, measures 2.0 meters in length (20º/200º), is 0.4 to 0.5 meters wide, and is 0.9 meters deep. The trench appears to be mechanically excavated into the bedrock and likely functioned as a water catchment. The bottom of the feature contains a thin layer of sediment on bedrock. The feature appears unaltered and is in fair condition.

**Site 24237, Feature E**

Feature E is an excavated crack in a *pāhoehoe* outcrop and measures 2.30 meters in length (20º/200º), is 0.82 to 0.95 meters wide, and is 0.80 meters deep. *Pāhoehoe* cobbles removed from the crack are randomly located around the perimeter of the pit. The bottom of the feature contains a thin layer of sediment on bedrock. The feature may be a prehistoric basalt extraction pit, or a catchment feature similar to Features C, D, and G in the immediate vicinity. The feature appears unaltered and is in fair condition.

**Site 24237, Feature F**

Feature F is rock alignment constructed of one to two courses of angular and subangular *pāhoehoe* cobbles piled on the steeply sloping terrain 3 meters west of Feature A. The alignment measures 1.4 meters long (north/south), is 0.50 meters wide, and measures from 0.20 to 0.42 meters in height. The feature appears to divert water to a catchment in a space between it Feature A. The feature appears unaltered and is in fair condition.

**Site 24237, Feature G**

Feature G is a rectangular trench located 15.0 meters northwest of Feature A, measures 1 meter in length (130º/310º), is 0.4 to 0.5 meters wide, and is 0.9 meters deep. The trench appears to be mechanically excavated into the bedrock, is lined with *pāhoehoe* cobbles around its top edge, and likely functioned as a water catchment. The bottom of the feature contains a thin layer of sediment on bedrock. The feature appears unaltered and is in fair condition.

**SITE 50-10-35-24238**

Site 24243 is located in the southeast corner of the study area, at an elevation of 98 meters (320 feet) amsl, and occupies an area of steeply sloping *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare *pāhoehoe* and bedrock outcrops (Figure 29). The west side of the site is a level basin containing an old stream channel, once part of the Waiākea Stream. Water no longer flows through this channel as a result of the construction of the Waiākea Stream cement spillway to the south of the study area. The site measures approximately 88 meters long (east/west), by 20 to 75 meters wide (north/south), and consists of 32 historic sugar cane field features (Features A–HH), likely part of Waiākea Mill Company plantation field Lot 20-A. Several large albezia trees, royal palms, *liliko`i* vines, and *ti* plants are located along the lower side of the site surrounding Feature A. Numerous modern liquor, beer, milk, medicine, Purex, Clorox, and food bottles; metal fence posts; and chunks of cement are located across the site.

**Site 24238, Feature A**

Feature A is a three-sided rectangular terrace located 45.00 meters southwest of Site 24237, Feature A. The terrace is constructed of stacked angular and subangular *pāhoehoe* cobbles, boulders, and boulder-sized chunks of flat cement. It measures 13.30 meters in length (3º/183º), is 2.25 to 6.00 meters wide, and is 0.13 to 0.98 meters in height along its western, northern, and southern sides (Figure 30). The terrace surface consists of a level *pāhoehoe* cobble/ boulder/ cement chunk paving that is level with the surrounding ground surface on its east side. There is a relatively open level ground surface on the feature's west side and a

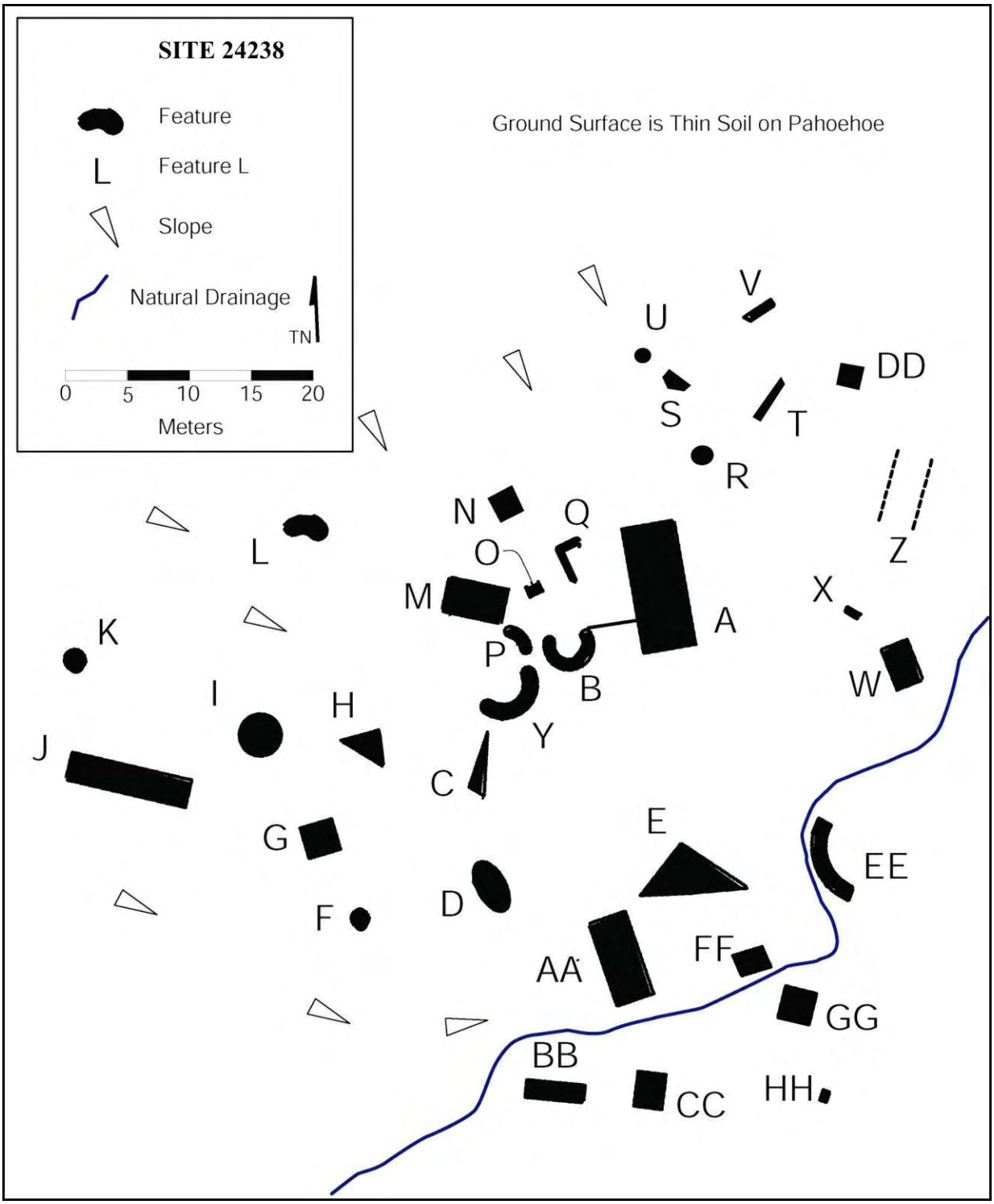


**Figure 29:** Planview of Site 24238.

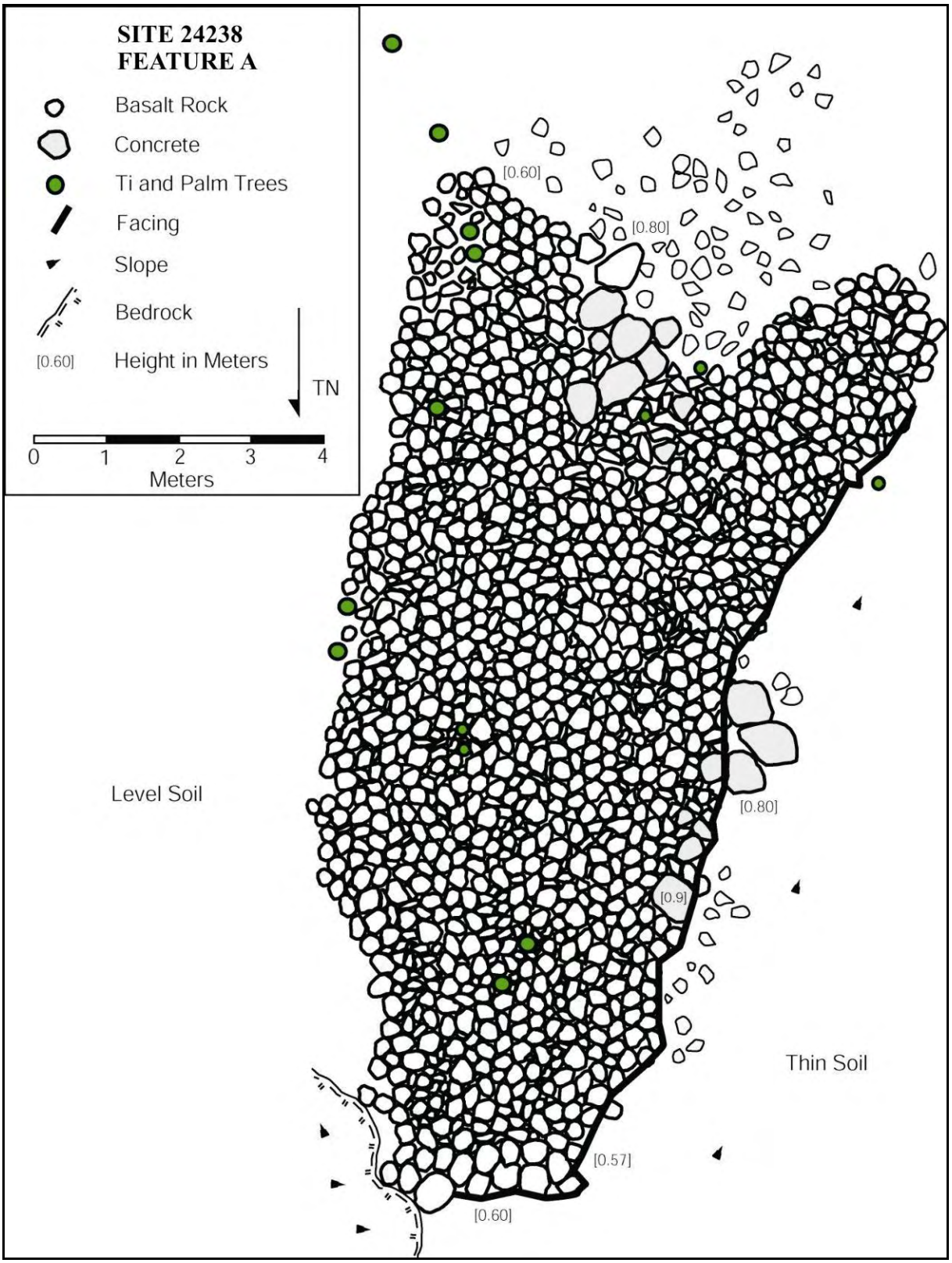


**Figure 30:** Planview of Site 24238, Feature A Terrace.

possible road surface leading north from the northern edge of the terrace. Another bulldozer-leveled road segment (Feature Z) likely leads to the clearing on the east side of the terrace. There are several royal palm trees and *ti* plants growing on and around the feature, as well as many historic bottles below the west side of the terrace. The terrace likely functioned as a collection and initial processing point for freshly cut sugar cane. Collected cane would have been loaded onto trucks and brought to the Waiākea Mill via nearby Puainako Street. The feature appears unaltered and is in good condition.

**Site 24238, Feature B**

Feature B is a crescent-shaped clearing mound constructed of angular and subangular *pāhoehoe* cobbles stacked against a bedrock outcrop to its south. It is located 2.50 meters southwest of Feature A, measures 2.60 meters long (76º/256º), 0.75 meters wide, is 0.30 to 0.40 meters in height, and is roughly faced on its north side. The feature appears unaltered and is in fair condition.

**Site 24238, Feature C**

Feature C is a triangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 7.00 meters southeast of Feature B. The feature measures 4.00 meters long (10º/190º), 3.45 meters wide, and is from 0.80 to 1.20 meters in height (Figure 31). The feature is well-faced on two sides, slightly collapsed along its east side, and is in good condition.

**Site 24238, Feature D**

Feature D is an octagonal clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 5.00 meters south of Feature C. It measures 4.00 meters long (150º/330º), 3.20 meters wide, and averages 0.74 meters in height (Figures 32 and 33). The feature is well-faced on all sides, is level on its top surface, appears unaltered, and is in good condition.

**Site 24238, Feature E**

Feature E is a triangular clearing mound constructed of angular and subangular *pāhoehoe* cobbles and boulders stacked against the west edge of a linear bedrock outcrop, located 10 .00meters east of Feature D. This feature measures 2.00 meters long (east/west), 2.50 meters wide, and is from 0.20 to 0.45 meters in height (Figure 34). The feature is faced on its north side, appears unaltered, and is in fair condition.

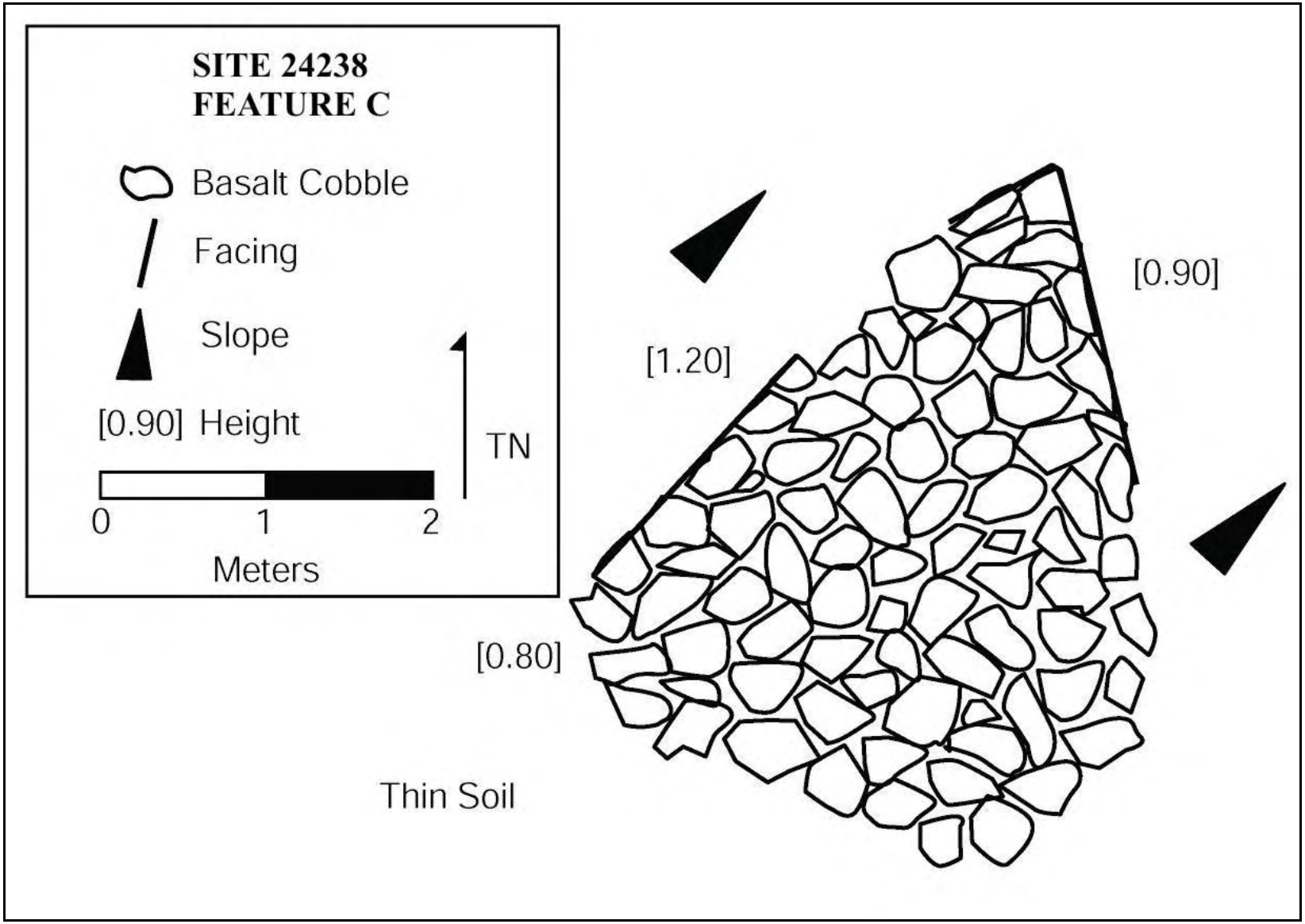


**Figure 31:** Planview of Site 24238, Feature C Clearing Mound.

**Figure 32:** Photograph of Site 24238, Feature D Clearing Mound Looking East.

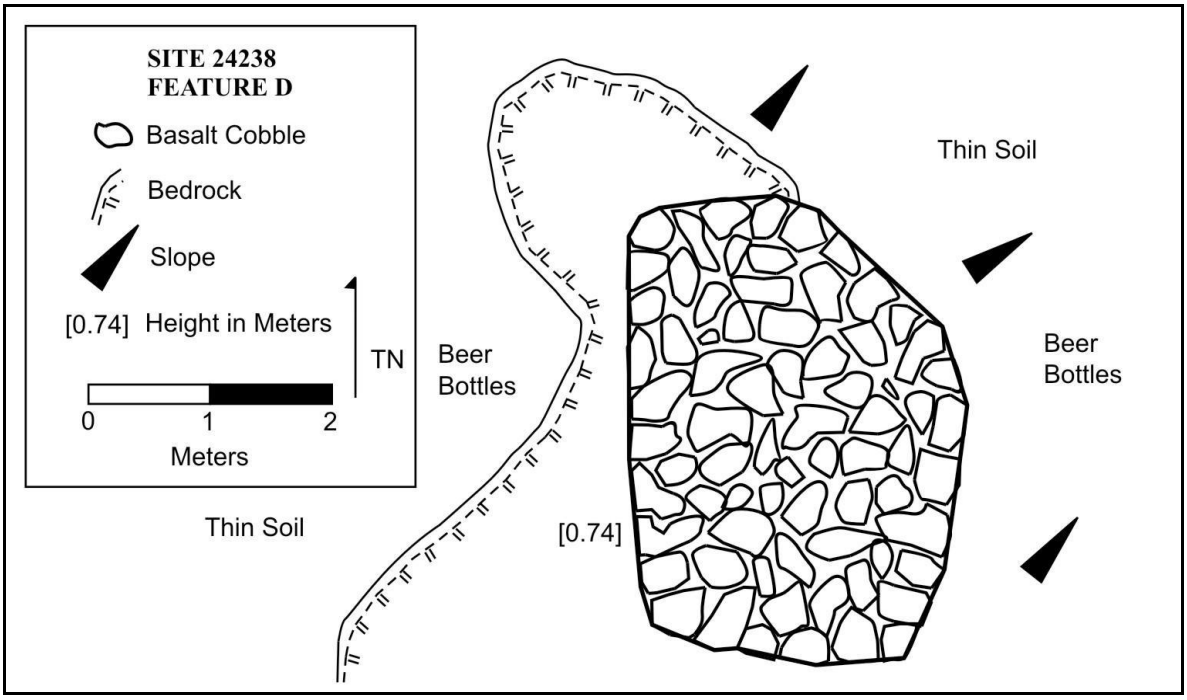


**Figure 33:** Planview of Site 24238, Feature D Clearing Mound.

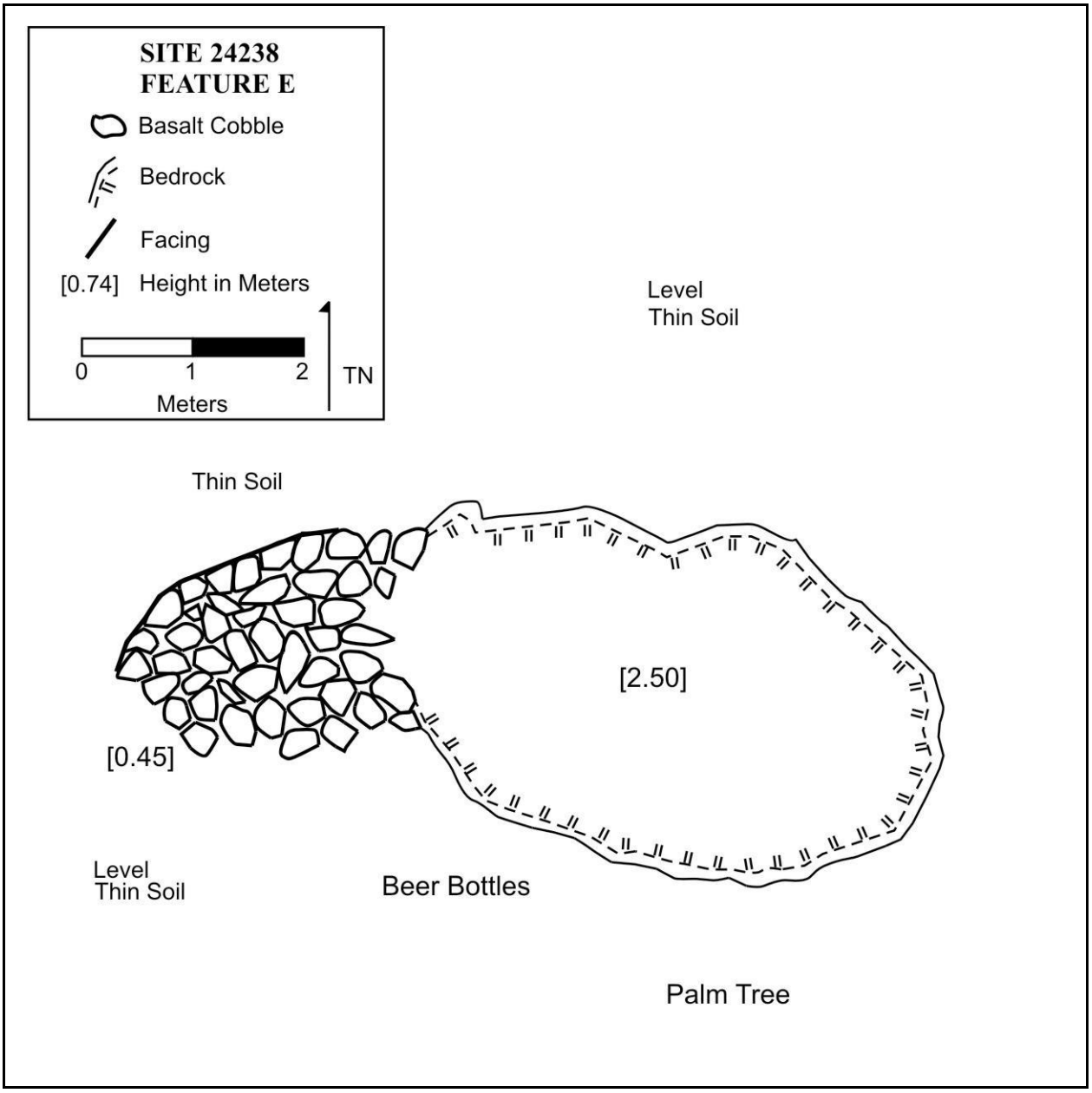


Figure 34: **Planview of Site 24238, Feature E Clearing Mound.**

**Site 24238, Feature F**

Feature F is a triangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 7.5 meters west of Feature D, measures 1.60 meters per side, and averages 0.55 meters in height (Figure 35). The feature is well-faced on all sides, appears unaltered, and is in good condition.

**Site 24238, Feature G**

Feature G is a trapezoidal clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 4.00 meters northwest of Feature F. It measures 2.50 meters along each side and averages 0.90 meters in height (Figure 36). The feature is faced on two sides, is collapsed along its southwest side, and is in good condition.

**Site 24238, Feature H**

Feature H is a diamond-shaped clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 4.00 meters north of Feature G, measures 4.00 meters along each side, and is from 0.55 to 1.25 meters in height (Figure 37). The feature is faced on all sides, is slightly collapsed along its south and southeast sides, and is in fair condition.

**Site 24238, Feature I**

Feature I is a dome-shaped clearing mound constructed of piled angular and subangular *pāhoehoe* cobbles and boulders located 3.50 meters west of Feature H. The feature measures 3.00 meters in diameter, and is 0.15 to 0.80 meters in height (Figure 38). The feature is not faced, is collapsed, and is in poor condition.

**Site 24238, Feature J**

Feature J is a rectangular clearing mound constructed of angular and subangular *pāhoehoe* cobbles and boulders stacked along the north face of a bedrock outcrop located 4 meters west of Feature I. This feature measures 8.5 meters long (102º/282º), is 1.0 to 2.0 meters wide and averages 0.80 meters in height (Figure 39). The feature is not faced, appears unaltered, and is in fair condition.

**Site 24238, Feature K**

Feature K is a square clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 8.5 meters northwest of Feature J. It measures 2.2 meters along each side and averages 0.9 meters in height (Figure 40). The feature is faced on its southeast side, appears unaltered, and is in good condition.

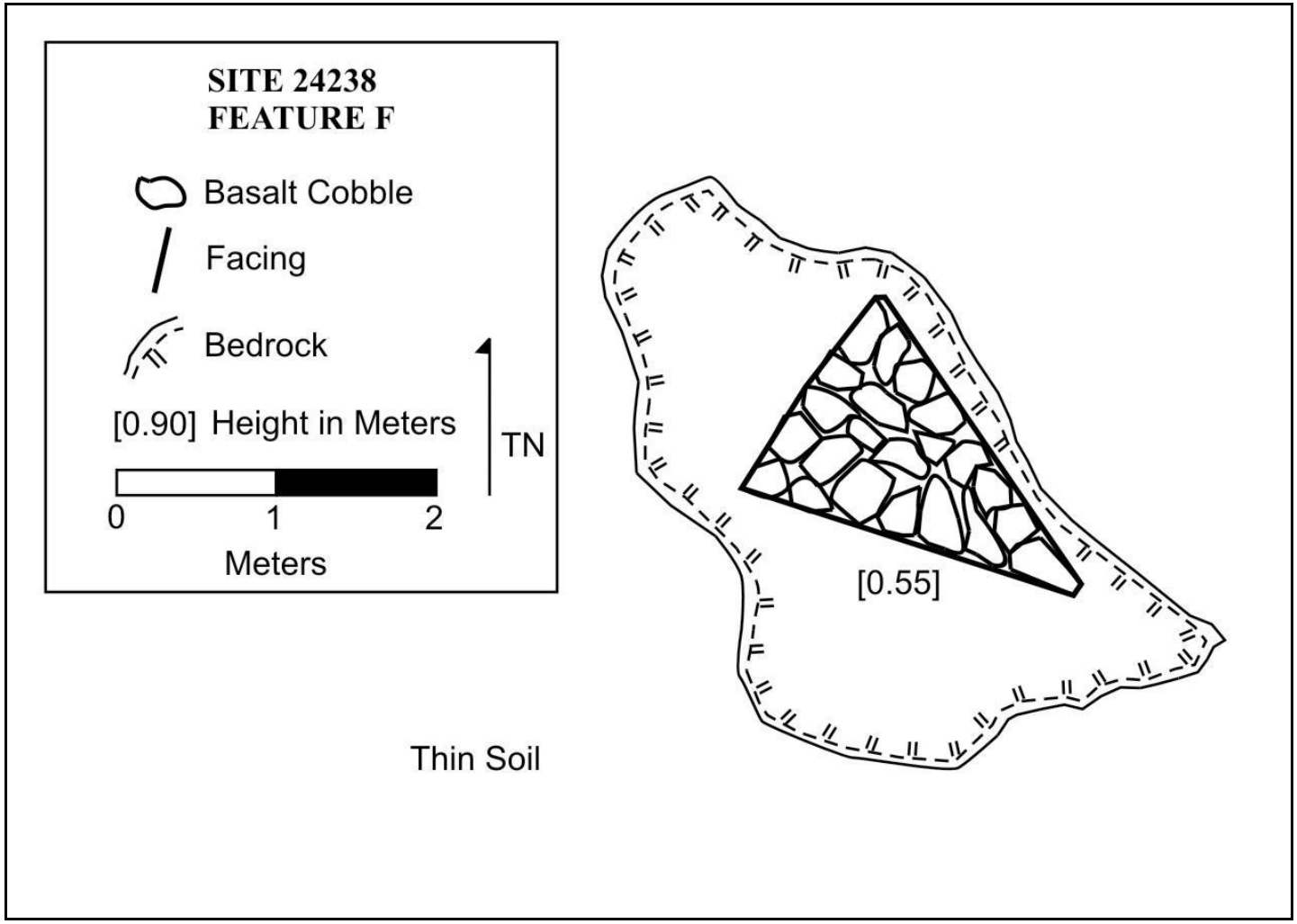


**Figure 35:** Planview of Site 24238, Feature F Clearing Mound.

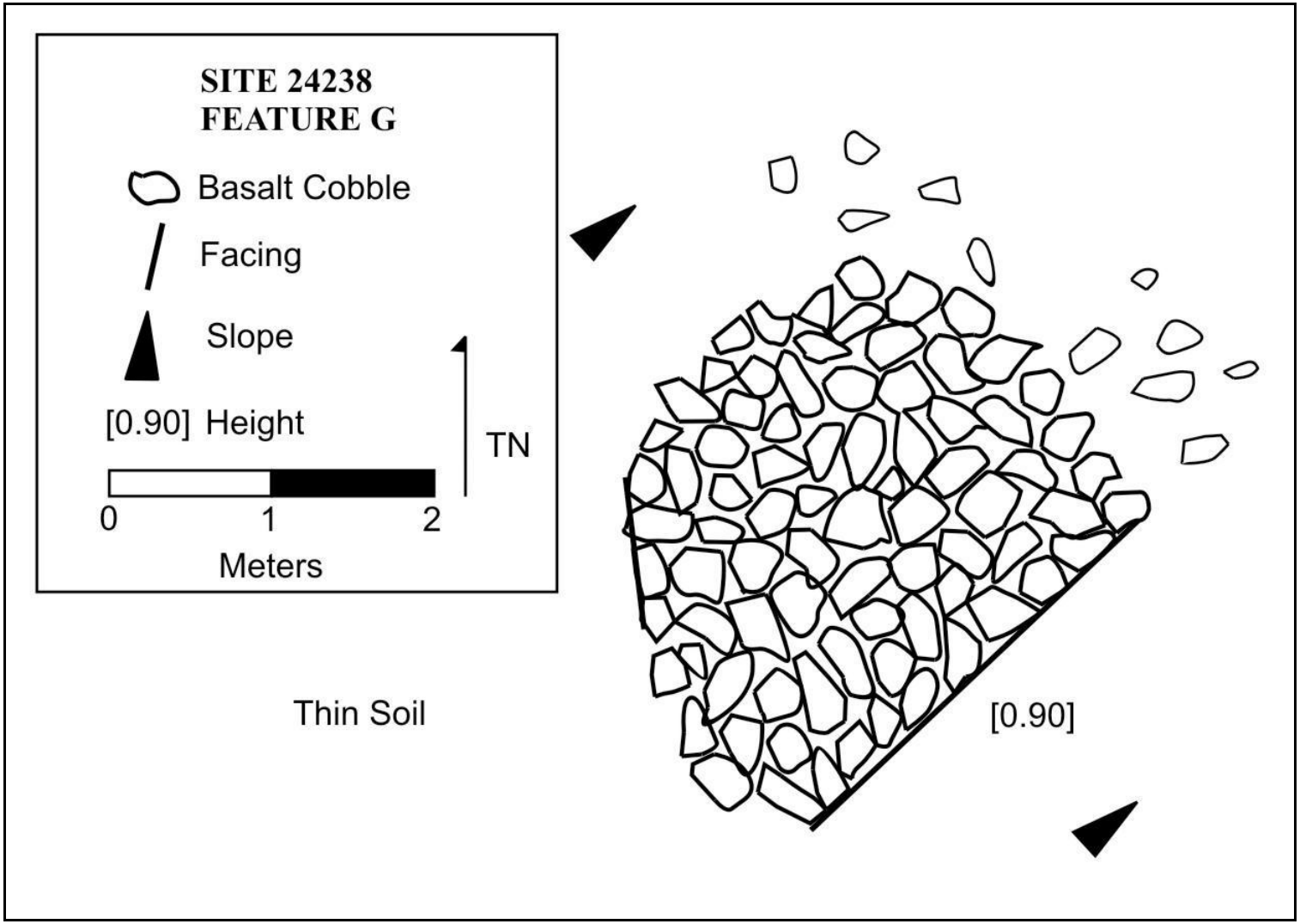


**Figure 36:** Planview of Site 24238, Feature G Clearing Mound.

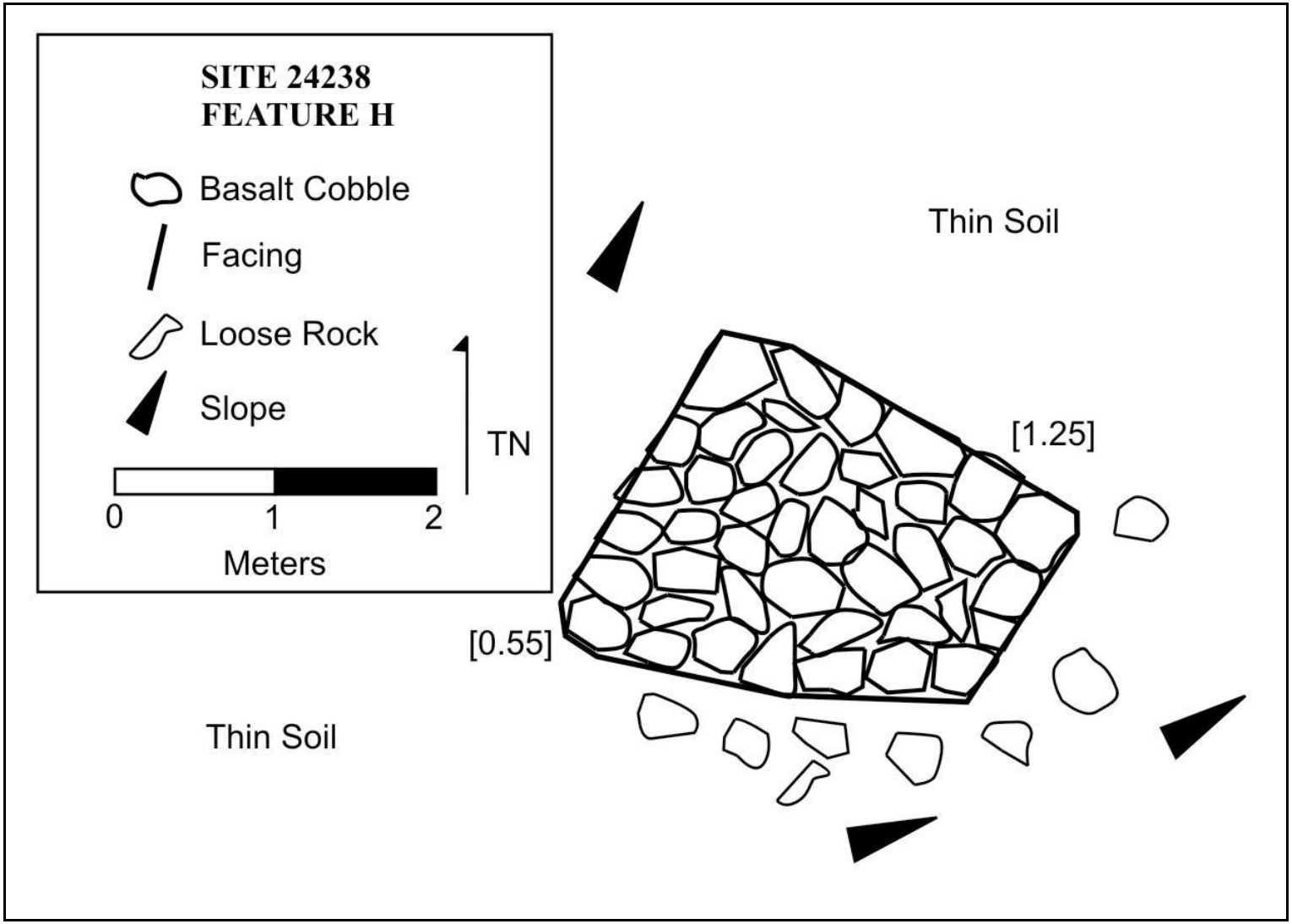


**Figure 37:** Planview of Site 24238, Feature H Clearing Mound.

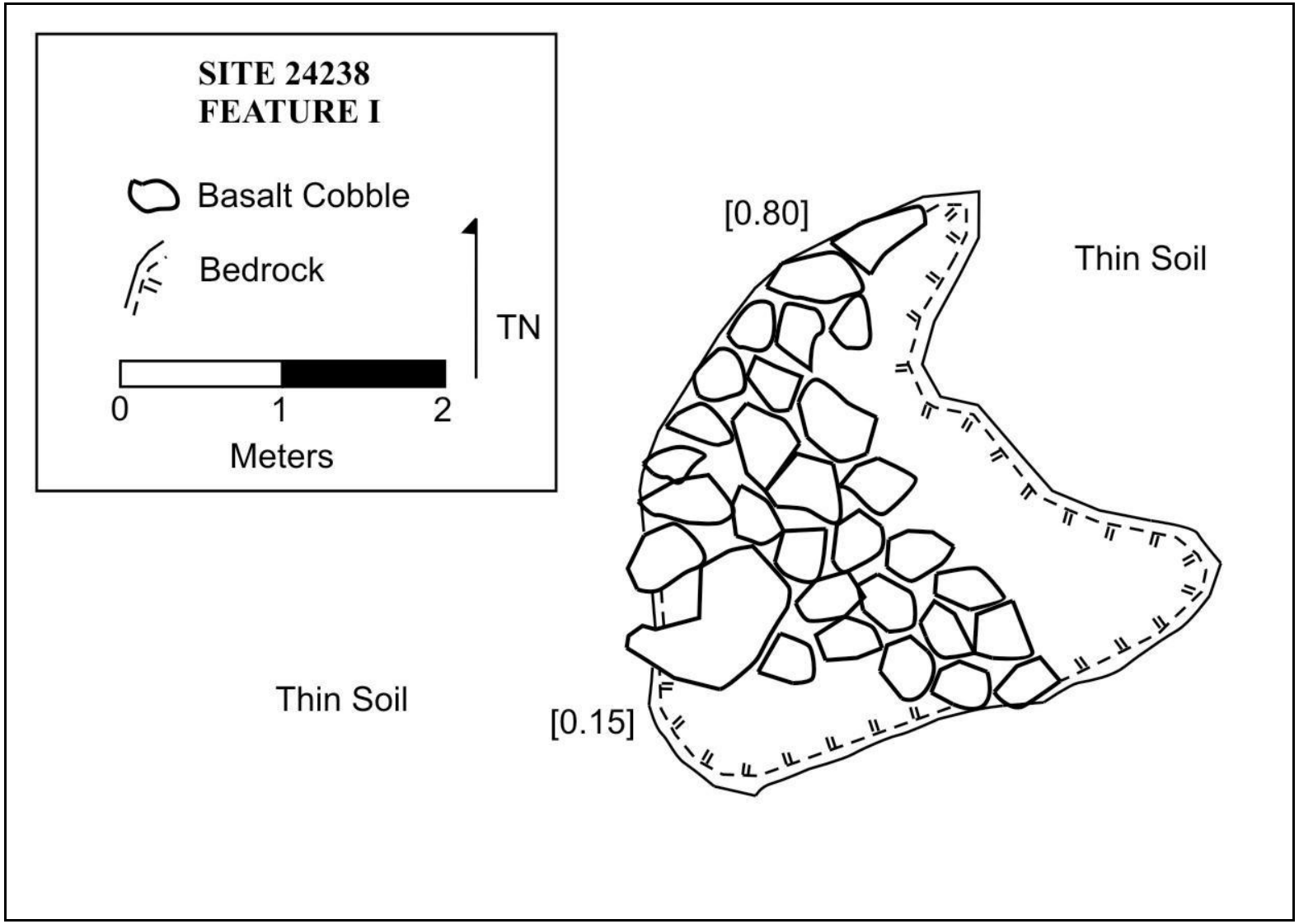


**Figure 38:** Planview of Site 24238, Feature I Clearing Mound.

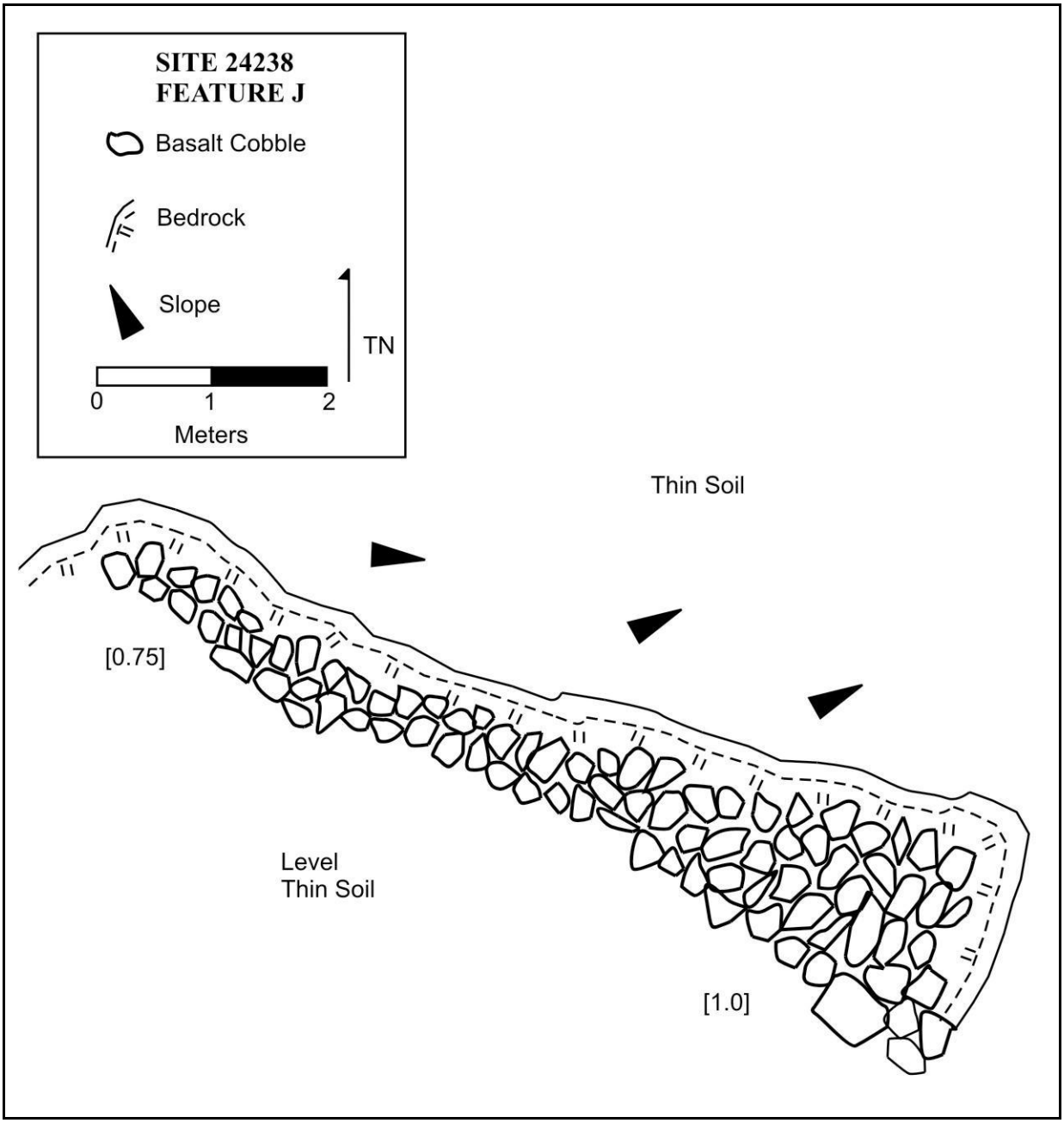


**Figure 39:** Planview of Site 24238, Feature J Clearing Mound.

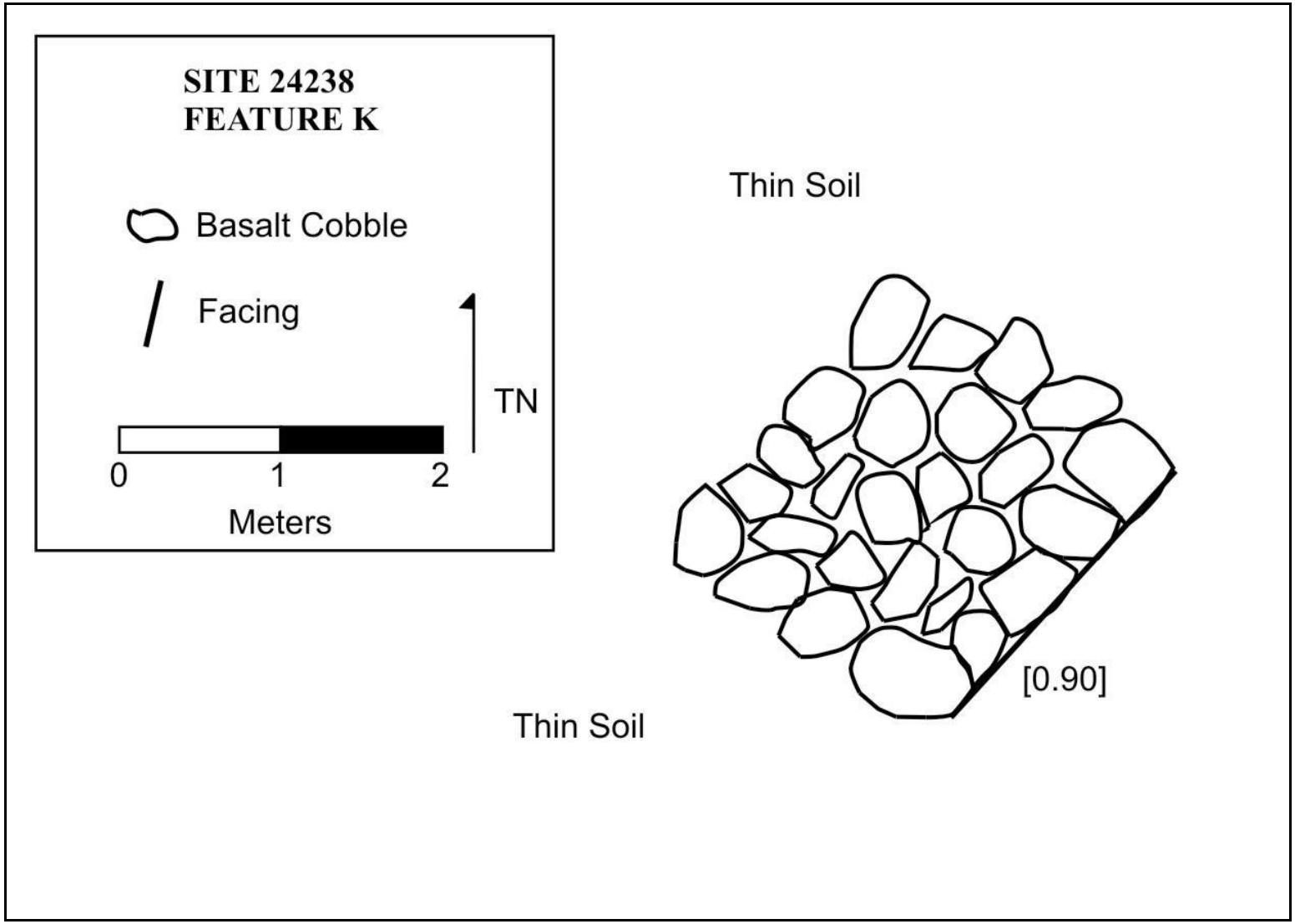


**Figure 40:** Planview of Site 24238, Feature K Clearing Mound.

**Site 24238, Feature L**

Feature L is a kidney-shaped clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 19.0meters northeast of Feature K. The feature measures 4.0 meters long (102º/221º), is 2.0 meters wide, and averages 0.8 meters in height (Figure 41). The feature is not faced, is unaltered, and is in good condition.

**Site 24238, Feature M**

Feature M is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 11.0 meters east of Feature L It measures 7.1 meters long (100º/280º) at base and averages 1.4 meters in height. The top surface is level and measures 5.2 meters by 3.0 meters. The feature is well-faced, appears unaltered, and is in excellent condition.

**Site 24238, Feature N**

Feature N is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 12.0 meters southeast of Feature D. The feature measures 5.2 meters long (160º/330º), 2.0 meters wide, and averages 0.6 meters in height in height (Figure 42). The feature is faced, appears unaltered, and is in good condition.

**Site 24238, Feature O**

Feature O is a rectangular trench located 6 meters west of Feature A. The feature measures 1.7 meters long (2º/182º), 1.0 meter wide, and averages 0.7 meters in depth. The trench appears to be mechanically excavated into the bedrock and likely functioned as a water catchment. The bottom of the feature contains a thin layer of sediment on bedrock. The feature appears unaltered and is in fair condition.

**Site 24238, Feature P**

Feature P is a rectangular trench located 7.50 meters west of Feature A. It measures 3.00 meters long (142º/322º), 0.65 meters wide, and averages 0.45 meters in depth. The trench appears to be mechanically excavated into the bedrock and likely functioned as a water catchment. The bottom of the feature contains a thin layer of sediment on bedrock. Rocks removed from the trench are located along the eastern edge of the trench. The feature appears unaltered and is in fair condition.

**Site 24238, Feature Q**

Feature Q is an L-shaped trench located 3 meters west of Feature A. It measures 2.0 meters in length (per segment), is 0.80 to 0.90 meters wide, and averages 0.55 meters deep. The trench appears to be mechanically excavated into the bedrock and is lined with *pāhoehoe* cobbles

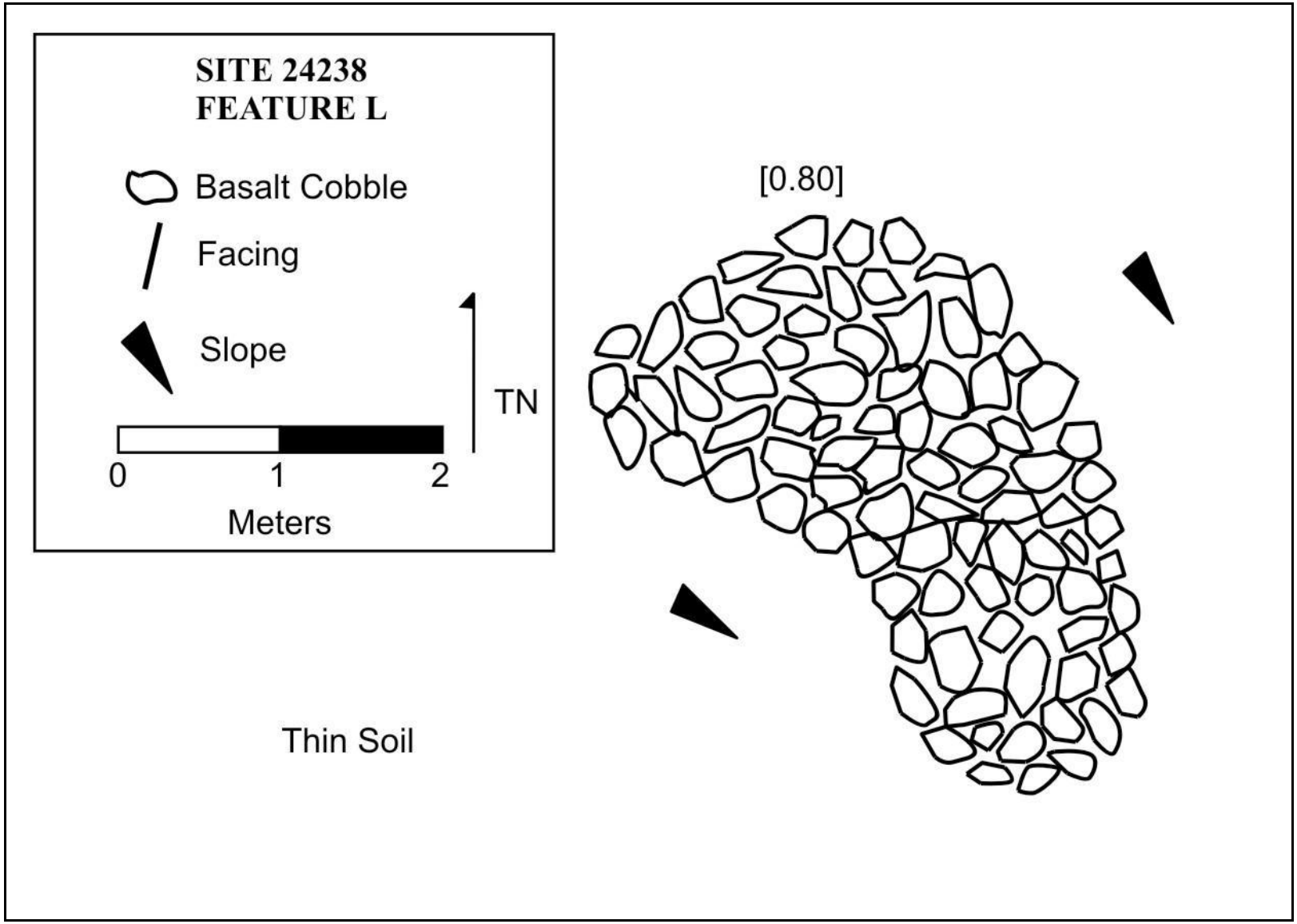


**Figure 41:** Planview of Site 24238, Feature L Clearing Mound.

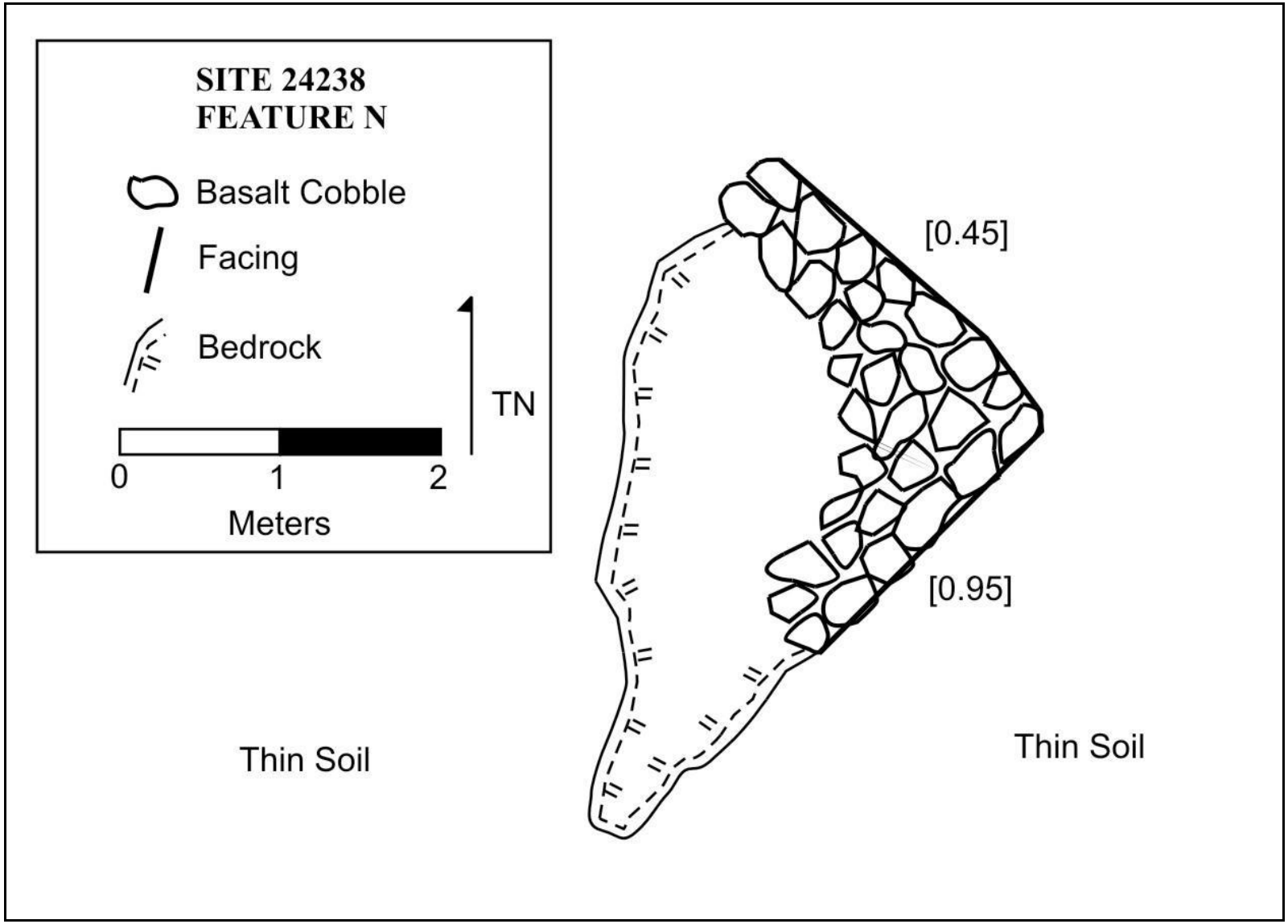


**Figure 42:** Planview of Site 24238, Feature N Clearing Mound.

around its top edge. The bottom of the feature contains a thin layer of sediment on bedrock. The feature likely functioned as a water catchment. The feature appears unaltered and is in fair condition.

**Site 24238, Feature R**

Feature R is a square clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 4.00 meters northeast of Feature A. It measures 1.80 meters along each side, and averages 0.45 meters in height. The feature is poorly faced, appears unaltered, and is in fair condition.

**Site 24238, Feature S**

Feature S is a semicircular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 3.50 meters north of Feature R. The feature measures 2.80 meters long (124º/304º), 2.00 meters wide, and averages 0.55 meters in height. The feature is built onto the northeast face of a bedrock outcrop, is faced, unaltered, and is in good condition.

**Site 24238, Feature T**

Feature T is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 10.00 meters northeast of Feature A, measures 4.20 meters long (29º/209º), is 1.75 meters wide, and averages 0.35 meters in height in height. The feature is built onto the side of a bedrock outcrop, is faced, appears unaltered, and is in fair condition.

**Site 24238, Feature U**

Feature U is a circular clearing mound constructed of piled angular and subangular *pāhoehoe* cobbles and boulders located 1.00 meter northwest of Feature S. It measures 1.30 meters in diameter, and averages 0.45 meters in height. The feature is not faced, is slightly collapsed, and is in fair condition.

**Site 24238, Feature V**

Feature V is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 7.50 meters northeast of Feature U. The feature measures 2.70 meters long (60º/240º), averages 0.95 meters wide, and averages 0.55 meters in height. The feature is faced, appears unaltered, and is in good condition.

**Site 24238, Feature W**

Feature W is a pentagonal clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 10.00 meters east of Feature A, measures 5.30 meters

long (8º/188º), 3.45 meters wide, and ranges from 0.40 to 1.84 meters in height. The feature is faced on all sides, is collapsed along its southern corner, and is in good condition. Several large chunks of flat cement are located in this low spot in the vicinity of Feature W.

**Site 24238, Feature X**

Feature X is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 2.50 meters northwest of Feature W. It measures 1.85 meters long (122º/302º), 1.00 meter wide, and averages 1.00 meter in height. The feature is built onto the northwest face of a bedrock ledge, is well-faced, appears unaltered, and is in good condition. A tin can was observed within the interstices of the feature.

**Site 24238, Feature Y**

Feature Y is a V-shaped rectangular trench located 8.75 meters west of Feature A. It measures 2.00 to 2.75 meters in length (per segment), is 0.80 to 0.90 meters wide, and ranges from 0.55 to 0.80 meters in depth. The trench appears to be mechanically excavated into the bedrock and is lined with *pāhoehoe* cobbles around its top edge. The bottom of the feature contains a thin layer of sediment on bedrock. The feature likely functioned as a water catchment. The feature appears unaltered and is in fair condition.

**Site 24238, Feature Z**

Feature Z is a 7.0-meter long segment of bulldozed road located 7.5 meters northeast of Feature X. The road surface is 2.5 to 3.0 meters wide and consists of bare *pāhoehoe*. The road segment appears to be a portion of Site 24241 Feature A. There are numerous modern beer bottles in the area around the feature. The road surface is overgrown, is not evident beyond the short segment documented, and is in poor condition.

**Site 24238, Feature AA**

Feature AA is a triangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 5.80 meters southeast of Feature D. The feature measures 5.10 meters long (160º/340º), 2.00 meters wide, and is from 0.66 to 0.90 meters in height (Figure 43). The feature is faced, appears unaltered, and is in good condition.

**Site 24238, Feature BB**

Feature BB is a kidney-shaped clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 13.00 meters south of Feature D. It measures 3.20 meters long (96º/266º), 1.15 meters wide, and averages 0.90 meters in height (see Figure 43). The feature is well-faced on all sides, appears unaltered, and is in good condition.

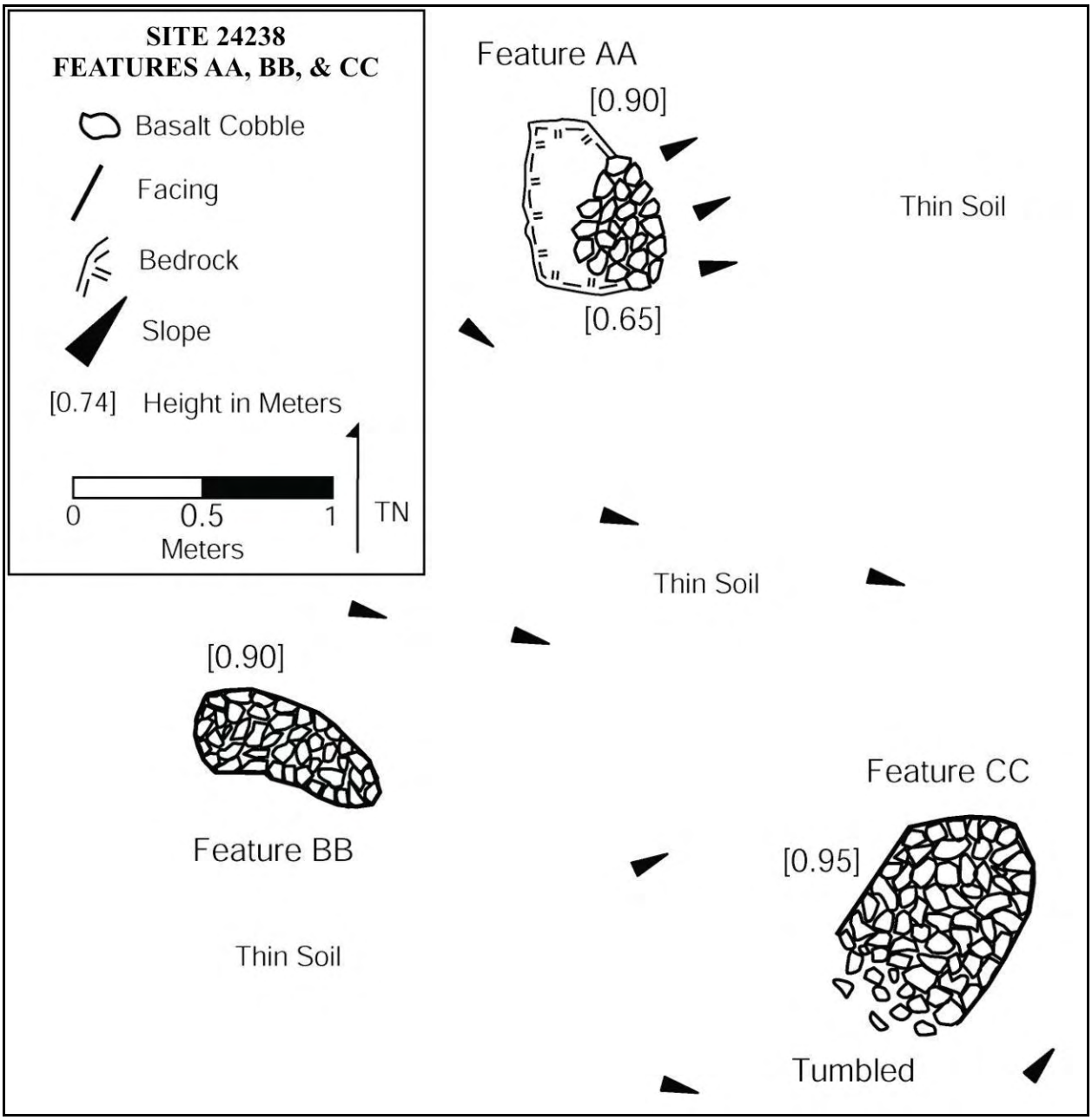


**Figure 43:** Planview of Clearing Mound Features AA, BB, and CC (Site 24238).

**Site 24238, Feature CC**

Feature CC is a bullet-shaped clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 3.00 meters east of Feature BB. It measures 3.30 meters long (north/south), 2.40 meters wide, and averages 0.65 meters in height (see Figure 43). The feature is faced on its east, north, and west sides, is collapsed along its south side, and is in fair condition.

**Site 24238, Feature DD**

Feature DD is a square clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 5.0 meters northwest of Feature Z. The feature measures 2.0 meters along each side and averages 0.70 meters in height. The feature is faced, appears unaltered, and is in good condition.

**Site 24238, Feature EE**

Feature EE is a rectangular clearing mound constructed of piled angular and subangular *pāhoehoe* cobbles and boulders located 17.0 meters southeast of Feature A. It measures 6.2 meters long (160º/340º), averages 1.4 meters wide, and is from 0.1 to 0.4 meters in height. The feature built onto the west side of a low bedrock outcrop, is not faced, appears unaltered, and is in fair condition.

**Site 24238, Feature FF**

Feature FF is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 7.00 meters southwest of Feature EE, measures 2.90 meters long (75º/255º), 1.84 meters wide, and ranges from 0.40 to 1.10 meters in height. The feature is well-faced, slightly collapsed along its southwest corner, appears unaltered, and is in good condition.

**Site 24238, Feature GG**

Feature GG is a pentagonal clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 1.20 meters southeast of Feature FF. The feature measures 1.34 meters long (160º/330º), 1.20 meters wide, and ranges from 0.70 to 1.10 meters in height. The feature is well-faced, appears unaltered, and is in good condition.

**Site 24238, Feature HH**

Feature HH is a kidney-shaped clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 3.8 meters south of Feature GG. It measures 1.2 meters long (east/west), 0.8 meters wide, and averages 0.6 meters in height. The feature is

built onto the north face of a low bedrock outcrop, is faced, appears unaltered, and is in good condition.

**SITE 50-10-35-24239**

Site 24239 is a dirt road situated from the southeastern corner of the project area to a modern water tank located approximately 500 meters to the northwest (see Figure 17). The winding road is visible on a 1964 aerial photomap and connects Puainako Street with the water tank. The road appears on an aerial photograph taken in 1950. The road surface is roughly 2.5 to 3.0 meters wide and consists of bulldozed *pāhoehoe* covered with sand and mechanically crushed *pāhoehoe* pebbles used as fill to bridge depressions in the bedrock surface. The road was constructed by the Water Department and was used to lay two 10.0-inch pipes bringing water from the tank into Hilo. The road is partially overgrown and there are numerous trash piles located along the side of the road consisting of various modern bottles, cans, a toilet, and swim fins.

**SITE 50-10-35-24240**

Site 24240 is located approximately 185 meters northwest of the southeast corner of the project area, 11 meters west of a dirt road (Site 24239) at an elevation of 105 meters (340 feet) amsl, and occupies an area of uneven and gently sloping *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare *pāhoehoe* and bedrock outcrops (Figure 44; see also Figure 17). The site consists of two features (Feature A and B). The features are located on a 2.0-meter high bedrock ridge overlooking the dirt road, and appear to be defensive positions constructed by the U.S. Army while training in the area during World War II (Maly 1996:32). An old water channel is located 4 meters to the northwest of the site; it is the same channel that bisects Sites 4 and 6, and has been blocked by the dirt road between Site 24240 and Site 24235. Water no longer flows through this channel as a result of the construction of the Waiākea Stream cement spillway to the south of the study area.

**Site 24240, Feature A**

Feature A is an oval enclosure encircling a crack in a bedrock outcrop and measures 2.40 meters long (75º/255º), 1.50 meters wide across center, ranges from 0.65 to 0.85 meters in depth below ground surface, and is located 32.00 meters west of Site 24235 Feature B. The interior of the enclosure measures 2.40 meters by 0.50 meters. The enclosure walls consist of a single course of *pāhoehoe* cobbles and boulders (0.30 meters wide) stacked two courses high (0.30 to 0.60 meters above ground surface). No cultural material was located in or around the feature.

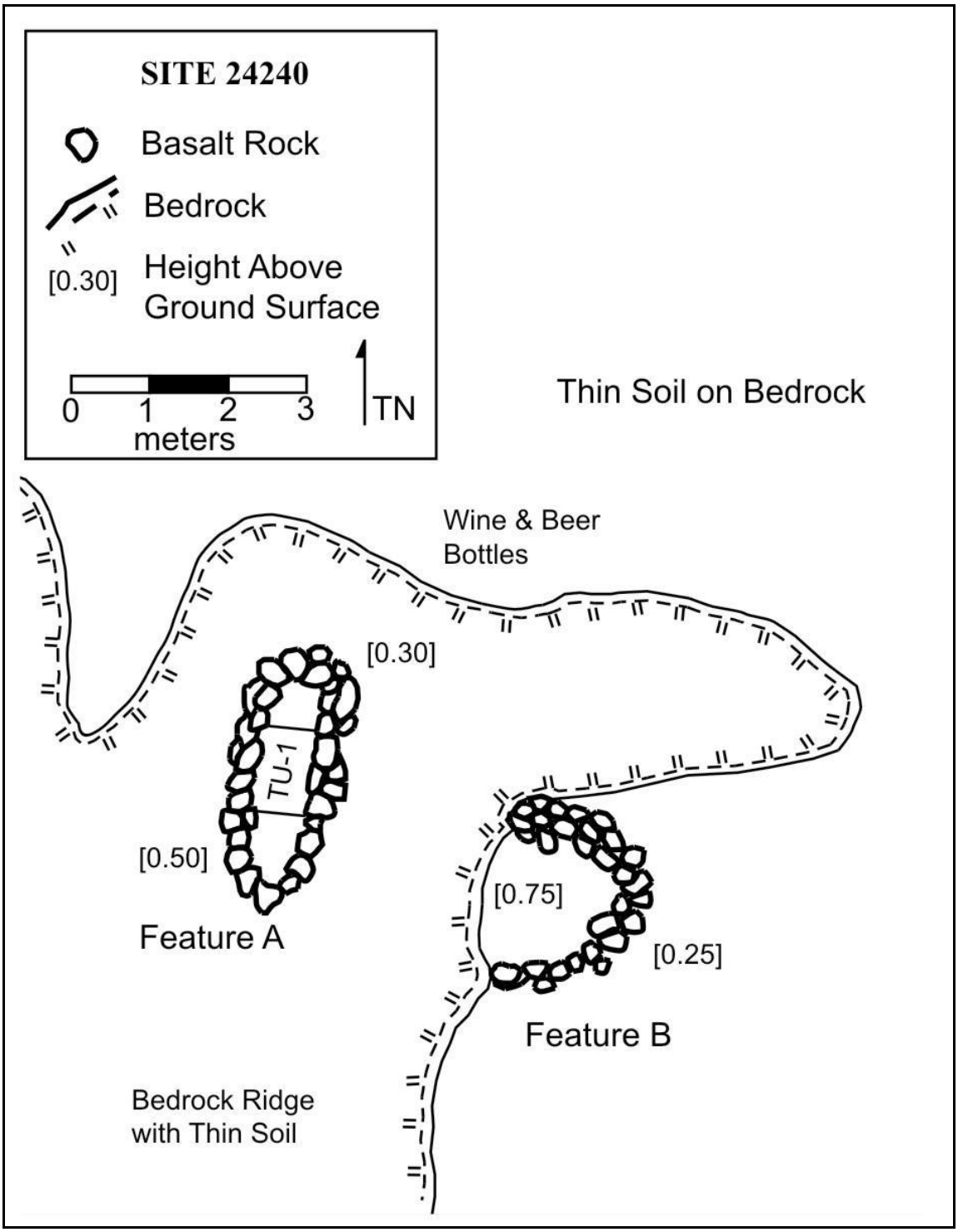


**Figure 44:** Planview of Site 24240.

**Site 24240, Feature A, Test-Unit 1**

A 0.50 by 1.0 meter test-unit was excavated in the center of the enclosure. All matrix was screened through 1/8-inch wire mesh. Layer I consisted of a variable 0.07 to 0.18 meters of a reddish brown (5YR 5/4) soft mulch with 80 percent root inclusions. Layer II consisted of a variable 0.17 to 0.37 meters of dark grayish red (5YR 4/2) sandy silt with strong peds and 10 percent exfoliated cobbles. TU-1 was excavated to bedrock and contained no cultural material.

**Site 24240, Feature B**

Feature B is a semicircular enclosure located 2.65 meters east of Feature A. It is constructed of piled angular and subangular *pāhoehoe* cobbles and boulders, measures 2.10 meters in diameter, and ranges from 0.25 to 0.34 meters in height. The enclosure walls are piled one to three courses wide and one to two courses high. The west side of the enclosure is a 0.75 meter high bedrock outcrop ledge. The interior of the enclosure is bedrock with a very thin layer of scattered sediment. No cultural material was located in or around the feature.

**SITE 50-10-35-24241**

Site 24241 is a square enclosure located approximately 128 meters northwest of the southeast corner of the project area, 10 meters west of a dirt road (Site 24239) at an elevation of 105 meters (340 feet) amsl, and occupies an area of level *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare *pāhoehoe* and bedrock outcrops (Figure 45; see also Figure 17). The site consists of a single square enclosure constructed of subangular *pāhoehoe* cobbles and boulders stacked along the perimeter of a wide crack in a bedrock outcrop (Figures 46 and 47). The enclosure measures 4.75 meters along each side and ranges from 0.30 to 0.40 meters above the outside ground surface. The interior measures 3.00 to 3.25 meters across and is from 0.60 to 1.60 meters deep. There are two level depressions in the northeast (0.40 meters wide) and southeast (1.00 meter wide) sides of the enclosure that appear to be access points into the enclosure. The northwest side of the enclosure slopes to ground surface and does not appear to be collapsed. The overall elevation of the top of the enclosure is level and may have supported a cover; however, no post-holes are evident in the enclosures surface. The feature is partially collapsed along the south corner and is in good condition.

The ground surface surrounding the enclosure is level *pāhoehoe*. Two large water-filled shallow skylights are located roughly 2 and 10 meters east and northwest of the enclosure. The lava tube skylight to the northeast is filled with modern trash consisting of liquor, beer, Clorox, medicine, and food bottles; several 12 volt and D cell batteries; and an oil filter.

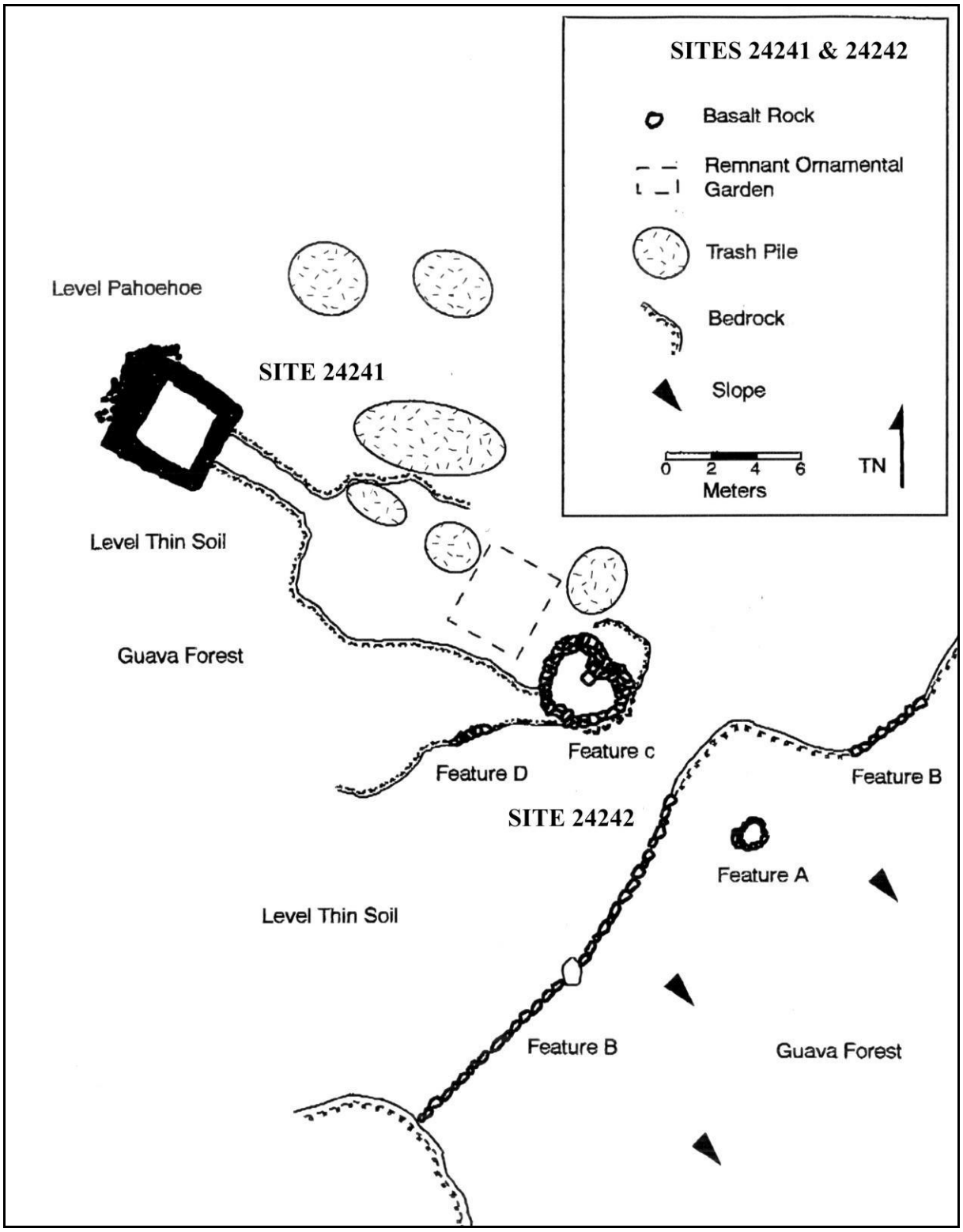


**Figure 45:** Planview of Sites 24241 and 24242.

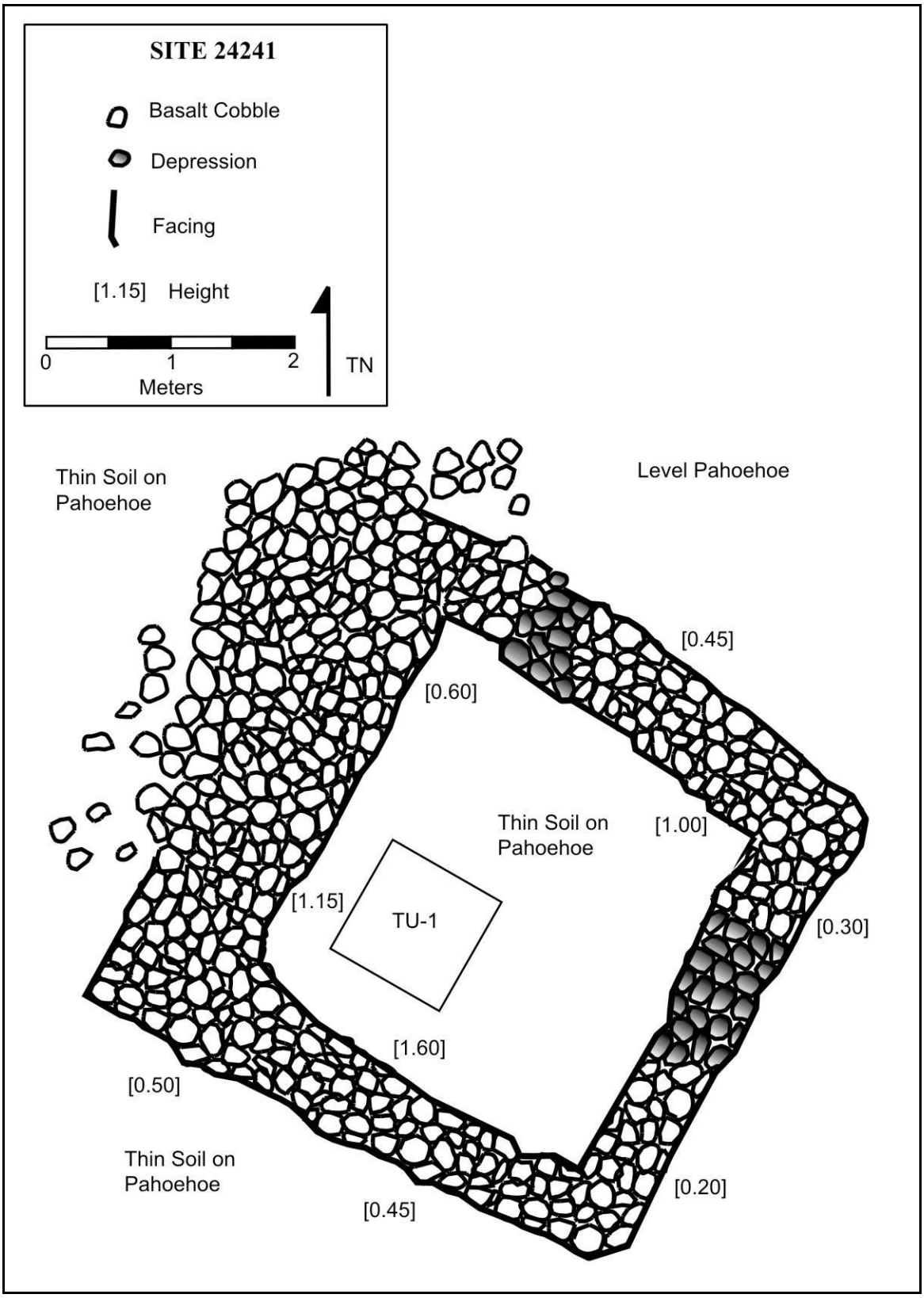


**Figure 46:** Planview of Site 24241 Enclosure Looking South.

**Figure 47:** Photograph of Enclosure (Site 24241) Looking South.

There is a second large modern trash pile located from 6.0 to 12.0 meters southeast of the enclosure. The refuse consists of bits of sheet plastic; mason jars; Noxema cold cream jars; dry cell batteries; scraps of sheet metal; light bulbs; a lamp; a drinking glass; boot soles; a tire; a galvanized bucket; a washing machine; a vacuum tube; an ash tray; a vase; Olympia beer cans; and whiskey, sake, beer, medicine, soda, Clorox, Purex, and food bottles. Just southeast of the trash pile is an overgrown remnant garden with a small avocado tree, ginger, and ornamental plants.

**Site 24241, Test-Unit 1**

A one by one meter test unit was excavated in the northwest corner of the enclosure. All matrix was screened through 1/8-inch wire mesh. A single layer consisting of a variable 0.10 to 0.20 meters of dark brown (7.5YR3/2) sandy loam with 80 percent root mat was excavated from the unit. TU-1 was excavated to bedrock and contained several pieces of insulted electrical wire and sherds of glass on the surface of Layer I. No other cultural remains were present in the test unit. Site 24241 is likely a rest and workstation associated with sugar cane agriculture in the immediate vicinity.

**SITE 50-10-35-24242**

Site 24242 is located approximately 100 meters northwest of the southeast corner of the project area between SIHP Site 50-10-35-18918 and Site 24241, and west of dirt road Site 24239, at an elevation of 340 feet (105 m) amsl, and occupies an area of level *waiwi* forest growing in pockets of Keaukaha extremely rocky muck series soil dispersed between bare

*pāhoehoe* and bedrock outcrops (Figures 17 and 46). The site measures 35 meters long (60º/240º), 15 meters wide, and consists of 5 features (Features A through D). Site 26 is associated with SIHP Site 50-10-35-18918, Sites 4, 7, and 10 and is part of the northwestern corner of historic sugar cane fields, likely Waiākea Mill Company plantation Lot 20-A.

**Site 24242, Feature A**

Feature A is an oval enclosure constructed of angular and subangular *pāhoehoe* cobbles and boulders piled on a bedrock outcrop located 1.80 meters north of SIHP Site 50-10-35-18918 Feature D, measures 3.00 meters long (east/west), 2.00 meters wide across center, and ranges from 0.20 to 0.80 meters in height. The *pāhoehoe* cobbles and boulders are piled one course wide and one to two courses high. The interior of the feature contains a thin deposit of soil. The feature appears to be the start of a clearing mound; it is not faced, it has been altered but is in fair condition.

**Site 24242, Feature B**

Feature B is a one-course wide rock alignment along a low bedrock ridge located 2.90 meters north of Feature A. The alignment consists of three segments totaling 35.00 meters long (60º/240º), is from 0.20 to 0.75 meters wide, and is from 0.15 to 0.45 meters high. The feature appears to mark an overgrown trail segment and may have served as a boundary marker. Several modern beer bottles are located across the site.

**Site 24242, Feature C**

Feature C is a heart-shaped enclosure (Figure 48) constructed of angular and subangular *pāhoehoe* cobbles and boulders piled on a bedrock outcrop located 8.00 meters north of Feature A. It measures 3.75 to 4.10 meters in diameter and ranges from 0.45 to 0.95 meters above the exterior ground surface. The *pāhoehoe* cobbles and boulders are piled two to three courses wide (from 0.50 to 090 meters wide) and three to four courses high. The interior is 3.00 meters in diameter, from 0.85 to 1.10 meters deep, and contains a thin layer of sediment scattered on exposed bedrock. The feature appears to be the start of a clearing mound, is faced, is unaltered, and is in good condition.

**Site 24242, Feature D**

Feature D is a rectangular clearing mound constructed of stacked angular and subangular *pāhoehoe* cobbles and boulders located 2.70 meters southwest of Feature C, measures 2.00 meters long (60º/240º), 0.50 meters wide, and averages 0.96 meters in height. The feature is built onto the southeast face of a bedrock ledge, is faced, appears unaltered, and is in good condition.

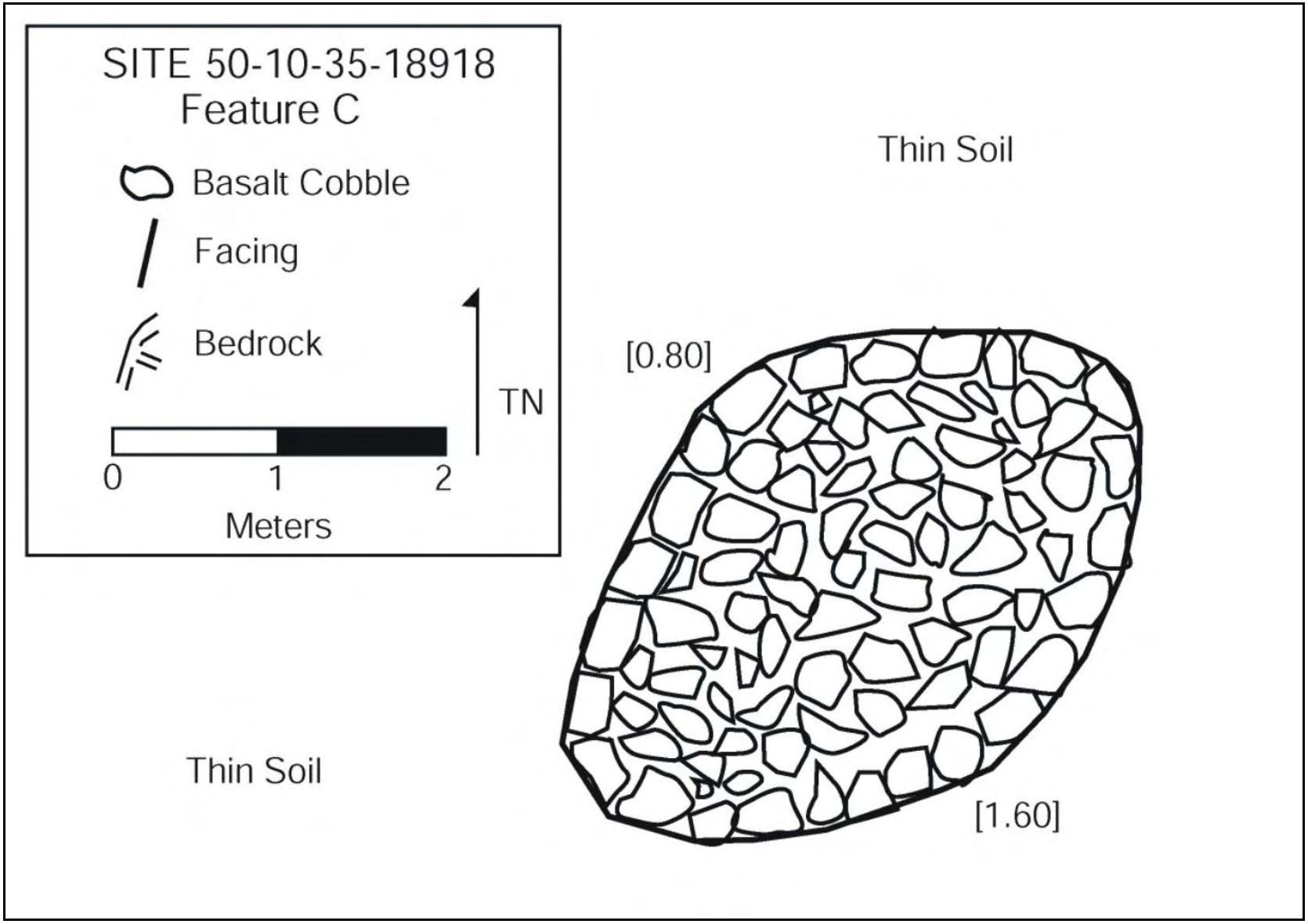


**Figure 48:** Planview of Site 50-10-30-18918 Feature C Clearing Mound.

## SITES LOCATED ON THE NORTHWEST EDGE OF THE PROJECT AREA

Sites located on the northwest edge of the project area (see Figure 15) are on property covered under General Lease 2751 and known as Waiākea Pasture Land. The 500-acre parcel was used as a dairy pasture and, during World War II, as a military training area by the U.S. Army (Maly 1996:36). A dirt road leading to a water tank in the center of the study area and connecting to both Puainako and Mohouli Streets is visible in an aerial photo taken in 1964. All sites documented in this portion of the project are located along the dirt road.

### SITE 50-10-35-24243

Site 24243 is located immediately *mauka* of Komohana Street at a distance of roughly 25 meters north of Nowelo Street, at an elevation of 100 meters (330 feet) amsl, and occupies an area of level *waiwi* forest (see Figure 15). The site is situated on an uneven and hummocky Mauna Loa *pāhoehoe* lava flow dated to between 750 and 1,500 B.P. A shallow layer of dark brown (7.5 YR 3/2) Pana`ewa very rocky, silty clay loam (Sato *et al*. 1973) covers roughly 60 percent of the *pāhoehoe* at the site. Site 24243 consists of eleven features (Features A through L) connected by a system of kerbstone-lined trails (Figure 49).

The site is most likely associated with military activities and may have been used earlier by Fair View Dairy. The parcel on which Site 24243 is located is designated on historic maps as Government Pastureland and Waikea Pastureland. Insignia have been branded, or carved onto several large *hala* trees located on the site (Figure 50). The insignia consists of the capital letter *A*, above the capitol letter *B*, above the letters *USA*, above a symbol that resembles the outline of a snow angel. Artifacts scattered across the ground surface at the site include beer bottles, liquor bottles, medicine bottles, metal brackets and bolts, and pieces of broken concrete.

### Site 24243, Feature A

Feature A is located 15 meters west of Komohana Street at a distance of roughly 25 meters north of Nowelo Street. The feature is an oval trough (Figure 51) measuring 3.4 meters long (45º/225º), 1.60 meters wide, and 0.77 to 1.00 meter in depth (Figures 52 and 53). The trough is from 0.36 meters above to level with the surrounding ground surface. It is constructed of crudely mortared sub-angular *pāhoehoe* cobbles lining a pit excavated into a bedrock outcrop. The feature has an organic shape that follows the bedrock pit into which it was built. The feature is likely a military foxhole, appears unaltered, and is in good condition.

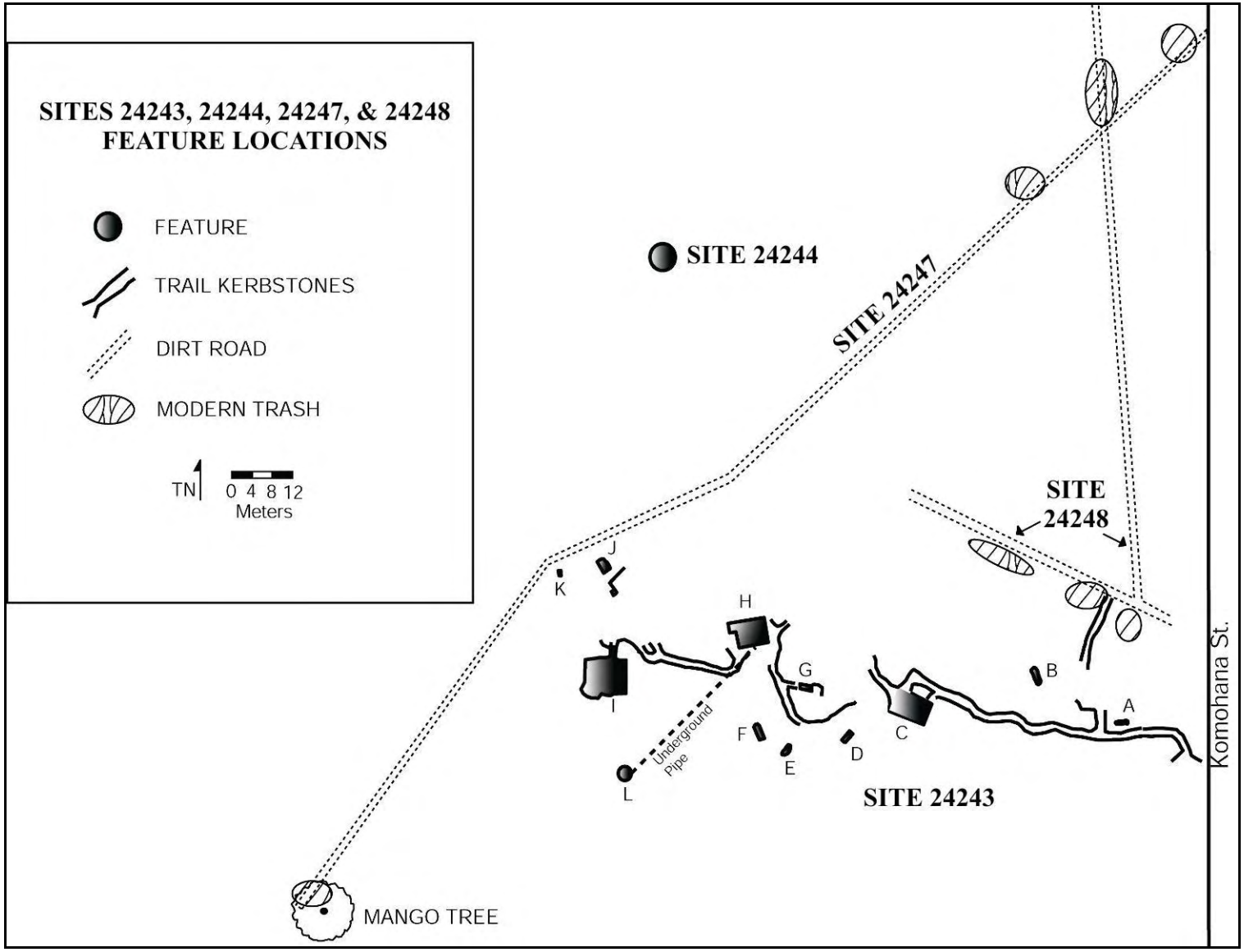


**Figure 49:** Planview Map of Sites 24243, 24244, 24247, and 24248 Showing Feature Locations.

**Figure 50:** Photograph of Insignia Carved into *Hala* Tree North of Site 24243, Feature I.

**Figure 51:** Photographs of Site 24243, Feature A Looking West (Planview) and Northwest (Profile).

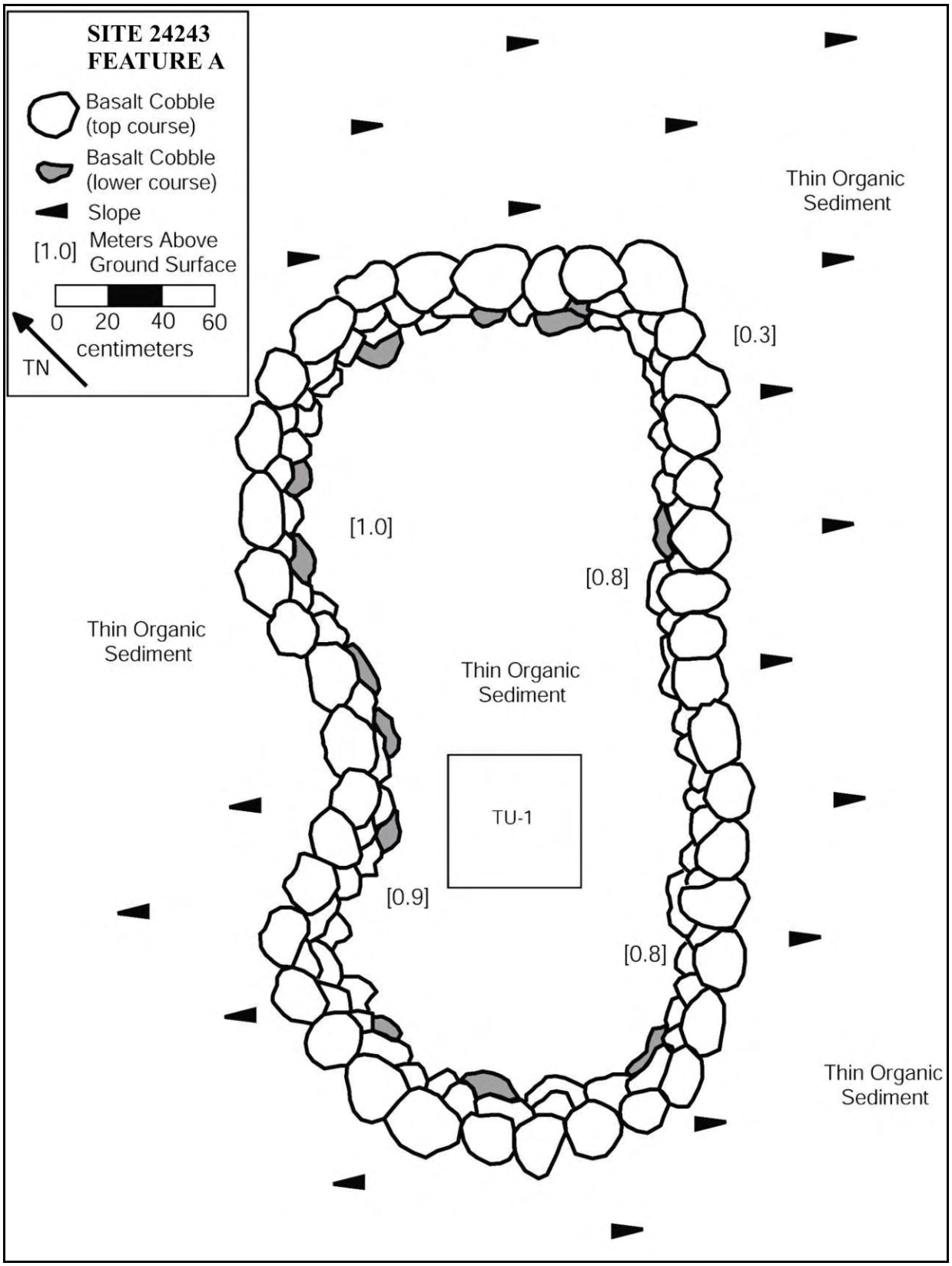


**Figure 52:** Planview of Site 24243, Feature A.

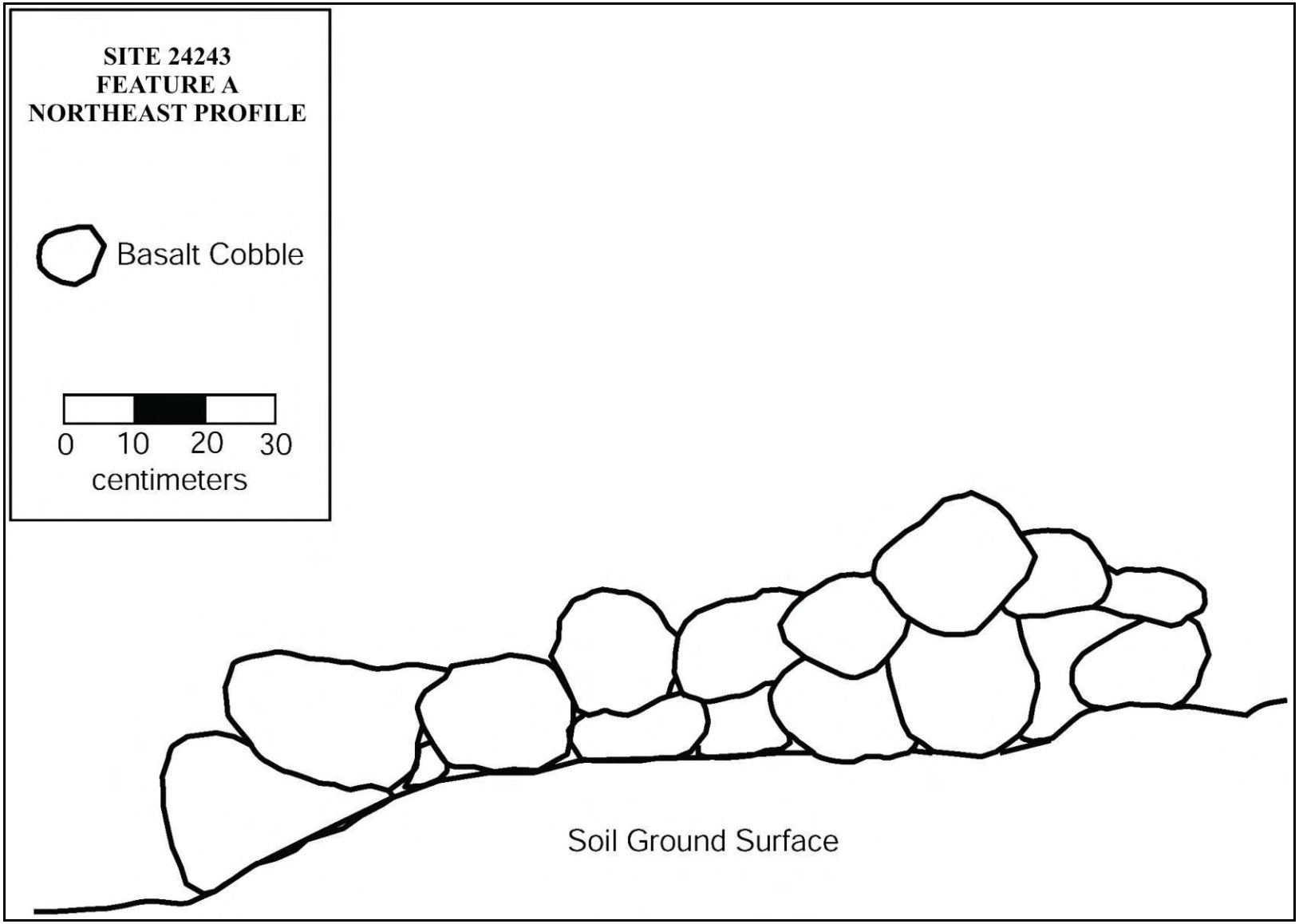


**Figure 53:** Profile of Site 24243, Feature A.

**Site 24243, Feature A, Test-Unit 1**

A 0.5 by 0.5 meter test unit was excavated to bedrock in the center of Feature A. A variable 0.8 to 0.1 meters of dark brown (7.5YR 3/2) sandy loam was removed as a single layer from TU-1. All sediment was screened through 1/8-inch mesh. The unit was excavated to bedrock and contained no cultural remains.

**Site 24243, Feature B**

Feature B is a roughly oval trough located 15.00 meters northwest of Feature A. It measures 3.60 meters long (160º/340º), 1.90 meters wide, and 0.94 to 1.00 meter in depth. The trough is level with the surrounding ground surface (Figure 54). It is constructed of crudely mortared sub-angular *pāhoehoe* cobbles lining a pit excavated into a bedrock outcrop. The feature has an organic shape that follows the bedrock pit into which it was built. The feature is likely a military foxhole, appears unaltered, and is in good condition. meters above the surrounding ground surface on its southeast edge (two to three basalt cobble courses high), and is level with the surrounding ground surface on the remaining three Feature C

Feature C is a rectangular platform located 18.00 meters west of Feature B. The feature measures 7.00 meters long (115º/295º) by 5.00 meters wide (Figure 55). The platform is 0.30 sides. A single course of basalt cobbles marks the outer boundaries of the platform. Two kerbstone-lined trails access Feature C on its north and northwest sides. A single cobble-lined depression is located on the eastern corner of Feature C. The feature is associated with U.S. Army training in the area. The feature appears unaltered, and is in good condition.

**Site 24243, Feature C, Test-Unit 2**

A one by one meter test-unit was excavated along the platform retaining wall in the south corner of Feature C. A variable 0.70 to 0.11 meters of dark brown (7.5YR3/2) sandy loam "A" horizon was excavated as Layer I. No artifacts were recovered from Layer I. Layer II was excavated to bedrock and consisted of a variable 0.27 to 0.35 meters of reddish brown (5YR5/4) silty sand. Layer II appears to be fill brought in from another location. No artifacts were recovered from Layer II.

**Site 24243, Feature D**

Feature D is a rectangular trough (Figure 56) located 8.00 meters southwest of Feature C. It measures 3 meters long (44º/226º), 1.20 meters wide, and 0.60 to 0.92 meters in depth (Figure 57). The trough is from 0.48 meters above to level with the surrounding ground surface. It is constructed of crudely mortared sub-angular *pāhoehoe* cobbles lining the southeast and southwest edges of a shallow skylight. The mortar on the inside of the trough displays flat

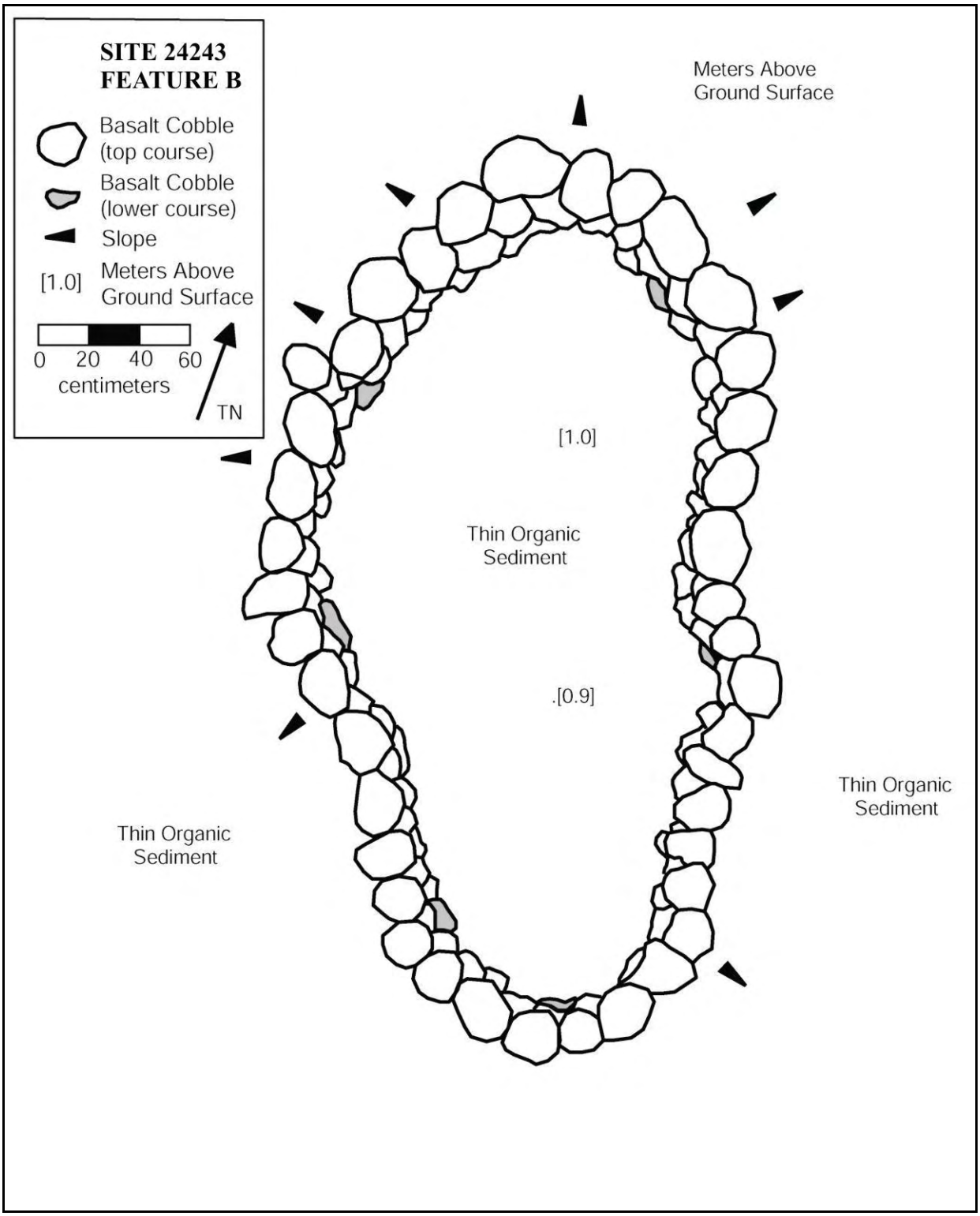


**Figure 54:** Planview of Site 24243, Feature B.

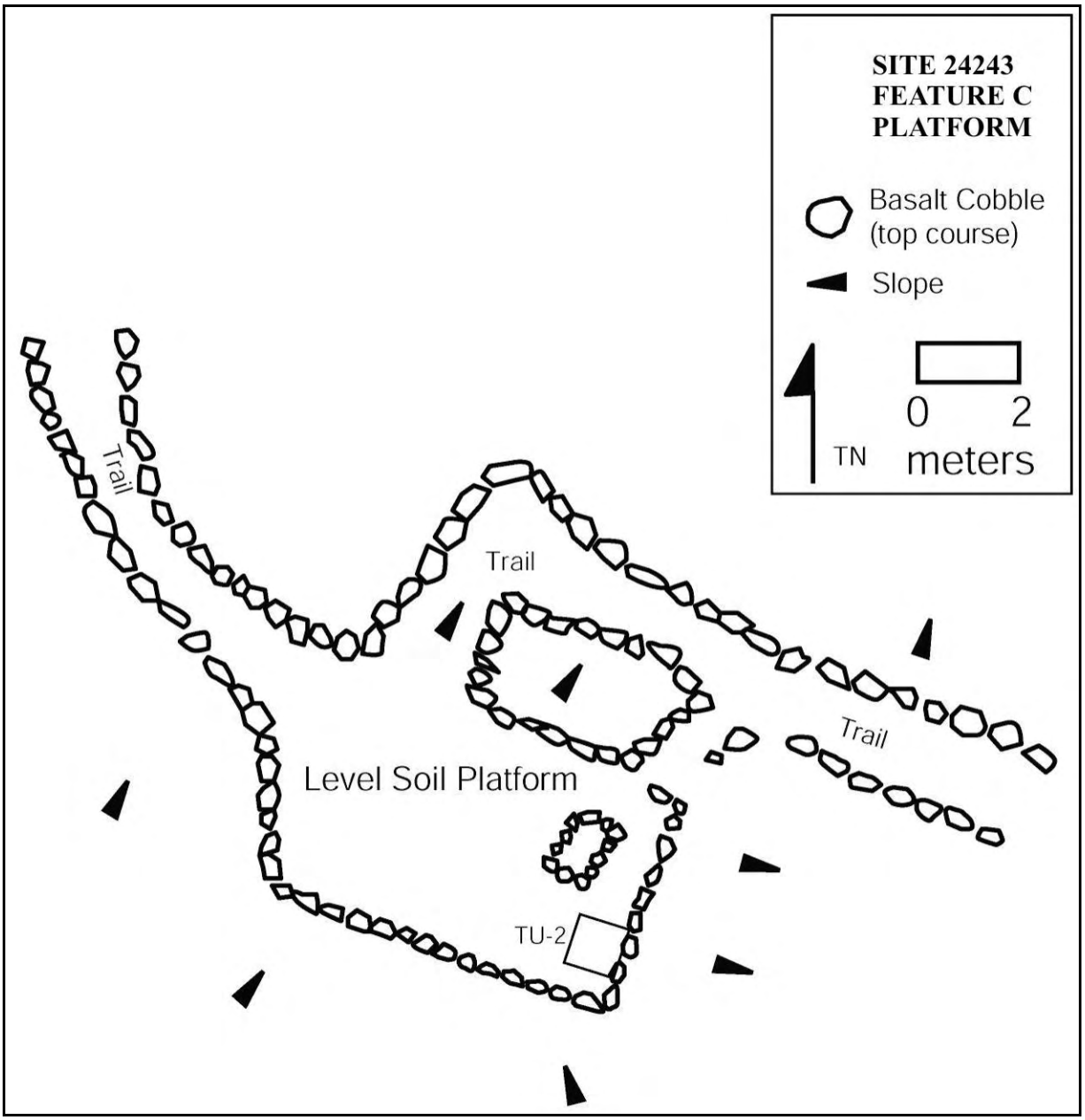


**Figure 55:** Planview of Site 24243, Feature C Platform.

**Figure 56:** Photograph of Site 24243, Feature D Looking West.

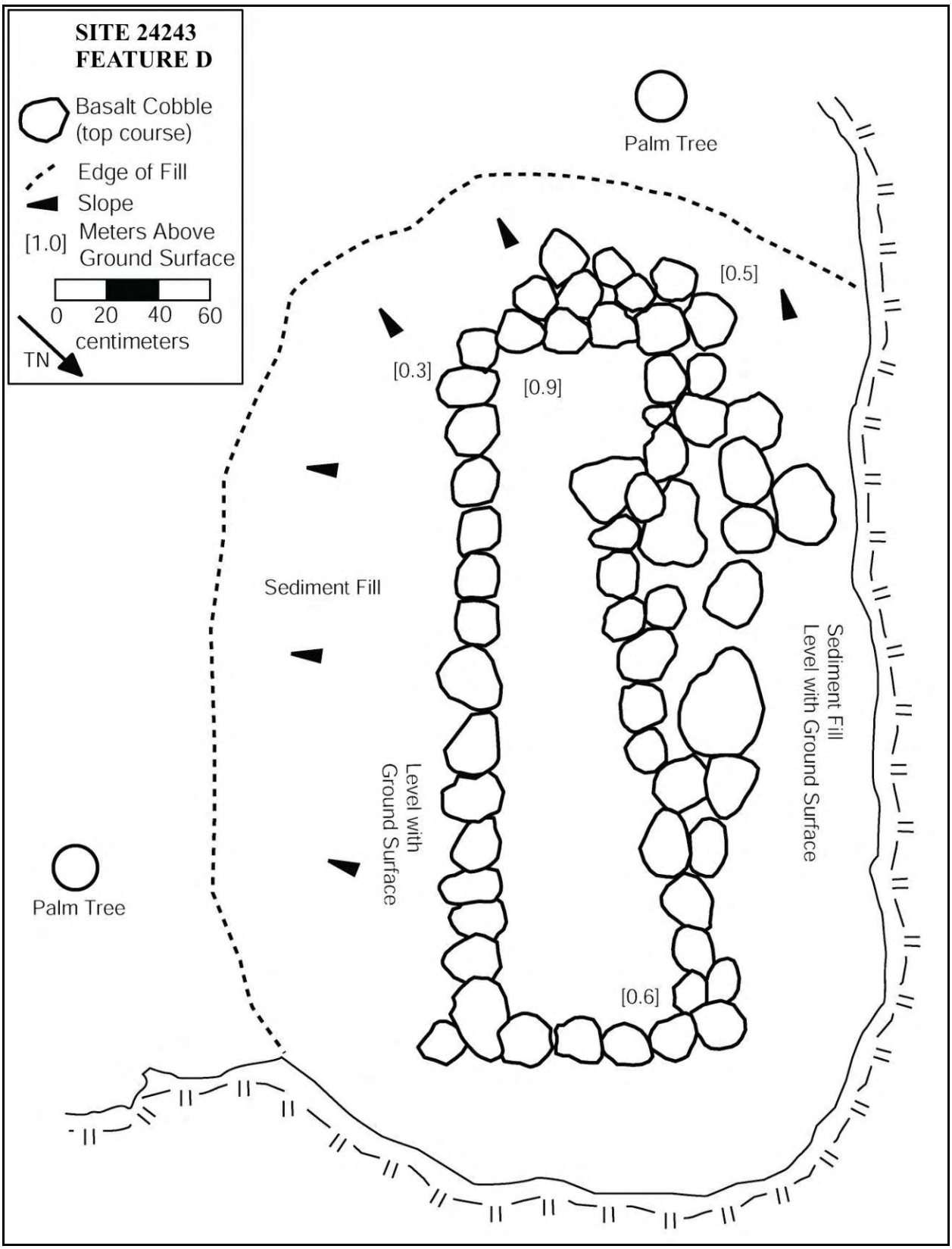


**Figure 57:** Planview of Site 24243, Feature D.

surfaces in places, suggesting that the feature was constructed using forms. Sediment fill has been piled up around the outside of Feature D. The feature is likely a military foxhole, appears unaltered, and is in good condition.

**Site 24243, Feature E**

Feature E is a rock mound located 10.0 meters west of Feature D. The feature measures 2.3 meters (east/west), 1.6 meters wide, and 1.3 meter in height (Figure 58). The feature consists of *pāhoehoe* cobbles and boulders piled in the center of a shallow skylight, and are likely materials used during the construction of a military foxhole similar to features A, B, D, and F.

**Site 24243, Feature F**

Feature F is a roughly rectangular trough located 5 meters west of Feature E. The feature measures 3.20 meters long (178º/355º), 1.60 meters wide, and 1.00 to 1.10 meters in depth (Figure 59). The trough is from 0.25 meters above to level with the surrounding ground surface. It is constructed of crudely mortared *pāhoehoe* cobbles lining a pit excavated into a bedrock outcrop. The feature is likely a military foxhole, appears unaltered, and is in good condition.

**Site 24243, Feature F, Test-Unit 3**

A 0.5 by 0.5 meter test-unit was excavated to a bedrock terminus in the center of Feature A. A variable 0.09 to 0.15 meters of dark brown (7.5YR3/2) sandy loam was removed as single layer from TU-3. All sediment was screened through 1/8-inch mesh. The unit was excavated to bedrock. Two water worn pebbles were recovered from TU-3; no additional artifacts were present.

**Site 24243, Feature G**

Feature G is a rock alignment/foot path located 10 meters northeast of Feature F. The feature measures 4.4 meters long (70º/250º), 1.2 meters wide, and ranges from 0.1 to 0.5 meters high (Figures 60 and 61). The alignment is one to three courses high, one course wide on each side, is well faced, and its surface is covered with soil. The alignment is situated within and perpendicular to a shallow bedrock channel and appears to allow foot access across this low swampy area. The feature appears unaltered and is in good condition.

**Site 24243, Feature H**

Feature H is a concrete building foundation located 10 meters northwest of Feature G. The feature measures 20 feet long (70º/250º), 16 feet wide, and is 1 to 3 feet above the surrounding ground surface (Figure 62). The wall footings along the outside of the foundation are 6 inches wide, 6 inches high, and contain two door openings on the west and east sides. The

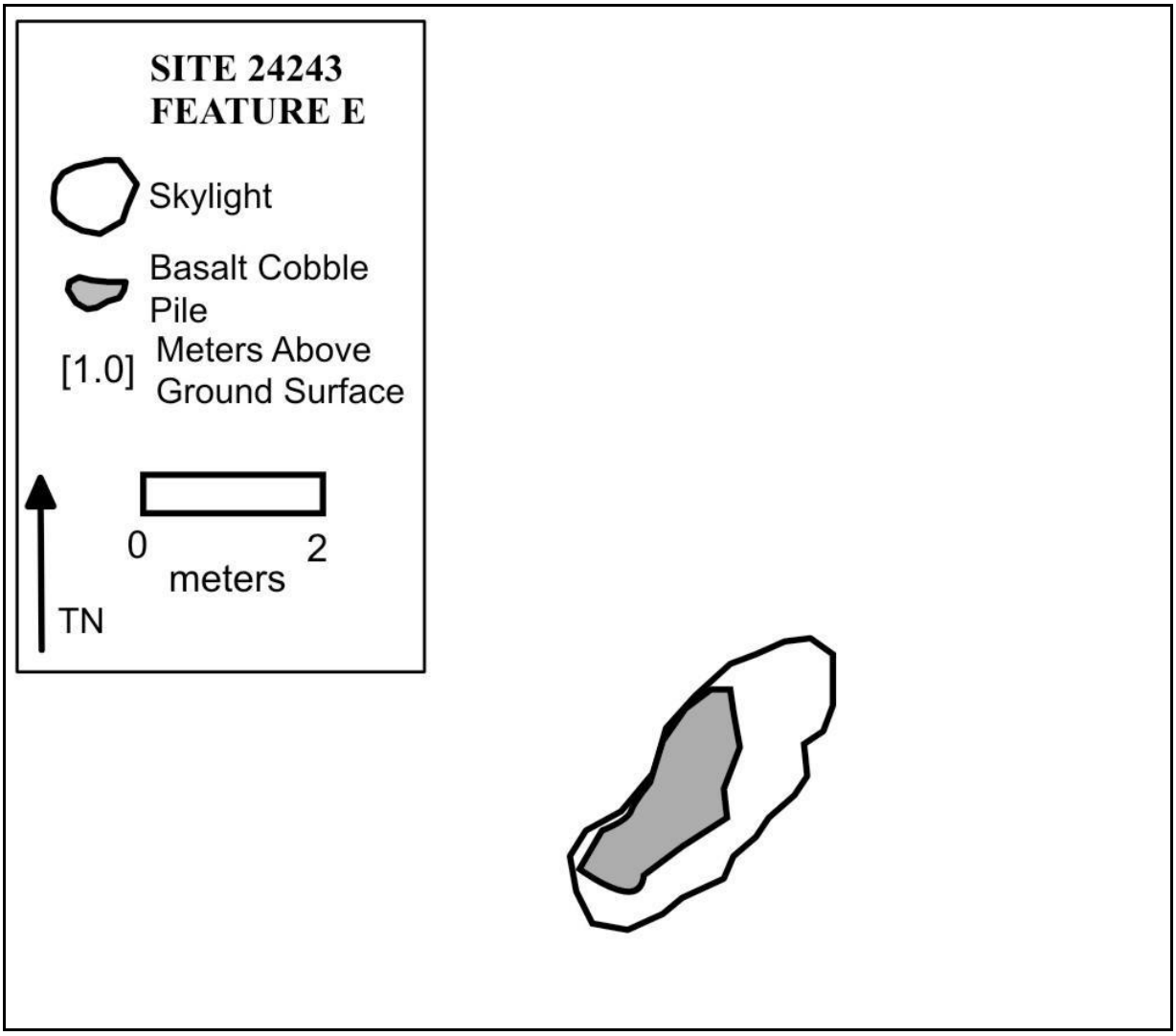


**Figure 58:** Planview of Site 24243, Feature E.

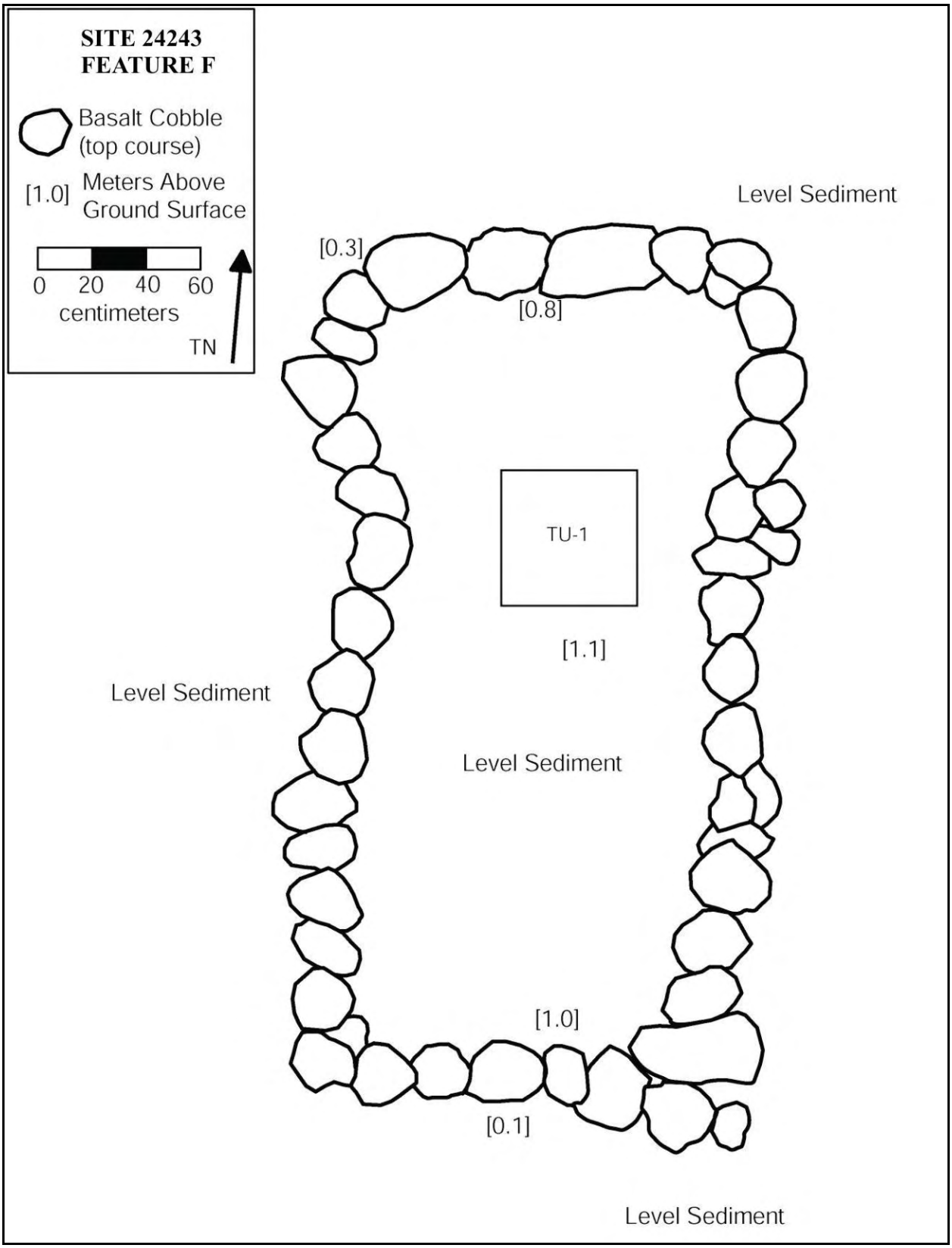


**Figure 59:** Planview of Site 24243, Feature F.

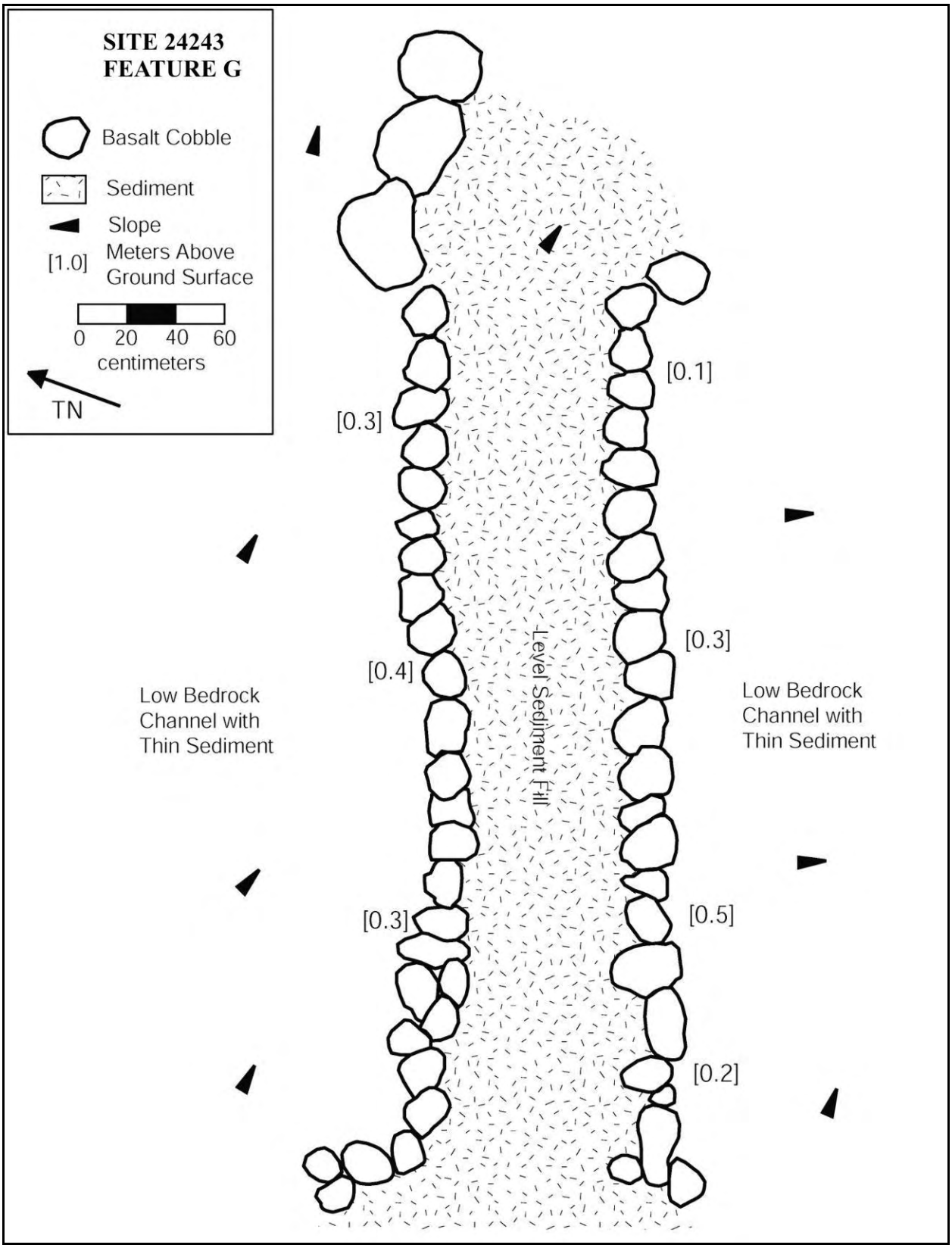


**Figure 60:** Planview of Site 24243, Feature G.

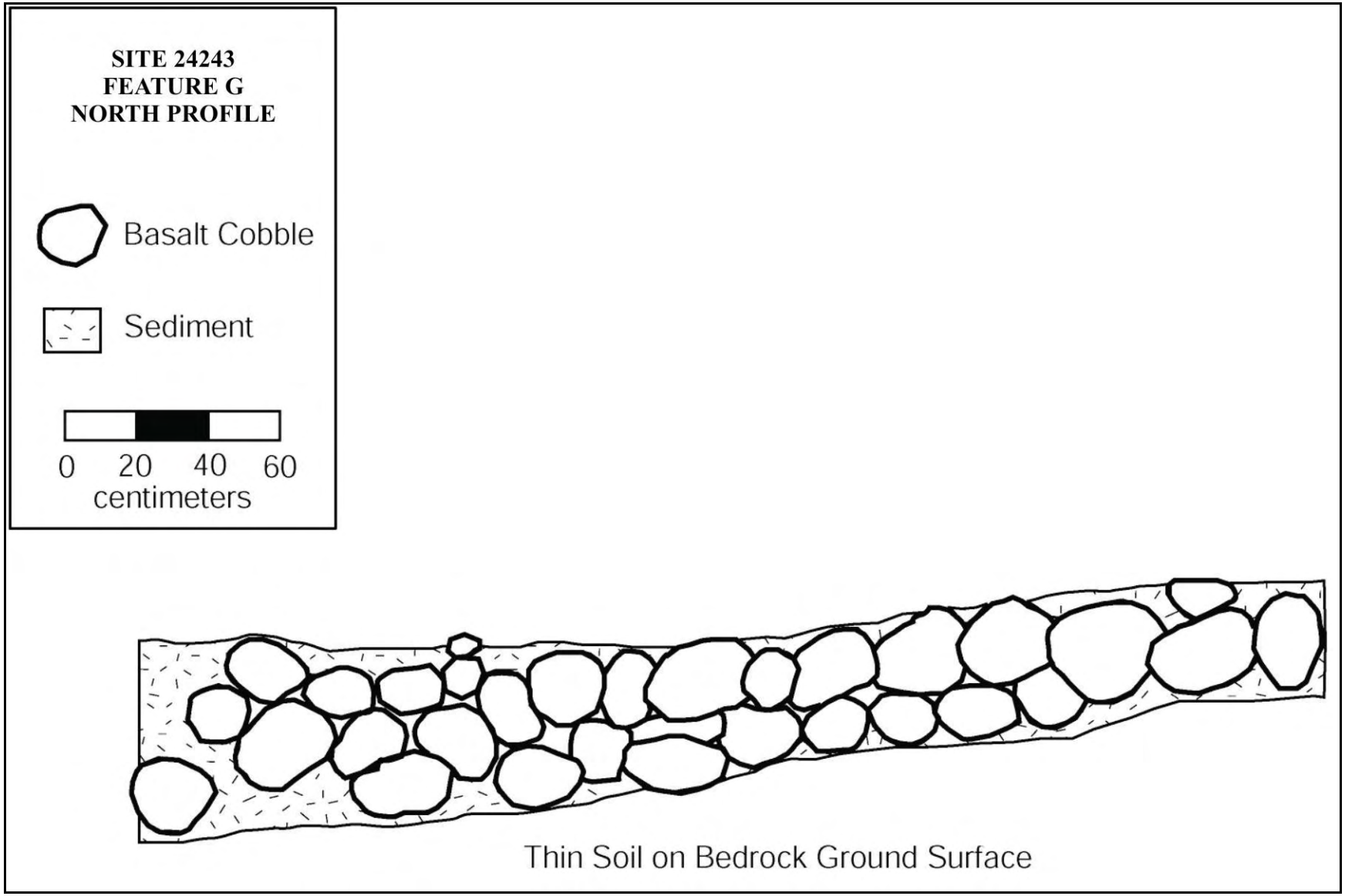


**Figure 61:** Profile of Site 24243, Feature G.

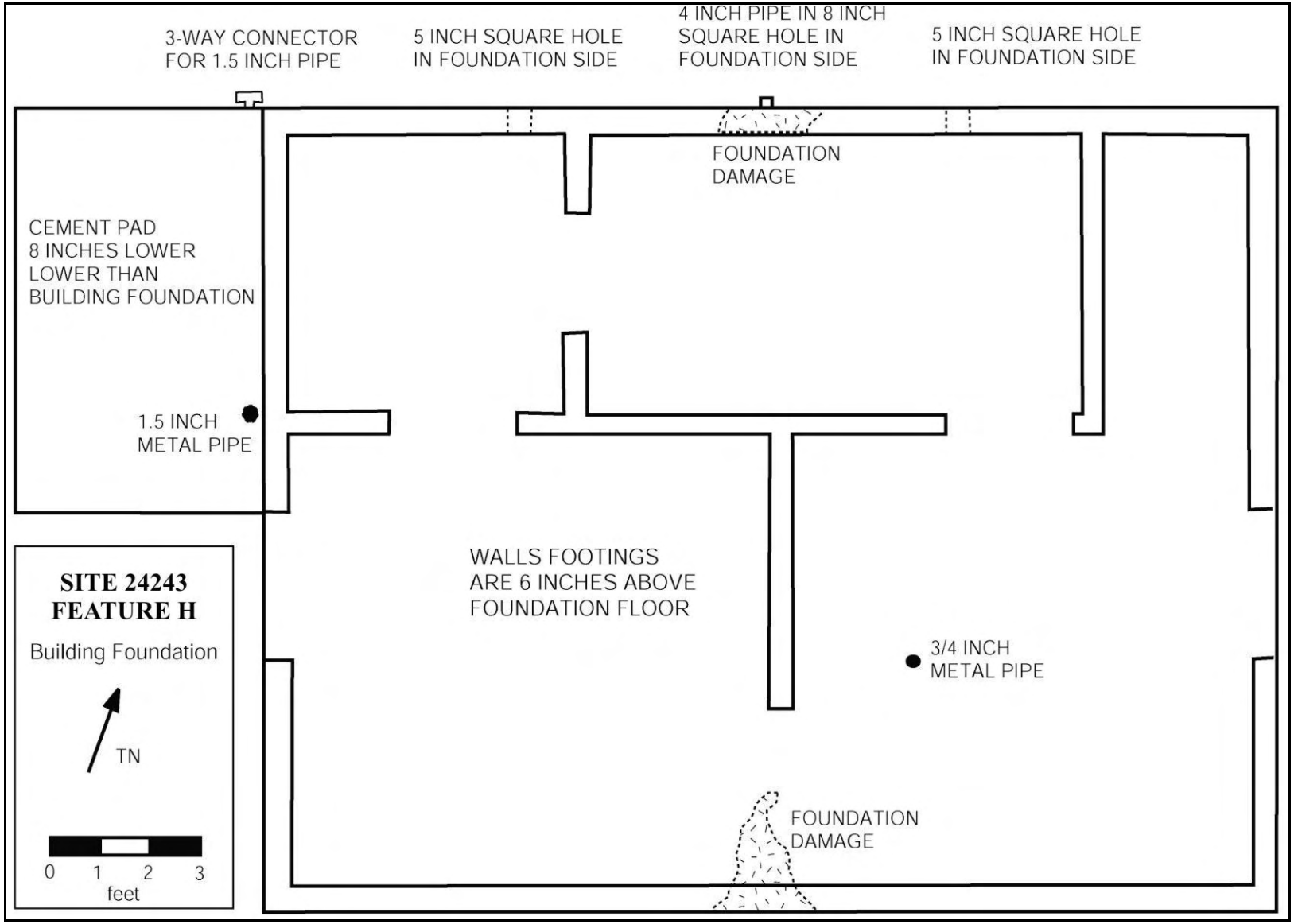


**Figure 62:** Planview of Site 24243, Feature H Building Foundation.

foundation is divided by interior wall footings (4 inches wide by 6 inches high) into five rooms. The floor in the southeast room contains a 3/4-inch pipe in its surface. Two other pipes (1.5 inch and 4 inch) exist in the north wall of the foundation. A five by eight foot concrete pad is attached to the northeast corner of the building foundation. The foundation is likely a structure associated with military training in the area. The foundation is in an overall good condition but is slightly damaged in two small areas.

**Site 24243, Feature I**

Feature I is a level clearing located 20.0 meters west of Feature G. The feature measures 9.0 meters long (east/west) by 7.0 meters wide. Several pipe joints, glass bottles, and pieces of foundation is divided by interior wall footings (4 inches wide by 6 inches high) into five rooms. The floor in the southeast room contains a 3/4-inch pipe in its surface. Two other pipes (1.5 inchand 4 inch) exist in the north wall of the foundation. A five by eight foot concrete pad is attached to the northeast corner of the building foundation. The foundation is likely a structure associated with military training in the area. The foundation is in an overall good condition but is slightly damaged in two small areas.

**Site 24243, Feature I**

Feature I is a level clearing located 20.0 meters west of Feature G. The feature measures 9.0 meters long (east/west) by 7.0 meters wide. Several pipe joints, glass bottles, and pieces of broken concrete slab are located on the ground surface. Two 2-meter square broken slabs (0.1 m thick) of concrete, likely from a water tank, are located on the western edge of the clearing. Feature I is likely a clearing for a military structure associated with U.S. Army training in the area.

**Site 24243, Feature J**

Feature J is a modified outcrop located 18 meters north of Feature I. The feature measures 2.5 meters long (east/west), by 2.0 meters wide, and is level with the surrounding ground surface (Figure 63). The feature is constructed of sub-angular and angular basalt cobbles and is interpreted as bulldozer push associated with a dirt road (Site 24247) located one meter north of the feature.

**Site 24243, Feature K**

Feature K is likely the remains of a collapsed concrete ammunition storage bunker (Figure 64) located 10 meters west of Feature J. The ground surface surrounding the top of the underground structure consists of level basalt cobbles. Two collapsed openings in the structure ceiling (0.1 by 0.2 and 1.6 by 0.5 meters) are partially filled by collapsed material and measure

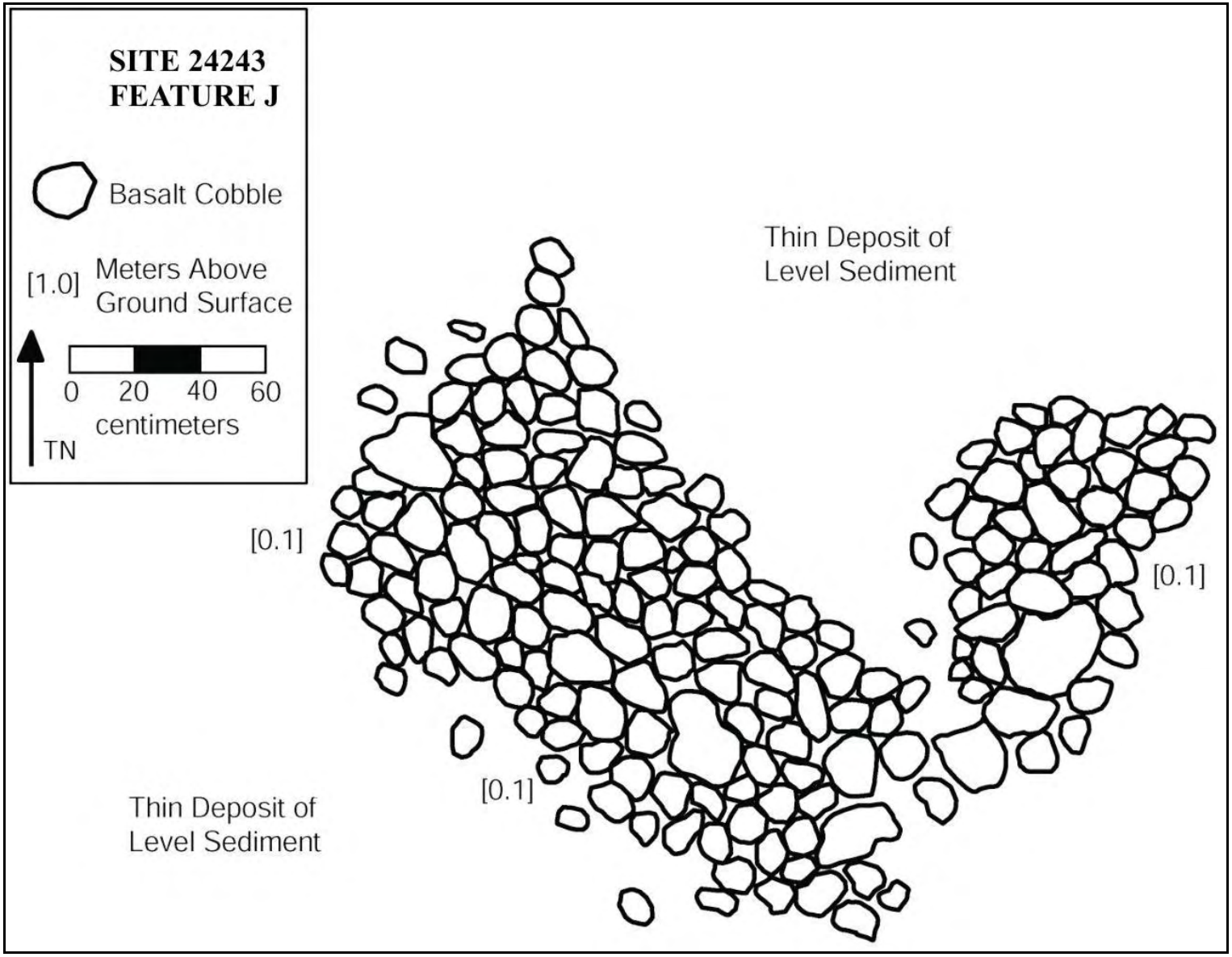


**Figure 63:** Planview of Site 24243, Feature J.

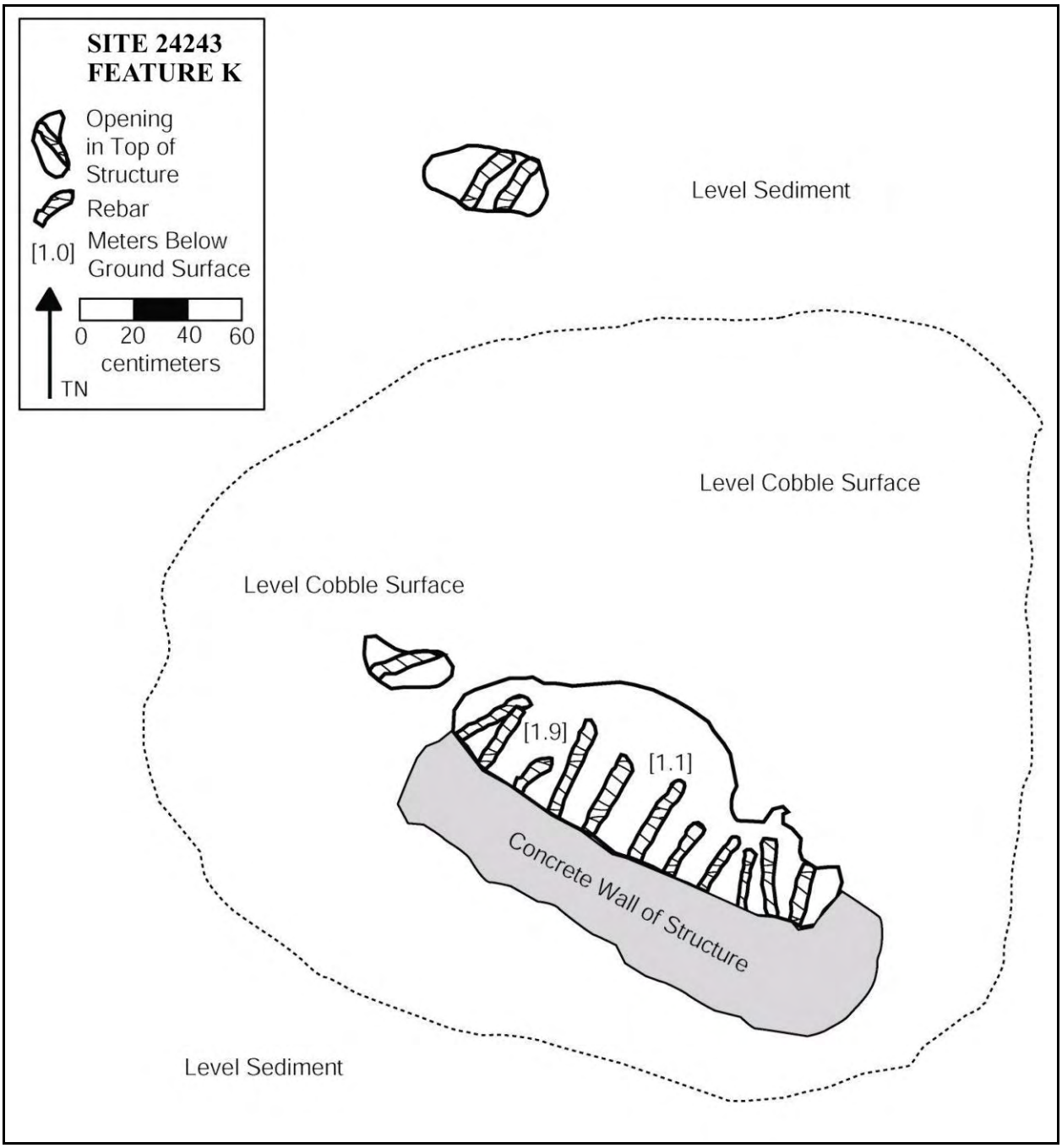


**Figure 64:** Planview of Exposed Portion of Site 24243, Feature K.

from 1.0 to 2.0 meters in depth. The top of the feature is exposed where it has collapsed, revealing tar-sealed concrete walls and one-inch thick rebar used in the construction of the bunker ceiling. The feature is in poor condition.

**Site 24243, Feature L**

Feature L is a cement-capped cesspool located 20.0 meters southwest of Feature I. The cesspool is roughly oval in shape, and measures 3.2 meters long (north/south), 2.6 meters wide, and is 6.0 meters deep. The cesspool appears to be hand-excavated into the bedrock and is covered by a cement cap. The cap was constructed by placing form planks (from 5 to 14 cm wide) over the excavated pit. O these, seven 15.0-foot long 1.5 inch gauge railroad tracks were laid. Four inches of cement was then poured over the railroad track support beams. The surface of the concrete is level and was covered by a thin layer of sediment. A four-inch pipe laid below ground surface is situated from inside the southeast edge of the cesspool to the south edge of the Feature H foundation. The feature is altered and in poor condition.

**SITE 50-10-35-24244**

Site 24244 is a roughly square enclosure located approximately 35.0 meters north/northwest of Site 24243, Feature H, at an elevation of 100 meters (330 feet) amsl, and occupies an area of level mixed *waiwi* and *uluhe* forest growing in pockets of Pana`ewa very rocky silty clay loam series sediment dispersed between bare *pāhoehoe* outcrops (see Figures 15 and 50). The enclosure is located on the northern edge of a bedrock outcrop and affords an unobstructed view of Hilo Harbor. The feature measures 5.0 meters long (east/west), 4.5 meters wide, and is from 1.0 to 2.0 meters in height (Figures 65 and 66). The feature is constructed of a concrete ring, the center of which is filled with mechanically crushed basalt base course. Basalt boulders and cobbles have been set in the concrete ring. Two additional courses of basalt cobbles and boulders are stacked on those embedded in the concrete ring. Beach sand containing water worn pebbles and small cobbles, possibly originally in sandbags, overlies the entire enclosure. Two pipes (3.5 and 4.5 inches in diameter) are located standing upright in small concrete pads along the southwest edge of the enclosure.

A well-faced stone alignment measuring 1.90 meters long, 0.45 meters wide, and 0.90 meters high is located off of the southeast edge of the enclosure. A second alignment along the southwest edge of the bedrock outcrop (7 meters southwest of enclosure) has been constructed to form a level access path to the enclosure.

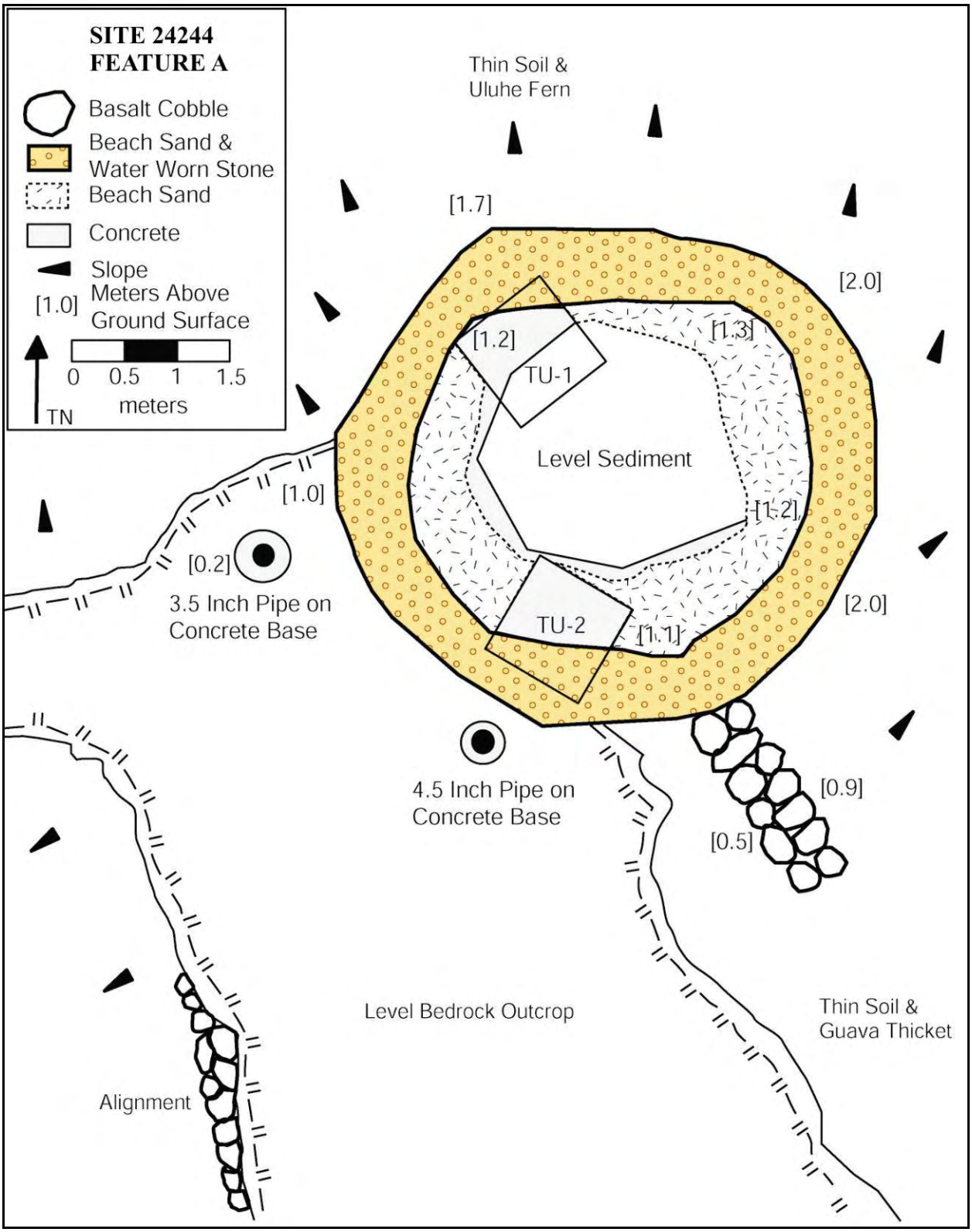


**Figure 65:** Planview of Site 24244 Enclosure.

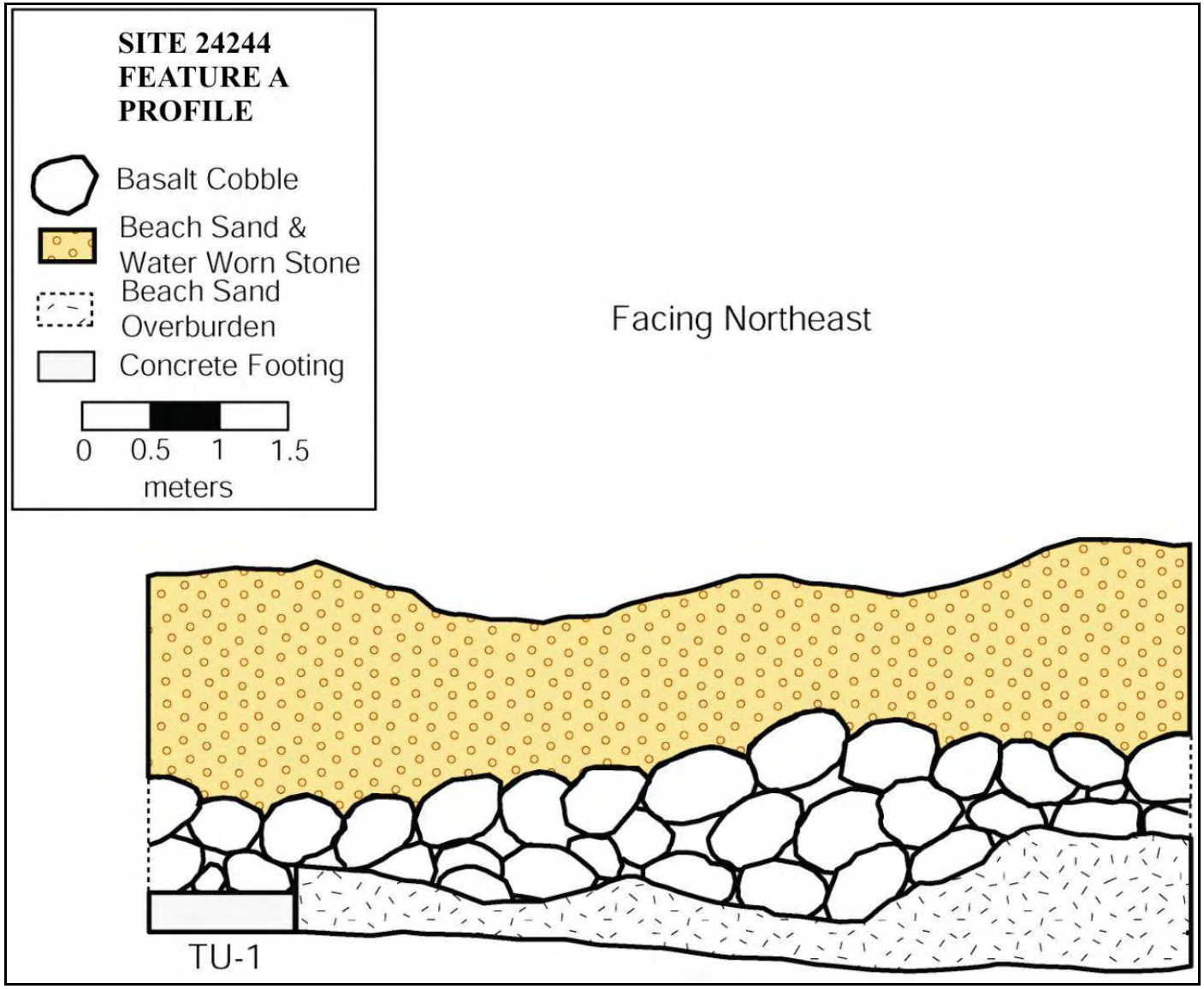


**Figure 66:** Profile of Site 24244 Enclosure.

Several pieces of metal wire, a piece of cloth screen, pieces of a boot sole, and a possible shell casing (pending positive ID by US Army) were located at Site 24244. The site is interpreted as a military gun emplacement and is in good condition.

**Site 24244, Test-Unit 1**

A one by one meter test-unit was excavated in the northwest corner of the enclosure. All matrix was screened through 1/8-inch wire mesh. A variable 0.25 to 0.44 meters of very dark brown (10YR2/1) sand was excavated as Layer I from the top of a concrete ring along the interior edge of the enclosure. Layer I continued 0.02 to 0.05 meters below the inside edge of the concrete ring. Layer 1 matrix contained 30 percent water-worn pebbles and is likely beach sand brought to the site in sandbags and used to cover the top of the stone enclosure. Layer I sediment appears to have eroded from the top of the enclosure walls and has been deposited on the ground surface in the interior of the enclosure. A single spent anti-aircraft shell was located at the interface of Layer I and the concrete footing ring in the northwest corner of the unit. The shell is tubular (no shoulder), measures 15.3 centimeters (6 inches) in height and 5.7 centimeters (2 inches) in diameter, and is highly corroded. No other artifacts were recovered from Layer I.

Layer II consisted of a variable 0.07 to 0.15 meters of light gray (10YR7/1) gravel and sand. Layer II is a layer of mechanically crushed base course overlaying angular and subangular basalt cobbles and boulders (Layer III). The concrete footing ring continues below Layer II. No artifacts were recovered from Layer II.Layer III consisted of a variable 0.34 to 0.45 meters of angular and subangular basalt cobbles and boulders, and terminated on bedrock. No artifacts were recovered from Layer III.

**Site 24244, Test-Unit 2**

A one by one meter test-unit was excavated along the interior southern edge of the enclosure. All matrix was screened through 1/8-inch wire mesh. A variable 0.34 to 0.49 meters of very dark brown (10YR2/1) sand was excavated as Layer I from the top of a concrete ring along the interior edge of the enclosure. Layer I terminated on a concrete footing ring surface. Layer 1 matrix contained 30 percent water-worn pebbles and is likely beach sand brought to the site in sandbags and used to cover the top of the stone enclosure. Layer I sediment appears to have eroded from the top of the enclosure walls and has been deposited on the ground surface in the interior of the enclosure. Several fragments of water-worn glass, metal wire, and pieces of boot sole were recovered from Layer I

Site 24244 is interpreted as an anti-aircraft gun emplacement overlooking Hilo Bay and was likely constructed during World War II while the U.S. Army was using the area for training.

**SITE 50-10-35-24245**

Site 24245 is an isolated find of three iron fence posts similar to the type used on ranches for pasture animals, located 50 meters northeast of Site 24244, at an elevation of 100 meters (330 feet) amsl, and occupies an area of level mixed *waiwi* and *uluhe* shrubland growing in pockets of Pana`ewa very rocky silty clay loam series sediment dispersed between bare *pāhoehoe* outcrops (see Figure 15). One post is stuck in the ground and the other two are laying roughly 2 meters away from the first. There is no fence wire, or other artifacts located at the site.

**SITE 50-10-35-24246**

Site 24246 is a rock alignment located 200 meters northeast of Site 24245, at an elevation of 85 meters (280 feet) amsl, and occupies an area of level mixed *ohi`a* and *uluhe* forest growing in pockets of Pana`ewa very rocky silty clay loam series sediment dispersed between bare *pāhoehoe* (1880–1881 flow) outcrops (see Figure 15). The alignment is constructed of *pāhoehoe* cobles and boulders piled on the bedrock surface, measures 3.0 meters long, averages 1.0 meter wide, and is from 0.4 to 0.8 meters in height (Figure 67). The alignment is bulldozer push associated with the dirt road (Site 24248) to the west. This rock alignment was made while making a road visible in a 1950 aerial photograph. It, too, is over 50 years old.

**SITE 50-10-35-24247**

Site 24247 is a dirt road (visible in an aerial photograph taken in 1950) situated from Komohana Street to a modern trash dump at its *mauka* (western) terminus, at an elevation of 100 meters (330 feet) to 110 meter (360 feet) amsl, and occupies an area of gently sloping mixed *waiwi* and *uluhe* forest growing in pockets of Pana`ewa very rocky silty clay loam series sediment dispersed between bare *pāhoehoe* outcrops (see Figures 15 and 50). The road surface consists of level sandy sediment containing water worn pebbles and was likely brought in from a different location. The road is partially overgrown and there are numerous modern dumpsites located along the roadside.

**SITE 50-10-35-24248**

Site 24248 is a dirt road situated (163º/343º) across a level ground surface between the corner of Mohouli and Komohana Streets and Site 24248 at an elevation of from 85 meters (280 feet) to 98 meters (320 feet) amsl. The road was visible in a 1950 aerial photograph. It occupies an area of level mixed *ohi`a* and *uluhe* forest growing in pockets of Pana`ewa very rocky silty clay loam series sediment dispersed between bare *pāhoehoe* outcrops (see Figure 15). The road surface is from 2.5 to 3.0 meters wide and consists of level sandy sediment containing water

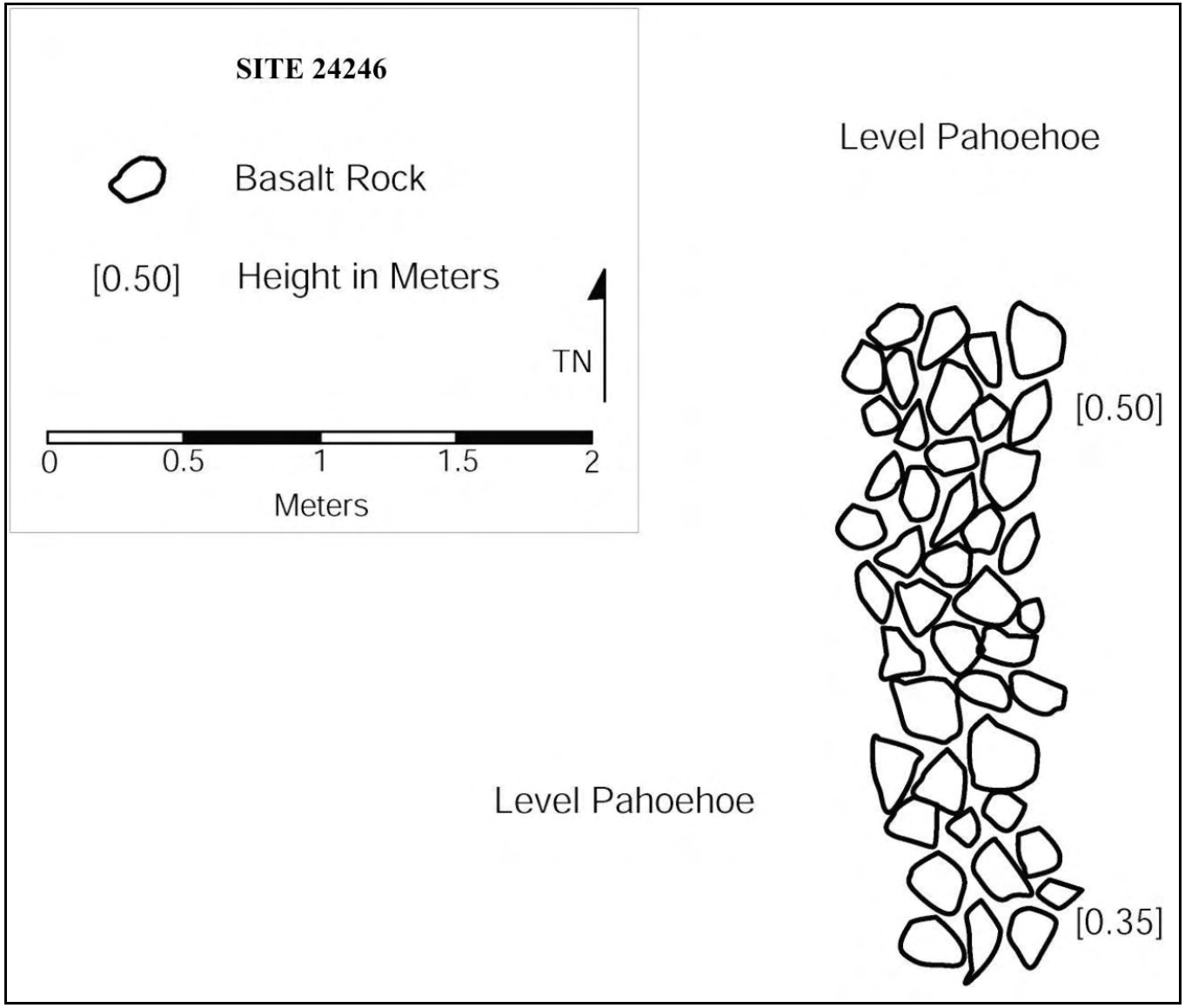


**Figure 67:** Planview of Site 24246 Stone Alignment.

worn pebbles, and was likely brought in from a coastal location. The road is partially overgrown and there are numerous modern dumpsites located along the roadside.

## SIGNIFICANCE ASSESSMENTS AND RECOMMENDED TREATMENTS

Numerous archaeological investigations have occurred in the immediate vicinity (Pu`ainako Street Expansion Project) and in the east central portion of the present project area (U.S.D.A Pacific Basin Research Center). Appendix A summarizes site assessments and recommendation for 18 sites recorded during these investigations.

Sites identified during this project were assessed in accordance with Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8 contained in draft Hawai`i Administrative Rules 13§13-275 (Table 3). To be assessed as significant a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and must be characterized by one or more of the following five criteria:

(A) It must be associated with events that have made an important contribution to the broad patterns of history.

(B) It must be associated with the lives of persons important in the past.

(C) It must embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value.

(D) It must yield or may be likely to yield, information important in prehistory or history.

(E) It must have an important value to the native Hawaiian people or to another ethnic group of the State due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

**Table 3:** Initial Site Assessment of Sites on the UH Hilo Mauka Lands Project.

| Site Number | Site Description | Criteria for Significance | Recommended Mitigation |
|---|---|---|---|
| 50-10-3524233 | Rock Alignment | D | None |
| 50-10-35-24233 | Rock Concentration | D | None |
| 50-10-35-24234 | Rock Mound | D | None |

| | | | |
|---|---|---|---|
| 50-10-35-24235 | Sugar Cane Field | D | None |
| 50-10-35-24236 | Enclosed Tube | D | None |
| 50-10-35-24237 | Water Catchment | D | None |
| 50-10-35-24238 | Sugar Cane Field | D | None |
| 50-10-35-24239 | Dirt Road | D | None |
| 50-10-35-24240 | Military Position | D | None |
| 50-10-35-24241 | Enclosure | D | None |
| 50-10-35-24242 | Sugar Cane Field | D | None |
| 50-10-35-24243 | Dairy/Military | A, D | Data Recovery |
| 50-10-35-24244 | Military | A, D | Data Recovery |
| 50-10-35-24245 | Fence Posts | D | None |
| 50-10-35-24246 | Rock Alignment | D | None |
| 50-10-35-24247 | Dirt Road | D | None |
| 50-10-35-24248 | Dirt Road | D | None |
| 50-10-35-18918 | Sugar Cane Field | D | None |
| 50-10-35-18919 | Sugar Cane Field | D | None |
| 50-10-35-20681 | Sugar Cane Field | D | None |

## RECOMMENDED TREATMENTS

There are 20 sites located on the UH Hilo *Mauka* Lands Project area. No further work is recommended at eighteen sites (Sites 1-11,14-17, and SIHP Sites 50-10-35-18918, 50-10-35-18919, and 50-10-35-20681). Two sites are recommended for Data Recovery (Sites 24243 and 24244). No sites are recommended for preservation.

### NO FURTHER WORK

Eighteen sites will require no further work (Sites 1–11,14–17, and SIHP Sites 50-10-35-18918, 50-10-35-18919, and 50-10-35-20681) because the significant data contained in these sites has been collected in the form of measurements, photographs, descriptions, figures, oral interview, and historical research. The appropriate research has been conducted for these sites, and further study would not contribute any new information. The eighteen sites are associated with historic agriculture and pasture activities. Test excavations at numerous historic agricultural sites in the immediate vicinity have underscored the low excavation potential of these types of features (Borthwick, *et al*. 1993; Hunt and McDermott 1994; Robins and Spear 1996; Eblé, *et al*. 1997; Dega 2000; and McDermott and Hammatt 2001). No prehistoric components were found within tested historic agricultural features. Interviews with informants who remember the construction of these sites have stated that field-clearing activities have removed any large-scale vestiges of prehistoric activity in the area (Maly 1996). The historic sugar cane fields are well documented on historical maps and in historical documents. Soil depths at these sites are very shallow, features are built on bedrock outcrops, and the dismantling

of features during past testing has contributed no new archaeological data to improve our understanding of them.

## DATA RECOVERY

Two sites are recommended for Data Recovery work: Sites 24243 and 24244. Data Recovery is recommended for Sites 24243 and 24244 recorded during the present study because of their importance to documenting military defense and training activities in the upland area of Hilo. U.S. Army Corps of Engineer documents indicate the construction of several anti-aircraft gun emplacements and four 155 mm harbor defense guns in the Hilo area, as well as several training facilities (David Cox). Data recovery at Sites 24243 and 24244 will contribute archaeological data to the scant documentary information presently on record.

### Site 24244

Site 24244 is an anti-aircraft gun emplacement used during World War II, and ancillary features associated with that function. Documents indicate that there were several anti-aircraft emplacements in the Hilo area. Based on the limited investigations conducted to date at the site, the emplacement at Site 24244 deviates from blueprints of similar Army Corps of Engineers constructed emplacements in being less formal and was likely constructed by the company that manned the gun. Data recovery is recommended at this site to fully expose the architecture of the gun emplacement. Excavations should also be conducted in strategic locations around the gun emplacement to understand the full organization of such sites. Data recovery should also include additional research into military activities of this type in Hilo via investigation of available records, and interviews with individuals and groups involved with this activity. The data recovery effort at Site 24244 should be designed in consultation with individuals and/or groups that have expertise in military history of Hilo.

### Site 24243

Site 24243 is a large multi-component site that was originally constructed as dairy facilities after 1939, and was later used as a center for U.S. Army military training during World War II. Excavations should be conducted in strategic locations at the site to fully understand feature construction sequences and to understand the specific functions of features. Data recovery should also include additional research into military activities of this type in Hilo via investigation of available records, and interviews with individuals and groups involved with this activity. The data recovery effort at Site 24243 should be designed in consultation with individuals and/or groups that have expertise in military history of Hilo.

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# APPENDIX A: MITIGATION OF CANE FIELD SITES

Archaeological Significance and Recommended Mitigation of Cane Field Sites

| Site (50-10-35-) | Relation to Current Project | Function | Significance Assessment | Recommended Mitigation |
|---|---|---|---|---|
| 18911 | 900 m East | Historic Agriculture | Criterion D | Data Recovery |
| 18912 | 600 m East | Historic Agriculture | Criterion D | Data Recovery |
| 18913 | 450 m East | Historic Agriculture | No Longer Significant | No Further Work |
| 18914 | 380 m East | Historic Agriculture | Criterion C, D | Preservation |
| 18915 | 250 m East | Historic Agriculture | Criterion C, D | Preservation |
| 18916 | 180 m East | Historic Agriculture | Criterion (C), D | Data Recovery (Preservation) |
| 18917 | 180 m East | Historic Agriculture | Criterion D | Preservation |
| 18918 | On Project | Historic Agriculture | Criterion D | Data Recovery |
| 18919 | On Project | Historic Agriculture/Pasture | Criterion D | Data Recovery |
| 18920 | 1200 m SW | Historic Agriculture/Pasture | No Longer Significant | No Further Work |
| 18921 | 3000 m SW | Historic Agriculture | Criterion D | Data Recovery |
| 18922 | 1000 m East | Clearing | Criterion D | No Further Work |
| 18923 | 1200 m East | Clearing | Criterion D | No Further Work |
| 20681 | On Project | Historic Agriculture | Criterion D | Data Recovery |
| Boulder Path | East | Transportation | Suggested | Preservation |
| 22734 | Near Center of Project | Burial | Burial | No Further Work |
| 22735 | Near Center of Project | Historic Agriculture | Criterion D | No Further Work |
| 22080 | Near Center of Project | Historic Transportation | Criterion D | Preservation |

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November 17, 2004

Mr. Glenn Escott
Scientific Consulting Services, Inc.
711 Kapiolani Blvd., Suite 975
Honolulu, Hawaii 96813

LOG NO: 2004.3367
DOC NO: 0411MM09

Dear Mr. Escott:

**SUBJECT: Chapter 6E-8 Historic Preservation Review, Revised Archaeological Inventory Survey, "An Archaeological Inventory Survey on Approximately 258 Acres of Land for the University of Hawai`i-Hilo *Mauka* Lands Development" Ahupua`a of Waiakea, South Hilo District, Hawaii Island TMK: (3) 2-4-001:122**

Thank you for submitting the revised version of the above mentioned report for our final review. The report, prepared for PBR Hawaii, was received on September 13, 2004. Our review is late and we apologize for any inconvenience this may have caused you or your client.

The report was revised in response to our initial review comments dated December 29, 2003 (Log No. 2003.2584, Doc. No. 0312PM11). The inventory survey of the roughly 258-acre project area was found adequate in terms of field survey and identification of sites, but comments on the significance evaluations and recommended site treatments were deferred until revisions were made.

All the requested revisions have now been adequately addressed. All twenty sites are assessed as significant under Criterion D for yielding information important in prehistory or history. Eighteen of the twenty sites are related to historic agriculture and pasture activities, and we agree that no further documentation or investigation is warranted. The remaining two sites, 50-10-35-24243 and 24244 are associated with military defense and training activities in the upland area of Hilo during World War II, are assessed as significant under Criterion D, and are recommended for data recovery mitigation.

These two sites are arguably eligible under Criterion A as associated specifically with World War II training activities. We believe, however, that data recovery mitigation is warranted and appropriate even if the sites are not preserved. We therefore accept the report as adequate and final, on the condition you revise this evaluation of significance. Please contact our Architecture Branch Chief, Thomas Lim at 692-8030, for recommendations on the form that data recovery work may need to take.

Aloha,

Melanie A. Chinen, Administrator
State Historic Preservation Division

MM:jen

c: Thomas Lim, Architecture Branch Chief
Christopher J. Yuen, Dir, Hawaii Planning, 101 Pauahi St, Suite 3, Hilo, HI 96720-3043

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December 29, 2004

Mr. Glenn Escott
Scientific Consulting Services, Inc.
711 Kapiolani Blvd., Suite 975
Honolulu, Hawaii 96813

Log No: 2004.3367
Doc No:0412MM07

Dear Mr. Escott:

**SUBJECT:** **Chapter 6E-8 Historic Preservation Review, Final Submittals for the Revised Archaeological Inventory Survey, "An Archaeological Inventory Survey on Approximately 258 Acres of Land for the University of Hawai`i-Hilo *Mauka* Lands Development"**
**Ahupua`a of Waiakea, South Hilo District, Hawaii Island**
**TMK: (3) 2-4-001:122**

Thank you for submitting one replacement page for the above mentioned report, which we received on December 20, 2004. The significance evaluations for two sites, Statewide Inventory of Historic Places (SIHP) Nos. 50-10-35-24243 and 50-10-35-24244, have been changed to include them under Criterion "A" as well as "D." This change was made in response to our November 17, 2004 review letter (Log. No. 2004.3367, Doc. No. 0411MM09), in which we approved this report on the condition you sent us this replacement page.

The report has been accepted as adequate and final. The next step will be the preparation of a mitigation plan for SIHP Nos. -24243 and -24244. If you have any questions, please call MaryAnne Maigret in our Kona office at 327-3690.

Aloha,

Melanie A. Chinen, Administrator
State Historic Preservation Division

MM: slc

c: Thomas Lim, Architecture Branch Chief
Christopher J. Yuen, Director, Hawaii County Planning, 101 Pauahi Street, Suite 3, Hilo, HI 96720-3043