



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MD 21010-5403

MCHB-TS-EGW (40)

21 January 2004

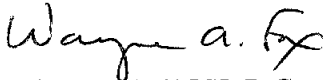
MEMORANDUM FOR National Guard Bureau (NGB-ARE-I/Fran Coulters), Building E-4430,
Aberdeen Proving Ground, MD 21010-5420

SUBJECT: ARNG Range Assessment No. 38-EH-00WVa-03, Hawaii Army National Guard
Kanaio Training Area, Ulupalukua, Maui, Hawaii, 20-28 February 2003

One paper copy of three CD-ROMs of subject final report are enclosed.

FOR THE COMMANDER:

Encl


WAYNE A. FOX, P.G.
Program Manager
Ground Water and Solid Waste

CF(w/encl):
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ARNG RANGE ASSESSMENT NO. 38-EH-00WVa-03
HAWAII ARMY NATIONAL GUARD KANAIO TRAINING AREA
ULUPALAKUA, MAUI, HAWAII
20-28 FEBRUARY 2003

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EXECUTIVE SUMMARY
ARNG RANGE ASSESSMENT NO. 38-EH-00WV a-03
HAWAII ARMY NATIONAL GUARD KANAIO TRAINING AREA
ULUPALAKUA, MAUI, HAWAII
20-28 FEBRUARY 2003

1. **PURPOSE.** The purpose of this Army National Guard (ARNG) Range Assessment (RA) was to evaluate potential sources of environmental contamination associated with closed impact ranges at the Hawaii Army National Guard (HIARNG) Kanaio Training Area and to assess the immediate or potential threat that possible wastes at the site pose to human health and the environment. Information gathered during the RA will be used to support a decision regarding the need for further environmental investigation at the site.

2. **CONCLUSIONS.**

a. The HIARNG presently uses active training areas 1, 2, and 3 within the northern half of the Kanaio Training Area for maneuver and blank fire training. The active training area may extend outside of the historic property boundaries to the west. HIARNG personnel reported that an active rifle range is situated in the vicinity of Impact Area 3A southwest of Pu'u Pimoe. Area D and most of Area C south of Pu'u Pimoe are considered to be closed.

b. Historic boundaries at the Kanaio Training Area generally appear to include Kanaio Homestead Lands 9 through 16, but to exclude all land grants and land commission awards (LCA) except for the three small LCA 3, 6, and 22 north of Pu'u Pimoe. Although it is possible that land outside of the historic boundaries was used for HIARNG training, it appears that the original intent was to restrict activities to within the historic boundaries shown on Figure E.

c. The coastal area of the Kanaio Training Area, previously situated within Area C, will no longer be included in the Kanaio Training Area under the executive order (EO). The HIARNG also wishes to acquire additional land under the EO. Both of these conditions may lead to a need for an environmental baseline study (EBS) at the Kanaio Training Area for land transfer.

d. Ordnance-related scrap found during unexploded ordnance (UXO) sweeps in 1981 and 1998 at the Kanaio Training Area include: 81mm illumination projectiles, practice projectiles, and live mortars; signaling flare tubes; 3.5-inch rockets and 4.2 inch rockets, M72 LAW rockets and motor tubes; 40mm grenades, practice grenades, and high explosive rounds; and small arms ammunition, small arms brass, M73 sub-caliber rounds, tail booms to recoilless rifle rounds, and 155mm projectile scrap. It is likely that high-explosives and/or pyrotechnics-containing duds

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exist below the ground surface at the Kanaio Training Area. The majority of the land surface at the Kanaio Training Area was not included in these UXO sweeps.

e. Impact Areas 1 and 2 are fenced and restricted from entry due to UXO concerns. The boundaries of Impact Areas 1 and 2 were established during initial UXO removal operations conducted in 1981, soon after high-explosives exercises were permanently suspended at the Kanaio Training Area. Therefore, it is likely that the fenced boundaries of Impact Areas 1 and 2 adequately delineate firing ranges and impact areas that should be restricted for safety purposes.

f. Previous UXO removal operations and the characteristics of high explosives and pyrotechnics-containing ammunition commonly used at Kanaio Training Area (including rockets and mortars) indicate that it is likely that duds exist on or beneath the ground surface at impact areas within the Kanaio Training Area. Explosives and pyrotechnics residues associated with the duds may have been released to the surrounding soil and rock material within the impact areas.

g. Low precipitation rates, combined with high evaporation rates reduce the potential for ground water beneath the site to be impacted by explosives and/or pyrotechnics associated with duds. If ground water is impacted, the only ground-water target(s) identified during the assessment were coastal spring-fed anchialine pools and the candidate endangered anchialine pool shrimp that reside within the pools. The pools found in southwest Kanaio Training Area contain thriving communities of native plants and animals, indicating that it is unlikely that they have been affected by Kanaio Training Area activities. It is possible, though unlikely, that the ground-water pathways would be completed for the Kanaio Training Area.

h. The Kanaio Training Area has low precipitation rates, high evaporation rates, and highly fractured and permeable surface lava. For these reasons, no surface water drainage features exist at the Kanaio Training Area, and it is unlikely that the surface water pathway would be completed for the site.

i. Most of the Kanaio Training Area is covered by a'ala lava without any soil development. Although there are isolated areas of the Kanaio Training Area having thin soil cover, levels of explosives, pyrotechnics, and/or metals contamination that might be associated with those soils are not expected to present a threat to human or environmental targets. It is unlikely that the soil and air pathways would be completed for the Kanaio Training Area.

3. RECOMMENDATION. None.

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HAWAII ARMY NATIONAL GUARD KANAIO TRAINING AREA
ULUPALAKUA, MAUI, HAWAII
20-28 FEBRUARY 2003

1. INTRODUCTION.

- a. References. Appendix A contains a list of references.
- b. Authority. Statement of Work between U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) and National Guard Bureau (NGB), dated 12 December 2002.
- c. Purpose. The purpose of this Army National Guard (ARNG) Range Assessment (RA) was to evaluate potential sources of environmental contamination associated with closed impact ranges at the Hawaii Army National Guard Kanaio Training Area and to assess the immediate or potential threat that possible wastes at the site pose to human health and the environment. Information gathered during the RA will be used to support a decision regarding the need for further environmental investigation at the Kanaio Training Area.
- d. Procedures. This RA was conducted by the USACHPPM between 20 and 28 February 2003. The scope of this investigation included activities conducted at the Kanaio Training Area since March 25, 1965, which is when the Kanaio Training Area property was leased to the Hawaii Army National Guard (HIARNG). The investigation was conducted by review of available documentation from the HIARNG, interviews with site workers, a comprehensive target and migration pathway survey, and offsite reconnaissance to the north and east. No environmental samples were collected or analyzed during this RA. The RA team physically observed only those areas of the Kanaio Training Area that were visible from outside the Kanaio Training Area boundaries to ensure personnel safety by avoiding rugged arid terrain containing possible unexploded ordnance (UXO). Moreover, USACHPPM felt that a thorough onsite reconnaissance was not necessary for the scope of this RA. The U.S. Environmental Protection Agency's (EPA) 1991 Guidance for Performing Preliminary Assessments under the Comprehensive Response, Compensation, and Liability Act (CERCLA) was used to focus this investigation. Supporting documentation is provided in Appendix B.

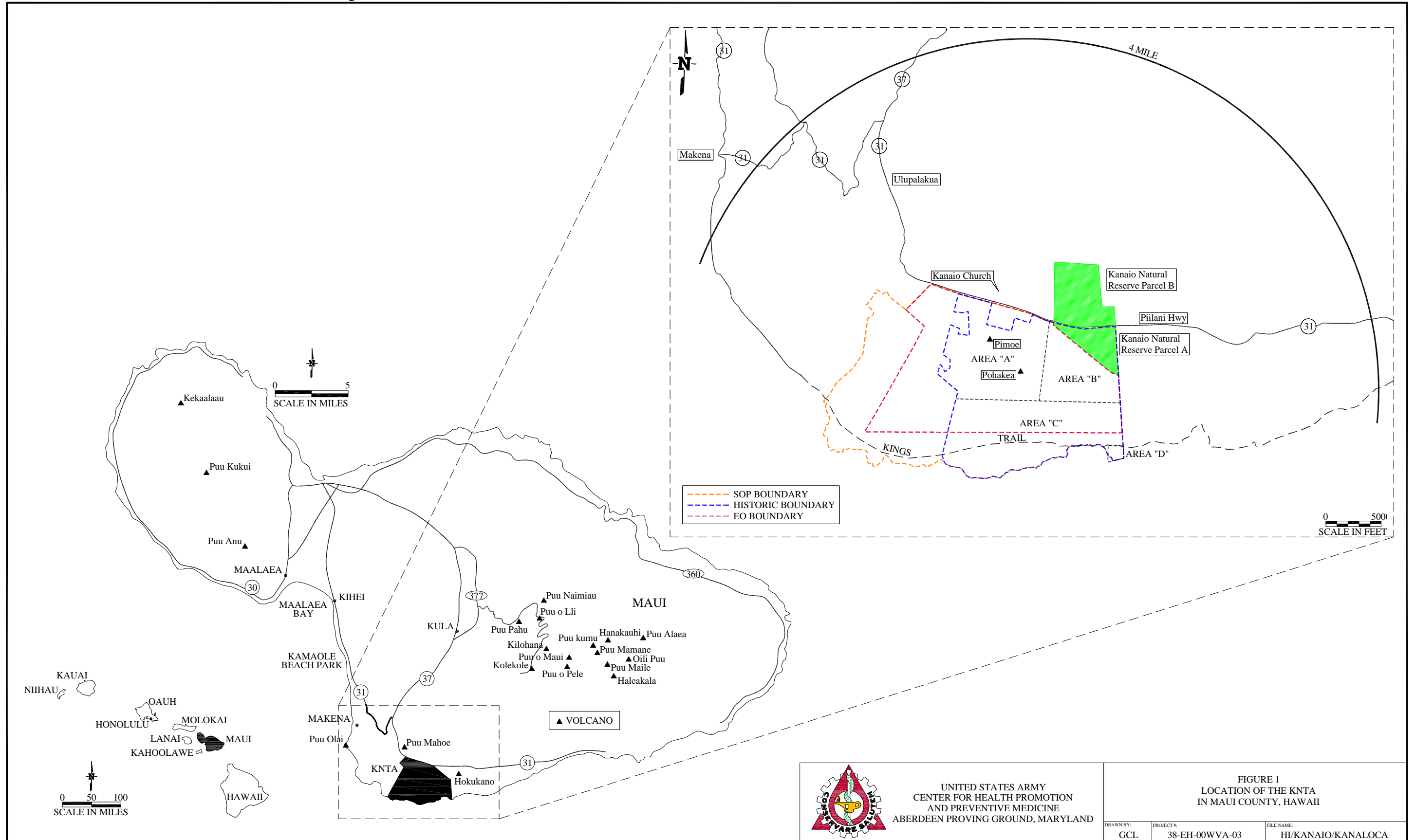
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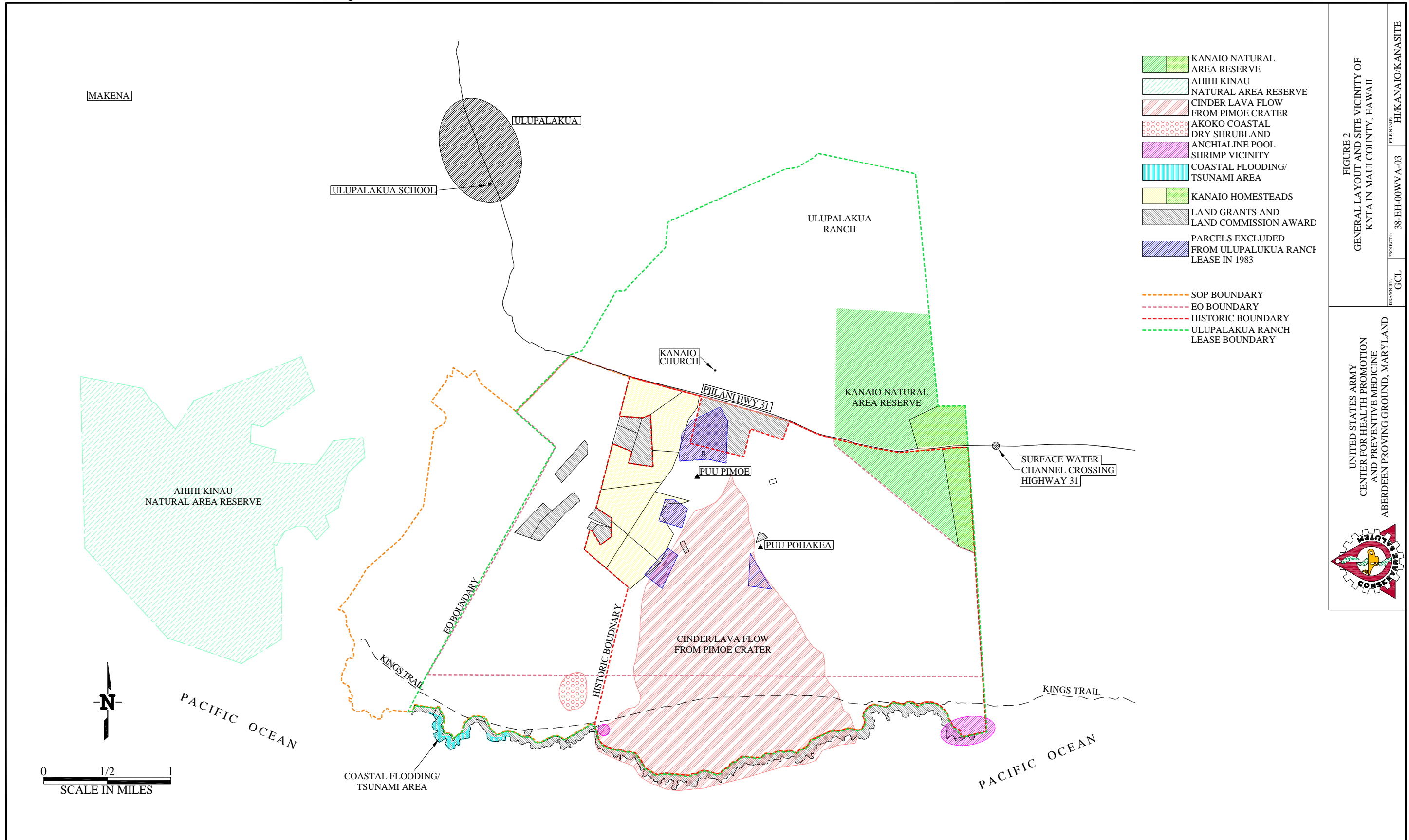
e. Personnel Contacted.

- (1) Bill Rogers, HIARNG
- (2) Ron Swafford, HIARNG
- (3) Mike Wysong, HIARNG
- (4) COL Young, HIARNG
- (5) MAJ Arnold Iaea, HIARNG
- (6) Charley Ice, Hawaii Department of Land and Natural Resources (DLNR)
- (7) SSG Roy Yamada, 1st Bn 299th Charlie Company, HIARNG
- (8) Michael Miyahira, Hawaii State Department of Health
- (9) Jason Koga, Hawaii DLNR
- (10) Arnold Abe, Engineering Department of Water Supply, Maui County
- (11) Trisha M.L. Kapualala, Zoning Office, Department of Planning, Maui County
- (12) Tony Durso, Ulupalakua Ranch
- (13) Sumner Erdman, Ulupalakua Ranch

2. **SITE DESCRIPTION.** The Kanaio Training Area is located on the outskirts of the town of Ulupalakua on the southeast coast of the island county of Maui, Hawaii, as shown in Figure 1. The address for the Kanaio Training Area is Maui Island, Ulupalakua, HI 96790. The geographic coordinates of the Kanaio Training Area range from 20°34'54" to 20°37'26" east longitude and 156°20'11" to 156°24'21" north latitude. The general layout of the Kanaio Training Area and vicinity is shown on Figure 2. The Piilani Highway (also named the 'Ulupalakua-Kaupā Road, Kanaio-Kalama Park Road, and Highway 31) and Pacific Ocean coast form the north and south boundaries of the Kanaio Training Area, respectively. Ulupalakua Ranch uses the property surrounding much of the Kanaio Training Area. Ranchland, small farms, and homesteads are located along the western side of the range. Trails and jeep roads provide access from Piilani Highway to the coast both on the Kanaio Training Area and nearby. An access road, formerly known as Kanaio Prison Road, connects Pu'u Pimoe cinder cone with Piilani Highway. The Kings Trail, which is a historic footpath and horse trail also known as the Hoapili Trail, Kings Highway, or Pi'ilani Trail, follows the entire coast of southeast Maui, traversing the coastal portion of the Kanaio Training Area. The Kanaio Training Area vicinity is a rural highland used primarily for cattle ranching; this area is also referred to as being part of Upcountry Maui, indicating its location on the upper slopes of Haleakala volcano. There are several tourist towns located on the coast between 2 and 4 miles west of the range, including Makena, Kanahena, Keoneio, and Keawakapu. Nearby residential development consists only of isolated small homesteads of up to 10 houses; many of the houses are used only on weekends or less often. The 2000 census population for the entire southwest slope of the Haleakala volcano was approximately 600 individuals; less than ¼ of that area may lie within 4 miles of the Kanaio Training Area boundaries (reference 1). The Kanaio Natural Area Reserve (NAR), which is administered by the U.S. Fish and Wildlife Service (USFWS) and/or DLNR, Division of Forestry and Wildlife, is located at the northeast corner of the Kanaio Training Area. The Kanaio Training Area presently encompasses approximately 4771 acres.



	UNITED STATES ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE ABERDEEN PROVING GROUND, MARYLAND		FIGURE 1 LOCATION OF THE KNTA IN MAUI COUNTY, HAWAII	
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a. Physiography. Figure 2 shows the topography and features in the vicinity of the Kanaio Training Area. The Kanaio Training Area is located on the southwestern slope of the dormant volcano Haleakala in the District of Makawao on the southeast coast of the Island of Maui. Cinder cones in the Kanaio Training Area vicinity exist in a pattern trending from northwest to southeast, reflecting the development of Haleakala's southwest rift zone (reference 2). The most prominent physical features at the Kanaio Training Area are two cinder cones, Pu'u Pimoe and Pu'u Pohakea, located on the north-central portion of the Kanaio Training Area. The ground surface is mostly a'a lava that recently originated from Pu'u Pimoe, with older, lighter-colored pahoehoe lava flows visible along the western side of the site and exposed in areas beneath the younger a'a lava flow (references 3 and 4). Several caves that formed within lava voids and tubes are present at the Kanaio Training Area. The overall elevation drops gently from about 1800 feet above mean sea level (msl) at Piilani Highway to msl at the southern coast. The top of Pu'u Pimoe is at 1766 feet msl. No karst features were identified at the Kanaio Training Area.

b. Vegetation. The vegetation at the Kanaio Training Area is described in depth in references 2 and 3. Native vegetation for this area included native dryland forests dominated by wiliwili (*Erythrina sandwicensis*), lama (*Diospyros sandwicensis*), and hao (*Rauvolfia sandwicensis*) (reference 3). Early Hawaiians converted the slopes around the Kanaio area to pili (*Heteropogon contortus*) grassland and farmed dryland crops (reference 3). The introduction of large feral cattle populations and human-related fire damage further altered native vegetation in the area (reference 3). As the native vegetation declined, non-native plants became established and further displaced native growth (reference 3). At present, most of the Kanaio Training Area is barren or is dominated by non-native scrub, primarily grasses and shrubs (reference 3). Native and indigenous plants scattered throughout the non-native species in the non-native scrub include a'ali'i (*Dodanea viscosa*), 'uhaloa (*Waltheria indica*), alena (*Boerhavia repens*) and pua kala (*Argemone glauca*) (reference 3). Small patches of vegetation occupy *kipuka*, which are island-like areas of older substrate surrounded by younger lava. *Kipuka* comprise important cattle grazing areas for local ranchers, and are sought out and protected for that use. The HIARNG uses some of the most disturbed and barren areas of the Kanaio Training Area, which were originally disturbed due to cattle and feral ungulate grazing, for its training activities (reference 3). Remnant pockets of native vegetation still provide habitat for rare and endangered plants, including the 'ohai tree (*Sesbania tomentosa*). Overall, vegetation communities that may contain native species occupy 15-20% of the site (reference 2).

c. Climate. The Kanaio Training Area is located on the leeward slope of Haleakala where the climate is mostly dry; less than 30 inches of annual precipitation occurs primarily during Kona, or winter storms (reference 5). Despite the arid climate, almost daily cloud cover collects over the slopes of the mountain and produces heavy mist (reference 2). The mean daily average temperature at the Kanaio Training Area is estimated to be between 70 and 75°F with the mean daily temperature range of 65 to 85°F (reference 6). Prevailing winds for the Island of Maui are from the northeast (reference 6).

d. Surface Water. Surface water features at the Kanaio Training Area are shown on Figure 2 and a 15-mile radius into the Pacific Ocean is shown on Figure 3. Due to the lack of precipitation and permeable nature of the surface lava, there are very few surface water features at the Kanaio Training Area (reference 2). When precipitation does occur, water infiltrates relatively rapidly into lava tubes, joints, and fractures. The only surface water feature identified within the Kanaio Training Area vicinity during this assessment was a channel that crosses Piilani Highway about $\frac{3}{4}$ mile east of the site. The channel reportedly fills with water and flows some distance during rain events (reference 7). The nearest water bodies are anchialine pools found along the southern Maui coast and the Pacific Ocean. Some areas along the coast are located within the 100-year coastal flood plain, which is subject to flooding due to wave action (reference 8). Most of the range is also subject to “minimal tsunami inundation” (reference 8). No wetlands have been identified at the Kanaio Training Area during various ground and aerial surveys (references 2, 4, and 9).

(1) Anchialine Pools. Anchialine pools are land-locked bodies of water formed in highly porous, relatively fresh lava where there is an underground connection to the ocean so that the pool water level rises and falls with the tide (reference 9). The water in anchialine pools is brackish due to the interaction of seaward-flowing fresh ground water mixing with intruding sea water (reference 10). Anchialine pools are considered to be sensitive habitats for the candidate endangered anchialine pool shrimp (*Metabetaeus lohena*) and other endemic Hawaiian organisms such as gobies and various crustaceans and mollusks (references 3, 4, and 11). One anchialine pool, notable for the absence of alien species, was identified near the coast within the southwest boundary of the Kanaio Training Area (reference 9). Additional anchialine pools are located outside of and southwest of the Kanaio Training Area, and an additional pool or pools may exist near the southeast coast of the Kanaio Training Area (references 2 and 7).

(2) Pacific Ocean. The uninhabited islands of Molokini and Kahoolawe are located within 15 miles of the Kanaio Training Area. Molokini Island is regulated by the State of Hawaii as a Marine Life Conservation District due to quality of reef habitat and the abundance of fish (reference 12). Molokini Island is also considered a state seabird sanctuary, and regulated black coral harvesting occurs along its coastline. Conservation efforts are underway to reestablish the native environment on Kahoolawe subsequent to military use of the island for bomber training by the Navy from WWII until 1994 (reference 13). Numerous public beaches and popular tourist locations are found along the Maui coast within the 15-mile radius. Activities such as fishing, surfing, diving, snorkeling, and boating trips are popular water activities within the 15-mile radius. In the year 2000, 32,578 lb of fish were landed off of the southern Maui coast within the 15-mile radius by commercial fisherman (reference 14). The Hawaiian Islands Humpback Whale National Marine Sanctuary protects humpback whales and their habitat from the shoreline to a depth of 600 feet throughout most of Maui (reference 15). Coastal and near-shore habitats including reefs are protected under the Pacific Islands Coastal Program (reference 16), and tidal pools house many species of young fish (reference 12). The Kealia Pond National Wildlife

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Figure 3. Surface water features, 15-mile ocean radius, and wells within 4 miles of the Kanaio Training Area in Maui County, Hawaii.

Refuge, which includes a wetland habitat, and Kealia Beach, a known nesting area for the endangered hawksbill sea turtle, are both located along the Maui coast near the approximate perimeter of 15-mile radius west of the Kanaio Training Area (reference 17). The Hawaiian monk seal critical habitat is designated from beaches to a depth of 120 feet around the northwest Hawaiian islands (reference 11). The green sea turtle, which is listed as threatened, and the endangered 'ua'u or Hawaiian dark-rumped petrel may also be encountered within the 15-mile radius (references 15, 18, and 19).

(3) Drinking Water. The Maui County Upper Kula drinking water distribution system, which utilizes the Olinda Water Treatment Facility, serves the Kanaio area and surrounding vicinity using treated surface water from the northeast slope of Haleakala (reference 20). No drinking water intakes or source areas were identified within 0.5 miles of the Kanaio Training Area or within the 15-mile surface water radius (reference 21). Several water tanks on and near the Kanaio Training Area are used for watering cattle. Potable drinking water may also be stored in aboveground tanks near the Kanaio Training Area (reference 20).

e. Soils. Soils at the Kanaio Training Area are described in detail in the Soil Survey of Maui County and are shown on Figure 4 (reference 22). Much of the Kanaio Training Area is covered by recent lava flows, and soils are generally found at higher elevations, north of Pu'u Pimoe and Pu'u Pohakea, or within older pahoehoe flows (reference 23). Most of the surface cover at the Kanaio Training Area falls in the rock land-rough mountainous land association, which is primarily a'a, stony land, or cinder land. About 10% of the Kanaio Training Area is within the Kamaole-Oanapuka association, which include soils developed in weathered volcanic ash. About 5-10% of the Kanaio Training Area may lie within the Pu'u Pa-Kula-Pane association, well-drained medium textured soils on intermediate uplands of East Maui. The soils at the Kanaio Training Area have relatively rapid to high permeability, and runoff is slow to medium.

(1) Rock Land-Rough Mountainous Land Association. Recent a'a lava, very stony land, and cinder land cover most of the Kanaio Training Area. A'a is defined as masses of clinkery, hard, glassy, sharp pieces of lava on rough to undulating topography. Thin layers of ash, extending into cracks and depressions near Pu'u Pimoe and Pu'u Pohakea, support stands of shrubs and grasses. Cinder land, a mixture of bedded magmatic ejecta such as cinders, pumice, and ash with little or no soil development, is found on Pu'u Pimoe and Pu'u Pohakea.

(2) Pu'u Pa-Kula-Pane Association. The Io silt loam, found at the base of Pu'u Pimoe, is developed in volcanic ash and material weathered from cinders. The Io soils consist of up to 40 inches of varying amounts of silt, clay, and loam overlying a substratum of black unweathered cinders. If the soils are exposed there is a slight hazard of wind erosion. The Uma rocky loamy coarse sand is found along the northern boundary of the Kanaio Training Area. The Uma developed in volcanic ash and fine cinders, and consists of less than 10 inches of rocky loamy coarse sand over fine cinders, with a depth to bedrock between 0.5 to 1 foot.

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Figure 4. Soils classification for the Kanaio Training Area in Maui County, Hawaii.

(3) Kamaole-Oanapuka Association. The Oanapuka extremely stony silt loam is found in the west-central part of the Kanaio Training Area. The Oanapuka consists of about 15 inches of silt loam overlying a substratum of silt loam and loam. Stones cover up to 15% of the soil surface area, and the depth to bedrock is between 3.5 and 5 feet.

f. Hydrogeology.

(1) Geology. The islands of Maui, Molokai, Lanai, and Kahoolawe were originally volcanic uplands upon the single ancestral island of Maui Nui (reference 24). As sea levels rose, the volcanic massif of Maui Nui was submerged, resulting in the four separate islands present today (reference 24). Maui is the second largest island in the present-day Hawaii archipelago, and is composed of two volcanoes connected by an isthmus. The Kanaio Training Area is situated upon the southwestern slope of Haleakala, the relatively younger of the two volcanoes that forms East Maui. Haleakala was created by Kula series volcanic eruptions during the Pleistocene era. The Kula andesitic rocks were deposited upon the Honomanu basal basalts and olivines (reference 25). After the Kula volcanic shield surface was deeply eroded, the current landscape of the Kanaio area was formed during recent eruptions of the Hana volcanic series (reference 25). The Hana eruption of Haleakala's Southwest Rift Zone resulted in lava flows and cinder cones, the most prominent of which is Pu'u Pimoe. The basaltic Hana lava flows consist of mostly a'a, with older flows of pahoehoe and cinder near the coast (reference 2). The a'a lava composition at the Kanaio Training Area is 44-45% silica, 10-16% of each iron oxide and magnetite, and 2-4% titanium oxide (reference 26). There is very little alluvium or soil development on the fresh Hana surface. Some limited exposure of Kula rocks may be encountered in the Kanaio Training Area vicinity (reference 25).

(2) Shallow Ground Water. The interconnected void spaces in pahoehoe and layers of clinker between highly fractured a'a flows characteristic of the Hana formation result in high surface permeability (references 2 and 27). A typical feature of the Hana surface is the lack of surface water runoff even during times of heavy rain, which limits development of permanent stream systems (reference 2). The lava in the core of an a'a flow typically cools as a massive body of rock with much lower permeability that may inhibit vertical ground-water flow (reference 27). Additionally, the Kula formation beneath the Hana is known to act as an aquitard in some places and an aquifer in others (reference 25). Perched lenses of fresh water could potentially be developed at the Kanaio Training Area upon confining layers and behind dikes associated with Haleakala's Southwest Rift Zone (reference 27). The Hana may also contain basal ground water near the coast (reference 25). Due to the highly permeable nature of surface, shallow ground water at the Kanaio Training Area would be susceptible to contamination from surface sources (reference 25). The depth to ground water beneath the site is unknown. No surface springs were identified during previous HIARNG surveys, though anchialine pools may be considered springs due to the surface interaction of ground water and sea water. Caves (lava tubes) and lack of surface drainage features due to rapid infiltration mimic karst behavior at the site, though there is no limestone to support true karst terrain development.

(3) Regional Ground Water. The Lualailua aquifer system, with aquifer ID no. 60603, is the regional aquifer system for the Kanaio area (reference 25). The surface of the Lualailua aquifer is primarily the Hana formation, with limited exposures of the Kula series. Basal ground water within the Lualailua occurs mostly within the underlying Honomanu series basalts (reference 25). The Honomanu aquifer may be recharged in upcountry areas where it is exposed to more plentiful surface water infiltration and where it is exposed in deeply eroded gulches. The Honomanu may also be recharged from the Hana formation where the Kula does not form an aquitard (reference 25). The Honomanu aquifer constitutes one of the principal developable aquifers of East Maui (reference 25). Where the Honomanu aquifer is unconfined, it is susceptible to contamination from surface sources. The depth to ground water within the Lualailua aquifer beneath the Kanaio Training Area has not been established. The direction of regional ground-water flow within the Lualailua aquifer system is expected to be toward the coast.

(4) Ground-Water Use. The Lualailua aquifer is not utilized as a primary water source in the Kanaio Training Area vicinity. There are no wells located on the Kanaio Training Area (references 7, 21, 28, and 29). Wells identified by the State of Hawaii within 4 miles of the Kanaio Training Area are shown on Figure 3. None of the wells within 4 miles are used for municipal or domestic water supplies (reference 20). The State of Hawaii has assessed the Lualailua aquifer as having a potential sustainable yield of 11 million gallons per day (MGD) in the Kanaio vicinity (reference 20).

g. Sensitive Environments and Receptors.

(1) Human Receptors. The nearest schools are 9 miles from the Kanaio Training Area in Kula. No schools or daycare centers were identified within 1 mile of the Kanaio Training Area. Kanaio Homestead Lands exist in and around the Kanaio Training Area. Several occupied homesteads appear to exist within the Kanaio Training Area boundaries. Kanaio Church, along with a small homestead community, is located just north of Piilani Highway adjacent to the Kanaio Training Area. The number of individuals residing within each homestead is unknown, but no more than 60 individuals are estimated to reside on or within 200 feet of the Kanaio Training Area (reference 1). There are no full-time employees at the Kanaio Training Area. Up to 400 individuals train at the Kanaio Training Area for up to 12 weekends per year.

(2) Sensitive Habitats. A biological resources reconnaissance of the Kanaio Training Area was conducted in 1993 (reference 3). Several sensitive habitats shown in Figure 2 were identified in the report, and recommendations were made to prevent damage of these important resources. No wetlands were identified in the Kanaio Training Area vicinity. One or more anchialine pools, rare brackish water bodies that provide habitat for a variety of native species including the candidate endangered anchialine pool shrimp, exist within the coastal boundary area of the Kanaio Training Area (reference 3). The rare lowland cave communities identified within Heliconia Cave on the Kanaio Training Area is one of only three such communities

known to exist (reference 3). Pu'u Pimoe supports populations of several rare plants including endangered 'ohai and rare 'aiea (*Nothocestrum latifolium*) and keahi (*Nesoluma polynesianum*) trees (reference 3). The Kanaio NAR, an 876-acre assemblage of native dryland trees and shrubs, is located adjacent to the range along the northeast border (reference 30). The 'akoko coastal dry shrublands, identified just west of the Kanaio Training Area, are considered extremely rare and are known to contain rare plants (reference 3). The 'Ahihi-Kina'u NAR, a 1,238-acre reserve containing marine and recent lava ecosystems is located about ½ mile west of the Kanaio Training Area (reference 30).

(3) Protected Species. A biological resources reconnaissance of the Kanaio Training Area was conducted in 1993 (reference 3). Sensitive, rare, and protected species were identified in the report, and recommendations were made to prevent damage to these important resources.

(a) Plants. Protected plant species known or expected to exist on the Kanaio Training Area include 'ohai, a Federally-listed endangered native shrub; 'ihi (*Portulaca villosa*), a rare herb; maiapilo (*Capparis sandwichiana*), a shrub on the active list of Category 2 candidates for Federal listing as threatened or endangered; pololei (*Ophioglossum concinnum*), a rare fern species; and 'aiea, a rare tree (reference 2). In 1995, a small population of 'ohai was discovered growing on the unconsolidated cinders of the Pu'u Pimoe crater wall (reference 5).

(b) Animals. The Hawaiian bat, or 'ope'ape'a (*Lasiurus cinereus semotus*), which could potentially be found in the rare lowland cave communities on the Kanaio Training Area, is a Federally-listed endangered species. The 'aiea hawkmoth, or Blackburn's sphinx moth (*Manduca blackburnii*), is also federally listed as endangered. The Kanaio Training Area has been identified as an important habitat for the 'aiea hawkmoth, and the HIARNG has mapped the distribution of the moth's host trees and declared them off-limits to training (reference 9). Other species of concern under the U.S. Endangered Species Act at the Kanaio Training Area include the koa bug (*Coleotrichus blackburniae*), o'ahu capper moth (*Plutella capparidis*), and the Howarth's cave cricket and Schauinsland's bush cricket (*Caconemobius* sp. *howarthi* and *schauinslandi*) (reference 2). Possible transient populations of other rare plants and animals have been identified at the Kanaio Training Area (for instance, plants that exist only on relatively fresh lava flow habitat that becomes unsuitable over time) (reference 3). Some vertebrate species may be seasonal in their presence at the Kanaio Training Area. Rare and endangered species such as the Hawaiian dark-rumped petrel and pueo or short-eared owl may fly over the Kanaio Training Area or briefly land in the vicinity. Resident populations of these species have not been identified at the Kanaio Training Area.

(4) Cultural Resources. A multitude of archaeological sites, both historic (or post-contact in 1778) and prehistoric (pre-contact in 1778), have been identified at the Kanaio Training Area (reference 31). A historic preservation plan has been prepared for the Kanaio Training Area, which describes archaeological resources at the site in detail (reference 31). The greatest known concentration of archaeological sites and features is in the coastal area south of

the Kings Trail (reference 31). Use of established firing ranges, including routine maintenance of existing roads and features, was determined to not have an effect on archaeological resources at the Kanaio Training Area (reference 31).

3. OPERATIONAL HISTORY AND WASTE CHARACTERISTICS.

a. General Site History and Current Operations.

(1) Pre-Ranch History. The name “Kanaio” refers to the naio, or bastard sandalwood tree (*Myoporum sandwicense*) (reference 30). The Kanaio Training Area is situated upon former Crown Lands of Hawaii (reference 32). Early Hawaiian land use in the Kanaio vicinity was for dryland agriculture, such as raising sweet and Irish potatoes, sugar cane, taro, pumpkins, gourds, and bananas (references 23 and 31). Nineteenth-century subsistence farmers may have raised cattle, goats, and pigs at the Kanaio Training Area, and locals are known to have collected sea salt and fished in the ocean, using footpaths that traverse the Kanaio Training Area. Many of the southern coastline villages were abandoned by at least 1879 (arch, 1996). The Kings Trail is one of the most conspicuous historic features of the Kanaio Training Area. The trail trends east to west through the coastal area of the Kanaio Training Area, and originally was constructed as a foot and horse path connecting the villages.

(2) Ranch Lease History. Ulupalakua Ranch, purchased by present owner C. Pardee Erdman, Jr in 1962 or 1963, is an important historic ranching operation on Maui (reference 31). The State of Hawaii leased two Tax Map Key parcels of land totaling 8,370 acres to Ulupalakua Ranch, Inc. under General Lease S-3700 starting in 1912 for the purpose of cattle grazing (reference 31). Tax Map Key parcel 2-1-02:01, located south of Piilani Highway as shown in Figure 5, contained 6229.00 acres. Tax Map Key parcel 2-1-03:50 contained 2141 acres north of Piilani Highway. Ulupalakua Ranch subleased 4177.29 acres of land within Tax Map Key 2-1-02:01 to the HIARNG for exercise and training purposes on the Kanaio Training Area, renewing yearly leases starting on 25 March 1965 (reference 33). In 1983, Ulupalakua Ranch negotiated a new lease with the State of Hawaii that excluded four surveyed the Kanaio Training Area impact areas (references 34, 35, 36, 37, and 38). The terms of Revocable Permit No. S-6001, signed on 19 March 1983, allowed Ulupalakua Ranch use of about 8,281 acres of government land within the two original Tax Key Map parcels, excluding about 88 acres used as impact areas by HIARNG (reference 38). On September 14, 1990, 876 acres within parcels 2-1-02:01 and 2-1-03:50 were set aside from the Ulupalakua Ranch lease as the Kanaio NAR (reference 39). The Kanaio NAR set-aside included 281 acres of Tax Map Key 2-1-02:1 that was previously included as the northeast corner of the Kanaio Training Area. On 12 March 1997, Ulupalakua Ranch terminated its contract with the State of Hawaii for Revocable Permit No. S-6001, including the parcel containing the Kanaio Training Area (reference 40).

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Figure 5. Land Ownership in the vicinity of the Kanaio Training Area, Maui County, Hawaii.

(3) Non- Kanaio Training Area Military Use. C. Pardee Erdman reported that live fire practice was conducted by the Army and/or Marines at Pu'u Pimoe during WWII, and that the Kings Trail was used for Jeep traffic and reconnaissance along the coastline. Other sources also reported that Marine training activities occurred in the Kanaio Training Area vicinity during WWII and into the 1950s and 1960s (references 4 and 41). C. Pardee Erdman indicated that ranch land north of the range was never used for military training purposes, and that live fire was never conducted from ships onto the Kanaio Training Area (reference 7). He stated that historic live fire exercises at Pu'u Pimoe set a precedent for military training at the site under which he negotiated the original lease with the HIARNG (reference 7). Evidence of 155mm artillery rounds found throughout the Kanaio Training Area during ordnance removal operations suggests use of the land by branches of the military service other than the Army (reference 4). The Ranch reported that Marines conducted dismounted maneuvers and blank firing practice at the Kanaio Training Area in the 1980s (reference 7).

(4) Army National Guard Lease History. In 1964, the HIARNG began inquiries with Ulupalakua Ranch regarding establishing a firing range (reference 42). The HIARNG had been forced to close the Paukukalo Range for safety reasons, and needed to establish a replacement rifle and weapons range, preferably on Maui. In March 1965, HIARNG entered into Land License No. 1-65 with Ulupalakua Ranch for the use of 4771.29 acres of the land that the ranch leased from the State of Hawaii under General Lease No. S-3700 within Tax Map Key parcel 2-1-02:01. Use of the Kanaio Training Area was originally authorized for up to 6 weekends per calendar year to locate firing points and for firing of heavy-caliber infantry support-type weapons (reference 33). The terms of the license were amended in 1966 to allow HIARNG use of the Kanaio Training Area for up to 12 weekends per calendar year (reference 43). In 1997, Ulupalakua Ranch terminated its contract with the State of Hawaii for the permit containing the Kanaio Training Area parcel. Since that time, the HIARNG seeks temporary Right of Way by submitting memoranda to DLNR for specified weekend training periods at the Kanaio Training Area, and the land has remained unencumbered. The HIARNG is presently seeking an Executive Order (EO) for land transfer of 4707 acres actively used by the HIARNG from the State of Hawaii, validating the Kanaio Training Area as a mission-essential training area available for use by all units of the guard (reference 44).

(5) Property Legal Description. Figure 5 shows land ownership and use in the vicinity of the Kanaio Training Area from 1965 to the present. The legal description describes the Kanaio Training Area as being located at Kanaio, Honualula, Makawao, Maui, Hawaii (reference 36).

(a) Great Mahele Land Commission Awards (LCA) and Grants. In 1848, when Hawaii changed from a feudal land system to private land ownership under the Great Mahele, or land division, individuals lobbied for title of the land (reference 45). Several LCA along the western boundary of the Kanaio Training Area and grants north of Pu'u Pimoe along Piilani Highway are consistently excluded from the Kanaio Training Area in site sketches from 1965 to the present.

Three LCA consistently included within the Kanaio Training Area boundaries are listed in Table 1. Most of the Kanaio Training Area is situated within Government Lands of Kanaio.

(b) Kanaio Homestead Lands. Kanaio Homestead Lands along the northwest edge and in the northeast corner of the Kanaio Training Area are listed in Table 1. Ownership of Kanaio Homestead Lands is unclear. It appears that the Homestead Lands may be privately used for farming and residential use within the Kanaio Training Area boundaries.

(c) 1983 Impact Area Parcels. In 1981 or 1982, HIARNG requested unspecified conditions for its future leases as a temporary measure to ensure continued Federal support at the Kanaio Training Area (reference 36). Accordingly, Ulupalakua Ranch indicated that it wished to reduce the area leased from the DLNR with a commensurate reduction in rental fees under its new permit (reference 46). In 1982, DLNR requested that HIARNG provide a more detailed map showing Areas A, B, C, and D to resolve issues surrounding the terms of the Ulupalakua Ranch's lease renewal (reference 35). In response, HIARNG submitted Parcels 1, 2, 3, and 4 as surveyed by R.T. Tanaka Engineers, Inc. on July 8, 1982 (reference 36). The parcels were subsequently excluded from the Ulupalakua Ranch, Inc., Revocable Permit No. S-6001 with the State of Hawaii DLNR. There is no further documentation regarding encumbrances for these parcels, although the HIARNG continued to use at least Parcels 1 and 2 for training and maneuvers from 1983 to 1997, apparently without requesting use of these areas directly from DLNR.

i. Parcel 1. Parcel 1 corresponds to Impact Area 3B plus part of the "All Other" areas north of Pu'u Pimoe. Parcel 1 was surveyed as 80.014 acres in size, and included the small arms range. Parcel 1 as surveyed in 1982 included a corral, two latrines, the concrete "kitchen pads," cinder pit, and three target rails (M16, M60, and 45-caliber) (reference 36). Parcel 1 contains LCA 5275:3 and is situated within portions of Kanaio Homestead Lands and Grant 1506 to Kuihelani (Table 1).

ii. Parcel 2. Parcel 2 corresponds to Impact Area 3A southwest of Pu'u Pimoe. Parcel 2 is 21.710 acres in size, and was fenced along the west and northwest edges, with a rock wall along the south edge in 1982 (reference 36). Parcel 2 is situated within government lands at Kanaio.

iii. Parcel 3. Parcel 3 is a restricted area due to UXO, corresponding with Impact Area 1; the parcel was fenced and posted with signs in 1981. Parcel 3 has an area of 24.441 acres and is located southwest of Pu'u Pimoe (reference 36). Kanaio Homestead Lands Parcels 13 and 15 are located west of and partly within the west edge of Parcel 3 (Table 1).

TABLE 1. LAND COMMISSION AWARDS, GRANTS, AND KANAIO HOMESTEAD LANDS PERTAINING TO THE KANAIO TRAINING AREA

Parcel Identification	Owner	Grant Identification	Acreage	Description
3 (also parcel 57)	Ulupalakua Ranch plus multiple owners	LCA 5275:2 RP 4327	2.488	Southwest of Pu'u Pimoe within Kanaio Training Area.
6	Multiple owners	LCA 5274:3	2.52	South of Pu'u Pimoe within Kanaio Training Area. Not shown on all tax maps, and "approximate location" used when it is.
22 (also parcel 56)	Multiple owners	LCA 5275:3 RP 4327	0.443	North of Pu'u Pimoe within Kanaio Training Area, wholly located within 1982 surveyed Parcel 1 maneuver area.
9	Kanaio Homestead Lands		73.2	Northwest corner within Kanaio Training Area
10	Kanaio Homestead Lands		71.4	Northwest corner within Kanaio Training Area
11	Kanaio Homestead Lands		79.5	Northwest corner within Kanaio Training Area
12	Kanaio Homestead Lands		76.0	Northwest corner within Kanaio Training Area
13	Kanaio Homestead Lands		74.0	Northwest corner within Kanaio Training Area, partly included within 1982 surveyed Parcel 3.
14	Kanaio Homestead Lands		37.8	Northwest corner within KA Kanaio Training Area
15	Kanaio Homestead Lands		57.0	Northwest corner within Kanaio Training Area, partly included within 1982 surveyed Parcel 3.
16	Kanaio Homestead Lands		159.7	Northeast corner inside/outside Kanaio Training Area, now within Kanaio NAR.
23	Multiple?	Grant 1506 to Kuihelani	101.00	North of Pu'u Pimoe along Piilani Highway, generally excluded from Kanaio Training Area boundaries but included within 1982 surveyed Parcel 1.
61	Multiple?	Grant 2338 to Kekuhaulua	85.731 acres	Approximately 1/3 of parcel is south of Piilani Highway, generally excluded from Kanaio Training Area boundaries but included within 1982 surveyed Parcel 1.

iv. Parcel 4. Parcel 4 is a restricted area due to UXO, corresponding with Impact Area 2; the parcel was fenced and posted with signs in 1981. Parcel 4 has an area of 14.983 acres and is a triangular-shaped piece of land southeast of Pu'u Pimoe. Parcel 3 is located within government lands at Kanaio.

(d) Kanaio NAR. Portions of Ulupalakua Ranch, including 281 acres in the northeast corner of the Kanaio Training Area, were set aside as the Kanaio NAR under the DLNR Division of Forestry and Wildlife in 1990 (reference 39). It is not clear as to whether the set-aside involved removal of this parcel from the Land License 1-65. The Kanaio NAR is not included in the EO package for inclusion in the Kanaio Training Area. Several of the HIARNG firing

points, including those used for firing 4.2-inch mortars toward Area D, were located within the present-day Kanaio NAR.

(e) Beach Reserve. Tax Map Keys indicate Beach Reserves and private land holdings along the coastal area of the Kanaio Training Area as shown in Figure 5. The beach reserve is not shown on all site sketches and maps.

(f) Standard Operating Procedure (SOP) Boundaries. The 299th Bn field map for the Kanaio Training Area indicates that areas west of the historic and EO boundaries are included as field training areas. It appears that an access road along the western edge of the SOP boundary may be important for HIARNG use of the Kanaio Training Area.

(6) Construction Activities. There are no permanent structures at the Kanaio Training Area for troop housing, support, or supply, though structures and elements of the firing range have been maintained at the Kanaio Training Area (reference 4). A shed with no utilities connections reportedly exists at the base of Pu'u Pimoe along with field latrines and two kitchen slabs. An access road, also known as Kanaio Prison Road, connects Piilani Highway to Pu'u Pimoe. In 1989, site improvements including temporary construction of unnamed features were suggested by the 1st Bn 299th (reference 47). It is not known whether any of these site improvements were made, but the SOP indicates that no construction of any type is authorized under the lease agreement (reference 48).

(7) Site Mission and Use. The Kanaio Training Area has been referred to as a Range and Weekend Training Site (WETS), Kanaio Firing Range, Kanaio Training Area and Range, and Kanaio Impact Range. The mission is to operate and maintain a safe training area for HIARNG personnel on up to 12 weekends per calendar year. The Kanaio Training Area was primarily utilized by the HIARNG 1st Battalion, 299th Infantry, C Company (-Det 1), and Det 1, and is administered by the Commanding Officer, 1st Bn 299th Infantry (reference 32). Other units who have trained at the Kanaio Training Area include the HI Air National Guard, US Army Reserve, components of the Armed Forces, and law enforcement agencies. The HCC has been disbanded, and HIARNG's 1st Bn and C Company combined presently train up to 130 troops quarterly at the Kanaio Training Area (reference 2). Infantry training activities at the Kanaio Training Area presently include limited cross-country dismounted infantry squad training and small weapons training and qualifying using blank and live fire in the vicinity of Pu'u Pimoe (reference 49). Small weapons training includes pistol and M60 rifle training using blanks, with live fire limited to annual qualification (reference 49). Areas makai, or ocean-side, of Pu'u Pimoe were used for training with larger weaponry including rockets, grenades, and mortars of various types prior to 1979 (reference 50). A small arms range north of Pu'u Pimoe was closed in December 1998.

(8) Public Use of the Kanaio Training Area. The SOP states that hunting is not permitted within the boundaries of the Kanaio Training Area, and that travel through the Kanaio Training Area to surrounding ocean areas is permitted with the approval of the Commanding

Officer, 1st Bn 299th Infantry. In general, though, public use of the Kanaio Training Area is authorized for recreational purposes unless guards are posted during active training (reference 2). Civilians use footpaths and 4-wheel drive roads to access the coastline, traverse the Kings Trail, and for recreational camping and hiking. Recreational and subsistence hunting, fishing, and non-authorized shooting and target practice take place on the Kanaio Training Area; numerous non-military firearm cartridges have been found near Pu'u Pimoe (references 2, 7, and 41). Locals have used lava tubes for refuse disposal without HIARNG authorization (reference 2). Civilians visit the Kanaio Training Area, particularly along the coastline area south of Kings Trail, for artifact collection, scenic viewing, photography, participation in religious activities, or study and worship of Hawaiian archaeological, cultural, and religious sites (reference 2). Private residences border the Kanaio Training Area along the east, north, and west boundaries; some residences appear to be located within the Kanaio Training Area boundaries. These nearby landowners engage in small-scale livestock raising and agriculture (references 2 and 45). Interagency biological and archaeological research is conducted on the Kanaio Training Area (references 2 and 5).

b. Regulatory Activities. No underground storage tanks have been registered at the Kanaio Training Area. An EO for the purpose of obtaining full ownership of the Kanaio Training Area from the State of Hawaii has been in-process since 1999. The HIARNG is involved in interagency management of endangered species and habitats on the Kanaio Training Area. At least two UXO removal operations have been conducted at the Kanaio Training Area in 1981 and again in 1998. A UXO removal operation was reportedly planned in 1988, but no confirmation could be found to determine whether the operation actually occurred. Archaeological sites on the Kanaio Training Area have been recommended for listing on the National Register of Historic Places. A small arms range was removed and the soil was tested for lead. Solid waste produced at the Kanaio Training Area is typically removed after training, but a lava tube was filled with refuse and was cleaned out during the 1998 UXO removal operation. No field refueling or rifle cleaning is conducted at the Kanaio Training Area. Extra rounds of ammunition remaining after practice or qualification is turned-in. No hazardous waste disposal areas have been identified at the Kanaio Training Area.

(1) Executive Order (EO).

(a) History and Rationale. The NGB requires the HIARNG acquire the Kanaio Training Area under State EO to obtain full stewardship control of the site and subsequent Federal funding (reference 5). The HIARNG sought acquisition of the EO for 4707 acres at the Kanaio Training Area A starting in March 1999 (Figure 5) (reference 5). The Land Division of the Hawaii DLNR agreed with the request of an EO for the unencumbered state lands, and approved a Conservation District Use Permit for the set-aside in October 1999 (reference 5). The DLNR requires the HIARNG to produce a State and County certified parcel map to include with the EO package for the Governor's signature. In September 2000, HIARNG contracted a surveyor to revise the existing plat maps, and several draft maps were reviewed by the Maui County

Planning Office (reference 5). The Maui County Land Use and Codes Division provided requirements for editing the maps, but the final subdivision maps have not yet been produced by the HIARNG (reference 5). Until the maps are produced, the EO package cannot be submitted for the Governor's signature.

(b) Land Use Changes Under EO. The coastal area of the Kanaio Training Area, previously situated within Area C, will no longer be included in the Kanaio Training Area under the EO. The proposed Kanaio Training Area boundaries for the EO encompass over 1,000 acres of land along the west edge of the Kanaio Training Area previously excluded from Kanaio Training Area site sketches and maps from 1965 to the present. It appears that the proposed Kanaio Training Area boundaries coincide with the historical Ulupalakua Ranch lease boundaries south of Piilani Highway excluding the coastal area. It should be noted that the proposed Kanaio Training Area boundaries encompass at least 13 LCA parcels that are privately owned, many of them by more than one owner apiece, plus a suite of Kanaio Homestead Lands lots. A brief note in one of the EO package figures indicates that the proposed boundary does not include homestead lots, grants, or LCA within the perimeter.

(2) Environmental Stewardship. The Kanaio Training Area is considered to be one of the HIARNG's most biologically rich ecosystems, and is a focus of HIARNG's resource conservation efforts (reference 9). Several biological surveys have confirmed that the Kanaio Training Area supports five significant biological communities, as well as a number of endangered, threatened, and rare species (reference 5).

(a) 'Ohai and 'Aiea Hawkmoth Habitat. In 1997 and 2001, HIARNG evaluated the habitat and distribution of 'ohai and 'aiea hawkmoth at the Kanaio Training Area, and recommended that the USFWS designate a total of 322 acres as Critical Habitat due to their importance for the species' survival (reference 5). The potential for Critical Habitat to conflict with training exercises was evaluated, and training restrictions were issued for the Kanaio Training Area; no mission impact was anticipated due to Critical Habitat designation (references 5 and 51). Training restrictions render Pu'u Pimoe off-limits for any type of training; no smoking of any kind is allowed; fire and/or signal flares are prohibited; and clothing, boots, gear, and equipment should be inspected for seeds, eggs, and larvae prior to entry onto the Kanaio Training Area (reference 51). The HIARNG constructed three fenced exclosures protecting 21 acres of dryland and a'a lava flow habitat from ungulate trampling and grazing (reference 5). Two half-acre sites were fenced to protect outplanted 'ohai communities, and the third site, which is located near the Kanaio coast, consists of relatively weed-free *kipuka* containing other native species. The HIARNG, with assistance by individuals from the State of Hawaii, University of Hawaii, and Ulupalakua Ranch, planted donated 'ohai stock along with endemic wiliwili stock in the exclosures in November 2001 (reference 5). The HIARNG is now awaiting completion of the EO before proceeding with active stewardship of the site biological resources (reference 5).

(b) General Environmental Management. Following issuance of the EO, the HIARNG plans to protect and manage the 'a'ali'i shrubland, to proceed with out-planting native host plants for the 'aiea hawkmoth, and to take biological inventories of lava tubes at the Kanaio Training Area (reference 52). The Kanaio Training Area has been the ongoing focus of a management plan that was developed by the National Park Service in 1996, fountain grass and other invasive species eradication efforts, a pesticide quantity reduction program, HIARNG land condition trend analysis, experimentation with use of native fire-resistant plants for fire management purposes, and a Natural Resources Compliance Program (reference 5). The Kanaio Training Area has also been used for experimental habitat restoration methods and programs (reference 5).

(3) 1981 UXO Removal Operation. In the summer of 1981, unexploded mortar shells were identified inland of the Kings Trail during an aerial survey of the Kanaio Training Area, indicating that troops did not remove UXO after training per the lease agreement (references 50 and 53). The Ulupalakua Ranch was notified of plans to clear the area of UXO, and the Kings Trail through the Kanaio Training Area was closed for safety purposes on 9 July 1981 (references 51 and 54). The explosive ordnance disposal (EOD) team that conducted UXO removal in 1981 concluded that the normal 10% recovery rate for UXO was not achieved at the Kanaio Training Area because the brittle lava allowed high-angle steel-cased and delay-fuzed mortars to penetrate and detonate underground, resulting in a heaving effect that covered debris and UXO that would normally be found on the surface (reference 26). Upon completion of the range sweep, the EOD team researched the feasibility of electronically locating UXO under the surface of the lava, finding that the then state-of-the-art MK22 locator, as tested on Kahoolawe where the lava is similar, would not work at the Kanaio Training Area (reference 26). For this reason, the EOD team felt that it would not be possible to conduct 100% removal of UXO at the Kanaio Training Area.

(a) August 1981 Survey. On 3-6 August 1981 an EOD team cleared the Kings Trail, fishermen's paths to and from the ocean, the 3.5" rocket firing range, M79 40 mm grenade range, and 2 M72 LAW impact areas (reference 26). Search sweeps produced debris from approximately thirty 81mm illumination projectiles, five 81mm old-style practice projectiles, three 81mm white phosphorus projectiles, and one 81mm illumination UXO along the Kings Trail, and more than 200 pieces of practice rounds from the M72 LAW rocket range (reference 26). UXO at these locations was destroyed in place (reference 55). The M72 LAW rocket range and the M72 LAW rocket or 40mm grenade range were not swept by the EOD team due to the sensitivity of the UXO fuzes (reference 26). UXO was observed at the M72 LAW rocket range; no UXO was observed at the M72 LAW rocket and 40mm grenade range (reference 26). The general boundaries of the two impact areas were enclosed with barbed wire fencing, marked with warning signs, and permanently restricted from entry (reference 26). The Kings Trail and fishermen's trails were reopened for public use on August 6, 1981 (reference 55). Future use of the Kanaio Training Area was restricted to small-caliber weapons, and mortar firing was discontinued.

(b) September 1981 Follow-Up Survey. On August 17, 1981, HIARNG received confirmation that 4.2-inch mortar firing was conducted at the Kanaio Training Area, requiring further sweeps from firing points 1 through 4 to Area D (reference 56). The follow-up sweeps were conducted on 14-18 September 1981 (reference 55).

(4) 1988 UXO Consolidation Plan. The HIARNG planned to conduct a UXO removal action during August through September 1988 using EOD and HIARNG personnel (reference 57). Plans included onsite detonation of UXO and consolidation of inert ordnance and other scrap metal into a single location for abandonment. There was no direct follow-up to this memorandum in the record. However, prior to the 1998 UXO removal operation, practice and illumination rounds were located in a pile within a ravine at the northern apex of Impact Area 2, and EOD experts concluded that the material was carried there in sandbags to be detonated during a previous consolidation effort (reference 4). The 1998 findings seem to confirm that the 1988 UXO consolidation operation may have been carried out as planned.

(5) 1998 UXO Removal Operation. The UXO operation was conducted between 27 November and 18 December 1998 (reference 58). The access road from Piilani Highway to Pu'u Pimoe was reconstructed, and four abandoned cars and a large dumpster were recovered and disposed-of offsite. The small arms range was closed, and a lava tube was cleaned out and barricaded to prevent subsequent dumping. Impact areas 1, 2, 3A, 3B, and an "all other" area, were cleared of live and practice ordnance. A 100% surface inspection was conducted of the ranges by teams moving at 5-foot separation intervals, and recovered scrap material was placed in small plastic tubs for subsequent inspection, sorting, and demolition if needed (reference 58). A total of 10 explosive ordnance items were disposed of by detonation, and 15 practice 81mm mortar rounds with inert filler were demilitarized using explosives (reference 58). Demolition was conducted in three tightly controlled, electronically initiated demolition shots in an undisclosed location (reference 58). All live ordnance items were completely destroyed, and damaged or distorted practice rounds were recovered and disposed of as scrap. A total of 886 lb of combined ordnance-related scrap metal was turned-in to Maui Scrap Metal Recycling (reference 58).

(6) Management of Archaeological Resources. Many historic and prehistoric (prior to 1778) archaeological sites have been identified at the Kanaio Training Area (reference 2). Archaeological sites are concentrated south of the Kings Trail along the coast; though some sites are found elsewhere on the Kanaio Training Area (reference 2). The area south of the 200 msl topographic line along the coast could qualify as a Historic District, based on the concentration of sites and features of archeological significance (reference 2). Seven sites at the Kanaio Training Area are protected by the State of Hawaii Historic Preservation Division; five of these sites meet the criteria for the National Register of Historic Places (reference 4). Sites within or near identified impact areas have been surveyed for archaeological resources. As further surveys are conducted, additional sites or features may be discovered that meet criteria for protection (reference 4). Guidelines for protecting archaeological resources at the Kanaio Training Area

include restricted military training outside of designated firing ranges near Pu'u Pimoe, restricted new development of military training facilities and infrastructure, oversight of environmental programs that might disturb archaeological sites in caves or other settings, and restricted public access to areas of known or expected archaeological sites (reference 31). No memorandum containing guidelines for protection of archaeological resources was found in 1st Bn HQ files for the Kanaio Training Area, so they may not yet have been implemented.

(7) Small Arms Range Remediation. Impact Area 3B is a small arms range located north of Pu'u Pimoe that was cleared for UXO and removed in 1998. The site was visually cleared of ammunition on 30 November and 4 December 1998 (reference 58). Three biased soil samples were collected in areas expected to have heaviest range use from 0-15 inches deep within Impact Area 3B after bulldozing the berms. One sample contained 38 mg/Kg lead, and the other two were non-detect, so results were below state and Federal cleanup requirements (reference 58). The EOD contractor recommended that Impact Area 3B be closed (reference 58).

(8) Solid Waste. The Kanaio Training Area SOP states that liquid kitchen wastes, garbage, and rubbish will be disposed of as indicated in FM 21-10 (Field Hygiene and Sanitation), as amended, or will be properly closed upon departure from the Kanaio Training Area (reference 48). The 1st Bn reportedly keeps training simple to minimize clean-up upon completion of exercises; rubbish and scrap metal are picked up and transported from the Kanaio Training Area after training (reference 49). A lava tube filled with rubbish was cleaned out using an excavator during the 1998 ordnance removal operation, and a soil sample was taken from the bottom of the lava tube for volatile organic compound (VOC) analysis (reference 58). Sample results were non-detect (reference 58). Steel plates were welded in place to prevent future unauthorized solid waste disposal in the lava tube (reference 58).

(9) Aerial Reconnaissance Surveys. Aerial reconnaissance surveys are conducted to support the lease agreement, originally with Ulupalakua Ranch and now with the State of Hawaii DLNR. The surveys are reportedly conducted annually, though continuous documentation of annual surveys was not readily available in HIARNG records. Typical annual aerial survey results indicate that fencing and signs are damaged, removed, and/or vandalized. Recommendations are generally made to replace/restore fencing and signage (references 59, 60, 61, and 62).

c. Site-Specific Operational History and Waste Characteristics Analysis. Site locations are depicted in Figure 6. Table 2 compares ranges listed on the NGB website for Kanaio WETS and the Kanaio Training Area with range documentation found during this assessment. The following paragraphs describe sites investigated during this assessment.

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Figure 6. Sites Investigated at the Kanaio Training Area, Maui County, Hawaii.

TABLE 2. KANAIO WETS AND KANAIO TRAINING AREA RANGES, NGB WEBSITE.

Range ID	Range Name	Type	Primary Munitions	Status	Inferred Comparison to Documented Training Areas
15A85-01	TSC Area	Heavy Maneuver Area	None Given	Currently Active	TA 1/2/3
15X07-01	Kanaio Light Maneuver Area	Light Maneuver Area	Pyrotechnics	Currently Active	TA 1/2/3
15X07-02	UXO Area-Non Standard Small Arms Range	Combined Non Standard Small Arms Range	Small Arms (Historic Use: Dudded Impact Area)	Currently Active	Impact Area 3A
15A85-02	NS Small Arms Range	Non-Standard Small Arms Range	Small Arms	Closed	Impact Area 3B
15A85-03	KD Range	Known-Distance Range-Single Purpose Small Arms	Small Arms	Closed	Impact Area 3B
15A85-04	KD Range	Known-Distance Range-Single Purpose Small Arms	Small Arms	Closed	Impact Area 3B
15A85-05	Core Impact Area	Impact Areas-Combined	None Given	Closed	Impact Area 1 or 2
15A85-06	Core Impact Area	Impact Areas-Combined	None Given	Closed	Impact Area 1 or 2
15A85-07	KD Range	Known-Distance Range-Single Purpose Small Arms	Small Arms	Closed	Impact Area 3B

(1) Areas A, B, C, and D. Areas designated as A, B, C, and D reflect the original plan for training use of the Kanaio Training Area. No environmental contamination is expected to be associated with historical small arms fire or maneuver training within Areas A, B, C, or D. Environmental contamination may be associated with buried explosives and/or pyrotechnics associated with high explosives training, particularly within Areas A, C, and D.

(a) Area A. Area A includes the western approximately 1-mile wide strip of the Kanaio Training Area plus the area surrounding both cinder cones. Area A was originally established for maneuver and bivouac training with live fire permitted only at the small arms range at the base of Pu'u Pimoe (reference 33). No construction of permanent structures was allowed under the original Land License. In 1966, the Land License was amended to allow use of Area A for location of firing points and for firing of heavy caliber infantry support-type weapons (reference 43). In 1982, the Land License was amended to allow construction of permanent structures incident to the operation of the small arms range or training of personnel at the range (reference 63). A Hawaiian burial cave located in Area A was declared off-limits to all HIARNG personnel, and no entrance into, maneuver over, or firing into this area was permitted under the Land License No. 1-65 (reference 33).

(b) Area B. Area B is located in the northeast corner of the Kanaio Training Area. Area B was established under the original Land License No. 1-65 for conducting live firing of heavy caliber support-type weapons from firing positions established along Piilani Highway (reference 33). On a 1981 map, firing points 1-4 are located along Piilani Highway, northeast of Pu'u Pimoe. Firing points 1 and 2 appear to be north of the Piilani Highway. It is likely that these

firing points were the source of reports that soldiers fired across Piilani Highway to the range (reference 41). The impact area for projectiles fired from Area B was limited to Area C under the original land license (reference 33). However, in 1981 the HIARNG determined that 4.2-inch mortars were fired from firing points 1-4 toward Area D (reference 56).

(c) Area C. Area C, which comprises most of the coastal portion of the Kanaio Training Area south of Areas A and B, was designated as an impact area for projectiles fired from Area B (reference 33). When the Land License was amended in 1982, live fire of small arms or heavy caliber infantry support-type weapons was authorized from Areas A, B, and C from firing positions established in accordance with standard safety requirements and procedures for range operations (reference 63). Early documentation indicated that Area C was designated as an impact area because the HIARNG considered it to be an impassible wasteland except by means of designated trails (reference 64). Ulupalakua Ranch designated *kipuka* within Area C as “no fire” areas in the use permit agreement because cattle find their way into the *kipuka* during extremely dry periods (reference 64).

(d) Area D. Area D, which is located along the coast in the far southeast corner of the Kanaio Training Area, contained a livestock watering area belonging to Ulupalakua Ranch and was considered to be outside of the licensed area prior to issuing the original Land License (reference 65). Area D was included in the final Land License No. 1-65 and in later revisions of the license, under the terms that it be declared off-limits to all HIARNG personnel (reference 33 and 63). However, Area D was later determined to have been the impact area for 4.2-inch mortars fired from firing points 1-4 along Piilani Highway prior to 1979 (reference 56). Although surface sweeps along the firing path from firing points 1-4 to Area D were recommended, available documentation did not indicate whether these particular sweeps were conducted (reference 55).

(2) Impact Areas 1, 2, 3A and 3B, and “All Other” Area. These sites are all located within Area A. Impact Areas 1, 2, 3A and 3B were so named for the purpose of the 1998 UXO removal operation. It should be noted, however, that although the sites were labeled as impact areas, they were in fact a combination of small arms ranges, high explosives firing points, and high explosives targets. Impact Areas 1, 2, and 3A, used for high explosives training, were first documented during the 1981 UXO removal operation. The last high explosive rounds training at the Kanaio Training Area occurred during July 1979 (reference 50). Access to Impact Areas 1 and 2 was restricted for safety reasons following the 1981 UXO removal operation, and Impact Area 3A was cleared during the 1998 UXO removal operation. Impact Area 3B, a small arms range, was removed and closed during the 1998 UXO removal operation. The only remaining active range at the Kanaio Training Area, a 25-meter rifle qualifying range, is reportedly located at Impact Area 3A. The “all other” area defined for the 1998 UXO removal operation consists of land used for training and maneuver, excluding live fire areas, surrounding Pu’u Pimoe. Site descriptions and applicable UXO removal operations are described in detail in the following paragraphs. No environmental contamination is expected to be associated with small arms and

maneuver training within the impact areas or “all other” area. Environmental contamination may be associated with explosives and/or pyrotechnics residues or buried UXO associated with high-explosives training, particularly in Impact Areas 1, 2, and 3A.

(a) Impact Area 1 (M72 LAW Missile and M79 40mm Grenade Range). This site is situated south-southwest of Pu’u Pimoe, and was described in 1996 as a 25-acre rectangular-shaped piece of land enclosed within a 2-strand barbed-wire fence that was used as an M79 grenade and LAW firing range (reference 4). Impact Area 1 was surveyed in 1982 for lease purposes as Parcel 3 (reference 36). The impact area is largely unvegetated, though some non-native scrub habitat exists along the western edge of the site (reference 4). No protected species or habitats were identified or are expected to occur within Impact Area 1 (reference 4). One archaeological site, a stone enclosure and stacked rock cairns probably related to 19th or early 20th century ranching activities, is present in the northeastern part of Impact Area 1 (reference 4). Abandoned cars were helicoptered into the mortar fire area for target practice (reference 7). Local ranchers observed white-painted mortar shells at the vehicle target sites (reference 7).

i. 1981 UXO Removal Operation. During the 1981 UXO removal operation, this site was deemed unclearable due to the sensitivity of the fuzing on both the LAW missiles and 40mm grenades, though UXO was not observed (reference 26). The M79 40mm grenade contains an impact/anti-graze fuze, which is designed such that changing the orientation of the grenade causes the main charge to detonate (reference 26). The area was enclosed with barbed wire fencing and warning signs in 1981, and was permanently restricted from use (references 55 and 66). A target site including two vehicle targets located 30 meters apart from one another was visually examined, and fin sections of detonated 81mm mortars were observed (reference 26). Several automobile chassis used for targets were removed from the range (reference 55).

ii. 1998 UXO Removal Operation. EOD personnel performed a surface sweep of Impact Area 1 on 2 December 1998, collecting 87.5 lb of ordnance-related scrap and 18.5 lb of non-ordnance related scrap (reference 58). Ordnance items found included live and practice 40mm rounds, M74 sub-caliber rounds, LAW rocket motor tubes, signaling flare tubes, and tail booms to recoilless rifle rounds (reference 58). Live ordnance items found included one 40mm practice round, one LAW rocket warhead with fuze, 2 LAW rocket warheads without fuze, and one 40mm HE round (reference 58). Target debris, including a 1958 Town and Country Station Wagon, was located in the center of Impact Area 1.

iii. Present Day Status. Impact Area 1 is restricted from use. Annual aerial surveys are conducted by HIARNG to confirm that signage and fencing is maintained to prevent unsafe entry by troops or civilians.

(b) Impact Area 2 (M72 LAW Rocket Range). The site is a 15-acre triangular-shaped parcel southeast of the Pu’u Pimoe cinder cone that was used for LAW rocket training. Impact Area 2 was surveyed in 1982 for lease purposes (reference 36). The eastern and western

boundaries of Impact Area 2 run along ridgelines, and the boundaries are marked by a 2-strand barbed-wire fence. One archaeological site, a rock enclosure cleared of large rocks that is typical of Pre-Contact temporary shelters common in Hawai'i, was identified in the northeastern portion of Impact Area 2 (reference 4). Impact Area 2 terrain consists largely of barren and undulating a'a fields. Sparse non-native scrub habitat at the site includes some native plants, though no rare or endangered plant or wildlife species or habitats were observed (reference 4).

i. 1981 UXO Removal Operation. In 1981, the M72 LAW rocket range was not swept due to the likelihood of fuzing; UXO were observed by the EOD team (reference 26). The M72 LAW utilizes two fuzes, which are so sensitive that the slightest action upon them can result in a detonation. The nose fuze contains a piezo-electric crystal that generates an electrical pulse upon minimal stress, movement, or temperature change; the detonator can also be functioned by electromagnetic radiation. The base fuze contains an anti-graze element; any action producing a sensation of deceleration allows the striker to detonate the main charge of explosives (reference 26). Impact Area 2 was enclosed with barbed wire fencing and warning signs, and was permanently restricted from access (references 55 and 66).

ii. 1998 UXO Removal Operation. An EOD surface ordnance sweep was performed at Impact Area 2 on 3 December 1998, collecting 424 lb of ordnance-related scrap and 3 lb of non-ordnance related scrap (reference 58). Ordnance items found included practice 3.5-inch rockets, practice 81mm mortar rounds, LAW rocket motor tubes and 81mm sub-caliber rounds (reference 58). Live ordnance items found were one practice 81mm mortar with live fuze, two LAW rocket warheads with fuzes, one LAW rocket warhead without fuze, and one 40mm HE round (reference 58). During initial reconnaissance, indications of 3.5 inch High-Explosive Anti-Tank (HEAT) and practice rockets, M73 LAAW subcaliber rounds, 81mm practice and illumination rounds, and 155mm artillery rounds were found (reference 4). Most of the practice and illumination rounds were located in a pile at the northern apex of the triangle in a ravine, appearing to have been carried there in sandbags to be detonated during a previous clearance effort (reference 4).

iii. Present Day Status. Impact Area 2 is restricted from use. Annual aerial surveys are conducted by HIARNG to confirm that signage and fencing is maintained to prevent unsafe entry by troops or civilians.

(c) Impact Area 3A (Sub-Caliber Range, SABOT, or 81mm Mortar Firing Point and Targets, Possible 25-Meter Rifle Range). This site is situated north of Impact Area 1 and southwest of Pu'u Pimoe as shown on sketches made in 1980, 1981, and 1987. Impact Area 3A was included within Parcel 2 during surveying for lease purposes in 1982 (reference 36). The boundary of the 10-acre site is indistinctly marked with white paint on the a'a lava surface (reference 4). The Impact Area 3A surface is mostly barren a'a lava with non-native scrub habitat and a few cinder patches near the access road (reference 4). Some native species were observed, but no rare or endangered plants or archaeological sites were identified or are expected

to exist at Impact Area 3A (reference 4). Impact Area 3A was a sub-caliber range for 81mm mortar, the position occupied by the center of a weapon during firing of the 81mm mortar was within 25 meters of the firing point marker (references 48 and 58). The SOP states that road guards were required during firing, indicating either that firing of mortar may have occurred from Impact Area 3A to targets farther south on the Kanaio Training Area, or from firing points north of Piilani Highway toward Impact Area 3A (reference 48).

i. 1998 UXO Removal Operation. An EOD team conducted a surface sweep at Impact Area 3A on 1 December 1998, collecting 171 lb of ordnance-related scrap along with 10.5 lb of non-ordnance scrap. Ordnance items found included 81mm mortar sub-caliber rounds and signaling flare tubes; no live ordnance items were found. Evidence of 155mm artillery rounds was found in Impact Area 3A (reference 4).

ii. 25-Meter Qualifying Rifle Range. Impact Area 3A is reportedly the present-day location of the 25-meter qualifying rifle range actively used by the HIARNG. Charlie Company and the 1st Bn reportedly use the 25-meter rifle range for live fire qualification and practice approximately once per quarter. A total of approximately 130 individuals practice quarterly using about 60 rounds per person per practice. During yearly qualifying, each individual may use up to 90 live rounds (reference 49).

(d) Impact Area 3B (Small Arms Firing Range, or Rifle, Pistol, and Machine Gun Range). This site is a 3.8-acre small arms range situated along the north flank of Pu'u Pimoe as shown in a 1987 sketch (reference 58). The small arms range was established under the original Land License No. 1-65 with firing points along the foot of Pu'u Pimoe with firing directed into the Pu'u (reference 33). Impact Area 3B was included within Parcel 1 during surveying for the lease agreement in 1982 (reference 36). Under the original license, firing was limited to a range of 25 meters and was not allowed to involve the construction of any permanent structures (reference 33). An undated plat map that appeared to be from the 1960s showed a range sketched along the east flank of Pu'u Pimoe. In 1996, the range was described as a flat area approximately 1060 feet east to west, extending 165 feet north from the base of Pu'u Pimoe. Five earthen berms extended perpendicular from the north base of Pu'u Pimoe, with the western and eastern berms forming the west and east boundaries of the range. The berms were spaced over 30 meters apart, and the space between each pair of berms was used as a small arms firing range. The four ranges appear to coincide with the NGB's list of closed small arms and known distance ranges at the Kanaio Training Area. The small arms range was entirely vegetated with non-native scrub habitat prior to the 1998 UXO removal operation. No rare or endangered plant or wildlife species or archeological sites were identified at the small arms range (reference 4). The County of Maui had a cinder quarrying operation west of the small arms range (reference 67).

i. Small Arms Firing Range. The small arms range was located north of Pu'u Pimoe and was apparently established in 1965 or soon thereafter. After mortar fire practice at the Kanaio

Training Area was suspended in 1981, the HIARNG indicated that the small arms range at the base of Pu'u Pimoe would continue to be used (reference 53). The small arms range may have been used until 1998.

ii. 1998 UXO Removal Operation. In December 1998, the surface berms were bulldozed toward the Pu'u Pimoe, restoring the original cone slope (reference 58). The EOD team conducted surface sweeps of Impact Area 3B on 30 November and 4 December 1998, collecting at least 10.5 lb of ordnance-related scrap along with 8.5 lb of non-ordnance related scrap metal (reference 58). Ordnance items found included small arms ammunition and brass, shotgun shells, and practice grenades (reference 58). The EOD contractor recommended that Impact Area 3B be closed (reference 58).

iii. Present-Day Status. Because of the area's wind and comparatively arid climate, small arms cartridge casings will probably continue to be revealed at Impact Area 3B (reference 58). Additionally, because access to the Kanaio Training Area is not restricted, civilians continue to use the area for recreational purposes introducing cartridge casings and other scrap metal to the area (reference 58).

(e) "All Other" Area. The "all other" area described for the 1998 UXO removal operation consists of the training and maneuver area surrounding Pu'u Pimoe, excluding areas used for live fire (reference 4). No live high explosive items were found in the "all other" area but considerable live, blank small arms cartridges were recovered (reference 58). During the 1998 UXO removal operation, four abandoned cars and a large dumpster were recovered from the "all other" area and disposed of offsite (reference 58). During 4-8 December 1998, 168.5 lb of ordnance-related and 100 lb of non-ordnance related scrap metal was collected from the "all other" area (reference 58). Ordnance items found included small arms brass, practice grenades, 155mm projectile scrap, sub-caliber LAW rocket motor tubes, and flare tubes (reference 58). The "all other" area may include rare and endangered species habitat and unrecorded archaeological sites (reference 4). No environmental contamination is expected to result from historic training and maneuver activities within the "all other" area.

(3) Training Areas 1, 2, and 3. The SOP divides the Kanaio Training Area into three active Training Areas (TA), all of which are situated between Piilani Highway and the south edge of Pu'u Pimoe and Pu'u Pohakea, and appear to wholly encompass Areas A and B as shown on many site sketches. TA 1 encompasses all of Area "B" and part of Area "A" east of Pu'u Pimoe (reference 48). The SOP indicates that all types of blank ammunition could be fired within TA 1, and that live fire was permitted only in the direction of the ocean. TA 2 encompasses Pu'u Pimoe, and TA 3 extends from the access road to the west edge of the Kanaio Training Area. TA 2 and TA 3 are wholly located within Area "A." Only blank ammunition is permitted in TA 2 and TA 3. TA 1, 2, and 3 appear to be the only active training areas used by HIARNG at this time. The "all other" area investigated during the 1998 UXO removal operation

seems to include most of TA 2. No environmental contamination is expected to be associated with maneuver and live small-arms fire within TA 1, 2, and 3.

(4) 3.5" Rocket Range. The 3.5" rocket range may have been located south of Pu'u Pimoe. The 3.5" rocket range was visually inspected for UXO during the 1981 UXO removal operation. Practice rounds containing no explosives hazards were found; over 200 items were removed (reference 26).

(5) Cinder Quarry and Prison Camp. Pu'u Pimoe and a nearby cinder quarry were used to supply cinders for local roadbuilding and landfill projects between the 1930s and 1950s. The Kanaio Prison Camp was constructed to temporarily house prisoners while they were building local roadways using the cinders (references 7, 68, and 69). The prison campsite may originally have been a WWII encampment site (reference 7). The access road connecting Pu'u Pimoe to Piilani Highway, originally called Kanaio Prison Road, was constructed by the prisoners so the county could transport cinders from the quarry to worksites (references 68 and 69). In the late 1950s the prison was abandoned. C Pardee Erdman, the Ulupalakua Ranch owner, indicated that the Pu'u Pimoe crater was used for live fire during WWII. He didn't remember which branch(es) of the armed forces conducted the live fire exercises at the site (reference 7). The cinder quarry, Pu'u Pimoe, and the prison camp are not expected to be contaminated by historic use.

(6) Lava Tubes. Three lava tubes are located at the Kanaio Training Area. A lava tube located near the access road was filled with garbage and debris, apparently by local residents. The lava tube was cleaned out using a mechanical excavator on 10 and 11 December 1998 (reference 58). Garbage and scrap metal were removed from the lava tube; no ordnance-related materials or hazardous materials were found within the lava tube (reference 58). A soil sample taken from the bottom of the lava tube did not contain any VOCs upon analysis (reference 58). The tube was sealed with welded steel plates and camouflaged with soil and boulders to prevent illegal dumping (reference 58). Two fence posts were welded onto the steel plates and a barbed-wire fence was replaced across the opening of the tube to prevent unauthorized entry (reference 58). The other two lava tubes did not appear to have been investigated during historic UXO removal operations. No environmental contamination is expected to be associated with the lava tubes.

4. GROUND-WATER PATHWAYS AND TARGETS.

a. General Ground-Water Pathway Analysis. If large quantities of contaminants were placed on the ground surface or disposed of beneath the ground surface at the Kanaio Training Area, ground water could potentially be impacted. A lava that covers about 60% of the Kanaio Training Area is highly permeable and brittle. Where soils are present at the Kanaio Training Area, permeability is moderate to rapid (reference 22). The Kanaio Training Area is arid, with less than 30 inches of rain per year. Pan evaporation may be as high as 100 inches per year

(reference 70). Precipitation is likely to evaporate rather than infiltrate to the subsurface under these conditions. Where the Kula or unfractured layers within the Hana act as aquitards, the underlying Honomanu aquifer is confined, and potential contamination is limited to shallow perched lenses of ground water impounded behind vertical dikes. In places where the Kula acts as an aquifer, direct infiltration of water from the surface to the regional aquifer may occur. The regional ground-water flow direction within the Lualailua aquifer system (which includes the Hana, Kula, and Honomanu formations) is toward the coast. Lava tubes and highly fractured and permeable a'a may mimic karst features at the Kanaio Training Area.

b. General Ground-Water Target Analysis. No primary human ground-water targets were identified during this assessment. Ground water is not a major resource in the vicinity of the Kanaio Training Area. Twenty-five wells are registered with the State of Hawaii within a 4-mile radius of the Kanaio Training Area as shown in Figure 2 (reference 28). Most of these wells are located north of, and therefore upgradient, of the Kanaio Training Area. There are no wells within the Kanaio Training Area boundaries. The nearest well, located 1.42 miles crossgradient of the western boundary of the Kanaio Training Area near La Perouse Bay, is an 8-foot hand-dug well used for irrigation. None of the wells within the 4-mile radius are used for domestic or municipal water supply (reference 28). There is no Wellhead Protection Plan (WPP) in place for the Kanaio Training Area vicinity (reference 20). The nearest WPP area is found in Makawao, approximately 17 miles north of the Kanaio Training Area. The only potential ground-water target identified at the Kanaio Training Area are the anchialine pools containing the candidate endangered anchialine pool shrimp. The ground-water source for these pools is most likely the Honomanu formation, though it is possible for the Hana formation to contain basal ground water near the coast.

c. Site-Specific Ground-Water Pathways. Explosives and/or pyrotechnic residues that may remain on or beneath the ground surface could be a potential ground-water source area at the Kanaio Training Area. Evaporation greatly exceeds precipitation in the Kanaio Training Area vicinity, but highly fractured surface rocks may allow rapid infiltration of precipitation that does not evaporate. Although ground water at and downgradient of the Kanaio Training Area is not presently a human drinking water source, the Lualailua aquifer has been identified as a potential future ground-water resource for east Maui. If ground-water quality within the Hana and/or Honomanu formations was affected by training activities at the Kanaio Training Area, it is possible that spring-fed anchialine pools situated along the southern Maui coast could be impacted. The likelihood that the ground-water pathway would be completed at the Kanaio Training Area is very low.

5. SURFACE WATER PATHWAYS AND TARGETS.

a. General Surface Water Pathway and Target Analysis. If contaminants are deposited on the ground surface in sufficient quantities, water passing over the ground surface could be affected. Because of the high evaporation rate and relatively high permeability of the a'a and

surface soils, most precipitation rapidly either evaporates or infiltrates into the subsurface so there are no recognizable surface water channels at the site. The nearest surface water bodies include the coastal anchialine pools and the Pacific Ocean. Neither water body is expected to receive surface runoff from the Kanaio Training Area, but may receive ground-water discharge from beneath the Kanaio Training Area. No primary surface water targets were identified for the Kanaio Training Area. Both the anchialine pools and the Pacific Ocean provide habitat for rare, protected, or endangered species.

b. Site-Specific Surface Water Pathways. No potential surface water source areas were identified during the assessment. It is unlikely that the surface water pathway would be completed for the Kanaio Training Area.

6. SOIL AND AIR EXPOSURE PATHWAYS AND TARGETS.

a. General Soil and Air Exposure Pathway and Target Analysis. Contaminants deposited on the ground surface could affect soils at the Kanaio Training Area. If loose soils were blown into the air, air quality could be affected. Most of the property is bare rock with thin soil cover in places. The small arms range was recently bulldozed, so exposed soils at that site could become entrained into the air column (reference 58). There are no full-time employees at the Kanaio Training Area. Up to 400 individuals train at the Kanaio Training Area for up to 12 weekends per year. The Kanaio Training Area is surrounded by widely spaced rural homesteads, and several homes may be located within 200 feet of the Kanaio Training Area. The nearest residences appear to be located within the Kanaio Training Area boundaries on Kanaio Homestead Lands. Overall, no more than 60 individuals are estimated to reside upon or within 200 feet of the Kanaio Training Area. The nearest schools are 9 miles from the Kanaio Training Area in Kula. The Kanaio Training Area contains communities of several endangered and rare plants and animals, including rare lowland shrub communities and anchialine pools. The Kanaio NAR is a protected sensitive habitat near the northeast Kanaio Training Area border. The 'Ahihi-Kina'u Natural Area Reserve contains extremely rare plant communities along the western Kanaio Training Area boundary.

b. Site-Specific Soil and Air Exposure Pathways. Soils at the Kanaio Training Area may contain low levels of explosives, pyrotechnics, and/or metals residues due to training exercises primarily at ranges. Most of the impact areas are a'a lava, with a low potential for contaminants to be entrained into the air. Although there are isolated areas at the Kanaio Training Area having thin soil cover, the levels of contamination that might be associated with those soils are not expected to present a threat to human or environmental targets. It is unlikely that the soil and air pathway could be completed for the Kanaio Training Area.

7. CONCLUSIONS.

a. The HIARNG presently uses active TA 1, 2, and 3 within the northern half of the Kanaio Training Area for maneuver and blank fire training. The active training area may extend outside of the historic property boundaries to the west. HIARNG personnel reported that an active rifle range is situated in the vicinity of Impact Area 3A southwest of Pu'u Pimoe. Area D and most of Area C south of Pu'u Pimoe are considered to be closed.

b. Historic boundaries at the Kanaio Training Area generally appear to include Kanaio Homestead Lands 9 through 16, but to exclude all land grants and LCA except for the three small LCA 3, 6, and 22 north of Pu'u Pimoe. Although it is possible that land outside of the historic boundaries was used for HIARNG training, it appears that the original intent was to restrict activities to within the historic boundaries shown on Figure 5.

c. The coastal area of the Kanaio Training Area, previously situated within Area C, will no longer be included in the Kanaio Training Area under the EO. The HIARNG also wishes to acquire additional land under the EO. Both of these conditions may lead to a need for an Environmental Baseline Study at the Kanaio Training Area for land transfer.

d. Ordnance-related scrap found during UXO sweeps in 1981 and 1998 at the Kanaio Training Area include 81mm illumination projectiles, practice projectiles, and live mortars; signaling flare tubes; 3.5-inch rockets and 4.2-inch rockets, M72 LAW rockets and motor tubes; 40mm grenades, practice grenades, and high explosive rounds; and small arms ammunition, small arms brass, M73 sub-caliber rounds, tail booms to recoilless rifle rounds, and 155mm projectile scrap. It is likely that high-explosives and/or pyrotechnics-containing duds exist below the ground surface at the Kanaio Training Area. The majority of the land surface at the Kanaio Training Area was not included in these UXO sweeps.

e. Impact Areas 1 and 2 are fenced and restricted from entry due to UXO concerns. The boundaries of Impact Areas 1 and 2 were established during initial UXO removal operations conducted in 1981, soon after high-explosives exercises were permanently suspended at the Kanaio Training Area. Therefore, it is likely that the fenced boundaries of Impact Areas 1 and 2 adequately delineate firing ranges and impact areas that should be restricted for safety purposes.

f. Previous UXO removal operations and the characteristics of high explosives and pyrotechnics-containing ammunition commonly used at the Kanaio Training Area (including rockets and mortars) indicate that it is likely that duds exist on or beneath the ground surface at impact areas within the Kanaio Training Area. Explosives and pyrotechnics residues associated with the duds may have been released to the surrounding soil and rock material within the impact areas.

g. Low precipitation rates, combined with high evaporation rates reduce the potential for ground water beneath the site to be impacted by explosives and/or pyrotechnics associated with duds. If ground water is impacted, the only ground-water target(s) identified during the assessment were coastal spring-fed anchialine pools and the candidate endangered anchialine pool shrimp that reside within the pools. The pools found in the southwest Kanaio Training Area contain thriving communities of native plants and animals, indicating that it is unlikely that they have been affected by Kanaio Training Area activities. It is possible, though unlikely, that the ground-water pathway would be completed for the Kanaio Training Area.

h. The Kanaio Training Area has low precipitation rates, high evaporation rates, and highly fractured and permeable surface lava. For these reasons, no surface water drainage features exist at the Kanaio Training Area, and it is unlikely that the surface water pathway would be completed for the site.

i. Most of the Kanaio Training Area is covered by a'a lava without any soil development. Although there are isolated areas of the Kanaio Training Area having thin soil cover, levels of explosives, pyrotechnics, and/or metals contamination that might be associated with those soils are not expected to present a threat to human or environmental targets. It is unlikely that the soil and air pathways could be completed for the Kanaio Training Area.

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8. RECOMMENDATION. None.

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APPENDIX A

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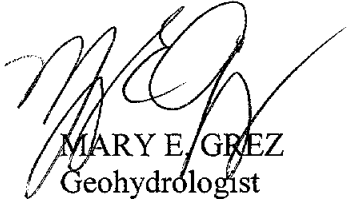
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APPENDIX B
SUPPORTING DOCUMENTATION

8. RECOMMENDATION. None.



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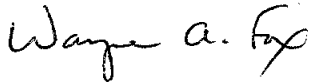
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