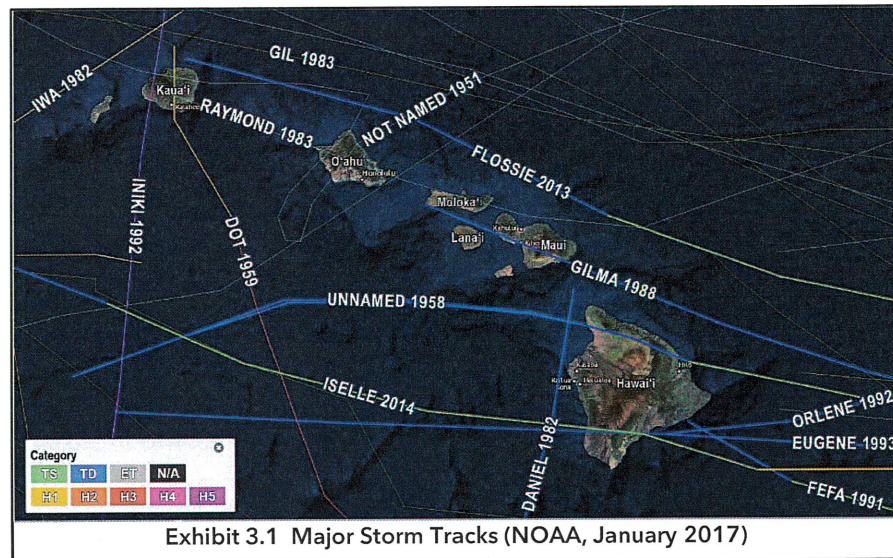


3.3.2 Hurricane Hazards

Hurricanes are tropical storms with winds greater than or equal to 74 miles per hour. They have affected every island in the State and can cause major damage and injury usually resulting from high winds, marine over-wash, heavy rains, and other intense small-scale winds and high waves. Hawaiian Memorial has and is still used by the community as a safe zone during hurricane and tsunami warnings because of its open space and elevation.

Exhibit 3.1 shows the paths of past hurricanes and tropical storms that have affected the Hawaiian Islands from 1950-2016 based upon hurricane tracking information from the National Oceanic Atmospheric Administration's (NOAA) website accessed in January 2017. Tropical Storm Flossie passed close to the Hawaiian Islands in July 2013, but only brought stormy weather. The Central Pacific basin had a record number of storms (15) in 2015.



Not all of these storms pass directly through the state, and actual hurricane strikes on the Hawaiian Islands are relatively rare in the modern record. More commonly, hurricanes pass close to the islands generating large swells and moderately high winds causing varying degrees of damage (USGS, 2002). Of these many storms, Hurricanes Dot (1959), Iwa (1982) and Iniki (1992) directly hit the Island of Kaua'i. Hurricane Iniki, hit Kaua'i as a Category 4 hurricane, causing nearly \$2 billion in damage, more than any other hurricane to affect the state since records began. In 2014, Tropical Storm Iselle impacted the southern end of the Island of Hawai'i.

Potential Project Impact

Should a hurricane make landfall on O'ahu, it is anticipated that sufficient warning would be available and that any visitors to the HMP area would be cleared and directed to a safe location. Hurricane damage is not anticipated to be higher in the project area compared to surrounding areas. The majority of the Petition Area would consist of landscaping with some minor accessory structures associated with family memorials. No significant danger to the public is anticipated.

3.3.3 Tsunami Hazards

Tsunami manifest themselves as large breaking waves, often largest around headlands where they are concentrated by wave refraction, or as sea levels that rise rapidly like a flooding tide. The coastline of the Hawaiian Islands is under continuous threat of tsunami inundation because the Pacific basin is one of the most geologically active regions on Earth. The HMP property is located well inland of the coastline and is outside of the City's designated tsunami evacuation zone. Hawaiian Memorial Park has and is still used by the community as a safe zone during tsunami warnings because of its open space and elevation.

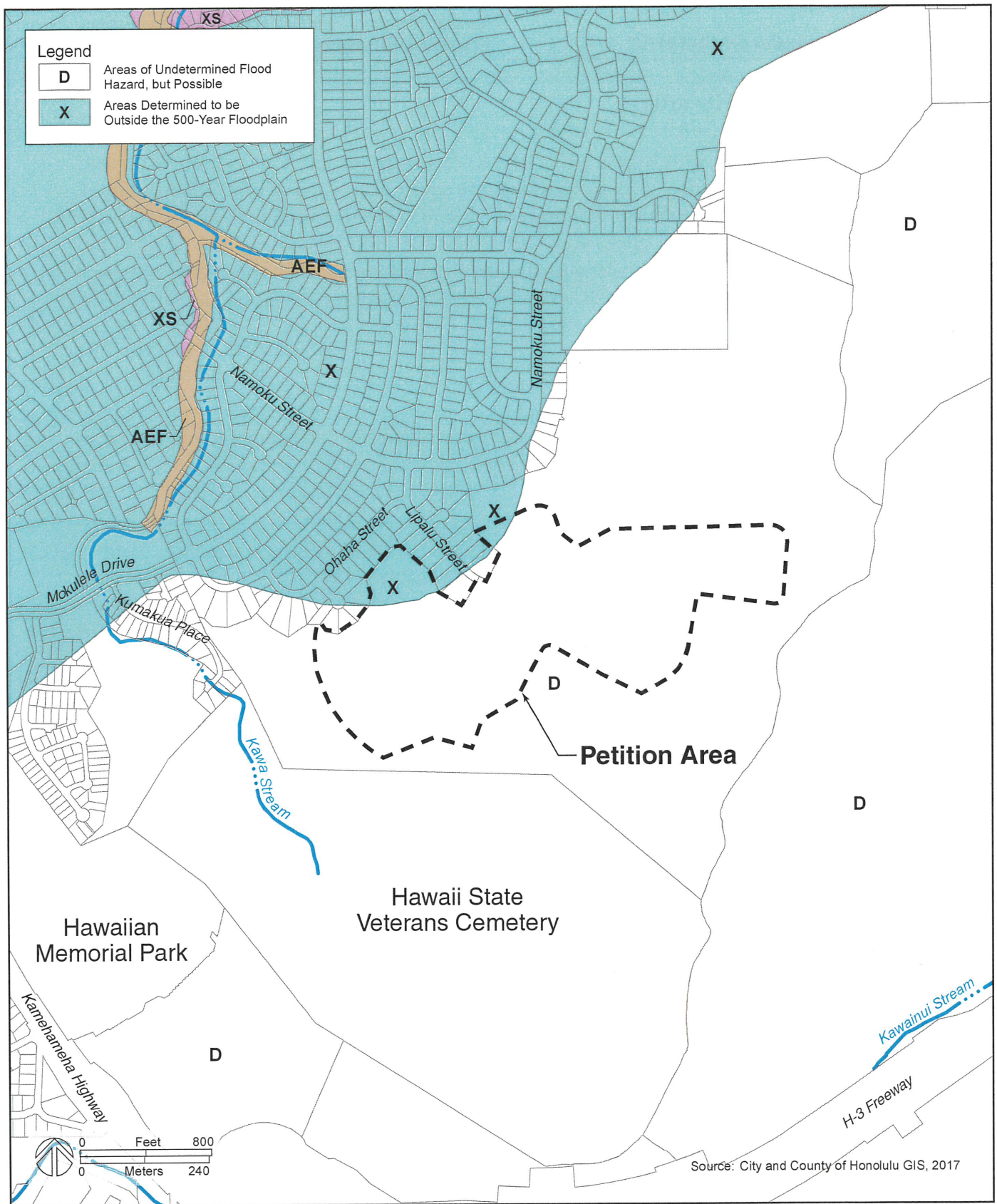
Potential Project Impact

The project area is not within the current City tsunami evacuation zone, and proposed improvements will not be affected by a tsunami.

3.3.4 Flood Hazards

According to the Flood Insurance Rate Map (FIRM) number 15003C0270JG (effective date: November 4, 2014) published by the Federal Emergency Management Agency (FEMA), the Petition Area is predominantly located within Zone D. Figure 3.3 shows the flood zone designations for the site and immediate area. Zone D denotes areas of undetermined flood hazard, but where flooding is possible. Small areas close to the Petition Area surrounding residences along Lipalu Street are designated Zone X. Zone X is for areas determined to be outside the 100- and 500-year floodplains.

Kāwā Stream begins in the upper reaches of the Hawai'i State Veterans Cemetery and flows in a northwest direction (makai) through the veteran's cemetery, and below HMP's Ocean View Garden toward Kumakua Place. This stream then flows through residential neighborhoods before discharging into Kāne'ohe Bay. Flood areas within the residences associated with this stream are designated Zone AEF. Zone AE areas are subject to a 1% or greater annual chance of flooding in any given year, and base flood elevations have been determined. Floodway areas are identified as the channel of a stream plus any adjacent floodplain that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. There is no flood hazard identified for this stream within the Hawai'i State Veterans Cemetery areas.



Flood Hazard Zones

Figure 3.3

Hawaiian Memorial Park Cemetery Expansion Project
 Kāne'ohe, O'ahu, Hawai'i

Potential Project Impact

The project should not impact existing designated flood hazards because there are none identified within the Petition Area. Project improvements would include drainage improvements to address increases in storm water runoff created by additional impervious surfaces. Kāwā Stream runs below (outside) the Petition Area over 400 feet away. Therefore, project improvements should not significantly impact this stream or alter its flow path. A preliminary engineering report prepared would address storm water runoff and potential flooding impacts associated with the project, and the Draft EIS will address changes to existing flood hazards in greater detail.

3.3.5 Rockfall Hazards

The Petition Area is located along the foot of the adjacent hillside, and could be subject potential rock fall hazards. Overall, both soil types (Kāneʻohe and Alaeloa) present are believed to have good suitability, have moderate shrink-swell potential, and have greater than 5 inches to bedrock based upon a prior engineering report conducted as part of HMP's 2008 Final EIS (HHF, 2008). However, there are a few areas along the hillside within the Petition Area that could have a slight potential for rockfall hazards.

Potential Project Impact

A slope stability analysis performed in the 2008 Final EIS determined that there should be no apparent potential for hazards to the Petition Area associated with slope stability of the hillside. A generally accepted minimum factor of safety for considering work within existing slopes and newly graded slopes is that it should next exceed a factor of 1.5 (ratio of horizontal distance to vertical distance) or 33% angle. Site improvements for the expansion of the cemetery should not need to exceed this 1.5 factor. Nevertheless, an updated rockfall study will be conducted to address slope stability issues based upon present project plans.

3.4 BOTANICAL RESOURCES

Existing vegetation found within the Petition Area can be characterized as being an alteration of native plant habitat. As a result, very few native plant elements remain in the area. A botanical study conducted in 2006 (HHF, 2008) determined that 95% of the vegetation present were alien or introduced. Only 5% of the existing vegetation was identified as native, primarily because the parcel has historically been disturbed when it was used for dairy ranching. Of the 94 plant species observed, 88 species were alien, four were indigenous (native to the Hawaiian Islands and elsewhere), and two were endemic (native only to the Hawaiian Islands).

The native species included infrequent occurrences of ʻuhaloa (*Waltheria indica*), hala (*Pandanus tectorius*), kaʻeʻe or sea bean (*Mucuna gigantean*), and moa (*Pisilotum nudum*). Of the two endemic species, two koa (*Acacia koa*) trees were observed near the Kawaʻewaʻe Heiau, and ʻakia (*Wikstroemia Oahuensis* var.

Oahuensis) was documented along the edges of the Ocean View Garden section of HMP and within the upper elevations near the ridgeline. Four Polynesian introduced plant species were observed, including: ti (*Cordyline fruticosa*); niu or coconut (*Cocos nucifera*); kukui (*Aleurites moluccana*); and hau (*Hibiscus tiliaceus*). The kukui and hau were observed scattered throughout the survey area especially in the small gulches and ravines. Ti plants were observed along the boundary of the existing HMP and scrub vegetation, as well as along several of the ridges (HHF, 2008).

Laua'e (*Phymatosorus grossus*) populations are also present, and are dominated by a thick canopy of monkeypod (*Samanea saman*), java plum (*Syzygium cumini*), and octopus trees (*Schefflera actinophylla*). Several liana species were observed growing up into the canopy of the forest, including, ka'e'e or sea bean (*Mucuna gigantea*), passion fruit (*Passiflora edulis*), and maile pilau (*Paederia foetida*).

No wetlands were encountered during the botanical survey. None of the plant species observed were a threatened or endangered species, nor was any plant a species of concern. All of the plants can be found in similar environmental habitats throughout the Hawaiian Islands.

Potential Project Impact

Project improvements should not have a significant effect on botanical resources because the vast majority of species present are alien or introduced. No threatened or endangered plant species would be affected. Native and endemic plant species within the cultural preserve could be increased as part of cultural restoration efforts conducted in that area, which would have a beneficial effect on botanical resources and support native Hawaiian cultural practices. The majority of the expanded cemetery area would consist of grass, however, native plants could be incorporated into landscape plans developed for other areas. An updated botanical survey will be conducted for the Draft EIS to evaluate current conditions and botanical resources present to assess the impact from present project plans.

3.5 FAUNAL RESOURCES

An avifauna and feral mammal survey conducted in 2008 (HHF, 2008) determined the project area provides habitat for a variety of alien birds and mammals, none of which are endangered or threatened. No native land birds were recorded during the survey, and the absence of native land birds was not unexpected given the location, elevation, and type of habitats available at this site. The short-eared Owl (*Asio flammeus sandwichensis*) or Pueo forages in grasslands, agricultural fields, and pastures as well as in upland forested habitat. This species was not recorded during the survey work done at HMP in 2008.

No native waterbirds were recorded, nor were any expected on this property due to an absence of suitable wetland habitat. Similarly, no seabirds were recorded on the property due to unsuitable habitat, the presence of ground predators, and habitat disruption. Some species of seabird may occasionally fly over the property. One species of migratory shorebird, the Pacific Golden-Plover or Kolea (*Pluvialis fulva*), was observed on lawns adjacent to the Petition Area. Kolea are not listed as either endangered

or threatened species by the U.S. Fish and Wildlife Service, nor proposed as a candidate for listing as an endangered or threatened species.

A total of 14 species of introduced (alien) birds were recorded. The more common of these species included: the Spotted Dove (*Streptopelia chinensis*); the Red-vented Bulbul (*Pycnonotus cafer*); the Red-whiskered Bulbul (*Pycnonotus jocosus*); the Japanese White-eye (*Zosterops japonicus*); and the House Finch (*Carpodacus mexicanus*).

Feral cats (*Felis catus*), Small Indian Mongoose (*Herpestes auro-punctatus*), and pigs (*Sus scrofa*) were observed. Pig tracks and uprooted areas caused by pigs were abundant throughout the site. Mice (*Mus musculus*) and rats (*Rattus* spp.) undoubtedly occur on the property. The native endangered Hawaiian Hoary Bat was not detected during the survey, and none were expected given the low number of bats reported to occur on O‘ahu.

Potential Project Impact

Project improvements should not have a significant effect on avifauna and faunal resources because the vast majority of species present are alien. No federal endangered or threatened species, or species of concern were observed.

Expansion of the cemetery would reduce areas that may currently be used by feral pigs (*Sus scrofa*) resulting in a change to their foraging and destructive activities, particularly on vegetation. The clearing of the area and its subsequent conversion to more landscaped lawn habitat would reduce the immediate, local populations of alien birds using the area. But, this change would provide new foraging space for the wintering Kōlea, who forage in grassy areas with a good insect supply.

Revegetation of portions of the Petition Area with a plant palette dominated by native and Polynesian-introduced plants could provide habitat for a number of avian species including the O‘ahu ‘*amakīhi*, Pueo, and any of the alien bird species typically found in Windward O‘ahu. There is an abundance of non-native habitat in the lands surrounding the Petition Area for bird species, and provides sufficient habitat for potential Pueo that may exist in the general area. An updated avifauna and faunal survey will be conducted for the Draft EIS to evaluate current conditions and species present to assess the impact from present project plans.

3.6 INVERTEBRATE RESOURCES

A survey of native invertebrate resources conducted for HMP in 2008 (HHF, 2008) encountered three native species: 1) the widespread endemic grass feeding bug *Trigonotylus hawaiiensis*; 2) the endemic Moss moth (*Eudonia* sp.); and 3) the endemic small moth or micro-moth (*Mestolobes*). No native mollusks were observed and no invertebrate listed under either federal or state endangered species statues was located. The extremely low level of native plants serving as arthropod hosts was most likely the reason for the absence of Hawaiian arthropods in the area.

Anecdotal information provided by area residents indicated the presence of the endangered native Blackline Hawaiian Damselfly (*Megalagrion nigrohamatum nigrolineatum*) being present on a small portion of the Petition Area. The Petition Area was subsequently surveyed by Dr. Steven Montgomery to determine the presence or absence of this species. Damselflies were typically common in a variety of lowland habitat, and the higher inland elevation of the HMP property is not a typical habitat. A small number (about 10 individuals) of federally listed endangered Blackline Hawaiian Damselfly were observed along a soggy drainage area within the northwestern section of the Petition Area.

All sections of the Memorial Fountain at the Ocean View Garden site were also inspected, but no Blackline Hawaiian Damselflies were observed. This water feature did have many tadpoles of the cane toad, *Bufo marinus*, but no native species. An adult *Bufo* was seen in the area above the seeps. Although *Bufo* may be a predator on the Damselfly adults, it is mostly a nocturnal feeder.

Potential Project Impact

Project improvements should not have a significant effect on native invertebrate species because of the low level of native plants serving as potential arthropod hosts within the Petition Area. Establishment of the cultural preserve could allow for cultural restoration of the area using native plants to replace alien plants. Increasing native plants within this preserve could support creating improved habitat for endemic arthropods, which is a beneficial effect.

An updated survey of native invertebrate resources would be conducted, and project effects addressed in the Draft EIS. This would include an expanded field inspection to determine the full extent of the presence of the endangered Blackline Hawaiian Damselfly. Necessary best management practices would be addressed to ensure the project does not impact Damselfly habitat.

3.7 HYDROGEOLOGICAL RESOURCES

3.7.1 Groundwater Hydrology

The State DLNR, Commission on Water Resource Management (CWRM) has established groundwater hydrologic units to provide a consistent basis for managing groundwater aquifers. A coding system has been established under the State's Water Resource Protection Plan that classifies and describes the islands aquifers. The project area is located within the Ko'olaupoko Aquifer system (30603) of the larger Windward Aquifer Sector (306) (CWRM, 2008). This system spans from the ridgeline of the Ko'olau Mountains to the shoreline and in a south to north direction from the beginning of Kāne'ōhe up to Waiāhole. The Windward aquifer has an estimated sustainable yield of 91 million gallons per day (mgd). The Ko'olaupoko Aquifer system has a sustainable yield of 30 mgd.

The most abundant form of groundwater on O'ahu is the basal aquifer, which is a lens of fresh to brackish water floating on sea water. The Petition Area is located in an area where a primary basalt aquifer is overlain with an upper aquifer of sedimentary caprock. The upper aquifer is an unconfined, basal sedimentary system. The upper aquifer is currently used, ecologically important, considered

irreplaceable, has low salinity (250-1,000 mg/l Cl⁻), and a high vulnerability to contamination. The lower aquifer groundwater is confined basal in dike compartments, and is classified as drinking water, with fresh salinity <250 mg/l Cl⁻, considered replaceable, and has moderate vulnerability to contamination.

The Underground Injection Control (UIC) line was established to protect the aquifers of Hawai'i, as established by §11-23, HAR. Above this line, the groundwater is considered to be useable for drinking water; below it is not. The Petition Area is located below the UIC line, and the state does not consider the area to be viable for developing drinking water.

Potential Project Impact

Windward O'ahu generally receives sufficient precipitation to minimize the need for supplemental irrigation of landscaping. However, some irrigation would be required for the Petition Area during establishment of new sections for use and during dry periods. Proposed improvements should not have a significant effect on the underlying aquifer. Although some impervious areas would be created by structures and roadways, the majority of the cemetery expansion area would be pervious areas consisting of landscaped grass. Detention and/or retention basins are planned as part of drainage site improvements that would enhance groundwater recharge. Such site improvements would be discussed in greater detail in the Draft EIS.

Groundwater can be influenced by turf management practices as well. New burial sections would be treated with slow release turf fertilizers, and maintenance activities would target applications during dry periods to ensure it is absorbed by the plant material. If herbicides or pesticides are necessary, its use would follow manufacturer specifications by trained personnel. This practice would be rare and avoided due to potential operational problems and expense.

The U.S. Environmental Protection Agency (EPA) does not regulate the burial of human remains under current environmental statues or regulations. As decomposition progresses there may be a very limited potential to release very small quantities of Formaldehyde into the adjacent soil and groundwater. However, Formaldehyde is diluted with water as part of the embalming process. This solution reacts with proteins in the embalmed body and to a smaller degree evaporates from the body prior to interment, thereby, reducing the residual amount of chemical to a less than significant amount. Thus, the potential for the release of Formaldehyde, which is a decomposable organic fluid, into adjacent soil and groundwater is thought to be very small to non-existent. HMP had a ground water study performed in 2010 that showed HMP did not contribute to any ground water contaminants. HMP also requires a concrete outer burial container that encases all human remains.

The Draft EIS will address the project's potential to impact groundwater resources. This would include addressing herbicide and pesticide use, impacts on groundwater recharge, and include further discussion of the embalming process to address potential issues with Formaldehyde.

3.7.2 Surface Water

There are no current perennial or intermittent streams running through the Petition Area. The area does have low lying areas serving as drainageways for storm water runoff from upland areas during periods of heavy rainfall. An old cement collection structure, likely constructed from previous cattle or pineapple farming, was identified that may have potentially been used to collect sparse to low volume spring water or intermittent drainageway flows. This structure could be providing habitat for the Blackline Hawaiian Damselfly, and will be assessed in greater detail in the Draft EIS.

Kāwā Stream starts from the Hawai‘i State Veteran’s Cemetery, and proceeds toward the residential subdivision where it eventually discharges into the southern portion of Kāne‘ohe Bay. This stream is located outside of the Petition Area, although the Petition Area is situated within the larger watershed discharging to the stream. Exhibit 3.2 shows the watershed serving this stream along with the seven subwatersheds within it. The Petition Area is located within subwatershed areas No. 3 and 4. As shown on the exhibit, the tributaries immediately below (south) the Petition Area feeding into the stream are identified as intermittent streams (OLI, 2002).

Kāwā Stream is included on the State’s Clean Water Act, Section 303(d) list of impaired waters that do not meet State Water Quality Standards, and is considered to be impaired by sediments, turbidity, and the nutrients nitrogen and phosphorus. These pollutants could enhance unwanted algae growth in the stream and impact coral reef resources in the receiving waters of Kāne‘ohe Bay. The order of magnitude Total Maximum Daily Loads (TMDLs) for total suspended solids (TSS), total nitrogen, and total phosphorus in Kāwā Stream was established by the State DOH (OLI, 2002). The water quality goal of these TMDLs is to control sources of TSS and nutrients to improve the water quality of the system, so that the designated uses for Kāwā Stream can be maintained.

