3.0 NATURAL AND PHYSICAL ENVIRONMENT

3.1 CLIMATE

3.1.1 Existing Conditions

3.1.1.1 Climate

The climate on the island of Kauaʻi, as well as within the State of Hawaiʻi, is characterized as having low day-to-day and month-to-month variability. Differences in the climate of various areas are generally attributable to the island's geologic formation and topography, resulting in miniature ecosystems ranging from tropical rain forests to dryer plains, along with corresponding differences in temperature, humidity, wind, and rainfall over short distances (Dept. of Geography, 1998).

Long-term climate data for Līhuʻe, located on the island's southeast coast, shows the average daily temperature ranging from 71 and 80 degrees Fahrenheit in the year 2000 with an average annual temperature of 76.2 degrees. The range in normal temperatures from the coolest month, February, to the warmest month, August, is less than 8 degrees. The daily range in temperature is also small, less than 15 degrees. Normal annual rainfall is over 40 inches, with three-fourths of this total, on average, falling during the seven month wet season which extends from October through April (NOAA, 2017).

Tradewinds from the northeast blow across the island during most of the year, and typically dominate weather patterns from April to November. Winds from the south are infrequent, occurring only a few days a year and mostly in the winter associated with "Kona" storms. Wind speeds are normally within the 13 to 24 miles per hour range (UH Department of Geography, 1983). Air quality throughout Kauaʻi is good, meeting all state and federal air quality criteria.

3.1.1.2 Climate Change

Climate change is a long-term shift in patterns of temperature, precipitation, humidity, wind and seasons. Scientific data show that earth's climate has been warming and mostly attributable to rising levels of carbon dioxide and other "greenhouse gases" generated by human activity. These changes are already impacting Hawaiʻi and the Pacific Islands through rising sea levels, increasing ocean acidity, changing rainfall patterns, decreasing stream flows, and changing wind and wave patterns.

In 2014, the University of Hawaiʻi at Mānoa Sea Grant College Program (UH Sea Grant) prepared a *Kauaʻi Climate Change and Coastal Hazards Assessment* (KC_3HA) as part of the County's Kauaʻi General Plan update. The study notes that the Island of Kauaʻi is subject to a variety of coastal hazards, including coastal storms, high wave events, flooding, coastal erosion and tsunamis. Each of these may be impacted by climate change-related sea level rise (SLR).

The KC_3HA stated that a range of sea level rise of one foot by year 2050 and three feet by year 2100 is a reasonable, possibly even conservative planning target for Kauaʻi and the other Hawaiian Islands (UH Sea Grant, 2014). Recently, the Hawaiʻi Climate Change Mitigation and Adaptation Commission released a report stating that this magnitude of SLR could occur as early as 2060, based on recent observations and predictions. Moreover, SLR is likely to continue for centuries (Hawaiʻi Climate Change Commission, 2017). SLR is expected to increase the frequency and severity

of wave inundation, erosion, and flooding. These hazards in turn can impact Kaua'i's critical infrastructure, economy, coastal habitats, public access, and residential communities.

According to the KC_3HA, the key coastal hazard impacts to consider for Kaua'i are1) coastal flooding and wave inundation; 2) erosion; 3) inland flooding; and 4) wind.

Coastal flooding and wave inundation is the flooding of normally dry, low-lying coastal land. It can be caused by elevated sea surfaces from static level rise or large tidal fluctuations, seasonal high waves that push water inland, and storm surge associated with low pressure systems, tropical storms, and hurricanes that cause an abnormal rise in the water level (UH Sea Grant, 2014). The Petition Area is not within a flood zone or the designated tsunami evacuation zone.

Historic studies of ***coastal erosion*** indicate that beach erosion is the dominant trend of shoreline change on Kaua'i. The National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands (Fletcher et al, 2012) reports that 71% of beaches on Kaua'i are eroding with nearly four miles of beach completely lost to erosion over the past century. On average, shorelines on Kaua'i retreated over 36 feet over the past century. Beaches on the north and east coasts of Kaua'i are undergoing the most erosion (76% and 78% of beaches, respectively) (ibid). Climate change induced SLR is expected to result in increase to historical erosion rates. The Petition Area is located approximately 1,000 feet inland from the coast, and will not directly impact or be impacted by coastal erosion.

Inland (stream) flooding on Kaua'i may be characterized by flash floods as well as prolonged flooding associated with slowly passing rainstorms that saturate the soils. Climate change is expected to cause more extreme rain events, which could lead to impacts from inland flooding. The Petition Area is not located in a flood prone area or adjacent to streams, and is at low risk of inland flooding.

Wind related events include Kona storms tropical storms, and hurricanes. As discussed in Section 3.5, Natural Hazards, Kaua'i has a history of damaging hurricane events, including Hurricanes Dot in August 1959, Iwa in November 1982, and Iniki in September 1992. Some studies indicate that climate change may result in an increase in tropical cyclone frequency around the Hawaiian Islands in the future.

3.1.2 Potential Impacts and Mitigation

The proposed development will have no effect on climatic conditions and no mitigation measures are needed. The Petition Area is located on the *mauka* side of Kūhiō Highway about 1,000 feet from the shoreline, at an elevation of about 100 feet. It is not vulnerable to coastal erosion or stream flooding that may occur as a result of long-term climate change. The two on-site detention areas are designed to provide areas for storm water drainage to percolate into the ground.

Like most of the island of Kaua'i, the Petition Area is vulnerable to wind related events such as hurricanes, which may become more frequent as a result of climate change. While the likelihood of storm and hurricane damage is difficult to assess, the future residential units will comply with all applicable County building codes.

3.2 GEOLOGY AND TOPOGRAPHY

3.2.1 Existing Conditions

The Island of Kaua'i consists of a single deeply eroded shield volcano, and the Petition Area in Keālia is located on the eastern flank of the shield. The geology of the project site includes lava flows from the Koloa Volcanic Series deposited during the Pleistocene era and recent deposits of alluvium beach and dune sand and lagoonal clays and marls (loose or crumbling earthy deposits high in calcium carbonate).

The Petition Area is located on the *mauka* slopes above Kūhiō Highway, and the topography is generally gently sloping from *mauka* to Kūhiō Highway. Near Kūhiō Highway, the elevation is about 100 feet above mean sea level (msl), and gradually rises to nearly 130 feet at the *mauka*-most areas of Keālia Road. The average slope from top to bottom is approximately three percent. The surrounding lands are largely undeveloped, with the flat lands being utilized as pasture. Valleys in the surrounding area are occupied by trees, bushes, and other greenery.

3.2.2 Potential Impacts and Mitigation

No significant modifications to site topography are planned. The Preliminary Engineering Report (PER) prepared by Kodani & Associates Engineers (2017) (Appendix G) includes a preliminary grading layout for the Petition Area. The preliminary grading plan shows the location of existing surface contours and proposed finished contours. The estimated earthwork quantity of excavation is 350,000 cubic yards (YD^3) and the total of estimated embankment is 347,000 YD^3. This results in a net excavation of 3,000 YD^3.

Best management practices (BMP) will be utilized during subdivision construction to prevent violations of State and County water quality standards due to storm water runoff. BMPs will also be implemented for long term development and operation of activities occurring on the site as part of pollution prevention measures.

3.3 SOILS

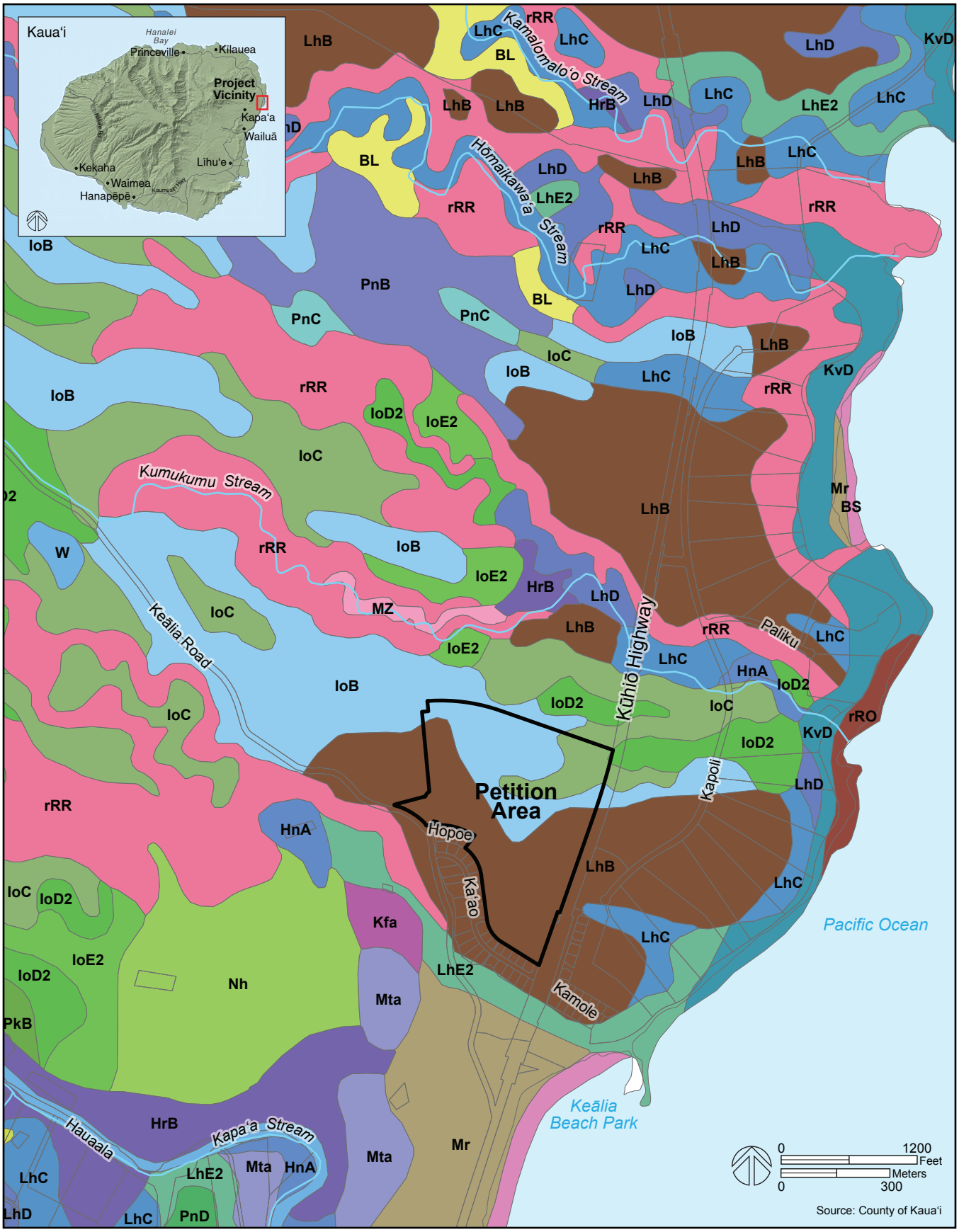
3.3.1 Existing Conditions

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil classification for the Petition Area is shown on Figure 3-1.

3.3.1.1 Soil Types

Ioleau Series. The Petition Area includes three soil types within the Ioleau soil series:

- Ioleau silty clay loam, 2 to 6% slope (IoB) in the northern half of the Petition Area
- Ioleau silty clay loam, 6 to 12% slope (IoC) in the northeastern portion
- Ioleau silty clay loam, 12 to 20% slope (IoD2) at the northeast corner.



Soils Map **Figure 3-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

The Ioleau series consists of well-drained soils on uplands on the island of Kauaʻi. These soils developed in material weathered from basic igneous rock, probably mixed with volcanic ash. They are gently sloping to steep. Elevations range from 100 to 750 feet. The annual rainfall amounts to 40 to 70 inches. The mean annual soil temperature is 72° F. Ioleau soils are geographically associated with Līhuʻe and Puhi soils.

These soils are used for irrigated sugarcane, pasture, pineapple, irrigated orchards, irrigated truck crops, wildlife habitat, and woodland. The natural vegetation consists of lantana, Koa haole, guava, and associated shrubs and grasses. [Foote et al. 1972:47]

Līhuʻe Series. The majority of the Petition Area contains Līhuʻe silty clay, 0 to 8% slope (LhB). The Līhuʻe series of soils consists of well-drained soils on uplands on Kauaʻi. These soils developed in material weathered from basic igneous rock. They are gently sloping to steep. Elevations range from nearly sea level to 800 feet. The annual rainfall amount to 40 to 60 inches. The mean annual soil temperature is 73° F. Līhuʻe soils are geographically associated with Ioleau and Puhi soils.

These soils are used for irrigated sugarcane, pineapple, pasture, truck crops, orchards, wildlife habitat, woodland, and homesites. The natural vegetation consists of lantana, guava, Koa haole, joee, Kikuyu grass, Molasses grass, Guinea grass, Bermuda grass, and Java plum. [Foote et al. 1972:82]

3.3.2 Potential Impacts and Mitigation

Appropriate erosion and sediment controls will be implemented during construction of the subdivision, and will comply with County of Kauaʻi grading ordinance and the State Department of Health National Pollutant Discharge Elimination System (NPDES) permit program. Soil erosion will increase dramatically during grading and other construction activities. When erosion occurs, sediment can be transported by wind or stormwater runoff, and has the potential to affect downstream water quality. Erosion control measures during construction may include phasing work to minimize bare areas, use of mulch, erosion blankets, and seeding bare areas to keep them vegetated. Sediment control is the capture of eroding sediments to keep them on site and away from surface waters. Examples of sediment control BMPs include silt fences, settling basins and sediment traps, and fiber rolls. BMPs will remain in working condition throughout the construction period. With the implementation of erosion and sediment control BMPs, no significant impacts to soils are anticipated.

Individual lot purchasers will be required to keep their lots vegetated until they are ready to build to minimize soil erosion. During construction, homeowners will be required to comply with the County grading ordinance and the requirements of the State Department of Health, including the NPDES permit program.

3.4 WATER RESOURCES AND HYDROLOGY

3.4.1 Existing Conditions

3.4.1.1 Watershed

A watershed unit is comprised of a drainage basin (or basins) which include both stream and overland flow, whose runoff either enters the ocean along an identified segment of coastline (coastal segment) or enters an internal landlocked drainage basin (CWRM, 2005). According to the *Atlas of Hawaiian Watersheds and their Aquatic Resources* (Hawaiʻi DAR, 2008), the island of Kauaʻi

is divided into five watershed regions, with East Kauaʻi part of the Līhuʻe Region. Within the Līhuʻe region, there are 12 identified watersheds. The Keālia Mauka Project Area appears to straddle two watersheds in the Līhuʻe region--the Kapaʻa Watershed (DAR Watershed Code 22004) and the Kumukumu Watershed (DAR Watershed Code 22002).

The Kapaʻa Watershed, which is the drainage area for Kapaʻa Stream, encompasses approximately 16.5 square miles with a maximum elevation of 3,251 feet. According to the Hawaiʻi Watershed Atlas, the Kapaʻa Watershed's DAR cluster code is 5, meaning that the watershed is medium size, steep in the upper watershed and with little embayment. Approximately 53.3% of the watershed is in conservation and 43.1% in agricultural use. The State has management control of 52.3% and private entities control 47.7%.

The Kumukumu Watershed, which includes the drainage basin for Kumukumu Stream, is located to the north of the Kapaʻa Watershed. This watershed encompasses 1.2 square miles with a maximum elevation of 404 feet. Approximately 97% is in agricultural use, with 100% of the watershed under private control.

Kauaʻi's watersheds are collectively overseen by the Kauaʻi Watershed Alliance (KWA), a collaboration of 11 public and private partners. The KWA was formed in 2003 and oversees 144,004 acres of forested wetland. Ongoing management activities include controlling invasive weeds and ungulates such as feral pigs and goats. Invasive plants and animals have been identified as the two most important threats to the watershed. (Kauaʻi Watershed Alliance, 2012). The KWA partners share the common goal of the long-term protection of the island's upper watershed in order to maintain ground and surface water and healthy native ecosystems.

3.4.1.2 Surface Water

There are no wetlands or streams located within the Petition Area, although there are streams outside the Petition Area to the north and south. Kapaʻa Stream (HSA Code 2-2-04), also referred to as Keālia River, is a perennial stream located to the south. In the project vicinity, Kapaʻa Stream crosses under Kūhiō Highway, and enters the ocean at the southern end of Keālia Beach.

As is common throughout Hawaiʻi, the upper elevations of Kapaʻa Stream were diverted in the 1920's as part of the irrigation system developed by the sugar plantations. The irrigation system, consisting of tunnels, ditches and flumes, is referred to as a "ditch" system. In its *mauka* reaches, Kapaʻa Stream was diverted to the Makaleha Ditch (4 MGD) and Kapahi Ditch (5 MGD) systems (CWRM, 1990). The Petition Area and surrounding areas were at one time irrigated by water flowing through the extensive ditch system. With the closure of the sugar plantation, much of the ditch system in urbanized areas of East Kauaʻi has been abandoned, but is intact and flowing elsewhere.

Located north and outside of the Petition Area, Kumukumu Stream (HSA Code 2-2-02) is a perennial stream, flowing *mauka* to *makai* and passing through the Keālia Kai subdivision before entering the ocean. The Hawaiʻi Stream Assessment (HSA) notes that stream flows in Kumukumu Stream are year-round in the upper portions but are intermittent at lower elevations. For much of the year, Kumukumu Stream in the project vicinity is a dry gulch leading to an estuarine pool, more or less open to the ocean. Runoff flows through this gulch only during storm events (County of Kauai, 2003).

3.4.1.4 Irrigation Ditch System

The existing non-potable ditch system in the area is managed by the Keālia Irrigation Company. There are two reservoirs, Kaneha and Halaula, associated with the system. The Halaula Reservoir is located *mauka* of the Petition Area, about half-way to the Spalding Monument. The Kaneha Reservoir is located further *mauka*, just outside the Moloaa Forest Reserve. The two reservoirs are regulated by the State of Hawai'i Department of Land and Natural Resources (DLNR). The ditch transmission system is not State-regulated.

The Keālia Irrigation Company has an easement through the Petition Area that feeds the Keālia Kai subdivision located *makai* of Kūhiō Highway. Transmission is all underground. There are no active irrigation ditches in the Petition Area or within the larger TMK parcel.

3.4.1.3 Groundwater

In Hawai'i, groundwater provides about 99% of domestic water and about 50% of all freshwater used in the State. The East Kaua'i area is within the State of Hawai'i Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM)'s Līhu'e Aquifer Sector, which has a total sustainable yield of 131 million gallons per day (mgd) (CWRM, 2015) The State Water Code defines sustainable yield as "the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source…"

The Keālia Mauka Petition Area is within the Līhu'e Aquifer Sector's Anahola Hydrologic unit (Aquifer Code 20104), which has a sustainable yield of 17 mgd (CWRM, 2015). Water users include the private Keālia Water System, the County of Kaua'i's Water Department and agricultural users. In 2015, pumpage from the Anahola Hydrologic Unit was 2.48 mgd, about 14.5% of its sustainable yield (County of Kaua'i and Fukunaga & Associates, 2015).

Water service for the existing Ka'ao Road subdivision and for the Keālia Kai development on the makai side of Kūhiō Highway is provided by a private domestic water system called the Keālia Water System, owned by the Keālia Water Company Holdings, LLC. Currently, the Keālia Water System provides water to approximately 60 homes on Ka'ao Road and Hopoe Road, and has 35 service connections at Keālia Kai. Water for the Keālia Water System is from a groundwater source, via two wells (Keālia 1A and 2a) on the west side of Keālia Road (Kodani & Associates, 2017).

Keālia Wells 1A and 2A are located within the area of a battery of seven wells developed and formerly used by Līhu'e Plantation. All nine of these wells were drilled through alluvial material comprised of various clays with some land and coral to access the semi-confined groundwater which resides in the unweathered Koloa volcanics at depth below the alluvium. All nine wells are solid cased to depths between 80 to 130 feet below sea level. They draw water from the open holes below the solid casings. The open hole depths span from 80 to 235 feet below sea level. Piezometric head of the semi-confined groundwater tapped by these wells varies between eight and ten feet above sea level. When originally constructed, at least three of the seven plantation wells were free flowing under artesian pressure (Tom Nance Water Resource Engineering, 2018).

According to the CWRM, certificates of well construction and pump installation for Keālia Wells 1A and 2A were issued on 9/19/2008. The approval pump capacity is 650 gpm (936 gpd) for Keālia Well 1A (State Well No. 3-0618-009) and 540 gpm (777,600 gpd) for Keālia Well 2A (State Well No. 3-0618-010) (personal communication with Queenie Komori, 3/12/2018).

3.4.1.4 Water Quality

State waters are classified as either inland waters or marine waters. Inland waters include streams and wetlands, and marine waters are either embayments, open coastal, or oceanic waters. Inland and marine waters are classified for the purpose of applying appropriate water quality standards. Both Kapaʻa and Kumukumu Streams flow into the nearshore coastal waters, which are rated Class A by the DOH Water Quality Standards.

The federal Clean Water Act (CWA) §305(b) and §303(d) requires states to describe the overall status of water quality statewide and extent to which water quality provides for the protection and propagation of a balanced population of shellfish, fish and wildlife and allows recreational activities in and on the water. The CWA §303(d) requires states to submit a list of Water Quality Limited Segments reporting pollutants, with a priority ranking of listed waters.

The DOH's 2006 303(d) list contained a total of 93 stream segments. The 2006 list of impaired waters (*State of Hawai'i Water Quality Monitoring and Assessment Report,* DOH 2006) included Kapaʻa Stream (Stream Code 2-2-04) and indicated it was impaired due to turbidity. The Keālia segment of the Kapaʻa system (Stream Code 2-2-04.01) was not considered impaired. In 2016, a Draft *2016 Water Quality Monitoring and Assessment Report* (DOH, 2016) was released. The 2016 report evaluated watershed "decision units," many of them coastal watersheds. Based on new data, both the Kapaʻa Watershed (Water Body ID TBD) and the marine body at Keālia (Kapaʻa Watershed) (Water Body ID H1402035) do not meet applicable water quality standards, with turbidity the pollutant of concern.

3.4.2 Potential Impacts and Mitigation

3.4.2.1 Construction Period

Construction activity within the Petition Area has the potential to impact the water quality of nearby streams and nearshore areas due to stormwater runoff and erosion. During construction of the Keālia Mauka subdivision, the contractor will implement and maintain storm and surface water runoff Best Management practices (BMPs), subject to any applicable review and approval of the State Department of Health. The BMPs will be designed to minimize soil erosion and sedimentation during activities such as grading, grubbing, and stockpiling. The BMPs will avoid violations of State water quality standards.

Construction of homes on the individual lots will be the responsibility of future lot owners. Measures to minimize construction period impacts would also be implemented as required by the Covenants, Conditions and Restrictions (CC&Rs) for the subdivision, which will require lot owners to comply with all State and County regulatory requirements.

3.4.2.2. Operational Period

The Petitioner has a water service agreement with Keālia Water Company which allows a daily aggregate of 300,000 gallons per day (gpd) of potable water to be reserved for the proposed project. The maximum daily water demand for the 235 single family homes has been estimated at 177,250 gpd, based on an average daily demand of 500 gallons per unit per day. This maximum daily demand is within the 300,000 gpd allocation from the Keālia Water Company. The estimated maximum daily water demand is also within the CWRM's-authorized pump capacity of the two

source wells (Keālia 1A and 2A). No new wells are proposed or required. An additional water storage tank will be constructed to meet fire flow and storage requirements.

At full build out of 235 homes, total pumpage from the Anahola Hydrologic Unit is estimated to be 2.98 mgd, representing less than 20% of the aquifer's sustainable yield of 17 mgd. The addition of up to 235 new single family residences will increase demand on groundwater resources, but this is within the capacity of the wells and within the aquifer's sustainable yield.

Findings of Hydrogeological Letter Report

During a Land Use Commission (LUC) meeting and in a Cultural Impact Assessment (CIA) interview (see Chapter 4, Section 4.5), one individual raised concerns about the impact of groundwater use on upgradient water users, specifically on a spring-fed *loʻi* located approximately 1.1 miles inland of the wells. A hydrogeological investigation was conducted by Tom Nance Water Resource Engineering (TNWRE) to evaluate the potential impact of additional water use from the two wells; the letter report is included as Appendix I.

The TNWRE report indicated that the Koloa volcanics, from which Keālia Wells 1A and 2A draw water, are generally moderate to poorly permeable, highly variable over short vertical and horizontal distances, and are often interbedded with nearly impermeable weathered soil layers. This results in very different water levels and hydraulic capacities in wells only short distances apart. As an example, the report compared two other wells on Hauaala Road. Well 0619-001, which was finished to a depth of 60 feet below sea level, has a water level at 66 feet above sea level. In sharp contrast, nearby Well 0619-003 has a well depth at 90 feet above sea level, and has a water level at 220 feet above sea level. The report noted that in the Koloa volcanics, such differences over short distances are more the norm than the exception.

Using Google Earth and the estimated location of the *loʻi,* the hydrogeologist estimated that the ground elevation at the *loʻi* is approximately 20 to 25 feet above sea level. The *loʻi*'s water source is not on this site, but about 200 yards away on the other side of a private dirt road, and on the order of tens of feet higher in elevation. The hydrogeologist was not able to visit the water source, which was on private property, but he talked to an individual familiar with it. It is either a spring source (as was represented by the individual in the CIA interview) or the discharge from the still active plantation irrigation system on the land immediately above.

The report stated that if it is an actual spring source at that elevation, it would be a discharge of perched groundwater with no hydrological connection to the semi-confined basal groundwater pumped by Keālia Wells 1A and 2A. The potential increase in pumpage of these wells would have no impact on the discharge rate of such a spring. If the supply is from the actively used surface water irrigation system on the land above, either as a direct connection or as a tailwater discharge, increasing pumping of the basal ground water would have no impact on its flowrate (TNWRE, 2018).

In conclusion, no adverse impacts to surface or ground water resources are expected as a result of the proposed residential use. The Proposed Action does not include any stream or surface water diversions, and will not modify any stream channels or irrigation ditches. The proposed groundwater use will not have an adverse impact on stream flow in Kapaʻa Stream, within irrigation ditches, and will not impact the water source for the taro *loʻi* mentioned during the LUC meeting and CIA interview.

3.5 NATURAL HAZARDS

3.5.1 Existing Conditions

Natural hazards include a variety of phenomena including seismic activity, hurricanes, tsunami inundation, and flood.

3.5.1.1 Seismic Activity

Seismic activity or earthquakes in the Hawaiian Islands are primarily associated with volcanic eruptions from the expansion or shrinkage of magma reservoirs, rather than shifts in the earth's crust. The island of Kauaʻi is periodically subject to episodes of seismic activity of varying intensity, but available historical data indicates that the number of major earthquakes occurring on Kauaʻi have generally been fewer and of lower intensity compared with other islands, such as Hawaiʻi Island.

Earthquakes cannot be avoided or predicted with any degree of certainty, and an earthquake of sufficient magnitude (greater than 5.0 on the Richter scale) could cause damage to roadways and structures. The Uniform Building Code (UBC) provides minimum design criteria to address potential for damages due to seismic disturbances. The UBC scale is rated from Seismic Zone 1 through Zone 4, with 1 the lowest level for potential seismic induced ground movement. Kauaʻi is designated Seismic Zone 1.

3.5.1.2 Hurricanes

Hurricanes are one subclass of a category of phenomena known to meteorologists as tropical cyclones. Hurricanes are characterized by the following life-threatening effects: high winds in excess of 74 mph; high storm surges; and heavy rains that will exceed flash flood conditions. The hurricane season in Hawaiʻi officially begins on June 1 each year and ends six months later on December 1.

Among the six most critical cyclones that approached the Hawaiian Islands between 1832 and 1949, three of the storms went toward Kauaʻi and Niʻihau. In 1959, Hurricane Dot caused $6 million in damage to Kauaʻi and was the most devastating storm up to that date in Hawaiʻi's history. In 1982, Hurricane Iwa struck Kauaʻi and Oahu and caused $234 million in property damage to both Islands. On September 11, 1992, Hurricane Iniki, a Category 4 hurricane with winds up to 150 mph (240 km/hr), resulted in an estimated $1.8 billion in damage to Kauaʻi.

The National Oceanic and Atmospheric Administration (NOAA) reported that the 2016 season included two hurricanes (Madeline and Lester), three tropical storms (Celia, Darby, and Ulika), and one tropical depression (Ivette). In addition to the six tropical cyclones, one out-of-season hurricane (Pali) occurred in January 2016 (NOAA, 2016).

3.5.1.3 Tsunami

The County of Kaua'i's tsunami evacuation zone map for Keālia to Alakukui Point shows the designated tsunami evacuation area encompassing the entire coastal area up to Kūhiʻo Highway in Kapaʻa Town. In the Keālia area, there are also some areas inland of Kūhiō Highway that require evacuation, but these are mostly south of Keālia Road. The Petition Area is located north of Keālia Road, and is not within the designed tsunami evacuation area.

3.5.1.4 Flood Zones

The Petition Area is in the Federal Emergency Management Agency (FEMA)'s flood Zone X, areas of minimal flood hazard, determined to be outside the 500-year flood (FIRM Community-Panel No. 1500020210F). Neither the Keālia Mauka site nor the adjacent Kaʻao subdivision are located within the designated FIRM flood zone (Figure 3-2). Flood prone areas are associated with Kapaʻa Stream, and mostly located to the south of Keālia Road. However, the lower section of Keālia Road closer to Kūhiō Highway is susceptible to flooding, within Zone AE and XS. This lower section of Keālia Road includes Keālia Farm, the old post office building, and an abandoned school building.

There are no FEMA flood zones associated with Kumukumu Stream or Homaikewaa Stream, both located outside the Petition Area to the north.

3.5.1.5 Dam-Related Flooding

The *mauka* lands throughout East Kauaʻi include a number of man-made reservoirs, dams, ditches and flumes that were developed in the early twentieth century as part of the sugar plantation irrigation system. Many of these structures are still in use. The Hawaiʻi Department of Land and Natural Resources (DLNR) Dam Safety Program maintains a data base of the State's reservoirs and dams, their characteristics and physical conditions. In the areas *mauka* of the Petition Area, there are two State-regulated reservoirs/dams that are owned by the Petitioner, Keālia Properties, LLC: Halaula Reservoir (State Dam ID #KA-0146) located about a half mile *mauka* of the Petition Area, off Keālia Road; and the larger Kaneha Reservoir (State Dam ID#KA-0015) located further *mauka*, about four miles from the Petition Area.

Dam "evacuation zones" represent areas where the public would be evacuated in the event of a potential or actual dam failure. The evacuation zones are designated by the Kauaʻi Emergency Management Agency (formerly Civil Defense) in the case of a potential dam break, and are much larger than the potential "inundation" area. The evacuation area includes major roads and intersections where roadblocks could be set up for traffic control.

The Petition Area is not within the dam evacuation zone. The closest dam evacuation zone, for Halaula Reservoir, is limited to lands south of Keālia Road. The evacuation area comes up to Keālia Road in the vicinity of the Petition Area, and includes some of the *makai* sections of Keālia Road near Kūhiō Highway (Evacuation Map, U.S. Army Corps of Engineers and Pacific Disaster Center, revised October 25, 2017).

As required by law, Keālia Properties, LLC, as the dam/reservoir owner, has prepared an Emergency Action Plan for the DLNR's Dam Safety Program and State and County emergency management agencies. The Emergency Action Plan is an emergency response plan and identifies proposed evacuation routes.

Flood Map **Figure 3-2**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

3.5.2 Potential Impacts and Mitigation

The proposed subdivision will not affect the occurrence of natural hazards or increase the public's vulnerability to natural hazards. Two on-site detention basins will accommodate storm water runoff from within the Petition Area and from surrounding areas. Compliance with existing County building requirements and standards during construction will avoid significant impacts associated with potential natural hazards. The Petition Area is not within a flood prone area, or within the tsunami evacuation area.

Although the Petition Area is not within the County's designated dam evacuation zone for Halaula Reservoir, the lower portion of Keālia Road is. As a result, access to Keālia Mauka subdivision could be disrupted or curtailed in the event of such an emergency. Compliance with Kauaʻi Emergency Management Agency instructions and procedures will mitigate adverse impacts to residents.

3.6 BOTANICAL RESOURCES

3.6.1 Existing Conditions

A Botanical Resources Assessment (LeGrande, 2016) was completed for the Keālia Mauka Petition Area, and is included as Appendix B. The study included field studies intended to:

- inventory flora;
- provide a general description of the vegetation on the project site;
- search for threatened and endangered species as well as species of concern; and
- provide recommendations regarding potential impacts to the plant resources of the area in regards to the proposed project.

The Petition Area has historically been utilized for various agricultural activities, including sugar cane production and livestock grazing. As with many areas in the Hawaiian Islands, the natural habitat has been highly modified and is characterized by introduced plant species. The study characterizes the Petition Area as an open, alien-dominated Guinea grassland with infrequently scattered shrubs and tree species.

The field survey noted a total of 63 observed plant species. Of these, 62 are alien (introduced) and one species is indigenous (native to the Hawaiian Islands and elsewhere). No threatened or endangered species were observed during the survey. An inventory of all the plants observed within the survey area is included in the botanical resources assessment report (Appendix B).

3.6.1.1 Dominant Vegetation Types

The following is a description of the dominant vegetation divided into two main areas within the Petition Area:

Guinea Grassland

The majority of the Petition Area is dominated by a Guinea grassland (*Panicum maximum*) with scattered shrub and tree species as well as areas where smaller weedy species dominate, such as in dirt roadways and along fence lines. Besides the guinea grass that the resident cattle are grazing on, smaller weedy species growing mixed in with the grass clumps include, false ragweed (*Parthenium hysterophorus*), castor bean (*Ricinus communis*), spiny amaranth (*Amaranthus spinosus*), owi

(*Stachytarpheta australis*), lantana (*Lantana camara*), Mexican poppy (*Argemone mexicana*), and slender mimosa (*Desmanthus pernambucanus*), Tree species observed included Koa haole (*Leucaena leucocephala*), African tulip (*Spathodea campanulata*), and Christmas berry (*Schinus terebinthifolius*). Dirt roadways were dominated by weedy grass species and smaller weeds such as owi, false ragweed, and *Sida* spp.

The main water trough for the cattle was full and overflowing, causing a rivulet of water running from a higher point of elevation at the western end near the middle of the property downslope eastward. Plant species adapted to a wetter habitat were observed growing in and at the edges of the water including, primrose willow (*Ludwigia octovalvis*), mosquito fern (*Azolla filliculoides*), and sedges such as kaluha (*Kyllinga brevifolia*), *Fimbristylis littoralis*, and *Cyperus difformis*.

Both areas planned for drainage basins (1 & 2) are dominated by Guinea grass and Koa haole. Along the boundary in the southeastern corner along Kūhiō Highway, larger stands of Koa haole were observed with the non-native maunaloa vine (*Canavalia cathartica*) growing in the branches.

Java Plum/Christmas Berry Stands

This vegetation type was only observed in small stands of trees along fence lines. Java plum (*Syzygium cuminii*) trees were mixed with smaller species such as African tulip, Christmas berry and Koa haole with a few coconut (*Cocos nucifera*) palms in some locations. Understory included weedy grass species such as fimbriate paspalum (*Paspalum fimbriatum*) and radiate fingergrass (*Chloris radiata*).

Discussion

Although the field surveys represent a one-time snapshot of the plants in the survey area, when considered together with the results of historical surveys, a reasonably accurate description of the environment and vegetation can be assembled. The botanical survey confirmed that native plant habitat within the Petition Area has been highly modified by human activities over the last several hundred years. Agricultural activities, road building, residential construction, and the intentional and accidental introduction of alien species has resulted in an overwhelming abundance and prevalence of non-native plant species on the site.

3.6.2 Potential Impacts and Mitigation

The nature of the land and its present and historical disturbance by agricultural activity limit the natural botanical resources that could occur on the site. The rare frequency of native plant species appears to confirm that only those species adapted to constant disturbances (e.g., geological, vehicular, invasive plant species, feral ungulates), can survive. Uhaloa (*Waltheria indica*), was the only indigenous (native to the Hawaiian Islands and elsewhere) plant species observed, and it was found very infrequently. There is no federally delineated critical habitat for any plant species on or adjacent to the Petition Area. In summary, the construction and operation of the proposed subdivision will not have an adverse impact on threatened or endangered plant species or critical habitat. No mitigation is required.

3.7 BIOLOGICAL RESOURCES

3.7.1 Existing Conditions

Avian and terrestrial mammalian surveys were conducted for the subject property as part of the environmental disclosure process. The field work was conducted on April 1, 2017. The resulting Fauna Survey (Rana Biological Consulting, 2017) is included as Appendix C. The primary purpose of the surveys was to determine if there are any avian or terrestrial mammalian species currently listed, or proposed for listing under the federal or State of Hawai'i endangered species statutes within or adjacent to the study area. The study evaluated the potential impacts of the proposed development on any sensitive or protected native species, and identified appropriate mitigation measures.

3.7.1.1 Avian Survey

The avian surveys were taken from five avian point count stations sited approximately equidistance from each other within the Petition Area. A total of 250 individual birds of 15 species, representing 12 separate families, were recorded during station counts. A listing of all species identified on site is included in Table 1 of Appendix C. All 15 avian species recorded on the property are alien to the Hawaiian Islands, and none are currently proposed for listed, or listed as endangered or threatened under either federal or state of Hawai'i endangered species statutes.

Avian diversity was in keeping with the property location and what was described as the heavily degraded habitat on the site (i.e., existing site is dominated by alien Guinea grass (*Megathyrsus maximus*) pasture with denser woody vegetation abutting two sides). Three species, Cattle Egret (*Bubulcus ibis*), Red Junglefowl (*Gallus gallus*) and Western Meadowlark (*Sturnella neglecta*), accounted for 54% of all birds recorded during station counts. The most commonly recorded species was the Cattle Egret, which accounted for 28% of the total number of individual birds recorded.

3.7.1.2 Mammalian Survey

The survey for terrestrial mammalian species was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the Petition Area during time spent within the Petition Area.

Three species of terrestrial mammals were recorded on the site. There was a herd of cattle (*Bos taurus*) on the site including one large Black Angus bull. Tracks and scat of pigs (*Sus scrofa*) were encountered along dirt roads within and adjacent to the Petition Area. Dogs (*Canis familiaris*) were heard barking from sites to the west and south of the site, and tracks of this species were also encountered along dirt roads within the site.

No mammalian species proposed for listing, or listed as endangered or threatened under either federal or state of Hawai'i endangered species statutes was recorded during the survey. These findings are consistent with the location of the property and the disturbed habitat present on the site (Rana Biological Consulting, 2017).

No endangered Hawaiian hoary bats were observed overflying the site. However, Hawaiian hoary bats are widely distributed in the low to mid-elevation areas on the Island of Kaua'i, and have been documented in and around areas that still have dense vegetation.

Although no rodent species were detected during the survey, it is probable that one or more of four established alien muridae found on Kaua'i--European house mice (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*)--use various resources found within the general Petition Area. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent on them.

3.7.1.3 Protected Species

In an EISPN comment letter dated December 27, 2017 (see Chapter 9), the United States Department of the Interior, Fish and Wildlife Service (USFWS) indicates that the following listed species may occur or transit through the vicinity of the proposed Petition Area: the endangered Hawaiian stilt *(Himantopus mexicanus knudseni)*, endangered Hawaiian coot *(Fulica alai)*, endangered Hawaiian gallinule *(Gallinula galeata sandvicensis)* and endangered Hawaiian duck *(Anas wyvilliana)* (collectively referred to as Hawaiian waterbirds); the endangered Hawaiian goose *(Branta sandvicensis)*; the endangered Hawaiian petrel *(Pterodroma sandwichensis)*, threatened Newell's shearwater *(Puffinus auricularis newelli),* and endangered band-rumped storm-petrel *(Oceanodroma castro)* (collectively referred to as Hawaiian seabirds); and the endangered Hawaiian hoary bat *(Lasiurus cinereus semotus)*.

None of these listed species were observed during the 2017 Rana survey. Although not observed during the avian survey, the Rana study notes that both the endangered Hawaiian Petrel and the threatened endemic Newell's Shearwater (*Puffinus newelli*) have been recorded over-flying the general project vicinity between April and the end of November each year.

The petrel is listed as endangered and the shearwater as threatened under both Federal and State of Hawai'i endangered species statutes. The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered to be the second more significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds can become disoriented by exterior lighting such as roadway lights, and collide with man-made structures. This is especially a concern during the fledging period, when young birds are finding their way out to sea for the first time. If not killed outright, the dazed or injured birds are easy targets for feral mammals. The Save Our Shearwaters Program is a multi-agency effort that enlists the help of citizens to aid birds who have become disoriented or injured. The program has recovered birds from both species from the general Keālia area over the past three decades.

The Hawaiian goose, or Nēnē (*Branta sandvicensis*) are a species of goose endemic to the Hawaiian Islands, and are known to occur in the northeast portion of Kaua'i. Nēnē are observed in a variety of habitats, but prefer open areas, such as natural grasslands and shrublands, pastures, wetlands, golf courses, and lava flows. No Nēnē were observed during the survey.

3.7.1.4 Critical Habitat

Critical habitat is a term defined and used in the federal Endangered Species Act (ESA). It is specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection.

According to the USFWS, there is no federally designated critical habitat within the immediate vicinity of the proposed project (see letter dated December 27, 2017, Chapter 9). Therefore, the construction and operation of the proposed subdivision will not impact any federally designated critical habitat. There is no equivalent statute under State law.

3.7.2 Potential Impacts and Mitigation

3.7.2.1 Impacts

Seabirds

The principal potential impact that construction of the proposed subdivision poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main ways that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, and 2) following build-out, the potential operation of streetlights or other security lighting.

Hawaiian Hoary Bats

It is likely that Hawaiian hoary bats overfly the Petition Area on a seasonal basis. The principal impact that proposed development can pose to bats is during vegetation removal during the clearing and grubbing phases of construction. The removal of vegetation has the potential to temporarily displace individual bats, which may use the vegetation as a roosting location. Because bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled.

Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the bat pupping season. With that said, there are no suitable roost trees within the proposed Petition Area. Therefore, vegetation clearing on the site is not expected to have any impact to this listed mammalian species.

Nēnē

Although no Nēnē were recorded during the avian surveys on the property, there is the potential that they could use resources on the site on a seasonal basis, depending on how tall the grass is. The primary potential impact to Nēnē would be during clearing and grubbing phases of the project. Clearing vegetation has the potential to disturb Nēnē nests, eggs, and young. When disturbed during nesting, Nēnē may abandon their nest, eggs, and to a lesser degree, the chicks. Increased vehicular traffic associated with construction activities also increases the risk of birds being run over or hit by vehicles within the project site.

3.7.2.2 Recommended Mitigation

Construction Period

During the construction phase of the project, the following mitigation measures and training are recommended to avoid adverse impacts to listed faunal species:

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- If Hawaiian goose (Nēnē) are observed loafing or foraging within the Petition Area during the Hawaiian goose breeding season (September through April), have a biologist familiar with nesting behavior survey for nests in and around the Petition Area prior to the start of work. Repeat surveys after any subsequent delay of work three or more days (during which time the birds may attempt to nest).

    - Cease all work immediately and contact the USFWS for further guidance if a nest is discovered within a radius of 150 feet of proposed work, or a previously undiscovered nest is found within said radius after work begins.

- In areas where Nēnē are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on site.

Operational Period

Once the subdivision is completed and occupied, the following is recommended:

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).