Agricultural Suitability for HoKua Place (Formerly Kapa'a Highlands Phase II) 
June, 2018

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INTRODUCTION

Kapaa Highlands Phase II is a 97 acre parcel of land in Kapaa, Kauai, Hawaii near Kapaa Middle School. Phase II is part of tax map key number (4) 4-3-003:001, a 163.42 acre parcel. Phase II is presently classified and zoned agriculture under the Hawaii State Land Use and County of Kauai designations. Because of Phase II’s location adjacent to urban areas and constraints that lessen its agricultural importance to the County of Kauai and the State, reclassifying Phase II from agriculture to urban would not have a significant negative impact on farming for Kauai or for the state.

SUMMARY

The climate and soils at Phase II are not ideal for the growing of most commercially viable crops due to the strong trade winds and the salt spray from the ocean.

The proximity of Kapaa Middle School and residential subdivisions to the property will require extensive buffers around the agricultural property and will require extreme care in the implementation of farming practices to prevent any dust, spray drift or noise pollution that may impact the school or existing residential property.

The cost of labor, the cost of water, less expensive food imports, food safety requirements, transportation costs and the economies of scale are all hinderances to creating a sustainable farming community on Kauai.

Kauai has an abundance of large parcels of good agricultural land that are not located within urban and rural areas.

The reclassification of 97 acres of agricultural land that is surrounded by urban development and is designated in the Kauai General Plan for urban expansion will have a minor impact on the potential of Kauai’s ability to feed its population over time.

DESCRIPTION OF THE PROPERTY

The property is located in Kapaa, Kauai above the Kapaa by-pass road and adjacent to Kapaa Middle School. The property is further identified by TMK (4) 4-3-003-001, Phase II. The land area in Phase II totals 97 acres that is classified and zoned as agricultural land. The property is not currently being used for any type of agriculture.
CLIMATE & SOILS

Climate
The climate is dominated by northeasterly tradewinds caused by high pressure weather systems with winds in the 15 to 35 plus mile per hour (mph) range. Low pressure systems occur during the winter and occasionally during the rest of the year. This latter type of weather system has winds that are variable and usually light to moderate (5 mph to 15 mph) from the south or west or a combination. There are conditions when the low pressure systems generate storms with high winds (50+ mph) and excessive rainfall. From June to November hurricanes can occur although they are infrequent.

The rainfall is approximately 50 inches although, possibly because of global warming, rainfall is difficult to predict and can be considerably higher at times than 50 inches per year.

Temperature during the day ranges from high 80 degrees Fahrenheit (°F) in the summer to low 70’s °F during the winter with slightly cooler temperatures during the night.

The strong tradewinds throughout this property are a negative factor for agricultural production. Costly windbreaks would be required to protect the crops. Another factor that will inhibit plant growth is the salt spray from the ocean carried by the strong winds. The salt spray can limit the crop selection as some agricultural crops are not tolerant of salt spray. Also, the salt spray can damage the production and decrease the quality and sale price.

Topography and Soils
The property elevation slopes gently from approximately 50 feet above sea level at southeast boundary of the property to 100 feet at the northwest section. There are no designated floodplains on the property except for a very small area on the western edge that lies within the 100 year floodplain.

The most extensive soil type on the property is the loleau silty clay loam with 2 to 30 percent slope although most of this soil type on Phase II has 2 to 6 percent slopes (approximately 40 acres). Soil depth to underlying igneous rock is 60 inches. This soil’s natural drainage is good and flooding and ponding are not a problem. The surface soil has some organic matter (5%). There are approximately 30 acres of the Puhi silty clay loam soil with 3 to 8 percent slopes. This soil is similar to the loleau soils except that the surface organic matter is 7 percent. There are about 12 acres of soil categorized as rough broken land on the eastern side of Phase II, along with 3.1 acres of poorly drained Mokuleia clay loam. There is a small section of marsh (.3 acres) on the south boundary.

Because the most prevalent soils on the property drain rapidly and rainfall can be erratic, an irrigation system would be required for optimum crop production.

A large portion of this property is presently covered with common trees and bushes all of which would require removal prior to any development.

See Appendix A – Climate and Soils Information.
HAWAII LAND CLASSIFICATIONS

The Hawaii Land Study Bureau (LSB) rates this property as B, C, D and E. This rating indicates that the agricultural potential is mediocre with some areas of good soil and others fair to poor soil. The Agricultural Lands of Importance to the State of Hawaii (ALISH) designation includes Prime and Other. This rating, as with the LSB rating, indicates areas of the property have the potential for some good crop production as well as medium to poor production.

See Appendix B - Hawaii Land Classification Maps.

AGRICULTURAL LAND ON KAUAI & ITS USE

The total land area of the Island of Kauai is 353,900 acres. The island’s four (4) basic land classifications are:

- Urban 14,573 acres
- Rural 1,253 acres
- Conservation 198,769 acres
- Agricultural 139,305 acres

Kauai has a farming and ranching community that utilizes approximately one half of the agriculturally classified acreage. There are a total of 63,244 acres in agricultural use. Pasture covers the largest acreage at 41,934 acres. Crops account for the remaining acreage with seed corn production the largest crop segment at 13,299 acres followed by coffee at 3,788 acres.

Recently the seed companies have been decreasing their acreage planted for seed production. Kauai Coffee, one of Kauai’s larger agricultural operations, is not expanding its acreage, but improving and replacing coffee trees on its existing acreage under cultivation to increase per acre production. Hawaii Department of Land and Natural Resources has agricultural land that is not being farmed and could be leased to farmers.

Because of the cessation of sugar production on Kauai and the release of these lands, these former sugar lands are available for other agricultural crops. Consequently, there is adequate agricultural land available on the island to produce food to supply the residents of Kauai. Presently, however, the available agricultural land is not being fully utilized because of other constraints to agricultural development.

See Appendix C – Crop Summary by Acreage (2015).
FUTURE FOOD PRODUCTION ON KAUA'I

The total acreage on Kauai that is classified for agriculture is 139,305. Of this land, 63,244 acres is currently in active agriculture. The total land area in active agriculture that is not in livestock production is 21,310 acres. Food crops account for 2,314 acres (includes aquaculture) and the predominant food crops are taro and tropical fruit. Food crops (for the purpose of this report) are crops that produce an edible vegetable or fruit. Livestock acreage is considered separately.

Providing food on Kauai for the people living on Kauai or for export is not a land availability issue and should not be in the future. The land that is classified for agriculture but is not in livestock or diversified crops totals 76,061 acres. If 75% of this land is suitable for growing food crops, the potential for growing food crops increases by approximately 57,000 acres. Suitable is land where the soils have a LSB rating of A, B or C; have adequate rainfall (approximately 60 inches per year) or adequate water for irrigation; are not impacted by salt spray from the ocean; and are tillable.

LOCATION

A major constraint to agricultural development on Phase II of this property is the proximity of the Kapaa Middle School, located on the northern side of the property. Additionally, there are adjacent subdivisions on the north and eastern sides of the property. The existing substantial urban development that is in close proximity to the agriculturally classified parcel will require extensive buffers around the agricultural property and will require extreme care in the implementation of farming practices to prevent any dust, spray drift or noise pollution that may impact the school or existing residential property. The Kauai General Plan designates this property as future urban expansion.

LABOR

The growing of food on Kauai for the people of Kauai is constrained by the lack of people willing to farm this land. A seasoned vegetable farmer expressed the opinion that if a farmer can make money farming, more farmers will farm.

The lack of both skilled and unskilled labor for the agricultural industry on Kauai is a major problem. The present unemployment rate on Kauai is 1.8%, which is essentially full employment. The competition for labor is a serious problem for most of the industries on Kauai. The tourist industry generally pays higher wages and has better benefits for its employees. Many workers prefer the type of jobs offered in the tourist industry versus the agricultural industry. In addition, the technology industry, construction industry, suppliers to these industries and some smaller cottage industries all compete for a finite labor supply and generally offer higher wages.

The County of Kauai Economic Development Department has a very proactive farm internship program in the local high schools to address the lack of farm labor on the island. This program has grown from two high school intern participants in 2014 to 41 interns in 2018. Although it will be many years before
this program can supply sufficient farm labor with the skills, experience, and desire to farm, it will eventually help to ameliorate the farm labor shortage.

**INFRASTRUCTURE COSTS**

Infrastructure costs to develop a farm are another constraint to farming Phase II. County water is available to the property. Although the County has an agricultural water rate to provide an incentive for farming, the water is still expensive. The current rate is $2.20 per 1,000 gallons. Installing an irrigation system would be required to ensure consistent and quality crop production. Well-designed windbreaks are needed to protect the crops from the prevailing tradewinds and require installation and time to grow large enough to provide adequate wind protection. Extensive brush clearing is required to remove the invasive plant material presently growing on the property. The primary plant species are Haole Koa (Leucaena leucocephala) and Guinea Grass (Megathyrsus maximus). Equipment and materials storage are required and would entail constructing a building. Land preparation and application of soil amendments based on a soil analysis would have to be done prior to planting the crops. A farm road(s) would need to be constructed. Incurring all these costs prior to receiving any income from the sale of the farm production requires capital and that can be difficult for a farmer to obtain.

**MARKETING**

For a profitable farm operation on this property investing in a good marketing program for the production is a key component. The County of Kauai is developing markets through its Sunshine Markets program for quality produce from small Island farms. However, most of the food presently consumed on Kauai is imported from the mainland because it is cheaper than the food that is produced on Kauai. Price of the product is the most important factor although quality and organic production can be factors in selling a product at a high price if the customer is motivated to pay more for what he or she considers a better product.

An important cost of marketing farm production is the requirement to comply with the United States Department of Agriculture (USDA) food security regulations. These USDA regulations are for consumer protection from diseases carried by food such as salmonella.

Efficient and available transportation to the market is another cost factor for the farm. Kauai has a severe traffic problem, and this increases the cost and makes transporting farm production to the markets a challenge.

**FOOD SECURITY**

Food security, defined as having sufficient food grown on Kauai to support the resident population in the event of a disruption in transportation between Hawaii and the U.S. Mainland, is a significant issue in Hawaii and is discussed on a regular basis. On Kauai the constraints listed here make achieving the
production of sufficient food to feed the population difficult. There is sufficient unused agricultural land on the island if these other issues are addressed satisfactorily to supply Kauai with adequate food for its population.

CONCLUSION

The reclassification of 97 acres of agricultural land surrounded by urban development will have minimal impact on Kauai’s ability to feed its population over time. The Island of Kauai has an abundance of good agricultural land that can be put into the production of food for the Island’s population. The bottlenecks are first and foremost the lack of farmers and farm workers. Until the farmer can make a good living farming, it will be difficult to provide enough local food to feed the people of Kauai. Other constraints are competition from imports (lower price), infrastructure costs and marketing.
Appendix A
Climate and Soils Information
## Soils Inventory Report

Thu May 31 2018 11:17:28 GMT-1000 (Hawaiian Standard Time)

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HnA</td>
<td>Hanalei silty clay, 0 to 2 percent slopes, MLRA 167</td>
<td>1.1</td>
<td>1%</td>
</tr>
<tr>
<td>IoB</td>
<td>Ioleau silty clay loam, 2 to 6 percent slopes</td>
<td>45.1</td>
<td>28%</td>
</tr>
<tr>
<td>IoC</td>
<td>Ioleau silty clay loam, 6 to 12 percent slopes</td>
<td>16.2</td>
<td>10%</td>
</tr>
<tr>
<td>IoD2</td>
<td>Ioleau silty clay loam, 12 to 20 percent slopes, eroded</td>
<td>10.6</td>
<td>7%</td>
</tr>
<tr>
<td>IoE2</td>
<td>Ioleau silty clay loam, 20 to 30 percent slopes, eroded</td>
<td>24</td>
<td>15%</td>
</tr>
<tr>
<td>LhB</td>
<td>Lihue silty clay, 0 to 8 percent slopes</td>
<td>8.2</td>
<td>5%</td>
</tr>
<tr>
<td>LhC</td>
<td>Lihue silty clay, 8 to 15 percent slopes</td>
<td>0.7</td>
<td>0%</td>
</tr>
<tr>
<td>LhD</td>
<td>Lihue silty clay, 15 to 25 percent slopes</td>
<td>3.9</td>
<td>2%</td>
</tr>
<tr>
<td>Mta</td>
<td>Mokuleia clay loam, poorly drained variant</td>
<td>3.1</td>
<td>2%</td>
</tr>
<tr>
<td>MZ</td>
<td>Marsh</td>
<td>0.3</td>
<td>0%</td>
</tr>
<tr>
<td>PkB</td>
<td>Pohakupu silty clay loam, 0 to 8 percent slopes</td>
<td>0.8</td>
<td>0%</td>
</tr>
<tr>
<td>PnB</td>
<td>Puhi silty clay loam, 3 to 8 percent slopes</td>
<td>31.4</td>
<td>19%</td>
</tr>
<tr>
<td>rRR</td>
<td>Rough broken land</td>
<td>16.1</td>
<td>10%</td>
</tr>
</tbody>
</table>

Total: 161.5 100%
Map Unit Description (Brief, Generated)

Island of Kauai, Hawaii

[Minor map unit components are excluded from this report]

Map unit:  HnA - Hanalei silty clay, 0 to 2 percent slopes, MLRA 167

Component:  Hanalei (85%)

The Hanalei component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flood plains on valley floors on islands. The parent material consists of alluvium derived from basalt. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is frequently flooded. It is occasionally ponded. A seasonal zone of water saturation is at 42 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 8 percent. This component is in the F164XY500HI Volcanic Ash Forest ecological site. Nonirrigated land capability classification is 2w. Irrigated land capability classification is 2w. This soil does not meet hydric criteria. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Map unit:  IoB - Ioleau silty clay loam, 2 to 6 percent slopes

Component:  Ioleau (100%)

The Ioleau component makes up 100 percent of the map unit. Slopes are 2 to 6 percent. This component is on uplands. The parent material consists of basic igneous rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria.

Map unit:  IoC - Ioleau silty clay loam, 6 to 12 percent slopes

Component:  Ioleau (100%)

The Ioleau component makes up 100 percent of the map unit. Slopes are 6 to 12 percent. This component is on uplands. The parent material consists of basic igneous rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria.
Map Unit Description (Brief, Generated)

Island of Kauai, Hawaii

Map unit: IoD2 - Ioleau silty clay loam, 12 to 20 percent slopes, eroded

Component: Ioleau (100%)

The Ioleau component makes up 100 percent of the map unit. Slopes are 12 to 20 percent. This component is on uplands. The parent material consists of basic igneous rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map unit: IoE2 - Ioleau silty clay loam, 20 to 30 percent slopes, eroded

Component: Ioleau (100%)

The Ioleau component makes up 100 percent of the map unit. Slopes are 20 to 30 percent. This component is on uplands. The parent material consists of basic igneous rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: LhB - Lihue silty clay, 0 to 8 percent slopes

Component: Lihue (100%)

The Lihue component makes up 100 percent of the map unit. Slopes are 0 to 8 percent. This component is on uplands. The parent material consists of basic igneous dust. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Map unit: LhC - Lihue silty clay, 8 to 15 percent slopes

Component: Lihue (100%)

The Lihue component makes up 100 percent of the map unit. Slopes are 8 to 15 percent. This component is on uplands. The parent material consists of basic igneous dust. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.
Map Unit Description (Brief, Generated)

Island of Kauai, Hawaii

Map unit: LhD - Lihue silty clay, 15 to 25 percent slopes

Component: Lihue (100%)

The Lihue component makes up 100 percent of the map unit. Slopes are 15 to 25 percent. This component is on uplands. The parent material consists of basic igneous dust. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Map unit: Mta - Mokuleia clay loam, poorly drained variant

Component: Mokuleia variant (85%)

The Mokuleia variant component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on coastal plains. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is occasionally flooded. It is occasionally ponded. A seasonal zone of water saturation is at 48 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3w. Irrigated land capability classification is 3w. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 97 percent. There are no saline horizons within 30 inches of the soil surface.

Map unit: MZ - Marsh

Component: Marsh (100%)

The Marsh component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on along Coastal Plains marshes. The parent material consists of organic. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 80 percent. Nonirrigated land capability classification is 8w. This soil meets hydric criteria. The soil has a slightly saline horizon within 30 inches of the soil surface.
Map Unit Description (Brief, Generated)

Island of Kauai, Hawaii

Map unit:  PkB - Pohakupu silty clay loam, 0 to 8 percent slopes

Component:  Pohakupu (100%)

The Pohakupu component makes up 100 percent of the map unit. Slopes are 0 to 8 percent. This component is on and terraces alluvial fans. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria.

Map unit:  PnB - Puhi silty clay loam, 3 to 8 percent slopes

Component:  Puhi (100%)

The Puhi component makes up 100 percent of the map unit. Slopes are 3 to 8 percent. This component is on uplands. The parent material consists of basic igneous rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 7 percent. Nonirrigated land capability classification is 2e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Map unit:  rRR - Rough broken land

Component:  Rough broken land (100%)

The Rough broken land component makes up 100 percent of the map unit. Slopes are 40 to 70 percent. This component is on mountain sides gullies. The parent material consists of alluvium and colluvium. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 55 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 6 percent. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.
Appendix B
Hawaii Land Classification Maps
Renewable EnerGIS Parcel Report - (4) 4-3-003:001

SITE DESCRIPTION
Parcel Area (acres): 163.420
County Zoning: No data
County Address: Oloheha Rd
State Land Use District: Agriculture; Urban

LAND ECOLOGY
Critical Habitat: No
Special Management Area (SMA): No
Thermal Springs Potential: No data
High Temperature Resource Areas: No data
Reserves: No

LAND USE / LAND COVER
Ag Land Use (2011-2015): Pasture
LSB Soil Rating: B; C; D; E
Ag Land Use (ALUM 1980): Grazing; S
Important Ag Land (IAL): No data
Ag Lands of Importance (ALISH): Unclassified; Prime; Other

INFRASTRUCTURE
Ditches: DITCH
Studied Hydro Projects: No

HYDROLOGY
Flood Zone: X
Streams: Waikaa

Point Details – Coordinates of Point: 22.0752, -159.32730

SOLAR RESOURCES
Solar Radiation (calories/cm2/day): 400-450
DNI Annual (Wh/m2/day): 4,303
GHI Annual (Wh/m2/day): 5,095

TERRAIN
NOAA Elevation (m): 31
USGS Slope (%): 2.81974
USGS Aspect (degrees from N): 219.137

MARINE RESOURCES
Temp Avg Diff (degrees C): No data
Temp Amplitude Diff (degrees C): No data
3-Mile Ocean Boundary: Not applicable
12-Mile Ocean Boundary: Not applicable
Benthic Habitat: No data
Whale Sanctuary: No data
Marine Managed Area: No data
Annual Rainfall: 45.168198

WIND RESOURCES
Wind Power Density at 50m (W/m2): 239.00
Wind Speed at 30m (m/s): No data
Wind Speed at 50m (m/s): No data
Wind Speed at 70m (m/s): No data
Wind Speed at 100m (m/s): No data

There are no expressed or implied warranties associated with the release, use, or interpretation of the data or information provided by Renewable EnerGIS. Specifically, no warranty is made that the GIS data or any subsequent updates will be error free and no warranty is made regarding the positional or thematic accuracy of the GIS data or information. The GIS data, information, and any features it depicts do not represent or confer any legal rights, privileges, benefits, boundaries or claims of any kind. Utilization of EnerGIS demonstrates understanding and acceptance of these terms by Renewable EnerGIS users. Information about the data used in Renewable EnerGIS, including dates and sources of the layers, can be viewed here.

SATE OF HAWAII

06/24/2018
Layer Name: Agricultural Lands of Importance to the State of Hawaii

Coverage Name: ALISH

Layer Type: Polygon

Status: Complete

Geog. Extent: Main Hawaiian Islands

Projection: Universal Trans Mercator, Zone 4

Datum: NAD 83

Description: Agricultural Lands of Importance to the State of Hawaii for islands of Kauai, Oahu, Maui, Molokai, Lanai & Hawaii.

Source: State Department of Agriculture 1:24,000 hand drafted blueline maps; compiled and drafted in 1977. Prepared with the assistance of the Soil Conservation Service, U.S. Department of Agriculture, and the College of Tropical Agriculture, University of Hawaii. See text below for information about the classification system, including criteria for classification.

History: Digitized in Arc/Info version 6 using ArcEdit by the Office of State Planning (OSP) from State Department of Agriculture's 1:24,000 blueline maps.

Attributes: Polygons:

- AREA: area of polygon (sq. meters)
- PERIMETER: perimeter of polygon (meters)
- ALISH#: Polygon internal number (for Arc/Info use)
- ALISH-ID: Polygon ID (for Arc/Info use)
- AGTYPE: Agricultural Type

- AGTYPE: Definition

- <blank>: Unclassified
- 0: Unclassified
- 1: Prime Lands
- 2: Unique Lands
- 3: Other Lands


The Classification System:

The classification system for identification of agriculturally important lands in the State of Hawaii provides for:

1. Establishment of classes of agricultural lands primarily, but not exclusively, on the basis of soil characteristics;
2. Establishment of criteria for classification of lands; and

3. Identification of lands which meet the criteria for the respective classes.

Three classes of agriculturally important lands were established for the State of Hawaii with the intent of facilitating the SCS effort to inventory prime farmlands nationally and adapting the classification to the types of agricultural activity in Hawaii. These classes and their corresponding SCS (national) equivalents are:

<table>
<thead>
<tr>
<th>Hawaii Classification System</th>
<th>SCS Classification System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Agricultural Land</td>
<td>Prime Farmland</td>
</tr>
<tr>
<td>Unique Agricultural Land</td>
<td>Unique Farmland</td>
</tr>
<tr>
<td>Other Important Agricultural Land</td>
<td>Additional Farmland of Statewide</td>
</tr>
<tr>
<td></td>
<td>and Local Importance</td>
</tr>
</tbody>
</table>

The criteria for classification of PRIME AGRICULTURAL LAND are identical to the criteria established by SCS for national application. The criteria for UNIQUE AGRICULTURAL LAND and OTHER IMPORTANT AGRICULTURAL LAND were established cooperatively by the Soil Conservation Service in Hawaii, the College of Tropical Agriculture, and the State Department of Agriculture.

Land considered for classification may or may not currently be in agricultural use, or may be in an agricultural use other than that which its classification may indicate as its agricultural capability. An example of the latter situation is land currently being used for grazing but which meets the criteria for Prime Agricultural Land. Lands not considered for classification as agricultural lands of importance to the State of Hawaii are:

1. Developed urban land over 10 acres;

2. Natural or artificial enclosed bodies of water over 10 acres;

3. Forest reserves;

4. Public use (parks and historic sites) lands;

5. Lands with slopes in excess of 35%; and

6. Military installations, except undeveloped areas over 10 acres.

The classification of agriculturally important lands does not in itself constitute a designation of any area to a specific land use. The classification should, however, provide decision makers with an awareness of the long-term implications of various land use options for production of food, feed, forage, and fiber crops in Hawaii.

Over time new areas may be developed for agricultural uses, other areas may be converted to irreversible non-agricultural uses, and new knowledge may be gained regarding soil interpretations. These and other developments will necessitate the periodic review and revision of the classification system and lands identified for the various classes.
The criteria for classification:

**Prime Agricultural Land**

Prime Agricultural Land is land best suited for the production of food, feed, forage and fiber crops. The land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

Prime Agricultural Land meets the following criteria:

1. The soils have an adequate moisture supply. Included are:
   
a. Soils having aquic or udic moisture regimes. (For definitions of moisture regimes see Soil Taxonomy, Agricultural Handbook 436, December 1975). These soils commonly are in humid or subhumid climates that have well distributed rainfall or have enough rain in the summer that the amount of stored moisture plus rainfall is approximately equal to or exceeds the amount of potential evapotranspiration. Water moves through the soils at some time in most years.

b. Soils having xeric or ustic moisture regimes and in which the available water capacity is great enough to provide adequate moisture for the commonly grown crops in 7 or more years out of 10.

c. Soils having aridic or torric moisture regimes and the area has a developed irrigation water supply that is dependable and of adequate quality. Also included are soils having xeric or ustic moisture regimes in which the available water capacity is limited but the area has a developed irrigation water supply that is dependable and of adequate quality.

d. Soils having sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone if the root zone is less than 40 inches deep, to produce the commonly grown crops in 7 or more out of 10 years.

   A dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown.

2. The soils have a soil temperature regime that is isomesic, isothermic, or isohyperthermic. These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 47 degrees F (8 degrees C), and the difference between the mean summer and mean winter temperature differ by less than 9.0 degrees F (5 degrees C).

3. The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone
is less than 40 inches deep. (Soils which have a pH of less than 4.5 in surface soil because of use of fertilizers are excluded). This range of pH is favorable for growing a wide variety of crops without adding large amounts of amendments.

4. The soils have no water table or a water table that is maintained at a sufficient depth during the cropping season to allow crops common to the area to be grown.

5. The soils can be managed so that in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.

6. The soils are not flooded frequently during the growing season (less often than once in 2 years).

7. The soils have a product of K (erodability factor) x percent slope of less than 2.0. That is, soils having a serious erosion hazard are not included.

8. The soils have a permeability rate of at least 0.06 inches (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches is less than 57 degrees F (14 degrees C). Permeability rate is not a limiting factor if the mean annual soil temperature is 57 degrees F (14 degrees C) or higher.

9. Less than 10 percent of the surface layer in these soils consists of rock fragments coarser than 3 inches (7.6 cm). These soils present no particular difficulty in cultivating with large equipment.

10. Must not be thixotropic and have isomesic temperature regime.

UNIQUE AGRICULTURAL LAND

UNIQUE AGRICULTURAL LAND is land other than PRIME AGRICULTURAL LAND and is used for the production of specific high-value food crops. The land has the special combination of soil quality, growing season, temperature, humidity, sunlight, air drainage, elevation, aspect, moisture supply, or other conditions, such as nearness to market, that favor the production of a specific crop of high quality and/or high yield when the land is treated and managed according to modern farming methods. In Hawaii, some examples of such crops are coffee, taro, rice, watercress and non-irrigated pineapple.

Land that qualifies as PRIME AGRICULTURAL LAND and is used for a specific high-value crop is classified as PRIME AGRICULTURAL LAND rather than as UNIQUE AGRICULTURAL LAND.
OTHER IMPORTANT AGRICULTURAL LAND

OTHER IMPORTANT AGRICULTURAL LAND is land other than PRIME or UNIQUE AGRICULTURAL LAND that is of state-wide or local importance for the production of food, feed, fiber and forage crops. The lands in this classification are important to agriculture in Hawaii yet they exhibit properties, such as seasonal wetness, erodibility, limited rooting zone, slope, flooding, or droughtiness, that exclude them from the PRIME or UNIQUE AGRICULTURAL LAND classifications. Two examples are lands which do not have an adequate moisture supply to qualify as PRIME AGRICULTURAL LAND and lands which have similar characteristics and properties as UNIQUE AGRICULTURAL LAND except that the land is not currently in use for the production of a "unique" crop. These lands can be farmed satisfactorily by applying greater inputs of fertilizer and other soil amendments, drainage improvement, erosion control practices, flood protection and produce fair to good crop yields when managed properly.

Other criteria which may qualify lands as OTHER IMPORTANT AGRICULTURAL LAND are:

1. The land has slopes less than 20%, is presently in crop or has cropping potential, and is not classified as PRIME or UNIQUE AGRICULTURAL LAND. The soils have a moisture supply which is adequate for the commonly grown crop.

2. The land has slopes less than 35%, is presently used for grazing or has grazing potential, and is not classified as PRIME or UNIQUE AGRICULTURAL LAND. The soils have:

   a. An aquic, udic, xeric, or ustic moisture regime in which the available water capacity is sufficient to produce fair to good yields of adapted forage.

   b. Less than 10% rock outcrops and coarse fragments coarser than 3 inches (7.6 cm) in the surface layer.

3. The soils are thin organic soils underlain by aa lava (typic tropofolists) having aquic, udic, xeric, or ustic moisture regimes and isohyperthermic (greater than 72 degrees F) or isothermic (59 - 72 degrees F) soil temperature regimes.

Contact: Joan Delos Santos, Office of Planning, State of Hawaii, PO Box 2359, Honolulu, HI 96804; (808) 587-2895. email: JDelos_Santos@dbedt.hawaii.gov
Renewable EnerGIS Parcel Report - (4) 4-3-003:001

SITE DESCRIPTION
Parcel Area (acres): 163.420
County Zoning: No data

County Address: Olohana Rd
State Land Use District: Agriculture; Urban

LAND ECOLOGY
Critical Habitat: No
Special Management Area (SMA): No
Thermal Springs Potential: No data
High Temperature Resource Areas: No data
Reserves: No

LAND USE / LAND COVER
Ag Land Use (2011-2015): Pasture
Ag Land Use (ALUM 1980): Grazing; S
Ag Lands of Importance (ALISH): Unclassified; Prime; Other

LSB Soil Rating: B; C; D; E
Important Ag Land (IAL): No data

INFRASTRUCTURE
Ditches: DITCH
Studied Hydro Projects: No

HYDROLOGY
Flood Zone: X
Streams: Waikae

Point Details – Coordinates of Point: 22.07523, -159.32730

SOLAR RESOURCES
Solar Radiation (calories/cm2/day): 400-450
DNI Annual (W/m2/day): 4,303
GHI Annual (W/m2/day): 5,095

TERRAIN
NOAA Elevation (m): 31
USGS Slope (%): 2.81974
USGS Aspect (degrees from N): 219.137

MARINE RESOURCES
Temp Avg Diff (degrees C): No data
Temp Amplitude Diff (degrees C): No data
3-Mile Ocean Boundary: Not applicable
12-Mile Ocean Boundary: Not applicable

Benthic Habitat: No data
Whale Sanctuary: No data
Marine Managed Area: No data
Annual Rainfall: 45.168198

WIND RESOURCES
Wind Power Density at 50m (W/m2): 239.00
Wind Speed at 30m (m/s): No data
Wind Speed at 50m (m/s): No data

Wind Speed at 70m (m/s): No data
Wind Speed at 100m (m/s): No data

There are no expressed or implied warranties associated with the release, use, or interpretation of the data or information provided by Renewable EnerGIS. Specifically, no warranty is made that the GIS data or any subsequent updates will be error free and no warranty is made regarding the positional or thematic accuracy of the GIS data or information. The GIS data, information, and any features it depicts do not represent or confer legal rights, privileges, benefits, boundaries or claims of any kind. Utilization of EnerGIS demonstrates understanding and acceptance of this disclaimer by Renewable EnerGIS users. Information about the data used in Renewable EnerGIS, including dates and sources of the layers, can be found here.
Layer Name: Land Study Bureau (LSB) Detailed Land Classification
Layer Type: Polygon
Status: Complete; currently being updated
Geog. Extent: Main Hawaiian Islands
Projection: Universal Trans Mercator, Zone 4. Meters, NAD 83 HARN
Description: Land Study Bureau's Detailed Agricultural land productivity ratings for Kauai, Oahu, Maui, Molokai, Lanai and Hawaii.
Source: Land Study Bureau's Detailed Land Classification Aerial Photos hand drafted onto paper overlays of the U.S.G.S., 1:24,000 topographic and orthophoto quads. Ratings were developed for both over-all productivity, and for specific crops. This layer represents only the over-all productivity ratings.
Dates of LSB studies:
Hawaii - 1965
Maui - 1967
Oahu - 1972
Kauai - 1967
Molokai - 1968
Lanai - 1967
History: Digitized in Arc/Info version 7.1.1 using ArcEdit by the Office of Planning (OP), 1998.
Note 1: Lands having the LSB rating of "U," which the Land Study Bureau assigned to built-up or urbanized areas (as of the date of the studies), were not digitized.
Note 2: All classified lands falling within the State Land Use Urban District were deleted from the layer using the 1995 LUDB coverages.
Note 3: Although LSB classification polygons falling within the 1995 LUDB Urban District were deleted from the GIS layer, the classifications themselves still exist – they simply are not represented in this GIS layer. Specifically, there is no provision in State law requiring the rescission of the soil ratings that apply to an area that has been reclassified by the Land Use Commission, e.g., from the Agricultural to Urban districts. Similarly, there is no provision in State law requiring the Detailed Land Classification (Land Study Bureau) bulletins to be reviewed and revised to reflect changes to the land areas for which urban development has occurred.
Attributes: Polygons:

AREA area of polygon (sq. meters)
PERIMETER perimeter of polygon (meters)
TYPE Agricultural Productivity Rating
Island Island
GISAcres Acreage, as calculated by GIS software

Discussion:


"Land Study Bureau's Overall Productivity Rating (LSB):

The Land Study Bureau of the University of Hawaii prepared an inventory and evaluation of the State's land resources during the 1960's and 1970's. The Bureau grouped all lands in the State, except those in the urban district**, into homogeneous units of land types; described their condition and environment; rated the land on its over-all quality in terms of agricultural productivity; appraised its performance for selected alternative crops; and delineated the various land types and groupings based on soil properties and productive capabilities.

**Office of Planning note: “urban district,” in this context/document, does not refer to the State Land Use District Boundary “Urban District”, but instead refers lands that were observed to have been “built areas” in the aerial photographs.

These properties included:

a. Texture-which refers to the proportion of sand, silt and clay in a particular soil. Medium-textured soils which have nearly equal proportions of sand, silt and clay are generally the most desirable for agriculture because of good tillability and water retention.

b. Structure-which refers to the cohesion of soil material into aggregates or clumps. The size, shape and amount of these clumps affect the pore spaces which contain the air and moisture necessary for growth.

c. Depth-which refers to the distance to which roots can penetrate. Generally, the deeper the rooting depth, the more desirable the soil because more moisture can be stored and more soil volume is available from which nutrients can be obtained.

d. Drainage-refers to the frequency and duration of soil saturation with moisture.

e. Parent material-refers to the geologic material from which a soil has developed. Soils formed from coral have neutral to alkaline reactions and are high in calcium. Most of the soils have developed from volcanic material and under tropical conditions of high temperature and rainfall. These soils tend to be acid and fertility levels are relatively low.

f. Stoniness-affects the productivity of land by limiting the use of machinery and the selection of crops.
g. Topography—refers to slope and surface configuration. Lands with flat terrain are better suited for a wider variety of agricultural uses than lands having steeper slopes. Cultivated lands generally have slopes of less than 20 percent. Lands with slopes between 20 to 35 percent usually are not machine-tilled, but are still suitable for certain uses such as orchards and grazing.

h. Climate—with its elements of temperature, sunlight and rainfall constitutes the exterior environment of land, unlike the soil properties which constitute the interior segment.

i. Rain—is the basic source of irrigation. Ideally, it should fall at the place, in the quantity and at the time when it is needed.

The interaction of particular soil properties, topography and climate served to differentiate land types and provided a basis for correlating and establishing productivity ratings. A five-class productivity rating system was developed with "A" representing the class of highest productivity and "E" the lowest.

From "Detailed Land Classification - Island of Kauai," December, 1967, Land Study Bureau, pp. 25-27:

"Over-all (Master) Productivity Rating:

The Over-all Productivity Rating evaluates each Land Type in its over-all or general productive capacity and not for any specific crop. Two independent methods were utilized in ascertaining and checking this over-all rating: averaging the Selected Crop Productivity Ratings and application of the Modified Storie Index (6) (7).

....The Modified Storie Rating Index is a formula whereby the productivity index of the land is developed by multiplying the several factors in the formula. The higher the product, the better suited the Land Type is for agricultural uses.

Modified Storie Rating Index = A x B x C x X x Y

A = percentage rating for the general character of the soil profile
B = percentage rating for the texture of the surface horizon
C = percentage rating for the slope of the land
X = percentage rating for such factors as salinity, soil reaction, damaging winds, erosion, etc.
Y = percentage rating for rainfall

The percentage rating for each factor (A, B, C, X and Y) increases as the favorableness of the factor increases. Therefore, it follows that as the land productivity index approaches 100 percent, the agricultural quality of the land increases. Conversely, less desirable lands have low value indexes. The following are the Modified Storie Index percentages and their associated Over-all Productivity Ratings:

<table>
<thead>
<tr>
<th>Modified Storie Index Percentages</th>
<th>Over-all Productivity Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-100</td>
<td>A</td>
</tr>
<tr>
<td>70-84</td>
<td>B</td>
</tr>
<tr>
<td>55-69</td>
<td>C</td>
</tr>
<tr>
<td>30-54</td>
<td>D</td>
</tr>
<tr>
<td>0-30</td>
<td>E</td>
</tr>
</tbody>
</table>

....each factor is discussed briefly to indicate its role in determining land quality for agricultural purposes:
The ratings for factor A take drainage and depth of the soil profile into consideration. Deep and shallow soils are recognized and differentiated. The nature of the surface soil and subsoil are considered. Parent material and degree of soil development are recognized as they affect fertility, structure, depth, aeration and moisture-holding capacity of the soil.

Factor B, which expresses the texture of the surface soil, reflects the relative workability of the soil as well as its composition of silt, sand and clay. Stony lands, including lava lands, are placed in special categories. The soils are separated into textural groups. Soils are usually expected to react quite similarly when of similar textural groups. Texture is closely associated with moisture-holding capacity and workability of the soil.

Factor C accounts for the variations in the slope of the land. The slope classes are designed to differentiate ease of irrigation and use of mechanical equipment, susceptibility to erosion, amount of surface runoff, and suitability for commercial forest production. In general, slopes exceeding 35 percent are considered too steep for cultivated crops, and slopes greater than 80 percent are assumed impractical for commercial forest production.

Factor X includes the miscellaneous land characteristics such as soil fertility, soil reaction, soil salinity, and presence of strong winds.

Factor Y accounts for rainfall and associated climatic feature. As a general rule, lands in the higher rainfall zones are cloudy and therefore lower in productivity; irrigated lands are rated 100 because the moisture requirement is adequately met. It is the general assumption that where irrigation is required, climate is usually satisfactory for crop production."

Note: For more detailed explanations of the Land Rating criteria, refer to the Land Study Bureau's publications for each island:

Detailed land classification: Island of Molokai., Honolulu: Land Study Bureau, University of Hawaii, June 1968.


Contact: Statewide GIS Program, Office of Planning, State of Hawaii, PO Box 2359, Honolulu, Hi. 96804; (808) 587-2846.
email: gis@hawaii.gov
Appendix C
2015 Crop Summary by Acreage
<table>
<thead>
<tr>
<th>Crop Types</th>
<th>Hawai'i</th>
<th>Kaua'i</th>
<th>Maui</th>
<th>Moloka'i</th>
<th>Lāna'i</th>
<th>O'ahu</th>
<th>State Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquaculture</td>
<td>165</td>
<td>183</td>
<td>-</td>
<td>28</td>
<td>-</td>
<td>274</td>
<td>651</td>
</tr>
<tr>
<td>Banana</td>
<td>536</td>
<td>26</td>
<td>62</td>
<td>-</td>
<td>-</td>
<td>345</td>
<td>969</td>
</tr>
<tr>
<td>Coffee</td>
<td>5,525</td>
<td>3,788</td>
<td>545</td>
<td>123</td>
<td>-</td>
<td>168</td>
<td>10,149</td>
</tr>
<tr>
<td>Commercial Forestry</td>
<td>21,061</td>
<td>1,743</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>26</td>
<td>22,864</td>
</tr>
<tr>
<td>Dairy</td>
<td>1,855</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,855</td>
</tr>
<tr>
<td>Diversified Crop</td>
<td>3,266</td>
<td>1,199</td>
<td>1,582</td>
<td>937</td>
<td>54</td>
<td>9,865</td>
<td>16,904</td>
</tr>
<tr>
<td>Flowers / Foliage / Landscape</td>
<td>1,612</td>
<td>165</td>
<td>134</td>
<td>26</td>
<td>10</td>
<td>484</td>
<td>2,432</td>
</tr>
<tr>
<td>Macadamia Nuts</td>
<td>21,359</td>
<td>-</td>
<td>186</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>21,545</td>
</tr>
<tr>
<td>Papaya</td>
<td>2,566</td>
<td>-</td>
<td>-</td>
<td>93</td>
<td>-</td>
<td>166</td>
<td>2,824</td>
</tr>
<tr>
<td>Pineapple</td>
<td>-</td>
<td>-</td>
<td>1,094</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3,414</td>
</tr>
<tr>
<td>Seed Production</td>
<td>-</td>
<td>13,299</td>
<td>754</td>
<td>2,342</td>
<td>-</td>
<td>7,333</td>
<td>23,728</td>
</tr>
<tr>
<td>Sugar</td>
<td>-</td>
<td>-</td>
<td>38,810</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>38,810</td>
</tr>
<tr>
<td>Taro</td>
<td>61</td>
<td>443</td>
<td>54</td>
<td>2</td>
<td>-</td>
<td>51</td>
<td>612</td>
</tr>
<tr>
<td>Tropical Fruit</td>
<td>3,144</td>
<td>463</td>
<td>104</td>
<td>43</td>
<td>-</td>
<td>227</td>
<td>3,980</td>
</tr>
<tr>
<td><strong>Crop Total:</strong></td>
<td>61,149</td>
<td>21,310</td>
<td>43,360</td>
<td>3,593</td>
<td>65</td>
<td>22,354</td>
<td>151,831</td>
</tr>
<tr>
<td><strong>Pasture</strong></td>
<td>554,324</td>
<td>41,934</td>
<td>108,447</td>
<td>38,261</td>
<td>-</td>
<td>18,464</td>
<td>761,429</td>
</tr>
<tr>
<td><strong>Total Agriculture</strong></td>
<td>615,473</td>
<td>63,244</td>
<td>151,808</td>
<td>41,854</td>
<td>65</td>
<td>40,818</td>
<td>913,261</td>
</tr>
</tbody>
</table>
Appendix D
Resources
RESOURCES


Kauai Coffee Company, LLC. Kalaheo, Hawaii.


**Economics for Goats**

*01-Jun-07*

<table>
<thead>
<tr>
<th>General Assumptions</th>
<th>Ratio</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>0.82</td>
<td>3.5</td>
</tr>
<tr>
<td>Animal units per acre</td>
<td>200</td>
<td>387</td>
</tr>
<tr>
<td>Total animal units (AU)</td>
<td>350</td>
<td>356</td>
</tr>
</tbody>
</table>

**Breeding herd:**
- Buck (1) 90% 150
- Doe (200) 200
- Kids per doe per year 1.5 300

Total animal units (AU) 356

*Note: Buck x Doe = 1 AU each, Kids = 1/2 AU each.*

<table>
<thead>
<tr>
<th>Annual Revenue from Goat Sales</th>
<th>Ratio</th>
<th>Units</th>
<th>Unit Price</th>
<th>Annual Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Kids Sales</td>
<td>75%</td>
<td>225</td>
<td>$ 160</td>
<td>$ 35,900</td>
</tr>
<tr>
<td>Hotwells Sales (FOB Liners)</td>
<td>25%</td>
<td>75</td>
<td>$ 160</td>
<td>$ 10,401</td>
</tr>
<tr>
<td>Total</td>
<td>300</td>
<td></td>
<td></td>
<td>$ 46,301</td>
</tr>
</tbody>
</table>

**Expense:**

- **Labor:**
  - Part-time labor (hours) 520 $15.00 $7,800

- **Feed:**
  - Barley Corn (per head) 200 $2.90 $580

- **Minerals:**
  - Mineral block (per head) 200 $12.00 $2,400

- **Veterinary Supplies:**
  - Worming (per head) 200 $2.00 $400

- **Water:**
  - Annual requirement (3 gallons per head per day) 200 $2.00 $400

- **Repair & Maintenance:**
  - Repair fences, gates, water system 1,200 $1,200
  - Vehicles - Repair, Maintenance and Fuel 2,000 $2,000

- **Hauling Costs (per head):**
  - Total Direct Costs 144

- **Overhead:**
  - Lease Rent (unit cost per acre per year) 35.00 $3,870
  - Administration 500 $500
  - Management 6,000 $6,000
  - Other 280 $280

Total Overhead $9,350

Net Operating Profit (Loss) $22,800
MANAGER'S REPORT 12-10:

July 21, 2011

Re: Kapaa Highland Request

RECOMMENDATION:
Your concurrence is requested to allow the staff to enter into an agreement in accordance with Part III Section XII of the rules with Kapaa Highland subject to county attorney concurrence. This exchange should be on a dollar for dollar basis not gallon for gallon.

BACKGROUND:
The developer is proposing the following exchange: the developer will give the DOW undeveloped water and in return, the DOW will provide the developer with storage for the developer’s project; both will be built to department standards.
The project has a large portion of land that shows in the community plan to be affordable housing though not currently zoned as such. I have checked with the county housing department and the Mayor’s office and both want to see the affordable housing go forward. This concurrence is verbal.
The planned storage for planned water exchange will allow this project to move forward when other developments have been stopped due to inadequate storage. There appears to be an overall county benefit and the implementation would be subject to finally getting the storage and source completed.

Our storage project is scheduled to be completed in 3-4 years. The source development could be sooner. The issue with this proposal is wells in different locations have different yields and DOW storage is only subject to available funds.
The developer has drilled a well and tested it. The well is too crooked to be used as a normal source of water and have to be redrilled in another location. The next one may not provide the same yield. It is low enough risk that this is being recommended.

Respectfully submitted,

David R. Craddock, P.E.
Manager and Chief Engineer

August 22, 2011

Mr. Gregg Allen
161 Waihau Road
Kapaa, HI 96746

Dear Mr. Allen:

Subject: Water Master Plan for the Kapa’a Highlands Project on TMK: 4-3-03:001

At the Department of Water, Water Board July 28th 2011 meeting, via Managers Report 12-10, in response to your letters of April 22, 2011 and May 11, 2011, accepted the proposed exchange of source for storage on a dollar for dollar basis. This acceptance is based on your commitment to proceed with zoning changes in your development to match the county zoning. That zoning change requires affordable housing in certain portions of your proposed development.

This acceptance is based on building permits and County water meter service not being issued if the source and storage requirements have not been completed as of the date of requested building permit approval. We ask that you submit a proposed draft of an agreement to memorialize this action. We would expect that this agreement runs with the land.

If you have any questions, please contact Mr. Gregg Fujikawa at (808) 245-5416.

Sincerely,

David R. Craddock, P.E.
Manager and Chief Engineer

4378 Puu Lake St., P.O. Box 1706, Lihue, HI 96766. Phone: 808-245-5400
Engineering and Finance Fax: 808-245-5413. Operations Fax: 808-245-5403, Administration Fax: 808-246-8628
Exhibit E

Irrigation Supply for
HoKua Place Agricultural Subdivision
(Formerly Kapa'a Highlands II)

Water Master Plan

MEMORANDUM

TO: Olina Allen
FROM: Torn Nanaa

SUBJECT: Irrigation Supply for the Kapaa Highlands Agricultural Subdivision

Introduction

This memo report assesses the feasibility of developing an onsite well (or wells) to provide the necessary irrigation supply for the Kapaa Highlands Agricultural Subdivision. The total area of the project is 153 acres. Wagner Engineering Services, Inc. has determined that up to 163 acres of the site is suitable for agricultural use (Figure 1). The Kauai Department of Water (DOW) standards require an average supply for irrigation for 2000 GPD/acre. For 113 acres, this translates to a year-round average of 0.283 MGD. Applying a maximum seasonal use factor of 1.5 results in a required summertime supply capability of 0.424 MGD (equivalent to 285 GPM operating continuously).

Results of an Onsite Exploratory Borehole

To investigate the possibility of providing the irrigation supply with an onsite well or wells, an exploratory borehole was drilled and pump tested. The location of this exploratory borehole is shown on Figures 1 and 2. Ground elevation at the well site is 25 feet. It was drilled to a depth of 250 feet or 235 feet below sea level. During the course of drilling, two separate aquifers were encountered. The upper aquifer has a static water level of about 19 feet above sea level (MSL) and extends to a depth of about 80 feet (i.e., to 55 feet below sea level). It has very limited yield (less than 30 GPM) as it is essentially a collection of water in the soil matrix perched on poorly permeable Kaliakai lavas beneath it.

The strata between 60- and 210-foot depth are poorly permeable and function as an aquiclude separating the upper and lower aquifers. The lower aquifer, which starts at 210-foot depth and extends below the 200-foot depth of the exploratory borehole, has a static water level about 13 feet (MSL). This lower aquifer is quite productive.

A pump test was run at my direction to determine the potential yield and quality of water from the lower aquifer. Using a combination of casing and grout, water from the upper aquifer was sealed off for this test. Results of the 12-hour test conducted on October 19, 2006 are presented on Figures 3, 4, and 5. A series of flowrate steps were run initially to define hydraulic performance (Figure 5). Using a curve

Exhibit "E"
filing technique, these results define acceptable drawdown for a range of pumping rates (Figure 4). For example, at 500 GPM, the drawdown would be 7.5 feet.

The remainder of the 12-hour test was run at 550 GPM to see if any salinity change would occur. These results are shown on Figure 5 and Table 1. The salinity (as measured by conductivity) actually decreased for the first two hours and stabilized after that. Chlorides of just 03 MCl/L demonstrate that the water is quite fresh and obviously suitable for irrigation use.

Conclusions and Recommendations Regarding the Irrigation Supply

1. Results of the exploratory borehole demonstrate that an adequate irrigation supply for the Agricultural Subdivision can be developed from a single onsite well located in the near proximity of the exploratory borehole.

2. The finished dimensions of the production well should be based on the following:
   a. A 17-inch borehole should be drilled to 300-foot depth.
   b. 220 feet of 8-inch solid casing and 60 feet of 8-inch perforated casing should be installed in the borehole.
   c. The annular space from 220 feet to the ground surface should be sealed with cement grout.
   d. Final pump testing at rates up to 650 GPM should be conducted to confirm the well's yield.

3. A companion report by ITC Water Management describes the delivery components of the irrigation system based on the following:
   a. A 7.5 horsepower, 450 GPM submersible pump and motor should be installed in the well at a depth of 30 to 40 feet.
   b. The well pump should deliver water to an adjacent storage tank of at least 30,000 gallons in size. Well pump cycles would be controlled by a level switch in the tank.
   c. An on-demand pump station of up to 600 GPM capacity should be installed next to the tank to draw water from the tank and deliver it to users in the agricultural subdivision.

Specific Conductance and Chlorides of Samples Collected During the 12-Hour Pump Test on October 19, 2006

<table>
<thead>
<tr>
<th>Sample Time</th>
<th>Pumping Rate (GPM)</th>
<th>Specific Conductance (µS/cm @ 20°C)</th>
<th>Chlorides (MG/L)</th>
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<tr>
<td>10:05</td>
<td>317</td>
<td>468</td>
<td>55</td>
</tr>
<tr>
<td>10:30</td>
<td>317</td>
<td>449</td>
<td>54</td>
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<tr>
<td>11:00</td>
<td>438</td>
<td>440</td>
<td>54</td>
</tr>
<tr>
<td>11:30</td>
<td>529</td>
<td>436</td>
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</tr>
<tr>
<td>12:00</td>
<td>528</td>
<td>432</td>
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</tr>
<tr>
<td>13:00</td>
<td>527</td>
<td>430</td>
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<tr>
<td>14:00</td>
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<td>53</td>
</tr>
<tr>
<td>16:00</td>
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<td>429</td>
<td>53</td>
</tr>
<tr>
<td>17:00</td>
<td>529</td>
<td>428</td>
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</tr>
<tr>
<td>18:00</td>
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<td>53</td>
</tr>
<tr>
<td>21:00</td>
<td>533</td>
<td>431</td>
<td>53</td>
</tr>
<tr>
<td>22:00</td>
<td>533</td>
<td>431</td>
<td>53</td>
</tr>
</tbody>
</table>

Notes:
1. Specific conductance measured in the TNWRE office using a HACH Sension 5 meter calibrated with a 12.88 mS/cm standard.
2. Chlorides determined by mercuric nitrite titration in the TNWRE office. Samples were diluted 10 fold.

Attachments
Exhibit E - Part 2

Private Water System
Mr. David R. Craddock
Manager & Chief Engineer
Department of Water
October 2, 2012

Page 2

3. The Storage Tanks will be located on the north boundary of Lot 3, as shown in Figure 3 of the Nance Report.

4. The Well design is shown on Figure 2 of the Nance Report. The Well will be twelve (12) inches in diameter and operated by two identical 100 gallons per minute (“GPM”) pumps, each driven by 7.5 horsepower motors. The first pump will supply the needs of the Subdivision, which is 97,310 gallons per day (“GPD”) maximum daily use, and the second will serve as a standby pump.

5. Based on the water needs of 50 farm dwelling units, the total maximum daily demand is 93,750 GPD. The two 50,000 gallon Tanks will be adequately sized to provide necessary storage plus fire flowrate protection. The Tanks will be lined with bolted steel with reinforced concrete base and passive cathodic protection (zinc anode rods).

6. The pipelines (“Pipelines”) for the PWS will be sized to provide fire flowrate with coincident maximum day demand and a minimum residual pressure of 20 psi (velocities not exceeding 10 fps); and peak flowrate with minimum residual pressure of 40 psi (maximum velocity in Pipelines of 6 fps). NSF-approved, high density polyethylene (HDPE) pipes will be used for the PWS. The Pipeline system is shown on Figure 3 of the Nance Report.

7. Pursuant to the Agricultural Master Plan submitted in this matter, the agricultural activities in the Subdivision will be limited to a goat raising operation (“Goat Project”). The Goat Project will require minimal water (at the most, 3,560 GPD), which will be supplied by the PWS.

8. The on-site Tank elevations will not provide adequate gravity pressure to meet the Department's delivery pressure requirements. Providing the necessary pressure would be done with parallel domestic and fire flowrate pumping systems with a generator to provide back power. These pump systems would provide up to 70 GPM for peak domestic use and 500 GPM for the fire flowrate condition. Both pumping systems would be sized to produce a total dynamic head of 110 feet, in effect creating a single, 270-foot service pressure zone across the entire project site.

B. Modification Of Requirements

The Applicants are requesting the Department and/or the Board of Water Supply (“Water Board”) to grant a modification from the Department’s Water System Standards for the PWS as follows:

[Additional text]
1. DOW Rule Part 3, Section XII, provides as follows:

"SECTION XII – MODIFICATION OF REQUIREMENTS

When conditions pertaining to any subdivision are such that the public may be properly served with water and with fire protection without full and strict compliance with these rules and regulations, or where the subdivision site or layout is such that the public interest will be adequately protected, such modification thereof as is reasonably necessary or expedient, and not contrary to law or the intent and purposes of these rules and regulations, may be made by the Department."

2. As part of the Subdivision in this case, the Applicants propose to have water for potable, fire, and agricultural uses for the Subdivision supplied by the PWS.

3. The PWS does not comply strictly with all of the Department’s Water System Standards ("DOW Standards") which typically apply to the DOW’s public water systems. These differences are set forth in the enclosed Comparison Of Kapaa Highlands PWS With DOW Water System Standards.

4. The Applicants are requesting the Department and/or the Water Board to find that the PWS will properly serve the water and fire protection needs of the Subdivision without full and strict compliance with the DOW Standards; that, given the fact that the Subdivision will be served by the PWS, the public interest will be adequately protected by the PWS; that the differences between the PWS and the DOW Standards are, under all of the circumstances of this case, reasonably necessary and expedient, and that such differences are not contrary to the law or the intent or purposes of the DOW Rules.

Based on the above, the Applicants are requesting the Department and/or the Water Board to approve the proposed PWS for the Subdivision, together with the requested modifications. In the event that this matter needs to be referred to the Water Board, then I am requesting that it be placed on the next available agenda of the Water Board. For these purposes, I have enclosed a Supporting Information For The Board Of Water Supply, County of Kauai in compliance with the Department’s requirements for persons wishing to testify at Water Board Meetings.

Thank you very much for your consideration of this request.

Sincerely yours,

BELLES GRAHAM<br>
WILSON & CHUN, LLP<br>
<br>Mark W. Graham, Jr.

Enclosures
ccc: Mr. Greg Allen, Jr., w/encls. (via email only)
     Andrea A. Suzuki, Esq., w/encls. (via email only)
     Mr. William Eddy, DOW, w/encls. (via email only)
     Mr. Gregg Fujinawa, DOW, w/encls. (via email only)
     Mr. Dale A. Guo, Staff Planner, w/encls. (via email only)
MEMORANDUM

To: Greg Allen

From: Tom Nance

Subject: Sizing and Layout of a Private Water System to Supply the Kapaa Highlands Project

Introduction

This memo and its attachments present the sizing and layout of major infrastructure elements of a private water system that would be developed to supply the Kapaa Highlands project. The basis of the water system sizing assumed the project would be developed in two phases. Phase 1 would consist of 16 residential units on five lots in an agricultural subdivision. Phase 2 would consist of an urban residential development comprised of 80 SF residential units, 663 MF residential units, and parks (0.1 ac.), church (0.4 ac.), commercial (0.4 ac.), roads (0.4 ac.), and unimproved open space (14.3 ac.). In the event that land use entitlements are not obtained for the residential development, Phase 2 would consist of 34 residential units on seven lots in an agricultural subdivision.

Required Water Supply

Due to the size of the residential lots in the agricultural subdivision, which vary from 1.47 to 8.67 acres in size for the Phase 1 development, an allocation of 2000 GPD as the average demand per residential lot is recommended, a rate which is four times greater than the Kauai Department of Water (DOW) design standard for single family residential units. For the residential subdivision in Phase 2, use of DOW’s design criteria is recommended. Based on these recommendations, Tables 1 and 2 are tabulations of the average and maximum day demands for the private water system. Maximum day demand is defined as 1.5 times the average demand, also in accord with DOW design standards.

Required Water System Capacities

Well Supply. DOW’s design criteria for well pumping capacity is to provide the maximum day demand in a 24-hour pumping day with the largest well pump out of service. For Phase 1, this requirement amounts to 48,000 GPD, equivalent to 33 GPM. With the addition of the Phase 2 residential development, this requirement increases to 498,275 GCD, equivalent to 345 GPM. If Phase 2 were limited to the agricultural subdivision, the ultimate well supply requirement would be 180,000 GPD or 104 GPM.

Summary of Computed Required Reservoir Storage Volumes*

<table>
<thead>
<tr>
<th>Design Criteria</th>
<th>Phase 1</th>
<th>Phase 2 Residential</th>
<th>Phase 2 Ag Subd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Maximum Day Demand (Gallons)</td>
<td>48,000</td>
<td>498,275</td>
<td>150,900</td>
</tr>
<tr>
<td>(2) Fire Flowrate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Flowrate (GPM)</td>
<td>900</td>
<td>2000</td>
<td>900</td>
</tr>
<tr>
<td>Fire Duration (Hours)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Coincident Max. Demand (GPM)</td>
<td>33</td>
<td>345</td>
<td>104</td>
</tr>
<tr>
<td>Well Inflow Credit (GPM)</td>
<td>350</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>Required Storage Volume (Gallons)</td>
<td>25,280</td>
<td>310,200</td>
<td>40,640</td>
</tr>
</tbody>
</table>

*Phase 2 storage volumes include the Phase 1 requirement.
Based on the foregoing calculations, the recommended reservoir storage is as follows:

- For Phase 1, a 60,000-gallon storage tank would be installed.
- For the Phase 2 residential project, a second tank of 50,000-gallon capacity would be installed.
- In the event that Phase 2 consists of the 34 SF residential units in an agricultural subdivision, the second tank would be 100,000 gallons.
- All storage tanks would be lined and bolted steel with a concrete floor and passive cathodic protection.
- The tanks would be located at the project's highest elevation which is adjacent to residential Lot 7 in Phase 1. The Phase 1 and Phase 2 tanks would have identical floor and spillway elevations of 142 and 160 feet, respectively.
- Except at the project's lowest elevations, pumped delivery from the storage tanks will be necessary to provide adequate delivery pressures and fire flowrates. These pumping requirements are described in the section following.

Pumped Delivery for the Distribution System. DOW's design criteria for required delivery pressures are appropriate for this private water system. These are: (1) to provide a minimum of 40 psi residual pressure during the peak flow rate condition, with peak flow rate defined as three times the average demand; and (2) to provide a minimum 20 psi residual pressure at the critical hydrant during fire flowrate at that hydrant and coincident maximum day demand throughout the system.

The onsite storage reservoir elevations will not provide adequate gravity pressure to meet either of these criteria. In each development phase, this will require parallel domestic and fire flowrate pumping systems with a generator to provide back up power. For Phase 1, the pump systems would provide up to 70 GPM for peak domestic use and a 500 GPM fire pump. For the Phase 2 residential development, the domestic pumping capacity would be increased to 700 GPM and the fire pump to 2000 GPM. All pumping systems would be sized to produce a total dynamic head of 110 feet, in effect creating a single, 270-foot service pressure zone across the entire project site.

Water System Layout

Figure 2 illustrates all of the water system components described above with the assumption that Phase 2 would consist of the 769-unit residential development. By development phase, these would consist of:

Phase 1
- 12-inch, 300-foot deep well, pump sump, and two 350 GPM pumps in the pump sump located at the makai end of the Phase 1 development area.
- A dedicated 6-inch transmission pipeline from the well pumps to the storage reservoir.
- A 50,000-gallon storage tank.
- Parallel domestic and fire flowrate pump systems at the storage tank with backup generator power.
- A distribution pipeline loop consisting of 12-inch for the section that will also serve Phase 2 and 6-inch for the remainder of the loop.

Phase 2
- No change or additions to the well, well pumps, or transmission pipeline.
- Second storage tank of 500,000-gallon capacity.
- Substantial capacity increases for the parallel domestic and fire pumping systems and generator backup power.
- Distribution pipelines of 12-, 6-, and 6-inch size.

cc: Max Graham [Email Only]
  greg@tmwco.com

Attachments
Table 1
Average and Maximum Day Demands for the Phase 1 Agricultural Subdivision and Phase 2 Residential Development

<table>
<thead>
<tr>
<th>Development Phase</th>
<th>Land Use</th>
<th>Design Criterion (GPD/Unit)</th>
<th>Average Demand (GPD)</th>
<th>Maximum Demand (GPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18 SF Residential</td>
<td>2,000</td>
<td>32,000</td>
<td>48,000</td>
</tr>
<tr>
<td>2</td>
<td>80 SF Residential</td>
<td>500</td>
<td>43,000</td>
<td>64,000</td>
</tr>
<tr>
<td></td>
<td>683 MF Residential</td>
<td>350</td>
<td>239,000</td>
<td>356,575</td>
</tr>
<tr>
<td></td>
<td>3.1 Ac. Parks</td>
<td>4,000</td>
<td>12,400</td>
<td>18,600</td>
</tr>
<tr>
<td></td>
<td>0.8 Ac. Church</td>
<td>4,000</td>
<td>3,200</td>
<td>4,800</td>
</tr>
<tr>
<td></td>
<td>0.4 Ac. Commercial</td>
<td>3,000</td>
<td>1,200</td>
<td>1,800</td>
</tr>
<tr>
<td>Total for Phase 2</td>
<td></td>
<td></td>
<td>208,860</td>
<td>448,275</td>
</tr>
<tr>
<td>Total for Both Phases</td>
<td></td>
<td></td>
<td>330,850</td>
<td>496,275</td>
</tr>
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</table>

Table 2
Average and Maximum Day Demands for Development of Phases 1 and 2 as Agricultural Subdivisions

<table>
<thead>
<tr>
<th>Development Phase</th>
<th>Land Use</th>
<th>Design Criterion (GPD/Unit)</th>
<th>Average Demand (GPD)</th>
<th>Maximum Demand (GPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18 SF Residential</td>
<td>2,000</td>
<td>32,000</td>
<td>48,000</td>
</tr>
<tr>
<td>2</td>
<td>34 SF Residential</td>
<td>2,000</td>
<td>68,000</td>
<td>102,000</td>
</tr>
<tr>
<td>Total for Both Phases</td>
<td></td>
<td></td>
<td>100,000</td>
<td>160,000</td>
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</tbody>
</table>

Figure 1
Recommended Well Development and Pump Installation for the Kapaa Highlands Project
Not to Scale
MEMORANDUM

To: Greg Allen
From: Tom Nance
Subject: Basis of Design of the Private Water System for the Kapaa Highlands Agricultural Subdivision

Introduction

This memo and its attachments describe the basis of design for a private water system to serve the 12-lot Kapaa Highlands Agricultural Subdivision. Figure 1 depicts the 12 agricultural lots and the 50-half acre homesteads that ultimately would be developed on the 12 lots. The water system would consist of: one 12-inch, 300-foot deep well equipped with two 100 GPM pumps, one of which would provide back-up capability; two side-by-side and identical 50,000-gallon storage reservoirs located next to Homestead 7; the highest elevation on the property; two parallel pumping systems to provide pressure and flow rates for peak and fire flowrate conditions; and 8- and 6-inch distribution pipelines.

As described herein, there are differences between the standards used for the private system’s design and the standards of the Kauai Department of Water (DOW). These differences are noted and discussed as appropriate in the sections following.

Required Water Supply

The agricultural use in the subdivision will be for raising goals for which no specific water allocation is made. An average demand of 1250 GPD for each of the 50-half acre homesteads is recommended, a use rate which is 2.5 times DOW’s standard for single family residential units. The higher use rate is an appropriate allowance due to the larger than typical size of the homesteads.

For the 50 homesteads, the total average demand is 62,500 GPD. In conformance with DOW’s standards, maximum daily use is defined as 3.5 times the average demand. For the 50 homesteads, the total maximum daily demand is 223,750 GPD.

550 N. Nani St. Suite 213 • Honolulu, Hawaii 96817 • Phone: (808) 539-1481 • Fax: (808) 539-7707 • Email: tnc@tncnow.com
Required Well Supply

Well Configuration. A test well, identified as State No. 0410-66, was drilled and pump tested at the middle end of the project site in October 2006. Over its 286-foot drilled depth, two aquifers were encountered. The upper aquifer cannot provide a sufficient source of supply and is also potentially subject to contamination due to its shallow depth. The lower confined aquifer was reached at a depth of about 215 feet or 190 feet below sea level. Its phreatic surface was about 13 feet above sea level or about 10 feet below ground. Pump testing showed that a properly designed well to exclusively tap this lower aquifer could develop up to 500 GPM of low salinity (chlorides of 55 mg/L), potable quality water. At its depth and due to the presence of the overlying and poorly permeable confining layers, this lower aquifer is not subject to contamination.

The low ground elevation (about 20 feet), high phreaticic head (about 13 feet above sea level), and modest drawdown provide the opportunity to develop one well configured with a pump sump that would enable two pumps to draw from the entire well, thereby providing the necessary standby pumping capacity for a stand-alone system with a single well. The recommendation herein is to drill a new 12-inch well to 335 feet depth and complete it with a pump sump and two pumps as shown on Figure 2. This will enable each pump to provide the required supply and the other pump to provide full back-up capacity.

Required Well Pumping Capacity. DW's design criteria for the well pumping capacity capable of delivering the maximum daily use in a 24-hour pumping day with the largest well pump out of service is adopted for the existing system. The project's 14,750 GPD maximum day use translates to a required well pump capacity of 85 GPM. The proposed herein is to install two identical 100 GPM pumps, each driven by 7.5 horsepower motors. Either pump would provide the required capacity with the other as standby.

Reservoir Storage

DW's reservoir storage sizing criteria are appropriate for the private water system. The first, to provide the maximum day use with no credit for well inflow, translates to a required storage volume of 93,750 gallons. The second is to provide the fire flowrate plus the maximum day demand for the duration of the fire with the reservoir's 34% full at the start of the fire. There is credit for well inflow with the largest well pump considered to be out of service.

For an agricultural subirrigation, DW standards require a fire flowrate of 250 GPM for one hour. A stricter standard of 600 GPM for two hours is adopted for the private water system. With one of the two 100 GPM well pumps on, this higher fire flowrate and longer duration translates to reservoir storage of 74,417 gallons (calculation below). The first criterion governs.

Proposed reservoir storage consists of two, side-by-side and identical 50,000-gallon tanks with 142- and 160-foot floor and spillway elevations, respectively. The storage tanks would be lined and coated with reinforced concrete for added protection of the concrete. However, lined and coated steel tanks have a successful operating history in Hawaii. With two side-by-side tanks, one can be taken offline when necessary for maintenance without interruption of service to customers.

Pumping Systems for Peak and Fire Flowrate Design Conditions

DW's design criteria for required delivery pressures are appropriate for this private water system. These are: (1) to provide a minimum of 40 psi residual pressure during the peak flowrate condition, with peak flowrates defined as three times the average demand; and (2) to provide a minimum 30 psi residual pressure at the critical fire hydrant during fire flowrate at that hydrant and coincident maximum day demand throughout the system.

The onsite storage reservoir elevations will not provide adequate gravity pressure to meet either of these criteria. The necessary pressure would be provided by parallel domestic and fire flowrate pumping systems with a generator to provide backup power. These pump systems would provide up to 70 GPM for one domestic use and 500 GPM for the fire flowrate condition. Both pumping systems would be sized to provide a total dynamic head of 110 feet, in effect creating a single, 270-foot service pressure zone across the entire project site.

Distribution Pipelines

The design criteria used for pipeline sizing for the private water system are equivalent to DW's standards. Pipelines shall be sized to provide: (1) fire flowrate with coincident maximum day demand and a minimum residual pressure of 20 psi at the critical fire hydrant with velocities not exceeding 15 fps; and (2) peak flowrate with a minimum residual pressure of 40 psi and a maximum velocity in pipelines of 8 fps.

DW's standards require pipelines to be of ductile iron or PVC, the latter conforming to ASTM C-800. However, NSF-approved, high density polyethylene (HDPE) pipes will be used for the private water system. SDR (pressure ratings) of HDPE pipe will be selected so as not to exceed 50 percent of the recommended working pressure rating. Hazen-Williams "C" values of 130 will be used for all
HDPE pipes. This is less (ie. more conservative) than manufacturer’s suggested values of 140 to 150 but
greater than DCM’s standards for ductile iron and PVC pipes.

Water System Layout

Figure 3 illustrates the water system components as described above. There would be a
dedicated 6-inch pipeline from the well to the storage tanks. Distribution pipeline sizing, driven by the fire
flowrate site’s criteria, would be 8- and 6-inch to the last hydrants and 4-inch beyond the last hydrants.

cc: Max Graham [confidential]
greg@bmwe.com

Attachments
FIGURE 2
RECOMMENDED WELL DEVELOPMENT AND PUMP INSTALLATION
FOR THE KAPAAN HIGHLANDS AGRICULTURAL SUBDIVISION
NOT TO SCALE
### Table 1
Cost Estimate of the Major Water System Components for Kapua Highlands Phase I

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Drill, Case, and Pump Test Supply Well</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobilization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill 12-inch Pilot Hole</td>
<td>300</td>
<td>LF</td>
<td>150</td>
<td>45,000</td>
</tr>
<tr>
<td>Video Log Pilot Hole</td>
<td>1</td>
<td>EA</td>
<td>2,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Test Pump Pilot Hole</td>
<td>1</td>
<td>EA</td>
<td>15,500</td>
<td>15,500</td>
</tr>
<tr>
<td>Ream Pilot Hole to 18 Inches</td>
<td>300</td>
<td>LF</td>
<td>35</td>
<td>37,500</td>
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<tr>
<td>12' Steel Casing</td>
<td>120</td>
<td>LF</td>
<td>284</td>
<td>34,080</td>
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<tr>
<td>12' Perforated Casing</td>
<td>80</td>
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<td>Plummeting and Alignment Test</td>
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<td>Furnishing and Installing Test Pump</td>
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<td>15,000</td>
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<tr>
<td>Development and Test Pump</td>
<td>72</td>
<td>NRS</td>
<td>280</td>
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<td>Demobilization</td>
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<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>$220,800</td>
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</table>

| Wait Site Work and Pump Outfitting                     |          |      |            |        |
| Site Earthwork                                         | 400      | CY   | 50         | 22,000 |
| Site Backcourse                                        | 650      | BY   | 20         | 13,000 |
| Site Fencing                                           | 348      | LF   | 35         | 12,180 |
| Site Gate                                              | 1        | EA   | 2,500      | 2,500  |
| Site Drainage System                                   |          |      |            | 15,000 |
| Wet Well Sump and Coffer at Well Casing                |          |      |            | 60,000 |
| Submersible Pump (250 GPM, 4-pole, 20 HP)              | 2        | EA   | 45,000     | 90,000 |
| Discharge Unit, includes Support Pads and Piping       |          |      |            | 25,000 |
| Pump Control Building                                  |          |      |            | 50,000 |
| Chlorination System                                    |          |      |            | 25,000 |
| Control Building Mechanical                            |          |      |            | 25,000 |
| Pump and Building Electrical                           |          |      |            | 50,000 |
| KSUC Transformer Pad and Ducts                         |          |      |            | 25,000 |
| Metering, Motor Control Center, SCADA System           |          |      |            | 150,000|
| Back Generator with Fuel Tank (50 KW)                  |          |      |            | 40,000 |
| Transformer Switch for Generator                       |          |      |            | 3,000  |
| KSUC Facility Change for Service (O Hotels Service Available) |          |      |            | 50,000 |
| **Total**                                              |          |      |            | $646,280 |

| New Well Access Road (from existing outfall)           |          |      |            |        |
| Access Road Excavation and Preparation                 | 1,636    | LF   | 60         | 76,500 |
| Backcourse                                             | 3,450    | LF   | 280        | 951,000|
| Drainage and Erosion Control                           |          |      |            | 30,000 |
| **Total**                                              |          |      |            | $161,500 |

---

### Table 1
Cost Estimate of the Major Water System Components for Kapua Highlands Phase I

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.05 MG Tank</td>
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<tr>
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<td>CY</td>
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<td>Backcourse</td>
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<td>BY</td>
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<tr>
<td>Gravel Pit</td>
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<td>BY</td>
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<td>Site Fence</td>
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<td>20,870</td>
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<td>2,500</td>
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<tr>
<td>Site Drainage System</td>
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<td></td>
<td>20,000</td>
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<tr>
<td>Tank Drainage System</td>
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<td></td>
<td></td>
<td>25,000</td>
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<tr>
<td>Pipe Valves and Fittings</td>
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<td>15,000</td>
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<tr>
<td>0.06 MG Site Tank with Concrete Floor</td>
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<td>190,000</td>
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<tr>
<td>Tank Level Transmitter System</td>
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<td>15,000</td>
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<tr>
<td>Pipe and Tank Water</td>
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<td>15,000</td>
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<td>Erosion and Dust Control</td>
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<td>10,000</td>
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<tr>
<td>Construction Survey</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>$405,130</td>
</tr>
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</table>

| Booster System                                         |          |      |            |        |
| Site work for Booster Pump Station                     |          |      |            | 25,000 |
| Booster Station Connection Piping & Valves             |          |      |            | 25,000 |
| Domestic Booster Pump Station (VFD 25 to 70 gpm, 5 HP) |          |      |            | 25,000 |
| Fire Pump Station (500 GPM at 110-8 TDH, 20 HP)        |          |      |            | 80,000 |
| Power and Control Connections                          |          |      |            | 50,000 |
| MCC for both station with SCADA Controls               |          |      |            | 125,000|
| Back Generator with Fuel Tank (50 KW)                  |          |      |            | 65,000 |
| Transfer Switch for Generator                          |          |      |            | 3,000  |
| **Total**                                              |          |      |            | $365,000 |

| Pipeline in Phase I Subdivision (includes 6-inch well field line) |          |      |            |        |
| Main Installation and Preparation                      |          |      |            |        |
| 12" HDPE Pipe                                          | 1,000    | LF   | 86         | 127,000|
| 8" HDPE Pipe                                          | 3,115    | LF   | 50         | 155,750|
| 6" HDPE Pipe                                          | 2,256    | LF   | 40         | 89,200 |
| 12" PVC pipe                                          | 2        | EA   | 3,000      | 6,000  |
| 8" PVC pipe                                           | 3        | EA   | 2,500      | 7,500  |
| 6" PVC pipe                                           | 2        | EA   | 2,000      | 4,000  |
| 12" DI Fittings                                       | 5        | EA   | 1,500      | 7,500  |
| 8" DI Fittings                                       | 4        | EA   | 1,200      | 4,800  |
| 6" DI Fittings                                       | 4        | EA   | 900        | 3,600  |
| Fire Hydrant w/Pipes                                   | 5        | EA   | 1,500      | 7,500  |
| Pipe Testing and Chlorination                          |          |      |            | 25,000 |
| Erosion and Dust Control                               |          |      |            | 30,000 |
| Construction Survey                                    |          |      |            | 15,000 |
| **Total**                                              |          |      |            | $505,405 |

**Total for Construction**: $2,356,376  
**Engineering Design (5%)**: $98,726  
**Construction Management (3%)**: $72,000  
**Total Cost**: $2,654,100
## Cost Estimate of the Major Water System Components

**for Kapaa Highlands Phase 2 Residential Project**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Amount</th>
<th>Total</th>
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<tr>
<td><strong>0.50 MG Tank and Booster Station</strong></td>
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</tr>
<tr>
<td>Tank Foundation Earthwork</td>
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<tr>
<td>Pipe Valves and Fittings</td>
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<td></td>
<td></td>
<td>33,000</td>
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<tr>
<td>0.50 MG Steel Tank With Concrete Floor</td>
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</tr>
<tr>
<td>Pipe and Tank Testing</td>
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<td></td>
<td></td>
<td>20,000</td>
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</tr>
<tr>
<td>Erosion and Dust Control</td>
<td>LS</td>
<td></td>
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<td>15,000</td>
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<td>Construction Survey</td>
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<td>Modify Booster Pump Station</td>
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<td></td>
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</tr>
<tr>
<td>Booster Station Connection Piping &amp; Valves</td>
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<td></td>
<td></td>
<td>40,000</td>
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</tr>
<tr>
<td>Domestic Booster Pump Station (VFD 200 to 625 gpm, 25 HP)</td>
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<td>120,000</td>
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<tr>
<td>Fire Pump Station (2060 GPM at 110-ft TDIH, 75 HP)</td>
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<td></td>
<td>125,000</td>
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</tr>
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<td>Power and Control Connections</td>
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<td>Modify Existing MCC for New Pump Stations</td>
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<td>New Back Generator with Fuel Tank for Fire Pump (175kw)</td>
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<td>Transfer Switch for Generator</td>
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<tr>
<td><strong>Total</strong></td>
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<td>Main Installation Access and Site Preparation</td>
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<td>Pipe Testing and Cleanout</td>
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<tr>
<td>Erosion and Dust Control</td>
<td>LS</td>
<td></td>
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<td>30,000</td>
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<td>Construction Survey</td>
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<td><strong>Total</strong></td>
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<td></td>
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<td>$776,600</td>
</tr>
</tbody>
</table>

**Total for Construction** $2,307,560
Engineering Design (8%) $176,449
Construction Management (3%) $66,000
**Total Cost** $2,440,000

---

**Exhibit F**

Preliminary Engineering Report Drainage Improvements
HoKua Place
(Formerly Kapa'a Highlands II)
Project Description

The Kapa'a Highlands Subdivision is on former cane lands situated on a bluff adjacent to the coastal plain of Kapa'a Town. It is bordered by Olohena Road to the north and the Kapa'a Bypass Road on the south and east sides of the project. Kapa'a Intermediate School is near the middle of the north portion of the property. Phase I of the development will consist of five agricultural lots on the west side of the property. The remainder of the property to the south and east of the school are proposed to be developed during Phase II of the subdivision. The proposed Phase II development will consist of 86 single and 683 multi-family units, plus a neighborhood commercial site, parks, and a church site as shown on Exhibit 1. Ground elevation of the development ranges from 20 to 180 feet above mean sea level.

Per the County of Kauai’s "Storm Water Runoff System Manual" 2001, all developments of this scope are required to maintain the existing stormwater flows and patterns as feasibly possible so that downstream properties are not subject to any additional stormwater flows that are created by the increases in impervious surfaces of the watershed by the proposed development. The report examines the existing drainage conditions of the property and the proposed measures to control the stormwater from the proposed Phase II development.

Figure 1: Tax Map Key 4-3-03 (4th Division)
Existing Conditions:

The property is located along Olohena Road about ½ mile mauka of Kapaa Town. The property rises from the coastal flat lands of Kapaa to an elevation of about 140 feet above mean sea level (msl). The Temporary Kapaa Bypass Road passes through a portion of the property along the east and south sides of the property. An unnamed stream flows along the west side of the property. The stream flows along the boundary, passes under a bridge on the By-Pass Road at the southwest corner of the property, and empties into the Waikaea drainage canal about 800’ downstream from the property. Near the middle of the property on the north side, along Olohena Road, is the Kapaa Intermediate School site.

The Lihue Plantation had planted a majority of the 163-acre property in sugar cane, which since the property-changed owners has been allowed to go fallow. The Phase II portion of the property is approximately 97-acres. The fallow lands are presently overgrown with grass and remnant cane. A portion of the property on the northwest side near the unnamed stream is being used for cattle pasture. There are numerous abandoned irrigation ditches on the property that will be filled or rendered inoperable as the property is developed. There is also a small amount of the property that is overly steep for farming and is presently covered in brush and trees.

According to the Natural Resource Conservation Service (NRCS) soil survey the soils on the property are Ioleau and Puhi silt clay loams. The NRCS hydrologic classification for these soils is Group C for the Ioleau soils and Group B for the Puhi soils. Group B soils have a moderately low runoff potential, while the Group C soils have a moderately high runoff potential. Both soils are in Group I erosion resistance classification, which is the least erodible of the NRCS classifications.

The topography of the site varies from gently sloping, bluff top property, to steep areas that drop off into drainage gullies that lead to the unnamed stream and to the Bypass Road. The topography is illustrated on Exhibit 1 from aerial mapping done in 1975 for the County of Kauai.

Proposed Phase II:

The proposed Phase II development will consist of 86 single and 683 multi-family units, plus a neighborhood commercial site, parks, and a church site as shown on Exhibit 1. Stormwater generated from each of the Phase II lots will be directed to the nearest downstream street or natural drainageway. A drainage system along the streets will collect the stormwater and convey it to the detention basins shown on Exhibit 1. The detentions basins moderate the storm flows and allow infiltration back into the soil. They are sized so that the outlet peaks flows match or lower the existing stormwater flows prior to the development for both small rainfall events and the 100 year storm event.
Exhibit G

Preliminary Engineering Report
WasteWater Improvements
HoKua Place
(Formerly Kapa'a Highlands II)
Project Description

The Kapa‘a Highlands Subdivision is on former cane lands situated on a bluff adjacent to the coastal plain of Kapa‘a Town. It is bordered by Olohena Road to the north and the Kapa‘a Bypass Road on the south and east sides of the project. Kapa‘a Intermediate School is near the middle of the north portion of the property. Phase I of the development will consist of five agricultural lots on the west side of the property. The remainder of the property to the south and east of the school are proposed to be developed during Phase II of the subdivision. The proposed Phase II development will consist of 86 single and 883 multi-family units, plus a neighborhood commercial site, parks, and a church site as shown on Exhibit 1. Ground elevation of the development ranges from 20 to 180 feet above mean sea level. Due to its high density the Phase II development will require connection to the Wailua-Kapa‘a Sewer System. The following report reviews the anticipated wastewater flows, the adequacy of the existing sewer collection system, and the proposed improvements needed to provide service for the development of Phase II.

Basis of Design

The Sewer Design Standards, 1973 by the County of Kauai, Department of Public Works, together with the Wailua Facility Plan, September 2008 by Fukunaga and Associates were the primary references for this report and will be abbreviated as SDS and WFP, respectively, when quoted in the report.

The WFP is a detailed study of the entire Wailua to Kapa‘a wastewater system completed in 2008 to guide the County with the necessary expansion and management of the system through the year 2025. It broke down projected flows to the Wailua Treatment Plant in three phases, the current and near term flows up to the year 2010, middle term flows for the 2010-2015 period, and far term flows for the years 2015 to 2025.

<table>
<thead>
<tr>
<th>Wailua-Kapa‘a Average Daily Wastewater Flows</th>
<th>Average Wastewater Flow (mgd)</th>
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</thead>
<tbody>
<tr>
<td>Current</td>
<td>0.70</td>
</tr>
<tr>
<td>Near Term (2010)</td>
<td>0.98</td>
</tr>
<tr>
<td>Middle Term (2015)</td>
<td>1.39</td>
</tr>
<tr>
<td>Far Term at Wailua WWTP(2025)</td>
<td>1.72</td>
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</tbody>
</table>

The need for the WFP was partially based upon the rapid development that was occurring in the Wailua-Kapa‘a area during 2004-2007 period. Development has slowed considerably since this time and several of the developments anticipated in the WFP calculations have been put on hold or are no longer proposed. Of the proposed developments, the Coco Palms Hotel will be removed from the near term anticipate flows and be considered part of the middle term flows. The Coconut Beach Resort and Coconut Plantation Village will be removed from the middle term flows and be considered for the far term flows.

The proposed Kapa‘a Highlands development is not expected to be at total capacity by 2015, but for the purposes of this report, it will be considered to be completed in the middle term planning period of the WFP. The table below is the adjusted Average Daily Flows (ADF) based upon the current flow to the Wailua Treatment Plant and adjustments due to slower development than anticipated by WFP.

<table>
<thead>
<tr>
<th>Adjusted Wailua-Kapa‘a Average Daily Wastewater Flows</th>
<th>Average Wastewater Flow (mgd)</th>
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</thead>
<tbody>
<tr>
<td>Current</td>
<td>0.70</td>
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<tr>
<td>Near Term (2010)</td>
<td>0.98</td>
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<tr>
<td>Middle Term (2015)</td>
<td>1.39</td>
</tr>
<tr>
<td>Far Term at Wailua WWTP(2025)</td>
<td>1.72</td>
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</table>

<table>
<thead>
<tr>
<th>Kapa‘a Highlands Phase II Wastewater Flow Estimates</th>
<th>Projected Wastewater Flow (gpd)</th>
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</thead>
<tbody>
<tr>
<td>Single Family Homes</td>
<td>34,400</td>
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<tr>
<td>Multi-Family Homes</td>
<td>170,750</td>
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<tr>
<td>Neighborhood Commercial</td>
<td>4,800</td>
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<tr>
<td>Total</td>
<td>209,950</td>
</tr>
</tbody>
</table>

Note: Single Family Homes assumed to have 4 occupants/unit and Multi-Family Homes have 2.5 occupants/unit.

Preliminary Design

Based upon the projected flow of 209,950 gpd (0.21 mgd), with a max load factor of 4.1, a 12” sewer main would be required to serve the development. The location of the main is shown on Exhibit 1. It would begin along the Kapa‘a By-pass Road and terminate at an existing manhole near the intersection of Ulu and Kukui Streets. The length of the main within the existing public Right-of-Ways would be about 3,400 linear feet. At the existing manhole connection the existing main downstream of the connection is a 21” main with a capacity of 3.2 mgd. The 21” main currently has a peak flow of about 0.6 mgd, therefore the proposed flow is well within the capacity of the existing sewer system, including allowances for the future increases anticipated in the “Final Wailua Facility Plan”, September 2008.
KAPAA HIGHLANDS PHASE II
PRELIMINARY SEWER PLAN
SCALE: 1 INCH = 1000 FEET
JULY 2011

COMPUTATION OF SANITARY SEWAGE FLOW

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>YEAR</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kapaa</td>
<td>2010</td>
<td>1 of 1</td>
</tr>
</tbody>
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SEWER: Kapaa

<table>
<thead>
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<th>DISTRICT ZONE OR STREET</th>
<th>TRIBUTARY AREA (ACRES)</th>
<th>TRIBUTARY POPULATION</th>
<th>AVERAGE FLOW</th>
<th>MAX FLOW</th>
<th>PEAK FLOW</th>
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<td>0.01</td>
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Remarks:

156