

**Table 4-25: Estimated Project Roadway Improvement Costs**

Concept	Ane Keohokalole Hwy	Palani Road Intersection	Internal Roadways	Total Roadways Costs
A	\$6,816,500 *	\$1,306,000	\$122,725,000	\$130,847,500
B	\$6,816,500 *	\$1,306,000	\$122,725,000	\$130,847,500
C	\$6,816,500 *	\$1,306,000	\$122,725,000	\$130,847,500

\* Assumes a 50 percent share in the cost of off-site road improvements of Ane Keohokalole Highway along the project site's frontage. All costs in 2007 dollars.

**4.8.2 Drainage Facilities**

**4.8.2.1 Existing Conditions**

There are currently no existing drainage facilities and no defined natural drainage ways on-site. The high permeability of the existing soils is evident by the absence of any natural storm water channels or gullies in the project area.

**4.8.2.2 Proposed Drainage System, Potential Impacts, and Mitigation Measures**

Storm water runoff from the site would be collected through swales, ditches, gutters, inlets, and catch basins, and transported through pipes to dry wells, seepage wells, or infiltration areas for disposal. Infiltration areas, seepage wells, and dry wells would be located in open spaces and parking lots, where practical. Dry wells would be located within the roadway right-of-way as needed. A UIC permit is required by the State DOH to construct and operate the dry wells. It is recommended that BMPs be included in the design of the drainage system, such as vegetated swales, bioretention areas, and storm drain filtration devices to capture sediments and prevent pollutants from entering the groundwater.

Potential Short-Term Impacts and Mitigation Measures

During grading activities, portions of the site would be disturbed and the potential for site erosion would increase. The contractor would be required to comply with Chapter 10 – Erosion

**ATTACHMENT I**

**INTERSECTION LANE CONFIGURATIONS – WITH PROPOSED IMPROVEMENTS**

# INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
1. Queen Kaahumanu Hwy (SR 19) & Henry St			Same As Future Conditions
*2. Queen Kaahumanu Hwy (SR 19) & Palini Rd (SR 190)/Alii Dr			Same As Future Conditions
*3. Kamakaeha Ave & Palani Rd (SR 190)		Same As Existing Conditions	
*4. Henry St/Ane Keohokalole Hwy & Palani Rd (SR 190)			
*5. Minor Site Access Rd & Palani Rd (SR 190)	Intersection Does Not Currently Exist		
6. Queen Kaahumanu Hwy (SR 19) & Makala Blvd			Same As Future Conditions

## LEGEND

- Stop Controlled
- FF Free Flow

\* See third page of this attachment for additional detail

\*\* The proposed project would construct the new road

# INTERSECTION LANE CONFIGURATIONS

	EXISTING CONDITIONS	FUTURE CONDITIONS	FUTURE CONDITIONS WITH MITIGATION
7. Ane Keohokalole Hwy & Makala Bl/ Major Site Access Rd	Intersection Does Not Currently Exist		
8. Pahilihoho St & Palani Rd (SR 190)			
9. Kealakaa St & Palani Rd (SR 190)			Same As Future Conditions
See Also Intersection 8			
10. Palani Rd (SR 190) & Uluaoa St		Same As Existing Conditions	
11. Queen Kaahumanu Hwy (SR 19) & Kealakehe Pkwy			Same As Future Conditions
12. Ane Keohokalole Hwy & Kealakehe Pkwy		Same As Existing Conditions	

**LEGEND**

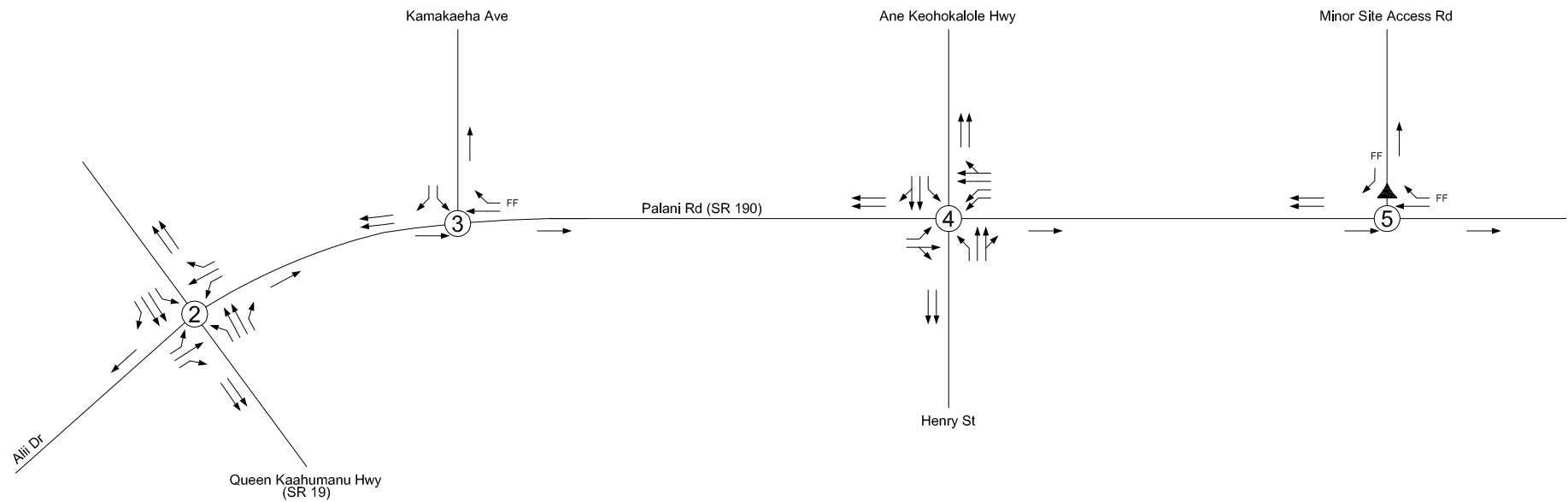
- Stop Controlled
- FF Free Flow

\*\* The proposed project would construct the new road

# CONFIGURATION OF PALANI ROAD (SR 190) - FUTURE WITH MITIGATION FROM PROJECT SITE TO QUEEN KAAHUMANU HIGHWAY



NOT TO SCALE



## Appendix G

---

CIVIL INFRASTRUCTURE

KEAHUOLU AFFORDABLE HOUSING PROJECT

KAILUA-KONA, HAWAII  
TMK: (3) 7-4-021: 20

PREPARED FOR:

Hawaii Housing Finance & Development Corporation  
677 Queen Street, Suite 300  
Honolulu, Hawaii 96813

PREPARED BY:



**BeltCollins**<sup>®</sup>

Belt Collins Hawaii Ltd.  
2153 North King Street, Suite 200  
Honolulu, Hawaii 96819

December 2007

## TABLE OF CONTENTS

1.0	PROJECT DESCRIPTION .....	1
2.0	EXISTING CONDITIONS .....	2
2.1	ROADWAYS AND TRAFFIC .....	2
2.2	DRAINAGE FACILITIES .....	3
2.3	WATER SUPPLY .....	3
2.4	WASTEWATER COLLECTION, TREATMENT, AND DISPOSAL .....	3
3.0	PROPOSED CIVIL INFRASTRUCTURE .....	3
3.1	ROADWAYS AND TRAFFIC .....	4
3.2	SITE GRADING AND EROSION CONTROL .....	4
3.3	DRAINAGE FACILITIES .....	5
3.4	WATER SYSTEM .....	5
3.4.1	OFFSITE .....	5
3.4.1.1	WELL SITES .....	5
3.4.1.1.1	WELL SITE NUMBER 4 AND RESERVOIR .....	6
3.4.1.1.2	WELL SITE NUMBER 3 AND RESERVOIR .....	7
3.4.1.2	RESERVOIR ON DHHL KEAHUOLU PROPERTY .....	8
3.4.1.3	WATER LINES .....	8
3.4.1.4	WATER SYSTEM COSTS .....	8
3.4.2	ONSITE .....	9
3.5	WASTEWATER SYSTEM .....	9
3.5.1	OFFSITE .....	10
3.5.2	ONSITE .....	10
3.6	SOLID WASTE .....	11
4.0	PROBABLE IMPACTS AND PROPOSED MITIGATION .....	12
4.1	POTENTIAL SHORT-TERM IMPACTS .....	12
4.1.1	ROADS .....	12
4.1.2	GRADING, DRAINAGE AND EROSION CONTROL .....	12
4.1.3	WATER ENVIRONMENT .....	12
4.1.3.1	SURFACE WATER .....	12
4.1.3.2	GROUNDWATER .....	12
4.1.4	WATER SUPPLY .....	13
4.1.5	WASTEWATER .....	13
4.1.6	SOLID WASTE .....	13
4.2	POTENTIAL LONG-TERM IMPACTS .....	14
4.2.1	ROADS .....	14
4.2.2	DRAINAGE AND EROSION CONTROL .....	15
4.2.3	WATER ENVIRONMENT .....	15
4.2.3.1	SURFACE WATER .....	15
4.2.3.2	GROUNDWATER .....	15
4.2.4	WATER SUPPLY .....	16
4.2.5	WASTEWATER .....	16
4.2.6	SOLID WASTE .....	16
5.0	REFERENCES .....	17



## LIST OF TABLES

Table 1-1A: Preliminary Development Plan – Concept A .....	1
Table 1-1B: Preliminary Development Plan – Concept B .....	1
Table 1-1C: Preliminary Development Plan – Concept C .....	2
Table 1-2: Alternative Concepts.....	2
Table 3-1: Water Requirements.....	5
Table 3-2: Sewer Requirements .....	9
Table 3-3: Solid Waste.....	11
Table 3-4: Summary of Solid Waste Diverted and Landfilled.....	14

## LIST OF FIGURES

Figure 1-1: Location Map .....	19
Figure 1-2: Area Map .....	20
Figure 2-1: Water Supply .....	21
Figure 3-1: Road System .....	22
Figure 3-2: Offsite Water System.....	23
Figure 3-3: Well Site Number 4 Aerial Photograph .....	24
Figure 3-4: Well Site Number 4 Tax Map with Contours.....	25
Figure 3-5: Well Site Number 3 Aerial Photograph .....	26
Figure 3-6: Well Site Number 3 Tax Map with Contours.....	27
Figure 3-7: Reservoir on DHHL Keahuolu Property.....	28
Figure 3-8: Offsite Sewer System Concept A – QLT Route.....	29
Figure 3-9: Offsite Sewer System Concepts B & C – QLT Route .....	30
Figure 3-10: Offsite Sewer System Concept A – La`i`opua Route.....	31
Figure 3-11: Offsite Sewer System Concepts B & C – La`i`opua Route.....	32

## APPENDICES

- Appendix A: Roads
- Appendix B: Water
- Appendix C: Sewer
- Appendix D: Solid Waste Management Plan

## 1.0 PROJECT DESCRIPTION

The proposed Keahuolu Affordable Housing project is a master planned community of 1,020 to 2,330 dwelling units (single-family and multi-family residences) on approximately 272 acres of land located at Tax Map Key: (3) 7-4-021: 20 in North Kona, Hawaii. See Figure 1-1: Location Map, and Figure 1-2: Area Map, following the text of this report.

The land use elements of the master planned community includes residential units, commercial/retail space, school facilities, neighborhood parks, archaeological preserves, landscape buffers, open space and associated infrastructure. Infrastructure facilities required to support the development include roads, drainage facilities, potable water system, wastewater collection system, electrical system, telephone system and cable television system.

Three preliminary development plan concepts with varying dwelling unit densities and the projected timeline are summarized in Tables 1-1A, 1-1B and 1-1C.

**Table 1-1A: Preliminary Development Plan – Concept A**

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	20 / 100		8,700
2014			
2015			
2016			
2017			
2018		100,000	
2019			
2020		97,000	
<b>Total</b>	<b>1,020</b>	<b>197,000</b>	<b>8,700</b>

**Table 1-1B: Preliminary Development Plan – Concept B**

Year	Land Use		
	Residential Units (multifamily/single family)	Commercial/Retail (SF)	School (SF)
2010	200 / 100		
2011	200 / 100		
2012	200 / 100		
2013	200 / 100		8,700
2014	200 / 100		
2015	200 / 100		
2016	40 / 0		
2017			
2018		100,000	
2019			
2020		97,000	
<b>Total</b>	<b>1,840</b>	<b>197,000</b>	<b>8,700</b>

Table 1-1C: Preliminary Development Plan – Concept C

Year	Land Use		
	Residential Units (multifamily)	Commercial/Retail (SF)	School (SF)
2010	300		
2011	300		
2012	300		
2013	300		8,700
2014	300		
2015	300		
2016	300		
2017	230		
2018		100,000	
2019			
2020		97,000	
<b>Total</b>	<b>2,330</b>	<b>197,000</b>	<b>8,700</b>

The three concepts include a variety of high and medium density multifamily units and low density single-family units. The residential units are located on approximately 162 acres in all three concepts. Table 1-2 provides a breakdown of the units and densities.

Table 1-2: Alternative Concepts

	Alternative Concepts		
	A	B	C
<b>Residential Units</b>			
High density – multifamily	400	800	800
Medium density - multifamily	220	440	1,530
Low density – single-family	400	600	0
<b>Total</b>	<b>1,020</b>	<b>1,840</b>	<b>2,330</b>
<b>Density (dwelling units per acre)</b>			
High density – multifamily	12	24	24
Medium density – multifamily	8	16	12
Low density – single-family	4	6	n/a
<b>Commercial/retail</b>	<b>197,000 SF</b>	<b>197,000 SF</b>	<b>197,000 SF</b>

## 2.0 EXISTING CONDITIONS

### 2.1 ROADWAYS AND TRAFFIC

Palani Road is the only existing road bordering the project, along the southern boundary. The proposed Ane Keohokalole Highway would border the project along the *makai* boundary and the proposed Keanalehu Drive would border the project along the *mauka* boundary. Keanalehu Drive and Manawale`a Street, along the northern-*mauka* tip of the project are currently under construction with a projected completion date of late 2008.

## 2.2 DRAINAGE FACILITIES

There are currently no existing drainage facilities and no defined natural drainage ways onsite. The high permeability of the existing soils is evident by the absence of any natural storm water channels or gullies in the project area.

## 2.3 WATER SUPPLY

No water is available from the County for new developments in the Kona area. New source well(s) would be required to support the project. There is no existing water system within the project site.

The majority of the project site is within the 595-foot elevation Kealakehe High School reservoir's service zone which extends from the 495-foot elevation to the 225-foot elevation. A portion of the site, along the extension of Keanalehu Drive, above the 495-foot elevation would have to be serviced from the 935-foot reservoir system, to provide adequate water pressure. See Figure 2-1: Water Supply, following the text of this report.

There is existing water system infrastructure around the project area, which connects to existing well sites above Mamalahoa Highway. An existing 16-inch water line in Manawale`a Street from the 595-foot elevation Kealakehe High School reservoir stubs out to the project site, and services the 495 to 225-foot elevation water service pressure zone. A 12-inch water line is under construction in Manawale`a Street as part of the road construction project to provide water service above the 495-foot elevation. There is an existing 16-inch water line in Palani Road along the project site.

A 1.0 million gallon (MG) reservoir exists at the 595-foot elevation Kealakehe High School reservoir site. The site is designed for a second 1.0 MG reservoir. The *Villages of La`i`opua Water Master Plan* (approved October 26, 2006 by the Department of Water Supply) prepared by Akinaka & Associates, Ltd. for the Department of Hawaiian Home Lands allocated 472,800 gallons from the two 1.0 MG reservoirs to the Keahuolu project.

## 2.4 WASTEWATER COLLECTION, TREATMENT, AND DISPOSAL

Hawaii County's Kealakehe Sewage Treatment Plant (STP) is located *makai* of Queen Ka`ahumanu Highway. There is no sewer service in the immediate project area. Regional sewer in the area connects to an existing 30-inch sewer line which crosses Queen Ka`ahumanu Highway near the police station. The County has reserved 431,360 gallons per day (gpd) capacity at the Kealakehe STP for the Keahuolu project.

## 3.0 PROPOSED CIVIL INFRASTRUCTURE

Infrastructure for the proposed project would be built over an approximately 12-year period as the project site is developed. Construction is anticipated to begin in 2008 and provide the required infrastructure for the initial stages of development in 2010. From 2010 until 2020, the infrastructure system would be expanded to accommodate the entire project. Construction of the proposed development is anticipated to be completed by 2020.

### 3.1 ROADWAYS AND TRAFFIC

The County of Hawaii's proposed Ane Keohokalole Highway is key to full buildout of the Keahuolu project. Without Ane Keohokalole Highway, vehicular access to the site would be limited to access on Keanalehu Drive, and one possible connection to Palani Road. See Figure 3-1: Road System, following the text of this report.

Ane Keohokalole Highway would be a minor arterial with a 120-foot-wide right-of-way and posted speed limit of 35 miles per hour. Two lanes are proposed in each direction. The County plans to designate the highway as a bus transit corridor. A regional bus transit stop at the Ane Keohokalole Highway/Makala Boulevard intersection fronting the Keahuolu project is proposed. Bus stops are also proposed on Ane Keohokalole Highway for local circulators serving the *mauka* and *makai* neighborhoods.

Landowners with frontage to Ane Keohokalole Highway would be expected to share in the cost of constructing the highway. The projected order-of-magnitude cost of the portion fronting the project property, including drainage but excluding other utilities, would be \$13,633,000. For planning purposes, the project would be allocated responsibility for half of this off-site road improvement cost, or \$6,816,500. This estimate would be the same for Concepts A, B and C. For details on the road cost, see Appendix A. (Note: All costs presented in this report are in 2007 dollars.)

A right in/right out intersection is proposed along Palani Road. To minimize impacts on traffic along Palani Road, the intersection would include deceleration and acceleration lanes and a raised median to prevent vehicles from attempting to make left turn movements. The order-of-magnitude cost for the Palani Road intersection would be \$1,306,000.

Keahuolu's internal roadways would be pedestrian friendly streets, which accommodate cars, bicycles and pedestrians. The roadways would be designed to County of Hawaii Department of Public Works standards for dedication to the County. The layout of the internal roads would be determined by the developer to coordinate with the development concept. An order-of-magnitude cost for the internal roadways, including water, sewer, drainage, electric, telephone and cable television utilities, based on the concept plan is \$122,725,000.

Existing traffic conditions are assessed in a separate report.

### 3.2 SITE GRADING AND EROSION CONTROL

The project does not propose major grading of the site. The existing topography would be altered only to the extent necessary for construction of the proposed improvements. It is anticipated that grading would occur on a localized scale and that cut and fill quantities would generally balance as construction progresses. Grading permits, approved by the State Department of Land and Natural Resources Historic Preservation Division, the County Planning Department and the County Department of Public Works would be required for all grading activities.

During all phases of construction, erosion control practices would comply with State, County and Federal regulations. National Pollutant Discharge Elimination System (NPDES) general permit coverage authorizing discharges of storm water associated with construction activities would be required for the project from the State Department of Health, Environmental Management Division, Clean Water Branch. Best management practices to control erosion during construction would be a component of the NPDES permit.

### 3.3 DRAINAGE FACILITIES

Storm water runoff from the site would be collected through swales, ditches, gutters, inlets and catch basins, and transported through pipes to dry wells, seepage wells or infiltration areas for disposal. Infiltration areas, seepage wells and dry wells would be located in open spaces and parking lots, where practical. Dry wells would be located within the roadway right-of-way as needed. An underground injection control (UIC) permit is required by the State Department of Health to construct and operate the dry wells. It is recommended to include best management practices in the design of the drainage system, such as vegetated swales and storm drain filtration devices to capture sediments and prevent pollutants from entering the groundwater.

### 3.4 WATER SYSTEM

The proposed water system would be developed in accordance with the 2002 State of Hawaii Water System Standards and revisions to the standards per discussions with Department of Water Supply staff. For details of the water system criteria, see Appendix B. The design and construction of the proposed offsite water system and onsite water system within the road right-of-way would meet County Standards for dedication to the Department of Water Supply.

The projected average water daily demand generated by the proposed development plan concepts and reservoir storage requirements are summarized in Table 3-1. Water system calculations are provided in Appendix B.

Table 3-1: Water Requirements

Development Plan	Average Daily Demand (gallons per day)	Reservoir * (million gallons)
Concept A	745,820	1.0
Concept B	1,158,680	1.5
Concept C	1,114,680	1.5

\* Reservoir calculations utilize 472,800 gallons of capacity in the Kealakehe High School reservoir site allocated for the project parcels in the existing and proposed 1.0 MG reservoirs.

#### 3.4.1 OFFSITE

##### 3.4.1.1 WELL SITES

Two source wells, numbered 3 and 4 in the *Villages of La`i`opua Water Master Plan* (October 26, 2006), have been identified for the project. See Figure 3-2: Offsite Water System, following the text of this report. The Hawaii Housing Finance and Development Corporation (HHFDC) and the Department of Hawaiian Home Lands (DHHL) have discussed HHFDC's development of well numbers 3 and 4 to provide source water for the project.

The proposed wells are within the Keauhou aquifer system and would tap into high-level ground water, based on *A Study of the Ground-Water Conditions in North and South Kona and South Kohala Districts, Island of Hawaii, 1991-2002* (September 2003) by Glenn R. Bauer. Ground water occurs in Hawaii as both a thin basal lens and as high-level aquifers. The extent of the high-level ground water and the nature of the confining hydrogeologic structure are not completely known. Data from the aquifer suggests that the Keopu area is the "drain"

for the ground-water flow system from the high water aquifer to the basal aquifer along the coastline. The effects of withdrawal of ground water from the high level aquifer are not known and monitoring of the existing and future wells will be continued by the Commission on Water Resource Management. Based on the *State Water Projects Plan, Volume 2 SWPP for Island of Hawaii*, February 2003 by Fukunaga and Associates, the Keauhou aquifer system has a sustainable yield of 38 million gallons per day (MGD). The total Keauhou aquifer demand from the State Water Projects Plan in 2018 is 4.98749 MGD, which added to the highest project demand of 1.16 MGD would be below the sustainable yield of the aquifer. A portion of the project is allocated in the State Water Projects Plan as part of the Department of Hawaiian Home Lands La'i opua development.

The Department of Water Supply's allows a project 50-percent of the yield for one developed well and 67-percent of the yield for two developed wells. Well site number 4 with a projected 2.0 MGD anticipated yield could provide the Keahuolu project with 1.0 MGD of water to meet the requirements for Concept A, which would be 0.7 MGD. Well site number 4 would not be able to support development Concepts B and C water demands, which exceed 1.0 MGD. Development of well site number 3, in addition to well site number 4, would be required for development Concepts B and C. The projected yield for well site number 3 would be 1.0 MGD. With the development of the two well sites 3 and 4, the total anticipated yield would be 3.0 MGD. The project would be allowed 67-percent of the 3.0 MGD, or 2.0 MGD to meet the requirements for Concepts B and C, which are 1.2 and 1.1 MGD, respectively.

Well site number 4 would required for Concepts A, B and C. Well site number 3 would be required in addition to well site number 4 for Concepts B or C.

The well site(s), reservoir(s), water lines and appurtenant structures would be dedicated to the Department of Water Supply. Construction of the well site(s) would require well permits pump installation permits, grading permits, NPDES general permit coverage authorizing discharges of storm water associated with construction activities, and building permits for the structures. An engineering report, including chemical analysis, would be required by the State Department of Health Safe Drinking Water Branch in the well permitting process for development of the production wells. If dry wells are constructed at the sites, an Underground Injection Control permit would also be required for the project.

#### **3.4.1.1.1 WELL SITE NUMBER 4 AND RESERVOIR**

Well site number 4, located at Tax Map Key: 7-5-13:22, is identified as Keopu Well, State Well No. 3957-03 in the Water Master Plan. See Figure 3-3: Well Site Number 4 Aerial Photograph and Figure 3-4: Well Site Number 4 Tax Map with Contours, following the text of this report. The parcel is owned by the State of Hawaii, and it is located approximately 3 miles south of Palani Junction along Mamalahoa Highway. The well site parcel is located *mauka* of Mamalahoa Highway with elevations ranging from approximately 1,490 feet to 2,440 feet. A negative declaration of the Final Environmental Assessment for an exploratory well, Keopu-HFDC Exploratory Well No. 1, was published in the September 23, 1994 Office of Environmental Quality Control Bulletin. The exploratory well at well site number 4, Keopu State Well No. 3957-05, was drilled at an elevation of 1,600.6 feet starting in August 2000 to a depth of 1,800 feet (-199 feet, mean sea level). The water level in the well was measured at 56.5 feet mean sea level. The well was pump tested in July and August 2002. The report *Results of Drilling & Testing Keopu-State Well (3957-05) North Kona, Hawaii* (Revised September 2007) by Water Resource Associates

indicates well number 4 is capable of yielding at least 2 million gallons per day of potable water. The daily chlorides ranged from 7 to 9 milligrams per liter, indicating excellent potable water quality.

Development of well site number 4 would require outfitting the well with a pump, installation of a well control building with a chlorination system and backup generator, a reservoir, and appurtenant structures. The reservoir would be sized to the average daily production rate of the well, or 2 million gallons (MG) based on the anticipated yield for the well. The reservoir would be located in cut, at the 1,683-foot elevation. The standard size for a 2.0 MG reservoir is approximately 145 feet in diameter, however, it could be constructed with a smaller footprint. A new access road would be required from Mamalahoa Highway to the well, well control building and reservoir. A new 16-inch water line would extend from the new reservoir to Mamalahoa Highway and extend approximately 7,000 linear feet north along Mamalahoa Highway to the existing Keahuolu (QLT #1) State Well No. 4057-01 well site.

#### 3.4.1.1.2 WELL SITE NUMBER 3 AND RESERVOIR

Well site number 3, located at Tax Map Key: 7-5-01:55, is identified as North Keopu Well, State Well No. 3957-02 in the Water Master Plan. See Figure 3-5: Well Site Number 3 Aerial Photograph and Figure 3-6: Well Site Number 3 Tax Map with Contours, following the text of this report. The parcel is owned by the State of Hawaii and is adjacent to parcel 117 which is owned by the Department of Water Supply. The site is located approximately 2.25 miles south of Palani Junction along Mamalahoa Highway. Parcels 55 and 117 are located *mauka* of Mamalahoa Highway, with elevations ranging from 1,580 feet to 1,620 feet. Access to the well site is through an easement on parcel 31, which is privately owned. The projected yield from well site number 3 is 1 MG. A monitor well, USGS Well #3957-02 or also known as the Kailua Observation Well or the USGS Komo Observation well was drilled in 1991 on parcel 117. The well was drilled at the 1,600 feet elevation to a depth below ground of 1,622.5 feet. A 12-inch diameter hole was drilled and a 4-inch diameter casing installed. The water level in the well has been measured at around 42 feet mean sea level. There is no data available on water quality or quantity for this well. An existing 50,000 gallon Department of Water Supply water tank, which is not in service, is located on parcel 55. The site is known as the Moeauoa Tank Station.

Development of well site number 3 would require drilling of a new production well, installation of a pump, testing of the well for quality and capacity, installation of a well control building with chlorination system and backup generator, a reservoir, and appurtenant structures. However, well site number 3, with a total land area of 31,799 square feet for both parcels 55 and 117, is not large enough to accommodate all the structures required for a well site. Additional adjacent private lands would have to be obtained to operate the well. A new 1.0 MG reservoir, located in cut around the 1,683-foot elevation, would be required for the well. A 1.0 MG reservoir is approximately 95 feet in diameter. A new access road would be required from Mamalahoa Highway to the well, well control building and reservoir. A new 16-inch water line would extend from the reservoir to Mamalahoa Highway and connect to the new 16-inch water line between well site number 4 and the existing QLT well site.



### 3.4.1.2 RESERVOIR ON DHHL KEAHUOLU PROPERTY

Either a new 1.0 MG reservoir for Concept A or 1.5 MG reservoir for Concepts B or C would be required for project water storage in addition to the 472,800 gallon reserve capacity within the existing Kealakehe Reservoir site. HHFDC and DHHL have discussed a new 595-foot elevation reservoir site located on the DHHL Keahuolu property at Tax Map Key: 7-4-21: portion of 21. See Figure 3-7: Reservoir on DHHL Keahuolu Property, following the text of this report. The site would be off the future extension of Keanalehu Drive, and a temporary access road with two 16-inch water lines would be required within the Keanalehu Drive right-of-way until Keanalehu Drive is built-out. The access road would be over Tax Map Key: 7-4-21: portions of 20 and 21, and grading for the access road on Tax Map Key: 7-4-21: portion of 21.

Construction of the reservoir site would require a grading permit, NPDES general permit coverage authorizing discharges of storm water associated with construction activities, and building permits for the reservoir structure. If dry wells are constructed at the reservoir site, an Underground Injection Control permit would also be required for the reservoir construction.

### 3.4.1.3 WATER LINES

The *Villages of La'i opua Water Master Plan* identified transmission deficiencies in the offsite water system. Approximately 3,200 linear feet of 8-inch water line in Kealakea Street, from Palani Road to Manawale'a Street, would require upsizing to a 12-inch water line. Approximately 800 linear feet of new 12-inch water line would be required in the existing Manawale'a Street. Approximately 2,820 linear feet of 12-inch water line would also be required in Ane Keohokalole Highway, between Palani Road and Makala Boulevard. The water line improvements are shown in Figure 3-2. Upon finalization of the development concept, the Department of Water Supply requested the developer update the *Villages of La'i opua Water Master Plan* to determine whether there are any other system deficiencies and required improvements.

### 3.4.1.4 WATER SYSTEM COSTS

Order-of-magnitude costs for the off-site water system improvements would be as follows. For details on the water system costs, see Appendix B.

Off-site Wells and Appurtenances (Well Site Number 4 required for all concepts, and Well Site Number 3 would be required in addition to Well Site Number 4 for Concepts B or C.

Well Site Number 4	\$11,296,000
Well Site Number 3	\$7,175,000

Reservoir on DHHL Keahuolu property: one would be required.

1.0 MG Reservoir – Concept A	\$7,403,000
1.5 MG Reservoir – Concept B or C	\$8,385,000

Water Line: upgrades required for all concepts.

3,200 linear foot (LF) of 12" in Kealakea Street	\$873,000
800 LF in Manawale'a Street	\$287,000
2,820 LF in Ane Keohokalole Highway	\$798,000

Additional off-site water system improvements or water line size upgrades may be required with the update of the *Villages of La`i`opua Water Master Plan*.

### 3.4.2 ONSITE

The onsite water system would consist of water lines within the roadway network. The system would be connected to the existing water system at Keanalehu Drive and Manawale`a Street and at Palani Road and Ane Keohokalole Highway, forming a looped water system. The Keahuolu water system network would have a minimum pipe size of 8-inches in diameter and a maximum pipe size of 16-inches in diameter, based on the proposed roadway layout and development layout and densities. The water lines would be sized to meet the maximum daily demand plus fire flow with a residual pressure of 20 pounds per square inch (psi) at the critical fire hydrant or the peak hour demand with a residual pressure of 40 psi.

### 3.5 WASTEWATER SYSTEM

The proposed sewer system would be developed in accordance with the Hawaii County Department of Environmental Management criteria. For details of the sewer system criteria, see Appendix C. The design and construction of the proposed offsite sewer system and onsite sewer system would meet County Standards for dedication to the County Department of Environmental Management.

The projected sewer flows are summarized in Table 3-2. Sewer system calculations are provided in Appendix C.

Table 3-2: Sewer Requirements

Development Plan	Design Average Flow (gallons per day)	Design Peak Flow (gallons per day)
Concept A	430,598	1,915,899
Concept B	665,436	2,568,875
Concept C	720,856	2,710,213

The project has reserved 431,360 gpd capacity at the Kealakehe Sewage Treatment Plant (STP). Additional capacity at the STP would be required to accommodate Concepts B and C, which are projected to exceed the reserved capacity. The Department of Environmental Management would have to expand the STP and are currently undertaking a master plan to review options to upgrade the STP. Two improvement projects to the STP are planned which include 1) sludge removal: \$4,600,000 (County of Hawaii FY 07-08 budget) and 2) aeration upgrade: \$1,500,000 (County of Hawaii FY 07-08 budget). The two improvement projects will allow the STP to continue to operate at the present capacity and allow for future capacity upgrades.

R-2 Water (disinfected secondary recycled water) from the Kealakehe STP is discharged to a pond in the lava fields *makai* of Queen Kaahumanu Highway in the DHHL/Villages of La`i`opua. R-2 Water is not suitable for irrigation use for the project. The County would have to further treat the effluent to R-1 Water (significant reduction in viral and bacterial pathogens) before the effluent would be suitable for irrigation use on the project site. The County has no plans to upgrade the STP to produce R-1 Water. In addition, a pump system, storage and transmission lines for the recycled effluent system would be required, but there are no plans by the County for a system to the project area.

### 3.5.1 OFFSITE

Sewer lines from the project site to the STP would be routed either through Queen Liliuokalani Trust (QLT) lands or through DHHL/Villages of La`i`opua lands. Figures 3-8 and 3-9 show the QLT route for the offsite sewer system for development concept A and concepts B and C, respectively. Figures 3-10 and 3-11 show the La`i`opua route for the offsite sewer system for development concept A and concepts B and C, respectively. Sewer lines would be sized to accommodate sewer flows from the project site, lands immediately *mauka* of the project, and the *makai* lands adjacent to the sewer line alignment. The sewer line alignment and sizes are subject to change based on the final development concept.

Based on the design flows, a new 30-inch sewer line would be required to convey sewer flows from the project site, across Queen Kaahumanu Highway to the STP for either route. A sewer line through the QLT route can convey wastewater flows from the entire project site to the STP. A sewer line through the Villages of La`i`opua route can convey the majority of the flows from the site. A low-elevation portion, approximately 40 acres of the project parcel near Palani Road could be developed with activities not requiring sewer service, such as parking lots, open spaces, preserve areas, and playfields and parks with restroom facilities located outside the low area. If sewer service is required for the low area, either a pump station would be required or a sewer line would have to be constructed through QLT land to convey flows from the low area. Figures 3-9 and 3-10 show the proposed sewer line to service the project low area through the QLT lands.

The following order-of-magnitude costs for sewer system construction assume that the low area would be developed with sewage-generating facilities. For details on the sewer system costs, see Appendix C.

#### Through QLT Lands:

Concept A	\$6,381,000
Concept B or C	\$6,663,000

#### Through the DHHL / Villages of La`i`opua:

Concept A	
Through La`i`opua	\$5,983,000
<u>Through QLT Lands</u>	<u>\$4,297,000</u>
Total	\$10,280,000
Concept B or C	
Through La`i`opua	\$5,983,000
<u>Through QLT Lands</u>	<u>\$4,543,000</u>
Total	\$10,526,000

These cost estimates are based on the best available information on DHHL and QLT plans for future development of their properties. QLT is in preliminary planning, and actual routing and sewer flows may change.

### 3.5.2 ONSITE

The onsite sewer system would consist of sewer lines within the roadway network. The system would connect to sewer line routed through either the DHHL/Villages of La`i`opua lands or the QLT lands. The sewer system would have a minimum pipe size of 8-inches in diameter and a maximum pipe size of 21-inches in diameter for the DHHL/Villages of La`i`opua route or 15-inches in

diameter for the QLT route. The sewer lines would be sized to convey the design peak flow from the upstream tributary areas.

### 3.6 SOLID WASTE

The County of Hawai'i requires all solid waste (also known as rubbish), to be removed from all buildings and premises and disposed of at an approved solid waste disposal facility. All solid waste generated from the project would be taken to the West Hawai'i Landfill in Pu'uana'hulu, a County transfer station, or recycled.

Quantities of solid waste were estimated for both construction and occupancy phases of the Keahuolu project. The "construction phase" of development is anticipated to begin in 2008 with construction of approximately 300 housing units per year. The school facilities, with 550 students and 70 faculty and staff, are projected for construction between 2011 and 2012. The commercial / retail spaces are projected for approximately 100,000 square feet of construction in 2016 and 2017, and 97,000 square feet of construction in 2018 and 2019. The "occupancy phase" of development refers to the time at which the facilities have been constructed and are open for use. The construction and occupancy phases are expected to overlap, as construction of later portions of the Keahuolu project would continue while earlier portions are completed and occupied. The project is estimated to be completed and occupied in 2020. The average amounts of solid waste generated by construction activities and occupancy are summarized in Table 3-3.

Table 3-3: Solid Waste

Year	Concept A		Concept B		Concept C	
	Construction Waste (tons/year)	Occupancy Waste (tons/year)	Construction Waste (tons/year)	Occupancy Waste (tons/year)	Construction Waste (tons/year)	Occupancy Waste (tons/year)
2008	525 - 910	0	525 - 910	0	450 - 780	0
2009	1,050 - 1,820	0	1,050 - 1,820	0	900 - 1,560	0
2010	1,050 - 1,820	1,086	1,050 - 1,820	1,086	900 - 1,560	950
2011	658 - 1,141	2,172	1,063 - 1,843	2,172	913 - 1,583	1,901
2012	358 - 621	3,259	1,063 - 1,843	3,259	913 - 1,583	2,851
2013	0	4,069	1,050 - 1,820	4,639	900 - 1,560	4,096
2014	0	4,069	585 - 1,014	5,725	900 - 1,560	5,046
2015	0	4,069	60 - 104	6,812	795 - 1,378	5,997
2016	150 - 260	4,069	150 - 260	6,938	495 - 858	6,947
2017	150 - 260	4,069	150 - 260	6,938	150 - 260	7,676
2018	146 - 252	4,730	146 - 252	7,599	146 - 252	8,337
2019	146 - 252	4,730	146 - 252	7,599	146 - 252	8,337
2020 and Beyond	0	5,370	0	8,240	0	8,977

A preliminary solid waste management plan is provided in Appendix D.

## 4.0 PROBABLE IMPACTS AND PROPOSED MITIGATION

### 4.1 POTENTIAL SHORT-TERM IMPACTS

#### 4.1.1 ROADS

No significant short-term environmental impacts are anticipated from the development of the roadways within the project site. Regional traffic impacts are assessed in a separate report.

#### 4.1.2 GRADING, DRAINAGE AND EROSION CONTROL

During grading activities, portions of the site would be disturbed and the potential for site erosion would increase. The contractor would be required to comply with Chapter 10 – Erosion and Sedimentation Control of the County Code, the Department of Public Works Storm Drainage Standard, and the NPDES permit requirements, including the best management practices (BMP) plan to contain and control site erosion and to prevent the discharge of sediment from the site. Based on the requirement for construction activities to comply with the County requirements and the approved NPDES permit, the short-term environmental impacts from grading activities are anticipated to be mitigated and insignificant.

The increase of impermeable surfaces resulting from site development would have the effect of increasing storm water runoff quantities on the site. To comply with the County's Storm Drainage Standard, runoff flow rates and volume would not be increased from the site. The runoff would be collected and discharged to on-site seepage areas, seepage wells and drywells for percolation into the ground. Thus, precipitation falling on the site would discharge into the ground as it does under pre-development conditions, and off-site runoff would not increase as a result of the proposed development. It is recommended that the drainage systems also include storm drain filtration devices to mitigate potential the impacts from potential pollutants. Filtration devices may include vegetated swales, bioretention areas, sand or organic filtering systems or commercially available proprietary products such as catch basin inserts and hydrodynamic devices. The method of filtration would be determined based on available technology and integrated with the system design.

#### 4.1.3 WATER ENVIRONMENT

##### 4.1.3.1 SURFACE WATER

There are no surface water bodies on or near the project site. The developer would be required to comply with the NPDES permit requirements, including the BMP plan, and Chapter 10 – Erosion and Sedimentation Control of the County Code during construction and prevent the discharge of sediment from the site. As areas of the site are developed, drainage systems would collect runoff and discharge it to the subsurface. The project would be designed to comply with the County's Storm Drainage Standard such that runoff volumes and rates would not increase as a result of site development. The project would have no significant short-term effects on surface waters because there would be no increase of runoff from the site.

##### 4.1.3.2 GROUNDWATER

Precipitation on the site currently percolates to the underlying groundwater. This would continue to be the case during and after site development. The NPDES permit requirements,

including the BMP plan would require the contractors to manage materials to prevent the discharge of pollutants to the ground. It is recommended that during and after development, landscape management practices would be applied in public and private areas to minimize the use of fertilizers and pesticides that could potentially enter the groundwater. The developer and his contractor would be required to conform with the NPDES permit requirements during construction. Best management practices, such as storm drainage filtration devices, are recommended to mitigate pollutants from entering the groundwater. It is anticipated that short-term impacts upon the local groundwater quality would not be significant.

#### **4.1.4 WATER SUPPLY**

Water supply infrastructure, including source wells, storage reservoirs and distribution lines would be constructed as required and approved by the County of Hawaii Department of Water Supply. Construction activities would be required to conform to the applicable environmental requirements for storm water protection and mitigation of potential noise and dust impacts. Short-term localized water system shut-downs and road closures may be required as the new water infrastructure is connected to the existing water system. No short-term detrimental impacts on the existing water supply system are anticipated as a result of the proposed project.

#### **4.1.5 WASTEWATER**

Extension of the sewer system to serve the proposed development would not have significant short-term impacts on the environment. Construction activities would be required to conform to the applicable environmental requirements for storm water protection and mitigation of potential noise and dust impacts. County fees associated with permission to connect would be applied by the County to upgrade the existing treatment and disposal facilities on an as-needed basis.

#### **4.1.6 SOLID WASTE**

Emphasis for the management of solid wastes generated by the Keahuolu project would be placed on waste diversion and recycling. Solid wastes would be managed in conformance with the applicable Department of Health and County requirements. The landfill nearest to the Keahuolu project is the West Hawaii Landfill at Pu'uana'hulu. Since the County of Hawaii does not provide waste collection services, recycle and disposal of construction and occupancy waste would be hauled by private contractors or individuals. Specific arrangements for construction and occupancy wastes would be made closer to the project beginning. Recyclables and wastes would be managed in either a centralized system or by private individuals, and hauled directly to recycling centers, transfer stations and the landfill. The average amounts of solid waste diverted through minimization and recycling, and landfilled are summarized in Table 3-4.

Table 3-4: Summary of Solid Waste Diverted and Landfilled

Year	Concept A		Concept B		Concept C	
	Diverted Waste (tons/year)	Landfilled Waste (tons/year)	Diverted Waste (tons/year)	Landfilled Waste (tons/year)	Diverted Waste (tons/year)	Landfilled Waste (tons/year)
2008	263-455	262-455	263-455	262-455	225-390	225-390
2009	525-910	525-910	525-910	525-910	450-780	450-780
2010	805-1,190	1,331-1,716	805-1,190	1,331-1,716	695-1,025	1,155-1,485
2011	889-1,131	1,941-2,182	1,092-1,482	2,143-2,533	947-1,282	1,867-2,202
2012	1,020-1,152	2,597-2,728	1,373-1,763	2,949-3,339	1,193-1,528	2,571-2,906
2013	1,050	3,019	1,722-2,107	3,967-4,352	1,507-1,837	3,489-3,819
2014	1,050	3,019	1,770-1,984	4,540-4,755	1,752-2,082	4,194-4,524
2015	1,050	3,019	1,787-1,809	5,085-5,107	1,945-2,236	4,847-5,139
2016	1,125-1,180	3,094-3,149	1,865-1,920	5,223-5,278	2,040-2,221	5,402-5,584
2017	1,125-1,180	3,094-3,149	1,865-1,920	5,223-5,278	2,055-2,110	5,771-5,826
2018	1,293-1,346	3,583-3,636	2,034-2,087	5,711-5,764	2,224-2,277	6,259-6,312
2019	1,293-1,346	3,583-3,636	2,034-2,087	5,711-5,764	2,224-2,277	6,259-6,312
2020 and Beyond	1,385	3,985	2,126	6,114	2,316	6,661

Although the project site is located in an area where the annual precipitation does not often exceed the amount of evapotranspiration (water lost to the atmosphere by evaporation and transpiration), all waste should avoid contact with water as best as possible. Waste that comes into contact with water before being hauled to the landfill may result in leachate (liquid produced when water percolates through any permeable material) at the landfill. Leachate could contaminate both ground and surface water, which may lead to various environmental and health problems as well as the degradation of local amenities. It can best be managed by daily covering of all waste.

According to the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawaii, the Pu'uanahulu Landfill is estimated to have 12 million cubic yards of air space which is enough to accommodate the waste generated by West Hawaii for approximately the next 40 years.

No significant short-term impacts on the existing solid waste collection and disposal systems or the environment are anticipated as a result of the proposed development.

## 4.2 POTENTIAL LONG-TERM IMPACTS

### 4.2.1 ROADS

No significant long-term environmental impacts are anticipated from the development of roadways within the project site. Regional traffic impacts are assessed in a separate report.

## **4.2.2 DRAINAGE AND EROSION CONTROL**

Site drainage in the long term would be collected and discharged to on-site seepage areas, seepage wells and drywells for percolation into the ground. Precipitation falling on the site would discharge into the ground as it does under pre-development conditions, and off-site runoff would not increase as a result of the proposed developments required compliance with the County's Storm Drainage Standard. Storm drainage filtration devices are recommended to mitigate pollutants from entering the groundwater. After completion of the project construction, ground surfaces would be stabilized with landscape and hardscape, and the potential for erosion would be minimal. Long-term impacts of the project on drainage and erosion are not anticipated to be significant.

## **4.2.3 WATER ENVIRONMENT**

### **4.2.3.1 SURFACE WATER**

Rainfall runoff from the developed site would be collected in the drainage systems and percolated into the ground in the on-site seepage areas, seepage wells and dry wells. Runoff volumes and rates would not increase as a result of site development in compliance with the County's Storm Drainage Standard, and the project would have no significant long-term effects on surface waters.

### **4.2.3.2 GROUNDWATER**

The source wells would draw the high-level groundwater from the Keauhou aquifer system. The projected sustainable yield from the Keauhou aquifer is 38 MGD, while the projected 2018 demand is 4.98749 MGD. The project would add approximately 0.7 to 1.2 MGD demand on the aquifer, which is within the sustainable yield of the aquifer.

The full build-out water demands of the Keauhou aquifer based on the Hawaii County General Plan is 170.8 MGD without agricultural demands and 245.4 MGD with agricultural demands. Based on the County Zoning, the full build-out water demands of the Keauhou aquifer is 39.1 MGD without agricultural demands and 111.6 MGD with agricultural demands. In the long-term, water demands in the Keauhou aquifer would exceed the sustainable yield of the aquifer and alternate water resource enhancement measures would be required to meet the water demands. Alternative water resource enhancement measures that have been identified in the *Draft Report Hawaii County Water Use and Development Plan Update*, December 2006, by Fukunaga and Associates, would include rainwater catchment systems in the areas *mauka* of Mamalahoa Highway, wastewater reclamation for use within close proximity of the waster treatment facilities and desalination from brackish wells between Queen Kaahumanu Highway and Mamalahoa Highway. Future reduction in development density, development of water conservation programs by the Department of Water Supply and continued monitoring of the aquifer have also been identified in the *Draft Report Hawaii County Water Use and Development Plan Update* to mitigate the long term impacts on the Keauhou aquifer.

It is recommended the developer implement measures to reduce the amount of pollutants from entering the groundwater by including best management practices such as storm drain filtration devices, ground stabilization with landscape and hardscape, educational warning signs on the drainage systems with wording such as "DUMP NO WASTES. GOES TO GROUNDWATER AND OCEAN. HELP PROTECT HAWAII'S ENVIRONMENT.", and



coordinating environmental educational programs for the project area residents with the Department of Health Clean Water Branch.

#### **4.2.4 WATER SUPPLY**

The long-term impacts of the project on the DWS water source, storage and transmission system would be an improvement of the existing system. The additional source well(s) for the project would increase water available to the region, as DWS only allocates a portion of the well yield to the project. As previously noted, DWS allows a project 50-percent of the yield for one developed well and 67-percent of the yield for two developed wells for a project. The project would add storage reservoirs and improve the area water transmission system, as required to provide water service from the source well(s) down to the site. No long-term detrimental impacts on the existing water supply system are anticipated as a result of the project.

#### **4.2.5 WASTEWATER**

The long-term impacts of the project on the sewer system would be the construction of new sewer lines through either the DHHL/Villages of La'i opua lands or the QLT lands to the Kealakehe STP. The impact would be an increase in daily flows to the STP of 430,598 GPD, 665,436 GPD or 720,856 GPD for concepts A, B or C, respectively. Concepts B or C would require the County to upgrade the Kealakehe STP. The new sewer lines *makai* of the project would also allow the potential development of the DHHL/Villages of La'i opua lands or the QLT lands adjacent to the new sewer line, depending on the ultimate route of the new line. The construction of new sewer lines through the Keahuolu project would also provide potential sewer service to lands *mauka* of the project site. No long-term detrimental impacts on the existing sewer lines are anticipated as a result of the project, since all new sewer lines from the project site to the STP would be constructed. Adequate treatment and disposal capacity has been reserved at the Kealakehe STP for project concept A, and no long-term detrimental impacts to the STP are anticipated. Concepts B and C would require the County to upgrade the STP to handle the added sewage flows and to mitigate any long-term detrimental impacts to the STP. The Department of Environmental Management is undertaking a master plan for the STP to determine the appropriate system upgrades to increase the STP capacity. Until the master plan assessment is completed, the County does not know the type and costs of the STP upgrades.

#### **4.2.6 SOLID WASTE**

Emphasis for the management of solid wastes generated by the Keahuolu project would be placed on waste diversion and recycling. According to the 2002 Updated Integrated Solid Waste Management Plan for the County of Hawaii, the Pu'uana'hulu Landfill is estimated to have 12 million cubic yards of air space which is enough to accommodate the waste generated by West Hawaii for approximately the next 40 years. The plan also notes that the County is also looking into waste reduction facilities for the island, using either a waste-to-energy incinerator, a thermal gasification plant (produces heat from waste), or an anaerobic digestion plant (breaks refuse into its molecular components). The project's full-build out annual occupancy landfill waste percentage of the annual West Hawaii Landfill waste would be estimated to be 4.43%, 6.79% or 7.40% for the development concepts A, B or C, respectively. The project's waste stream is a small fraction of the waste that would go to the landfill.

No significant long-term impacts on the solid waste collection and disposal system or the environment are anticipated as a result of the proposed development.