Bow Engineering & Development, Inc.
1953 S. Beretania Street, PH-A
HONOLULU, HAWAII 96826-1342

Telephone: (808) 941-8853
Fax: (808) 945-9299
WWW.BOWENGINEERING.COM

WATER ANALYSIS FOR

HOKUA PLACE

TMK (4) 4-3-003:001 (PORTION)

February 2021

1. INTRODUCTION/PROJECT DESCRIPTION

The proposed development is a 97-acre subdivision that will consist of single-family and multi-family residential lots. The subdivision will be broken into two phases with Phase I including 16 single-family residential units on five agricultural lots (1.47 to 6.6 acres each), and Phase II including 86 single-family residential units and 683 multi-family residential units. In addition to the residential units in Phase II, a 3.1-acre park, 1.4-acre parcel for commercial use, and 14.3-acres of open greenway areas are also proposed.

In the *HoKua Place Section 343-5e HRS Final Environmental Impact Statement* (FEIS), dated November 2019, two options were proposed to provide adequate water service to the development. The first option under the Water Master Plan, prepared by Tom Nance Water Resource Engineering (TNWRE), the developer will dedicate the new well site to the County Department of Water Supply to provide water to the County's storage tanks and existing water system in exchange for the County providing water storage for the proposed development. If the Water Master Plan is not accepted by the County, the second option is to use the new well to provide a private water system for the development.

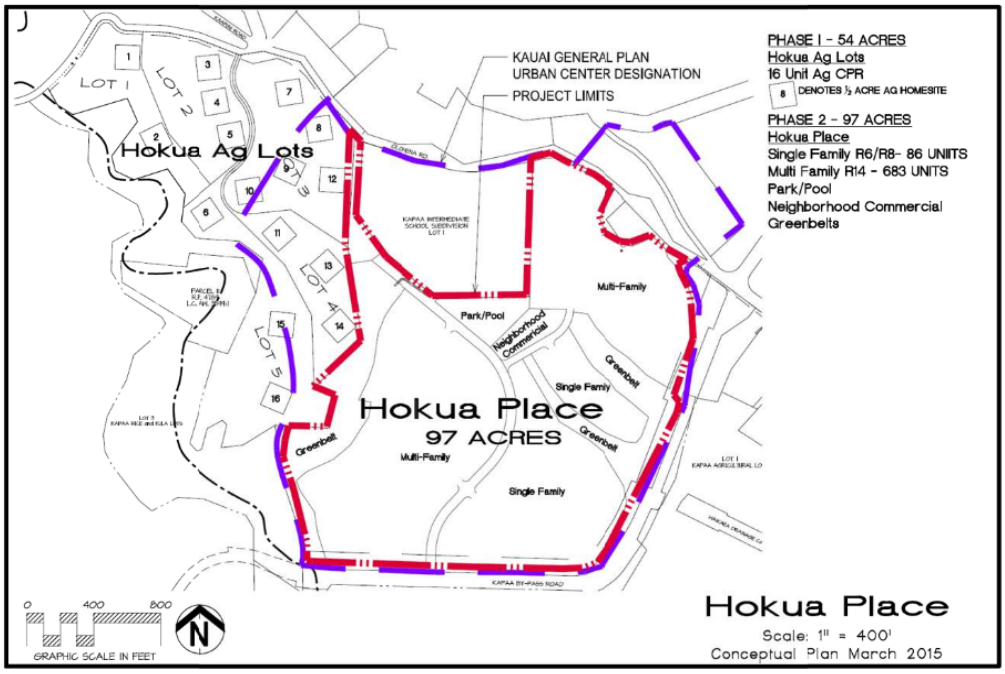

Figure 1 – Project Location

2. PROPOSED CONDITIONS

2.1 WATER DEMAND REFERENCES

The Water System Standards (WSS) was used to determine the water demand for the proposed development. The following tables were used to calculate the Average Daily Demand, Maximum Daily Demand, Peak Hour Demand and required Fire Flows for the proposed development. Table 100-18 listed below was used to calculate the preliminary Average Daily Demand for the subdivision based on the number of single family and multifamily units and commercial, park, and church area allocations discussed in the FEIS.

TABLE 100-18 - DOMESTIC CONSUMPTION GUIDELINES

AVERAGE DAILY DEMAND*

ZONING DESIGNATION	HAWAII	**KAUAI**	MAUI	OAHU
RESIDENTIAL:				
Single Family or Duplex	400 gals/unit	**500 gals/unit**	600 gals/unit	500 gals/unit
			3,000 gals/acre	2,500 gals/acre
Multi-Family Low Rise	400 gals/unit	**350 gals/unit**	560 gals/unit	400 gals/unit
			5,000 gals/acre	4,000 gals/acre
Multi-Family High Rise	400 gals/unit	**350 gals/unit**	560 gals/unit	300 gals/unit
COMMERCIAL:				
Commercial Only	3,000 gals/acre	**3,000 gals/acre**	6,000 gals/acre	3,000 gals/acre
Commercial/ Industrial Mix	-	**5,000 gals/acre**	140 gals/1000 sq. ft.	100 gals/1000 sq. ft.
Commercial/ Residential Mix	-	**3,000 gals/acre**	140 gals/1000 sq. ft.	120 gals/1000 sq. ft.
RESORT (To include hotel for Maui only)	400 gals/unit (1)	**350 gals/unit**	350 gals unit	350 gals/unit
			17,000 gals/ acre	4,000 gals/acre
LIGHT INDUSTRY:	4,000 gals/acre	**4,000 gals/acre**	6,000 gals/acre	4,000 gals/acre
SCHOOL, PARKS:	4,000 gals/acre	**4,000 gals/acre**	1,700 gals/acre	4,000 gals/acre
	60 gals/ student	**60 gals/ student**	60 gals/ student	60 gals/ student
AGRICULTURE:		**2,500 gals/acre**	5,000 gals/acre	4,000 gals/acre

* - Where two or more figures are listed for the same zoning, the daily demand resulting in higher consumption use shall govern the design unless specified otherwise.
(1) - Subject to special review and control by the Manager

Table 100-19 from the WSS listed below was used to determine the required Fire Flows for the development.

TABLE 100-19 - FIRE FLOW REQUIREMENTS				
LAND USE	**FLOW (GPM)/DURATION (HRS)/FIRE HYDRANT SPACING (FT.)**			
	HAWAII	**KAUAI**	**MAUI**	**OAHU**
Agriculture	500/0.5/600 (1)	**250/1/500**	500/2/500	1000/0.5/700
Rural			1000/2/500	
Single Family	(2)	**(4)**	1000/2/350	1000/1/350
Duplex	1500/1/300	**(4)**		
PUD Townhouse and Low Rise Apartments	1500/1/300	**(4)**	(5)	
Schools, Neighborhood Businesses, Small Shopping Centers, Hotels (except Maui), and High Rise Apartments	2000/2/300	**2000/2/350**	2000/2/250	2000/2/250
Light Industy, Downtown Business, Large Shopping Center, and Hosiptals	2000/2/300	**3000/3/350**	2000/2/250	4000/3/250
Heavy Industry, Hotels	2000/2/300	**3000/3/350**	2500/2/250	(3)

(1) - Applies to one acre lot size or less
(2) - 10,000 sq. ft. or larger lot size = 500/2/600; Less than 10,000 sp. Ft. lot size = 1000/1/600
(3) - Subject to special review and control by Manage
(4) - R-2 = 500/1/500 R-4 = 750/2/500 **R-6 = 1000/2/500** **R-10 = 1250/2/350** **R-20 = 1500/2/350** RR-10 = 1500/2/350 RR-20 = 2000/2/350
(5) - A-1 = 1500/2/250 A-2 = 2000/2/250

Note:

1. On dead end streets, the last F.H. shall be located at one half the spacing distance for F.H.s from the last house/unit (frontage property line or to the driveway/access for the property)
2. Spacing of fire hydrants shall be measured along the roadway

Table 100-20 from the WSS listed below was used to calculate the Maximum Daily Demand and Peak Hour demand from the calculated Average Day demand.

TABLE 100-20 - DEMAND FACTORS		
Island	Maximum Daily Demand	Peak Hour
Hawaii	1.5 x Average Day	5.0 x Average Day
Kauai, Maui, Oahu	**1.5 x Average Day**	**3.0 x Average Day**

2.2 WATER DEMAND CALCULATIONS

As mentioned in the FEIS, if the Water Master Plan is approved by DOW, the development will be served by the County's 313-foot and 214-foot zones. Table 2-1 shows the water demand calculations for Phase 1 and Table 2-2 for Phase 2. Each table shows the split between the two service zones. The service zone line was determined by TNWRE in the *Water Master Plan for the Kapaa Highlands Project on TMK 4-3-03:01* (Kapaa Highlands WMP), dated May 2009 and Revised June 2010. The Phase 1 Average Daily Demands were calculated by using the Irrigable Area (areas outside the floodway and proposed road easement through the property) and the Phase 2 Average Daily Demands were calculated using single and multi-family units counts and commercial and park area.

The number of units for the single-family and multi-family lots were taken from the FEIS and its references. Figure 3 depicts the outdated layout provided in the Kapaa Highlands WMP. While this layout is no longer applicable, it shows the 22 multi-family areas that were used in the water calculations.

TABLE 2-1 PHASE 1 WATER DEMAND CALCULATIONS

Service Zone	Gross Area (Acres)	Irrigable Area (Acres)	Avg. Daily Demand (GPD)	Max Daily Demand (GPD)	Peak Hour (GPD)
313-Foot	15.72	14.28	35,646	53,469	106,938
214-Foot	40.34	28.97	72,426	108,638	217,277
Total for Both Service Zones			**108,071**	**162,107**	**324,214**

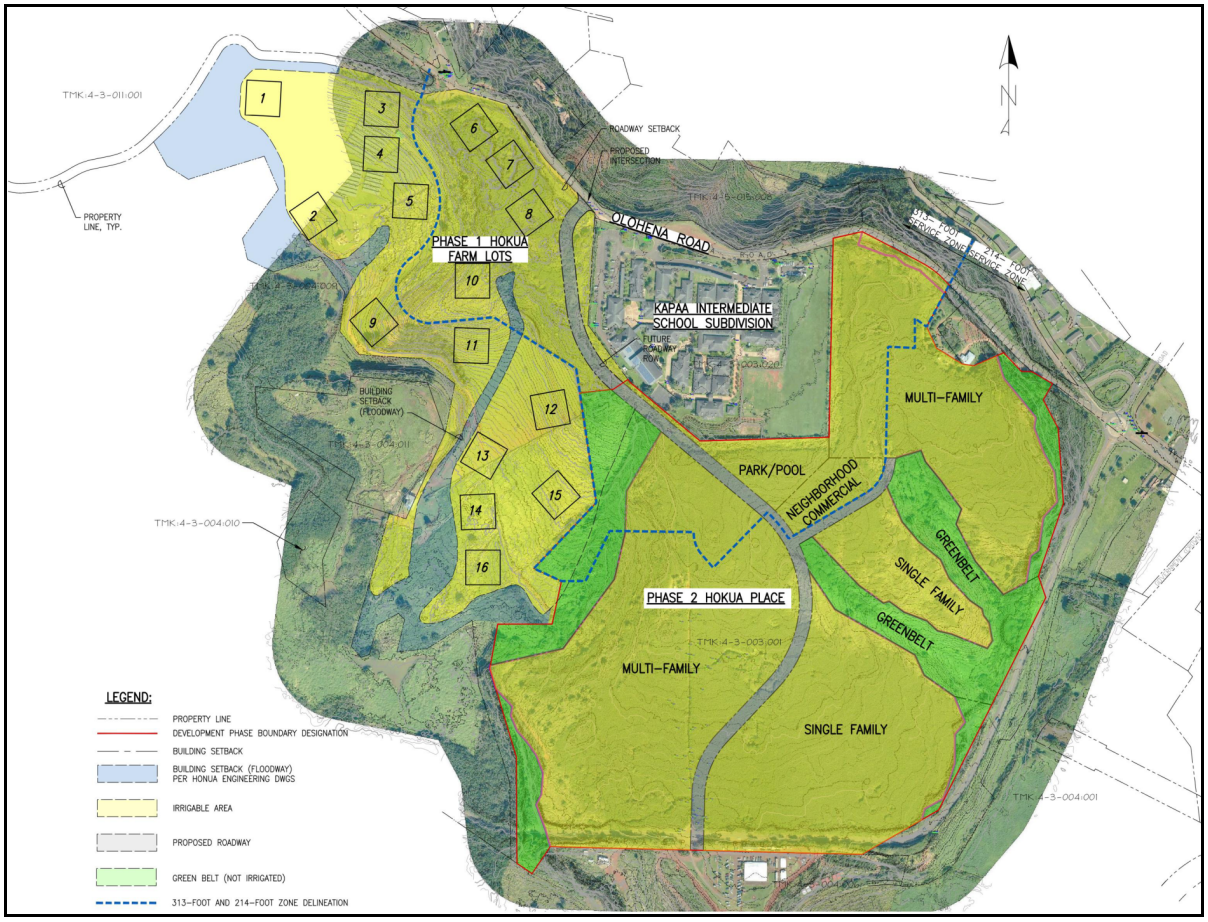

Figure 2 – Project Water Service Zone

TABLE 2-2 PHASE 2 WATER DEMAND CALCULATIONS					
Service Zone	**Land Use**	**Units**	**Avg. Daily Demand (GPD)**	**Max Daily Demand (GPD)**	**Peak Hour (GPD)**
313-Foot	Single Family	4	2,000	3,000	6,000
	Multi-Family 1	53	18,550	27,825	55,650
	Multi-Family 2	41	14,350	21,525	43,050
	Multi-Family 7	17	5,950	8,925	17,850
	Multi-Family 13	18	6,300	9,450	18,900
	Multi-Family 14	49	17,150	25,725	51,450
	Multi-Family 15	14	4,900	7,350	14,700
	Multi-Family 16	10	3,500	5,250	10,500
	Multi-Family 17	7	2,450	3,675	7,350
	Park	2.37 ac.	9,480	14,220	28,440
	General Commercial	0.4 Ac.	1,200	1,800	3,600
	TOTAL		**85,830**	**128,745**	**257,490**
214-Foot	Single Family	82	41,000	61,500	123,000
	Multi-Family 3	35	12,250	18,375	36,750
	Multi-Family 4	32	11,200	16,800	33,600
	Multi-Family 5	34	11,900	17,850	35,700
	Multi-Family 6	84	29,400	44,100	88,200
	Multi-Family 8	62	21,700	32,550	65,100
	Multi-Family 9	15	5,250	7,875	15,750
	Multi-Family 10	43	15,050	22,575	45,150
	Multi-Family 11	62	21,700	32,550	65,100
	Multi-Family 12	18	6,300	9,450	18,900
	Multi-Family 18	20	7,000	10,500	21,000
	Multi-Family 19	24	8,400	12,600	25,200
	Multi-Family 20	24	8,400	12,600	25,200
	Multi-Family 21	11	3,850	5,775	11,550
	Multi-Family 22	10	3,500	5,250	10,500
	Church (Light Industry)	0.8 ac.	3,200	4,800	9,600
	Park	0.73 ac.	2,920	4,380	8,760
	TOTAL		**213,020**	**319,530**	**639,060**
PHASE 2 TOTAL			**298,850**	**448,275**	**896,550**
Completed Project 313-Foot Zone			**121,476**	**182,214**	**364,428**
Completed Project 214-Foot Zone			**285,446**	**428,168**	**856,337**
Completed Project Total			**406,921**	**610,382**	**1,220,764**

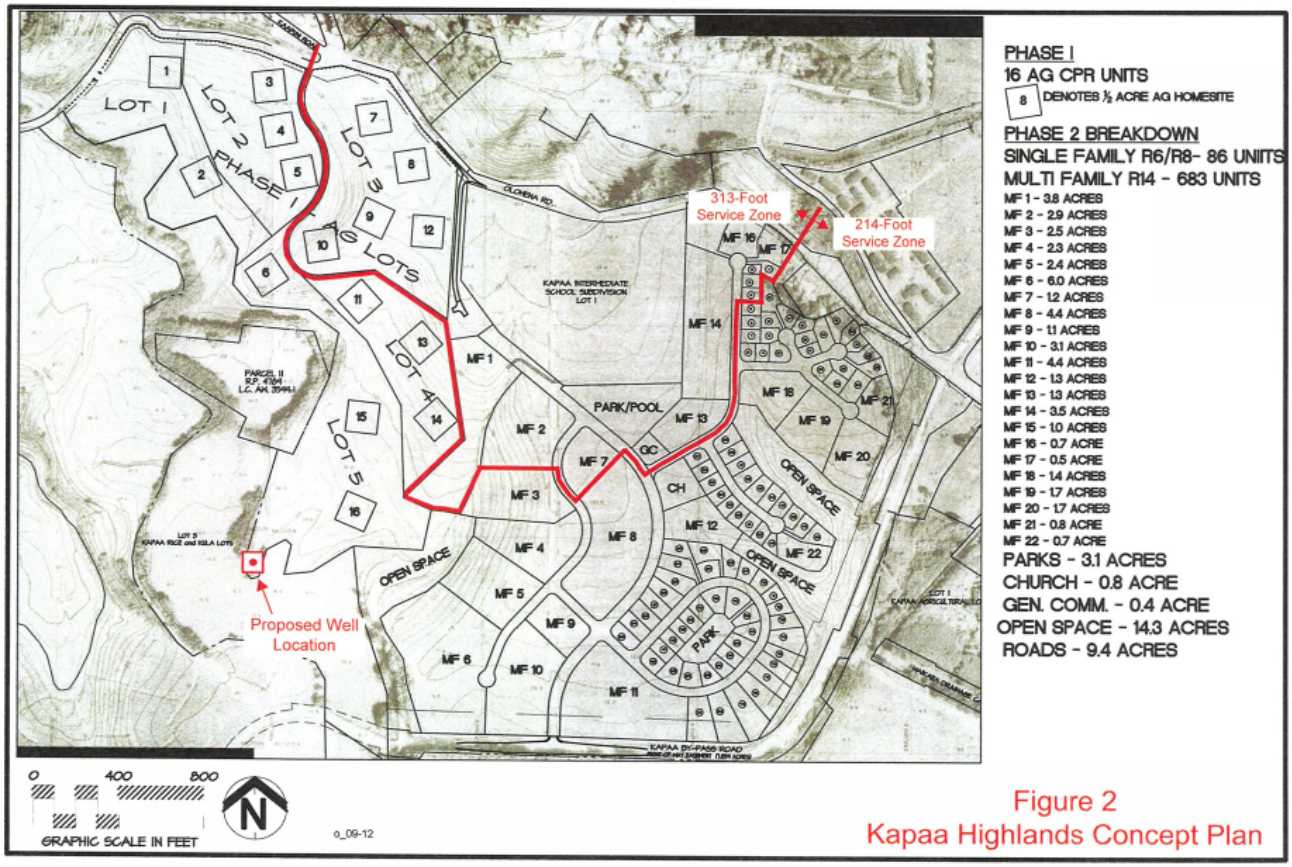

Figure 3 – Concept Plan from Kapaa Highlands WMP

2.3 FIRE PROTECTION

Per Water System Standards, the capacity of the distribution system shall deliver the maximum daily demand simultaneously with the required fire flow, as well as the peak hour flow (without fire flow).

For the Phase 1 agricultural subdivision, a fire flow of 250 GPM for a duration of one hour is required per Table 100-19 of the WSS. A fire flow of 2000 GPM for a duration of two hours is required for the neighborhood businesses per Table 100-19 of the WSS and is used for Phase 2 as the stricter criterion between the residential and commercial allocations.

2.4 PROPOSED WATER SOURCE

To meet the water demands of the development, a new source well is proposed as part of Phase 1. Per the Kapaa Highlands WMP, a test well was drilled at the proposed location and was pumped for 12 hours at 550 GPM and produced water of consistently low salinity. Based on the results, it was determined that a capacity of 500 GPM is sustainable for a properly developed well and that further pump testing of the new well will be conducted to observe the aquifer response to the well. Additional well testing will be needed to confirm the well capacity and that the proposed site is still viable with the final well design being based on the findings of the addition tests.

Further discussion and collaboration with DOW will be required to determine pump requirements and connection procedures of the new well to the current DOW system. See Figure 4 for the proposed well and approximate water main location.

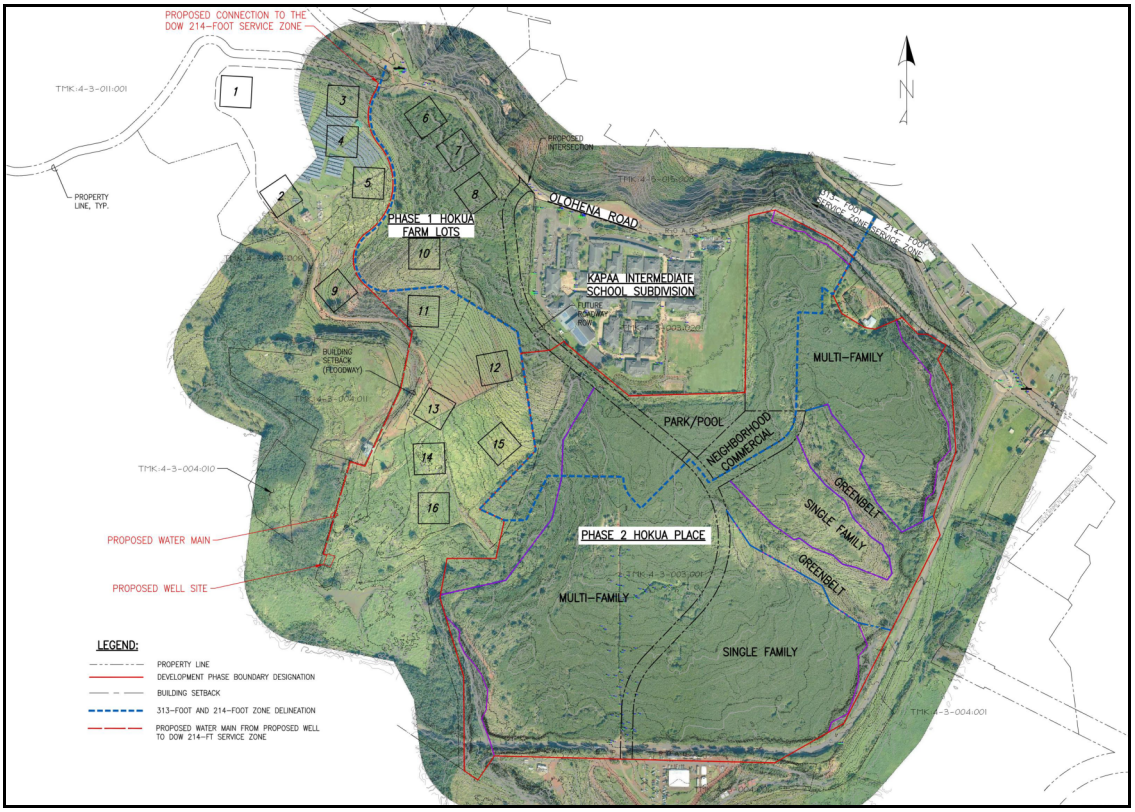

Figure 4 – Proposed Well and Water Main Location

2.5 REQUIRED STORAGE CAPACITY

According to Section 111.07 - RESERVOIR CAPACITY in the WSS, the required storage volume must meet the following design criteria:

1. Meet the Maximum day consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.
2. Meet the maximum day rate plus fire flow for the duration of the fire. Reservoir ¾ full at the start of the fire, with credit for incoming flow from pumps, one maximum size pump out of service.
3. Minimum size of the reservoir shall be 0.1 MG. Reservoir size shall be as specified in Section 105.10 – RESERVOIR, Subsection A – Size.

The required reservoir storage for each phase of the project is summarized below in Table 2-3 with the required storage based on the governing criterion bolded and italicized.

TABLE 2-3 REQUIRED RESERVOIR STORAGE

Service Zone	Required Reservoir Storage	
	Phase 1	**Phase 2***
313-Foot Zone		
Max Day Demand (Gallons)	***53,469***	182,214
Fire Flow Rate (GPM)	250	2000
Fire Duration (Hours)	1	2
Coincident Max. Demand (GPM)	37	127
Fire Flowrate and Maximum Day Use Rate for Duration of the Fire, Reservoir 3/4 Full at Start	22,970	***340,246***
214-Foot Zone		
Max Day Demand (Gallons)	***108,638***	***428,168***
Fire Flow Rate (GPM)	250	2000
Fire Duration (Hours)	1	2
Coincident Max. Demand (GPM)	75	297
Fire Flowrate and Maximum Day Use Rate for Duration of the Fire, Reservoir 3/4 Full at Start	26,035	267,574

*Phase 2 values are inclusive of Phase 1

**No well inflow credit given as one well pump is being provided

According to the Kapaa Highlands WMP, DOW will allow Phase 1 to utilize storage capacity from existing DOW storage facilities and may allow Phase 2 to utilize available storage capacity. At the time of the Kapaa Highlands WMP, DOW storage facilities were not adequate to serve Phase 2. However, in a letter from David Craddick, former DOW Manager and Chief Engineer, to HoKua Place dated August 22, 2011 (after the Kapaa Highlands WMP was written) stated "At the Department of Water, Water Board July 18th 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." The Manager's Report 12-10 states that the County storage project was scheduled to be completed in 3-4 years from the time the report was submitted indicating that the additional storage required by Phase 2 may be available.

Further discussion with DOW will be required to verify that there is currently enough storage capacity within the existing DOW facilities to accommodate Phase 1 and if the exchange of source for storage on a dollar for dollar basis is still an option.

The HoKua Place Water Master Plan has not been approved by DOW and a formal request for water service with detailed water demand calculations and proposed source, storage and transmission requirements and contributions will need to be submitted and approved by the Water Resources and Planning Division.

2.6 WATER PIPE SIZING REQUIREMENTS

Water lines shall be sized to meet the requirements in the WSS Section 111.06 Pipeline Sizing. Pipes will be sized to meet the following requirements:

1. Maximum daily flow plus fire flow with a residual pressure of 20 psi at critical fire hydrant.
2. Peak hour flow with a minimum residual pressure of 40 psi.
3. In determining the carrying capacity of the mains, the "C" values to be applied are shown in Table 100-21.

Table 100-21 – "C" * FACTORS	
Pipe Diameter (In.)	"C"
4", 6"	100
8", 12"	110
16", 20"	120
24" and Larger	130

*Not for metallic non-cement lined pipe.

4. Maximum velocity in distribution main (without fire flow) is 6 feet per second.

2.7 PRIVATE WATER SYSTEM

In the event that connection to the DOW system is not granted, the development will then be served by a private water system with its water source from the proposed well. Construction of storage reservoir tanks will be required for the private system. The demands calculation for the private system will be unchanged from the demands calculated for connection to the DOW system.

Table 2-4 summarizes the required reservoir storage and proposed tank size the development requires if the development will be served by a private water system.

TABLE 2-4 – PRIVATE WATER SYSTEM REQUIRED RESERVOIR STORAGE		
	PHASE 1	PHASE 2*
Max Day Demand (Gallons)	**162,107**	**610,382**
Fire Flow Rate		
Fire Flow Rate (GPM)	250	2000
Fire Duration (Hours)	1	2
Coincident Max. Demand (GPM)	113	242
Required Storage Volume (Gallons)	29,006	387,820
Proposed Tank Volume (Gallons)**	**200,000**	**200,000 (Phase 1) + 500,000 = 700,000**
Proposed Tank Volume (MG)	**0.20**	**0.20 + 0.50 = 0.70**

*Phase 2 values are inclusive of Phase 1
**Based on WSS Section 105.10 - Reservoir, Subsection A – Size
***No well inflow credit given as one well pump is being provided

3. REFERENCES

Water System Standards, State of Hawaii, Board of Water Supply, City and County of Honolulu, 2002

Water Master Plan for the Kapaa Highlands Project on TMK 4-3-03:01 in Kapaa, Kauai, Prepared for Kapaa Highlands LLC, Prepared by Tom Nance Water Resource Engineering, May 2009, Revised June 2010

HoKua Place Section 343-5e HRS Final Environmental Impact Statement (FEIS), Volume I, Prepared for Accepting Authority State of Hawai‘i Land Use Commission & Petitioner HG Kaua‘i Joint Venture LLC, Prepared by Agor Jehn Architects, LLC, November 2019