Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

State of Hawaii Department of Health
Environmental Health Administration
Environmental Planning Office
919 Ala Moana Boulevard, Room 312
Honolulu, HI 96814

with
Tetra Tech, Inc. and AECOS, Inc.

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EXECUTIVE SUMMARY – STATE OF HAWAII DEPARTMENT OF HEALTH

Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

The State of Hawaii Department of Health (DOH) proposes establishing Total Maximum Daily Loads (TMDLs) for four major streams in the Nawiliwili Bay Watershed on the island of Kauai, Hawaii. TMDLs are required for pollutant-impaired water bodies on the State's Clean Water Act (CWA) Section 303(d) list. The primary objectives of the proposed TMDLs are to stimulate and guide action that will control sources of excessive nutrients, sediment, and pathogens, and to improve the water quality of the streams so that the designated and existing uses of waterbodies throughout the Nawiliwili Bay Watershed will be protected and sustained. These uses include protection of native breeding stock, the support and propagation of aquatic life, recreation, aesthetic enjoyment, agricultural and industrial water supplies, and support for traditional and customary native Hawaiian beliefs, values, and practices.

The Nawiliwili Bay watershed (see Figure 1-1 through 1-6), located in the southeastern portion of the island, covers about 37 square miles. Early Hawaiians developed extensive irrigated pondfield and fishpond complexes along the streams and shoreline, remnants of which persist today. While much of the watershed arable land was devoted to sugarcane cultivation throughout the 20th century, today's more diversified agricultural landscape is increasingly dominated by pasture and forestry, with ongoing conversion to residential and commercial uses in the lower elevations.

Nawiliwili Harbor, which receives the bulk of watershed runoff, hosts a wide variety of traditional, recreational, and commercial vessels. The greater Nawiliwili Bay provides recreational, aesthetic, cultural, and wildlife resources for the island of Kauai. A resort hotel and public beach park are located near Kalapaki Beach along the northeastern shore of the bay, where surfers, swimmers, boaters, and fishing enthusiasts enjoy the bay's protected waters. The Huleia National Wildlife Refuge, located at the western end of Nawiliwili Bay along Papakolea Stream and the estuary of Huleia Stream, provides habitat for many of Hawaii's endangered native waterbirds. The Alekoko fishpond (also known as Menehune Fishpond), added to the National Register of Historic Places in 1973, is an impoundment of the Huleia estuary adjoining the eastern end of Huleia National Wildlife Refuge. Although wetlands and fishponds persist within the Refuge and other nearby conservation lands, they have disappeared over time from other areas of the coastal zone. Biological assessments and surveys conducted across the four streams by various investigators revealed widespread impairment of habitat quality and biotic integrity when compared with high-quality reference stream conditions keyed to the presence of native fish, mollusks, and crustaceans (Section 1.1.1).

This TMDL decision rationale reviews historical and existing conditions in the Nawiliwili Bay watershed and presents an analysis of pollutant load distributions and resulting water quality in Huleia, Papakolea, Puali, and Nawiliwili streams. We provide calculations of waterbody pollutant loading capacities, and of their allocations to identified pollutant sources such that water quality standards for total suspended solids (TSS), nitrate+nitrite nitrogen (N+N), total nitrogen (TN), total phosphorus (TP), and *enterococcus* (bacterial indicator) in these four streams will be achieved as required. The basis for this analysis is the 2005 "Total Maximum Daily Load Technical Report, Nawiliwili Bay Watershed, Kauai, Hawaii" (hereafter "2005 Technical Report") prepared by Tetra Tech, Inc. and AECOS, Inc. for the DOH Environmental Planning Office (EPO).

Nawiliwili Bay, the marine receiving water for all streams in the watershed, is currently listed under Section 303(d) as a water body in which water quality is impaired by excessive nutrients and turbidity. Three water quality monitoring stations in Nawiliwili Bay are also included on the list of impaired waters: Nawiliwili Harbor and Kalapaki Beach stations are listed for excessive enterococci (bacterial indicator), and the Nawiliwili Bay offshore embayment station is listed for excessive nitrogen, chlorophyll a, and turbidity. Water quality in Huleia Stream, Nawiliwili Stream, and Puali Stream is impaired by elevated turbidity and nitrogen based on previous visual and numeric assessment by the DOH (Environmental Health Administration 2008, see excerpts from 2006 list in Appendix A).

Papakolea Stream, previously considered as a tributary of Huleia Stream, is now treated as a distinct freshwater segment for TMDL development purposes, since it actually flows into the estuarine portion of the Huleia Stream System, not the freshwater portion. Numeric assessment completed during the TMDL development process established additional impairments and threats by elevated *enterococcus* in all four streams; by excessive TSS in Papakolea, Puali, and Nawiliwili; by elevated TP in Papakolea and Nawiliwili; and by excessive turbidity, N+N, and TN in Papakolea. Thus the proposed TMDL decision addresses a total of 20 waterbody/pollutant combinations – 3 for Huleia, 5 for Puali, and 6 each for Papakolea and Nawiliwili (see Sections 1.1.1, 2.2, 2.3.4, and Table 2-8). This is explained by our expectation that implementing TMDLs calculated for TSS and nutrients will lead to attainment of the turbidity criteria (TSS and nutrient concentrations as surrogate numeric targets for turbidity) (see Appendix D, Water Quality Impairment Rationale).

Although TMDLs are provided for *enterococcus* in all four streams, they are not presented in the Executive Summary tables below (see Section 3.6). In general DOH does not consider chronic exceedances of *enterococcus* criteria to unequivocally represent threats to human health or impairments of recreational use. Before taking action to implement bacterial indicator TMDLs, it is important to acquire more conclusive evidence that human sewage or human-pathogenic organisms are present at levels that indicate an unacceptable public health risk. According to the DOH on-site disposal system strategy and water quality monitoring strategies, any implementation activities conducted should first focus on inventory and inspection of sanitary sewer collection systems and individual wastewater systems; repairing and upgrading failing and sub-standard systems (as indicated by inspection results); and completing watershed sanitary surveys and wastewater source tracking to complement information obtained from system inventory/inspection and ambient receiving water monitoring.

Due to a lack of historic water quality data to support our analysis, we sampled water quality at numerous stream locations to obtain pollutant concentrations under baseline and critical flow conditions. During baseline flow conditions (non-targeted flow regime), concentrations of TSS and TP generally met water quality criteria (no impairments), while N+N and TN concentrations did not. During targeted storm flow (critical) conditions, concentrations of TSS and TP exceeded the water quality criteria in some areas. Tables 2-1 through 2-7 provide a summary of the sampling efforts and the impairment decisions.

A regional analysis of hydrologic information used relationships between land cover, tributary area, and precipitation to generate the streamflows used for TMDL development (Section 3.3). The stream segmentation established by the sampling locations was retained for TMDL calculations, and loading capacities for each segment were calculated by multiplying each segment streamflow by each water quality criterion (Section 3.4). Loading capacity, or Total Maximum Daily Load (TMDL) is defined as the maximum pollutant load a waterbody can receive and still remain in compliance with water quality standards. Each resulting TMDL was then distributed according to the standard equation:

$$TMDL = WLA + LA + MOS$$

In this equation, WLA (Waste Load Allocation) is the portion of the maximum pollutant load that is delivered from point sources. In our case this represents discharges regulated under National Pollutant Discharge Elimination System (NPDES) permits issued and enforced by the DOH Clean Water Branch (CWB). Among the regulated point sources in the area (see Appendix E), the only major facility WLAs are for a rock quarry, which is presently allowed to discharge stormwater runoff into Huleia stream only when 24-hour rainfall exceeds that calculated for the 10-year event. WLAs are also assigned to stormwater discharges from five industrial facilities regulated under general permit coverage. General permit coverage for stormwater associated with construction activities regulates more temporary activities that are expected to be controlled by shorter-term site-specific Best Management Practices (BMPs) and general permit conditions. LA (Load Allocation) is the portion of the maximum pollutant load (the remainder of the total load) that is delivered from non-point sources. In the Nawiliwili Bay Watershed these include polluted runoff from urban, agricultural, and conservation lands, as well as groundwater sources that may be under the influence of human inputs (such as the leaching of fertilizers and wastewater). MOS (Margin of Safety) accounts for errors, limitations, and uncertainty in computing the load allocations.

After establishing the TMDLs for each targeted pollutant, we then estimated existing pollutant loads by multiplying measured pollutant concentrations (from the water quality data) times the corresponding flow. To estimate pollutant loads during baseline flow conditions, we multiplied the geometric mean concentration of the pollutant times the average daily stream flow for both the Wet Season (November-April) and Dry Season (May-October) regulatory periods. For storm flow conditions, we estimated existing pollutant load using the 1-year through 10-year storm event total runoff volume (Section 3.5). Subtracting the existing loads from the TMDLs indicates the reductions in mass loading required to attain the concentration limit established by the State water quality standards. Dividing these reductions by the existing loads translates them into "% reductions required." The following tables show the TMDL (loading capacity), estimated existing loads, and load reductions required for TSS, N+N, TN, TP, and enterococcus in each stream segment under six flow conditions (Wet Season, Dry Season, and four Storm flow regimes) and are the numerical expression of our proposed TMDL decisions.

NOTE - In the following tables, Waste Load Allocations (WLA) entered as “0” indicate that WLA=0 (no industrial facilities discharging to the receiving segment).

WLA entered as “0.0” (for mathematical purposes) indicate that WLA>0 (“de minimis”) since the total area of the NPDES-permitted facilities in a sub-basin is so small (compared to the total area sub-basin for which each TMDL is calculated) that it yields an extremely low WLA (though greater than zero) when an areal-proportional computation is employed.

For regulatory purposes, the WLA under baseline flow conditions are “de minimis,” representing loads from rain-induced polluted runoff that is controlled as required by a facility Storm Water Pollution Control Plan, site-specific Best-Management Practices, federally-established effluent limits, and related NPDES permit conditions.

<u>Acronyms for following tables:</u>

TMDL = Total Maximum Daily Loads	TSS = Total Suspended Solids
WLA = Waste Load Allocation	TN = Total Nitrogen
LA = Load Allocation	N+N = Nitrate+Nitrite Nitrogen
MOS = Margin of Safety	TP = Total Phosphorous
lb/d = pounds per day (daily load)	ENT – Enterococcus

Table ES-1: TMDLs, Existing Loads, and Reductions Required for Baseline Flow Pollutant Loads in Four Major Streams of the Nawiliwili Bay Watershed

Wet Season (November-April)

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	1992	118	None	0	1892.4	99.6
Halfway Bridge	7282	324	None	0.0	6918	364
Stone Bridge	12922	575	None	0.0	12276	646
Nawiliwili Sub-basin						
Upper Nawiliwili	1239	94.7	None	0	1177.1	62
Lower Nawiliwili	1638	274	None	0.0	1556.1	81.9
Puali Stream	211	28.2	None	0.0	200.5	10.6
Papakolea Stream	1637	601	None	0.0	1555	82
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	7.0	4.0	None	0	6.6	0.3
Halfway Bridge	25.5	22.5	None	0.0	24.2	1.3
Stone Bridge	45.2	65.3	31%	0.0	42.9	2.3
Nawiliwili Sub-basin						
Upper Nawiliwili	4.3	69.0	94%	0	4.1	0.2
Lower Nawiliwili	5.7	85.7	93%	0.0	5.4	0.3
Puali Stream	0.7	3.1	76%	0.0	0.7	0.0
Papakolea Stream	5.7	59.8	90%	0.0	5.4	0.3
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	24.9	13.8	None	0	23.7	1.3
Halfway Bridge	91.0	50.2	None	0.0	86.5	4.6
Stone Bridge	162	135	None	0.0	153.9	8.1
Nawiliwili Sub-basin						
Upper Nawiliwili	15.5	75.5	79%	0	14.7	0.8
Lower Nawiliwili	20.5	106	81%	0.0	19.5	1.0
Puali Stream	2.6	4.2	38%	0.0	2.5	0.1
Papakolea Stream	20.5	70.9	71%	0.0	19.5	1.0
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	5.0	0.7	None	0	4.7	0.3
Halfway Bridge	18.2	2.2	None	0.0	17.3	0.9
Stone Bridge	32.3	4.7	None	0.0	30.7	1.6
Nawiliwili Sub-basin						
Upper Nawiliwili	3.1	2.9	None	0	3.0	0.2
Lower Nawiliwili	4.1	0.8	None	0.0	3.9	0.2
Puali Stream	0.5	0.1	None	0.0	0.5	0.0
Papakolea Stream	4.1	0.6	None	0.0	3.9	0.2

Dry Season (May-October)

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	729	133	None	0	692.6	36.5
Halfway Bridge	2617	228	None	0.0	2486	131
Stone Bridge	4665	527	None	0.0	4432	233
Nawiliwili Sub-basin						
Upper Nawiliwili	453	35.8	None	0	430	23
Lower Nawiliwili	532	149	None	0.0	505.4	26.6
Puali Stream	41.6	14.7	None	0.0	39.5	2.1
Papakolea Stream	579	432	None	0.0	550	29
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	2.2	1.2	None	0	2.1	0.1
Halfway Bridge	7.9	10.6	26%	0.0	7.5	0.4
Stone Bridge	14.0	37.4	63%	0.0	13.3	0.7
Nawiliwili Sub-basin						
Upper Nawiliwili	1.4	50.7	97%	0	1.3	0.1
Lower Nawiliwili	1.6	58.2	97%	0.0	1.5	0.1
Puali Stream	0.1	1.0	88%	0.0	0.1	0.0
Papakolea Stream	1.7	21.8	92%	0.0	1.7	0.1
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	13.1	10.1	None	0	12.4	0.7
Halfway Bridge	47.1	38.5	None	0.0	44.7	2.4
Stone Bridge	84.0	85.8	2%	0.0	79.8	4.2
Nawiliwili Sub-basin						
Upper Nawiliwili	8.2	53.1	85%	0	7.8	0.4
Lower Nawiliwili	9.6	73.2	87%	0.0	9.1	0.5
Puali Stream	0.8	1.6	53%	0.0	0.7	0.1
Papakolea Stream	10.4	39.3	74%	0.0	9.9	0.5
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	2.2	0.4	None	0	2.1	0.1
Halfway Bridge	7.9	1.6	None	0.0	7.5	0.4
Stone Bridge	14.0	3.5	None	0.0	13.3	0.7
Nawiliwili Sub-basin						
Upper Nawiliwili	1.4	2.3	42%	0	1.3	0.1
Lower Nawiliwili	1.6	0.7	None	0.0	1.5	0.1
Puali Stream	0.1	0.1	None	0.	0.1	0.0
Papakolea Stream	1.7	0.5	None	0.0	1.7	0.1

Note: Tabulated values are rounded to the nearest 0.1 lb, thus (a) TMDL may be different than the sum of WLA+LA+MOS and (b) values tabulated as 0.0 are actually greater than 0.

Table ES-2: TMDLs, Existing Loads, and Reductions Required for Storm Event Pollutant Loads in Four Major Streams of the Nawiliwili Bay Watershed

1-Year Storm Event

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	24,884	18,812	None	0	23,640	1,244
Halfway Bridge	104,247	110,710	6%	3,297	95,738	5,212
Stone Bridge	179,048	117,813	None	3,297	166,798	8,952
Nawiliwili Sub-basin						
Upper Nawiliwili	15,470	201,416	92%	0	14,696	773
Lower Nawiliwili	33,093	390,499	92%	9.2	31,429	1,655
Puali Stream	9,305	18,163	49%	529	8,310	465
Papakolea Stream	25,915	92,257	72%	169	24,450	1,296
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	89.6	5.2	None	0	85.1	4.5
Halfway Bridge	375	144	None	27.7	328.9	18.8
Stone Bridge	645	394	None	27.7	584.7	32.2
Nawiliwili Sub-basin						
Upper Nawiliwili	55.7	62.5	11%	0	52.9	2.8
Lower Nawiliwili	119	234	49%	0.1	113.1	6.0
Puali Stream	33.5	88.4	62%	4.0	27.8	1.7
Papakolea Stream	93.3	399	77%	2.8	85.8	4.7
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	259	153	None	0	245.9	12.9
Halfway Bridge	1,084	757	None	79.9	950.1	54.2
Stone Bridge	1,862	1,450	None	79.9	1,689	93.1
Nawiliwili Sub-basin						
Upper Nawiliwili	161	205	22%	0	152.8	8.0
Lower Nawiliwili	344	744	54%	0. 3	326.7	17.2
Puali Stream	96.8	160	40%	11.6	80.4	4.8
Papakolea Stream	270	1,335	80%	8.2	247.8	13.5
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	49.8	12.4	None	0	47.3	2.5
Halfway Bridge	208	122	None	16.6	181.5	10.4
Stone Bridge	358	113	None	16.6	323.6	17.9
Nawiliwili Sub-basin						
Upper Nawiliwili	30.9	37.4	17%	0	29.4	1.6
Lower Nawiliwili	66.2	121	45%	0.0	62.8	3.3
Puali Stream	18.6	15.8	None	1.9	15.8	0.9
Papakolea Stream	51.8	74.1	30%	1.1	48.1	2.6

2-Year Storm Event

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	27,889	21,084	None	0	26,495	1,394
Halfway Bridge	122,209	129,786	6%	3,866	112,233	6,110
Stone Bridge	207,803	136,734	None	3,866	193,547	10,390
Nawiliwili Sub-basin						
Upper Nawiliwili	17,338	225,745	92%	0	16,471	867
Lower Nawiliwili	39,159	462,073	92%	10.9	37,190	1958
Puali Stream	11,521	22,489	49%	655	10290	576
Papakolea Stream	31,256	111,271	72%	204	29,489	1563
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	100	5.80	None	0	95	5.0
Halfway Bridge	440	168	None	37.6	380	22.0
Stone Bridge	748	457	None	37.6	673	37.4
Nawiliwili Sub-basin						
Upper Nawiliwili	62.4	70.0	11%	0	59.3	3.1
Lower Nawiliwili	141	277	49%	0.1	133.8	7.1
Puali Stream	41.5	109	62%	6.2	33.3	2.1
Papakolea Stream	113.0	481	76%	4.1	103.2	5.7
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	259	172	None	0	245.9	12.9
Halfway Bridge	1,084	887	None	92.7	937.3	54.2
Stone Bridge	1,862	1,683	None	92.7	1,676	93.1
Nawiliwili Sub-basin						
Upper Nawiliwili	161	230	30%	0	152.8	8.0
Lower Nawiliwili	344	880	61%	0.3	326.6	17.2
Puali Stream	96.8	198	51%	14.3	77.6	4.8
Papakolea Stream	270	1,610	83%	9.9	246.2	13.5
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	55.8	13.9	None	0	53.0	2.8
Halfway Bridge	244	143	None	19.3	212.5	12.2
Stone Bridge	416	131	None	19.3	375.9	20.8
Nawiliwili Sub-basin						
Upper Nawiliwili	34.7	42.0	17%	0	33.0	1.7
Lower Nawiliwili	78.3	143	45%	0.1	74.3	3.9
Puali Stream	23.0	19.6	None	2.3	19.5	1.1
Papakolea Stream	62.5	89.4	30%	13.2	46.2	3.1

5-Year Storm Event

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	31,769	24,017	None	0	30,181	1,588
Halfway Bridge	147,163	156,287	6%	4,656	135,149	7,358
Stone Bridge	247,266	162,701	None	4,656	230,247	12,363
Nawiliwili Sub-basin						
Upper Nawiliwili	19,750	257,151	92%	0	18,763	988
Lower Nawiliwili	47,505	560,554	92%	13.2	45,117	2375
Puali Stream	14,654	28,605	49%	833	13,089	733
Papakolea Stream	38,877	138,403	72%	254	36,679	1944
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	114.0	6.6	None	0	108.3	5.7
Halfway Bridge	530	203	None	38.1	465.4	26.5
Stone Bridge	890	544	None	38.1	807.4	44.5
Nawiliwili Sub-basin						
Upper Nawiliwili	71.1	79.8	11%	0	67.5	3.6
Lower Nawiliwili	171	336	49%	0.1	162.3	8.6
Puali Stream	52.8	139	62%	6.4	43.8	2.6
Papakolea Stream	140.0	598	77%	4.3	128.7	7.0
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	330	196	None	0	313.5	16.5
Halfway Bridge	1,530	1,068	None	110	1,344	76.5
Stone Bridge	2,572	2,003	None	110	2,333	129
Nawiliwili Sub-basin						
Upper Nawiliwili	205	262	22%	0	194.8	10.3
Lower Nawiliwili	494	1,068	54%	0.377	468.9	24.7
Puali Stream	152	252	40%	18.3	126.1	7.6
Papakolea Stream	404	2,002	80%	12.3	371.5	20.2
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	63.5	15.9	None	0	60.3	3.2
Halfway Bridge	294	172	None	23.0	256.3	14.7
Stone Bridge	495	156	None	23.0	447.3	24.8
Nawiliwili Sub-basin						
Upper Nawiliwili	39.5	47.8	17%	0	37.5	2.0
Lower Nawiliwili	95.0	174	45%	0.1	90.2	4.8
Puali Stream	29.3	24.9	None	3.0	24.9	1.5
Papakolea Stream	77.8	111	30%	1.7	72.2	3.9

10-Year Storm Event

Waterbody	TMDL	Existing Load	Percent Reduction	WLA	LA	MOS
TSS (lb/d)						
Huleia Sub-basin						
Kamooloa	33,849	25,590	None	0	32,157	1,692
Halfway Bridge	161,343	171,346	6%	5,104	148,172	8,067
Stone Bridge	269,489	177,324	None	5,104	250,911	13,474
Nawiliwili Sub-basin						
Upper Nawiliwili	21,044	273,995	92%	0	19,992	1,052
Lower Nawiliwili	52,210	616,077	92%	14.5	49,585	2,611
Puali Stream	16,455	32,121	49%	936	14,696	822.8
Papakolea Stream	43,293	154,122	72%	283	40,845	2,165
Nitrate + Nitrite (lb/d)						
Huleia Sub-basin						
Kamooloa	122.0	7.04	None	0	115.9	6.1
Halfway Bridge	581	222	None	41.5	510.4	29.1
Stone Bridge	970	593	None	41.5	880.0	48.5
Nawiliwili Sub-basin						
Upper Nawiliwili	75.8	85.0	11%	0	72.0	3.8
Lower Nawiliwili	188	370	49%	0.1	178.5	9.4
Puali Stream	59.2	156	62%	7.1	49.2	3.0
Papakolea Stream	156.0	666	77%	4.8	143.5	7.8
Total Nitrogen (lb/d)						
Huleia Sub-basin						
Kamooloa	352	209	None	0	334.4	17.6
Halfway Bridge	1,678	1,171	None	120	1,474	83.9
Stone Bridge	2,803	2,183	None	120	2,543	140
Nawiliwili Sub-basin						
Upper Nawiliwili	219	279	22%	0	208.1	11.0
Lower Nawiliwili	543	1,174	54%	0.4	515.4	27.2
Puali Stream	171	283	40%	20.4	142.0	8.6
Papakolea Stream	450	2,230	80%	13.7	413.8	22.5
Total Phosphorus (lb/d)						
Huleia Sub-basin						
Kamooloa	67.7	16.9	None	0	64.3	3.4
Halfway Bridge	323	189	None	25.0	281.9	16.2
Stone Bridge	539	170	None	25.0	487.1	27.0
Nawiliwili Sub-basin						
Upper Nawiliwili	42.1	50.9	17%	0	40.0	2.1
Lower Nawiliwili	104	191	45%	0.7	98.7	5.2
Puali Stream	32.9	27.9	None	3.3	27.9	1.7
Papakolea Stream	86.6	124	30%	1.9	80.4	4.3

Note: Tabulated values are rounded to the nearest 0.1 lb, thus (a) TMDL may be different than the sum of WLA+LA+MOS and (b) values tabulated as 0.0 are actually greater than 0.

As a final step in the pollutant loading analysis, we used a screening-level mathematical model to evaluate the impact of stream loading, BMP implementation, and load reductions on water quality in Nawiliwili Bay. The results suggest that significant improvements in estuary and embayment water quality would begin to occur after 70% or more reduction of TN stream loading is achieved (Appendix H).

In conjunction with TMDL development, the DOH Environmental Planning Office conducted and evaluated biological assessments that provide baseline information about stream- habitat quality and biotic integrity (see Section 1 and Appendix B). These assessments provide an additional framework for tracking changes in stream conditions over time and for comparing stream conditions in the Sub-basin with conditions in other streams. Although the goals for restoring habitat quality and biotic integrity to the streams are not a subject for EPA approval, they can help guide TMDL implementation towards areas where pollutant load reduction and water quality improvement practices may best contribute to restoration efforts.

The proposed decision will affect water pollution control permits [NPDES (CWA Section 402) and Water Quality Certification (CWA Section 401)] and provide guidance for other planning and regulatory approvals (e.g. land use, zoning, and environmental management) and voluntary compliance efforts in the watershed. As required by the Code of Federal Regulations (C.F.R.) and Hawaii Administrative Rules (HAR), 40 C.F.R. sec. 122.44(d)(1)(vii)(B) and HAR sec. 1 1-55-19(a)(4)(C), and intended by Hawaii's Continuing Planning Process for Surface Water Pollution Control (approved by EPA June 14, 1976 and last reviewed by EPA in August 2001), upon approval of the TMDLs by EPA, any TMDL Waste Load Allocations (WLAs) are immediately effective to be applied in NPDES permits. NPDES permits issued by the DOH shall include limitations needed to implement the WLAs in TMDLs, and the DOH shall enforce these limits.

The State will assure implementation of the approved TMDL WLAs through the enforcement of NPDES permit conditions (HAR §11-55) and will pursue implementation of load allocations through Hawaii’s Implementation Plan for Polluted Runoff Control (Coastal Zone Management Program and Polluted Runoff Control Program, 2000) and Hawaii’s Coastal Nonpoint Pollution Control Program Management Plan (Hawaii Coastal Zone Management Program, 1996), and the State of Hawaii Water Pollution Control Revolving Fund Intended Use Plan (Clean Water State Revolving Fund Loan Program, 2008), all of which serve the State Water Quality Standards (HAR § 11-54). A “Restoration and Protection Plan” completed by the University of Hawaii Water Resources Research Center in 2005 serves as a watershed based plan for polluted runoff control and an implementation plan for the nonpoint source load allocations in these TMDLs. Therefore implementation activities identified in that Plan and in the TMDL implementation framework discussed in this TMDL decision document are eligible to receive “incremental funds” via the CWA 319(h) grant program administered by the DOH.

The watershed area covered by the Restoration and Protection Plan (used for calculating the stream TMDLs) extends beyond the boundaries of the contributing areas of the four freshwater streams. Given that water quality impairments in the Nawiliwili Bay watershed extend into the brackish and marine receiving waters for these streams, and that nonpoint sources are the overwhelming concern throughout the watershed (with many known sources that can be immediately targeted for direct action), any implementation activities completed within the larger watershed area are expected to benefit these receiving waters, and should be considered part of the TMDL implementation framework. While much of the pollutant loading to Nawiliwili and Puali streams is from non-urban nonpoint sources, biological surveys and assessments indicate that the additional loading and impact from nonpoint and point source urban stormwater in these sub-basins is critically important to stream and watershed health. Thus management of the storm drainage systems and wastewater disposal systems in the Lihue-Puhi urban core should be a focus for County and State polluted runoff control (nonpoint sources) and water pollution control (NPDES) implementation efforts.

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APPENDICES

ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice(s)
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cm	Cubic meter
CN	Curve number
DO	Dissolved oxygen
DOH	State of Hawaii Department of Health
ft	feet
GIS	Geographic information system
gm/L	Grams per liter
GM	Geometric mean
HAR	Hawaii Administrative Rule
HUC	Hydrologic unit code
Hwy	Highway
KCC	Kauai Community College
LA	Load Allocation
lb/d	Pounds per day
LCS	Laboratory control sample
m	meter
mg/L	Milligrams per liter
MOS	Margin of safety
MS/MSD	Matrix spike/matrix spike duplicate
N+N	Nitrate plus nitrite as nitrogen
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity units
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RPD	Relative percent difference
SCS	Soil Conservation Service
TMDL	Total Maximum Daily Load
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Waste Load Allocation
WWTP	Waste Water Treatment Plant

1.0 INTRODUCTION AND PURPOSE

Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

The State of Hawaii Department of Health (DOH) proposes establishing Total Maximum Daily Loads (TMDLs) for four major streams in the Nawiliwili Bay Watershed on the island of Kauai, Hawaii. TMDLs are required for pollutant-impaired water bodies on the State's Clean Water Act (CWA) Section 303(d) list. The primary objective of the proposed TMDLs is to stimulate and guide action that will control sources of excessive nutrients, sediment, and pathogens and improve the water quality of the streams so that the designated and existing uses of waterbodies throughout the Watershed will be protected and sustained. The proposed decision will affect water pollution control permits [NPDES (CWA Section 402) and Water Quality Certification (CWA Section 401)] and provide guidance for other planning and regulatory approvals (e.g. land use, zoning, and environmental management) and voluntary compliance efforts in the watershed.

TMDLs are a tool for implementing water quality standards, based on the relationship between point and nonpoint sources of pollutants and receiving water quality. The TMDLs must consider critical conditions, seasonal variations, future growth, and a margin of safety that accounts for uncertainty in the pollutant load calculations. EPA approval of TMDLs is based upon a checklist of elements (Appendix A) that must be satisfactorily addressed in the State's TMDL decision. DOH uses these same elements as an organizing framework for responding to public review of the proposed decision (Appendix I). This TMDL decision rationale reviews historical and existing conditions in the Nawiliwili Bay watershed and presents an analysis of pollutant load distributions and resulting water quality in Huleia, Papakolea, Puali, and Nawiliwili streams. We provide calculations of waterbody pollutant loading capacities, and of their allocations to identified pollutant sources such that water quality standards for total suspended solids (TSS), nitrate+nitrite nitrogen (N+N), total nitrogen (TN), total phosphorus (TP), and bacterial indicator (enterococcus) in these four streams will be achieved as required. The basis for this analysis is the 2005 "Total Maximum Daily Load Technical Report, Nawiliwili Bay Watershed, Kauai, Hawaii" (hereafter "2005 Technical Report") prepared by Tetra Tech, Inc. and AECOS, Inc. for the DOH Environmental Planning Office (EPO), and additional information compiled and synthesized by EPO, including public comment on earlier drafts.

This rationale document was prepared by Alexandre Remnek, Renee Kinchla, and David C. Penn (DOH Environmental Planning Office) from the 2005 Technical Report and additional information. We gratefully acknowledge technical assistance from our contractors (Tetra Tech, Inc. and AECOS, Inc.), Eric Crecelius (Battelle), the U.S. Department of Agriculture Natural Resources Conservation Service (Lihue Field Office), the University of Hawaii Water Resources Research Center, the University of Hawaii Stream Research Center, the U.S. Geological Survey Pacific Water Science Center, and our DOH colleagues throughout the DOH Environmental Health Administration, particularly the Environmental Health Analytical Services Branch staff (State Laboratories Division), the Polluted Runoff Control Program (Clean Water Branch), the Clean Water Branch Engineering Section (Joanna Seto, Shane Sumida, and Ann Teruya), Gary Ueunten (Clean Water Branch Monitoring and Analysis Section), Richard Palmer (Hazard Evaluation and Emergency Response Office), Sina Pruder (Waste Water Branch) and Linda Koch, Glen Fukunaga, Glenn Haae, Maile Sakamoto, Barbara Matsunaga, and Kelvin Sunada (Environmental Planning Office).

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- County of Kauai (Planning Department, Public Works Department)
- East Kauai Soil and Water Conservation District
- State of Hawaii Department of Transportation, Kauai District (Airports, Harbors, and Highways Divisions)
- State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, Kauai District

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The remainder of this section (1) identifies and defines the TMDL problem, (2) provides a physical description of the watershed and a specific discussion of each stream, and (3) discusses previous studies and reports reviewed during the preparation of this report. Section 2, Field Sampling and Data Analysis, provides a summary of the sampling methodology and results. Section 3, Load Analysis, presents the assessment of pollutant sources, linkage methodology, watershed hydrology, and load calculations. Section 4, Discussion and Conclusions, discusses the analytical results, loading reductions required to meet the TMDLs, and evaluation of TMDL reductions and their impacts on the estuary waters and Nawiliwili Bay. Section 5 outlines a framework for ongoing TMDL implementation activities, and the remaining sections (6 and 7) describe reasonable assurance and public participation components of the TMDL process. Figures and tables are presented within the sections as they are introduced. A reference list (Section 8) and nine appendices (A through I) follow the main text.

1.1 PROBLEM DEFINITION

1.1.1 Water Quality Standards and Impaired Waters

Designated Uses

TMDLs are established to achieve and maintain water quality standards. A water quality standard consists of the designated use(s) for the water, water quality criteria designed to protect the use(s), and an antidegradation policy. According to Hawaii classification of designated uses in the Hawaii Administrative Rule (HAR §11-54-3), the Huleia Stream System (inland freshwater and brackish waters) and Papakolea Stream network (inland freshwater) include both Class 1 and Class 2 segments, while the other two inland water systems (Papakolea, Puali, and Nawiliwili) are exclusively Class 2. Throughout all Class 1 waters (including wetlands), any conduct which results in a demonstrable increase in levels of point or nonpoint source contamination is prohibited.

In Class 1.b. segments in the northwest headwaters of the Huleia tributary network, uses to be protected are domestic water supplies, food processing, protection of native breeding stock, the support and propagation of aquatic life, baseline references from which human-caused changes can be measured, scientific and educational purposes, compatible recreation, and aesthetic enjoyment. We have no evidence of existing or historic use for domestic water supplies or food processing, and have not assessed the attainment of other protected uses in these remote segments. However, biological assessments and surveys of Huleia Stream in downstream Class 2 segments documented a dramatic change in habitat from a shallow riffle-dominated stream to a deep run-dominated stream where native *'o'opu-nakea* (*Awaous guamensis*) and *'opae-kalaole* (*Atyoida bisulcata*) once common in the site were replaced by predatory small-mouthed bass (*Micropterus dolomieu*) and Mozambique tilapia (*Oreochromis mossambicus*) (Kido 1999), suggesting threats to the protection of native breeding stock in upstream Class 1 segments.

In Class 1.a. segments in the Huleia Estuary and Papakolea Stream (both within the National Wildlife Refuge, which also includes Class 1.a. wetlands), the uses to be protected include those in Class 1.b. segments (except for domestic water supplies and food processing), and other nondegrading uses which are compatible with the protection of ecosystems associated with this class. Although we have not completely assessed use attainment in these segments, an assessed site in Papakolea Stream exhibits impairment of both habitat quality [due to the stream channel being overgrown by *hau* (*Hibiscus tiliaceus*)], high sediment loads and coarse organic matter sitting on the stream bottom, and the scarcity of natural rock substrate) and biotic integrity (due to dominant total numbers and total biomass of alien poeciliid fish species, although a few native *'o'opu-akupa* were collected). Predatory fish species (native-eating small-mouth bass and tilapia) were observed to be very common in the deeper waters below the site and in the adjoining ditch systems (Kido 2002). Also, bacterial data from upstream segments of Papakolea Stream (El-Kadi et al. 2003) suggest that full-body contact recreational uses may be threatened downstream.

The objectives of Class 2 waters are to protect uses for recreational purposes, the support and propagation of fish and other aquatic life, and agricultural and industrial water supplies. Uses to be protected include all uses compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. Agricultural water supply was a major historical use of all four streams and existing agricultural uses persist today. Existing uses throughout the four streams also include support of recreational activities, aesthetic values, and traditional and customary native Hawaiian beliefs, values, and practices. As with Papakolea, bacterial data from Puali and Nawiliwili Streams suggest that full-body contact recreational uses may be threatened.

Biological assessments and surveys across the four streams conducted by the University of Hawaii, Hawaii Stream Research Center (Kido 2002, see figures in Appendix B) revealed gross symptoms of habitat degradation - particularly altered flow regimes, extremely high sediment loads and lack of natural rocky substrate on stream bottoms, unstable and eroding stream banks, altered stream channels, and excessively closed riparian zones populated by aggressive alien tree and shrub species. Biological impairment was apparent in the nearly complete dominance of alien aquatic species in stream environments coupled with low primary/secondary productivity due to the highly degraded habitat conditions. Native *'o'opu* were only observed/collected in stream habitat with estuarine influence (i.e. lower Huleia River and lower Papakolea Stream). Similar assessments conducted by DOH (Paul et al. 2004) rated overall habitat quality and biotic integrity as impaired in lower and middle Puali Stream and middle and upper Huleia Stream (native aquatic macrofaunal species absent; only alien species present including *M. lar* and tolerant fish species; > 11% of *'o'opu* individuals with external symptoms of disease and/or attached leeches), and poor at lower Huleia Stream (few expected native macrofaunal species present; alien *M. lar* as or more abundant than native species but other alien species absent or rare; total *'o'opu* population and sensitive species densities/size classes well below expectations; < 10% of *'o'opu* individuals with external symptoms of disease but no incidence of external leeches).

The most severe impairment of aquatic life use appears to occur in lower Nawiliwili Stream (with extreme sediment loads on the stream bottom, absence of functional riparian zones removed by adjacent housing subdivisions, highly unstable stream banks, and a lack of natural rock substrate), where even alien species numbers were low, conspicuously so for swordtails (*Gambusia affinis*) and guppies (*Poecilia reticulata*) which are prolific breeders and usually super-abundant in most degraded stream sites (Kido 2002). Similar results were reported by the U.S. Geological Survey (Wolff 2005), whose multi-metric environmental assessment and Preliminary Hawaiian Benthic Index of Biotic Integrity rated sites at lower Nawiliwili Stream and lower Puali stream as severely impaired (with Nawiliwili the most impaired of all 24 Oahu and Kauai sites assessed). Factors influencing these ratings include high concentrations of organochlorine compounds in Nawiliwili and Puali fish tissue and Nawiliwili bed sediment (which also exhibited high metals concentrations) (see figures in Appendix B).

The greater Nawiliwili Bay (the marine receiving water for all streams in the watershed) provides recreational, aesthetic, cultural, and wildlife resources for the island of Kauai. A resort hotel and public beach park are located near Kalapaki Beach along the northeastern shore of the bay, where surfers, swimmers, boaters, and fishing enthusiasts enjoy the bay's protected waters. Despite its connection with Class 1 inland waters, Nawiliwili Bay is a Class A marine embayment. It is the objective of Class A waters that their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. Class A waters shall not act as receiving waters for any discharge that has not received the best degree of treatment or control compatible with the criteria established for this class.

Although the TMDL decisions proposed in this document apply only to the freshwater segments of the four inland streams, not to the inland estuary or marine embayment, it is expected that the implementation of these TMDLs will lead to estuary and marine water quality improvements. In addition to these stream inputs, any future TMDL decisions directly addressing estuarine and marine water quality would be expected to evaluate all other sources of pollutant loading that discharge along the shoreline, and to scrutinize other potential causes of water quality problems. These may include oceanic inputs, marine vessel traffic, and sediment resuspension (as stirred by both natural forces and vessel engines).

Numeric Water Quality Criteria

Specific water column criteria for Hawaii streams (HAR §11-54-5.2) first approximated their existing form in 1979 and were last revised in 2004. Four parameters (temperature, pH, dissolved oxygen, salinity) have limits defined by specific upper or lower bounds. Five other parameters (turbidity, total nitrogen, nitrate+nitrite nitrogen, total phosphorus, and total suspended solids) are defined by three numeric criteria – a geometric mean and two exceedance values (10% and 2%) - for each of two seasons, wet and dry. The numeric water quality criteria for these parameters are displayed in Table 1-1, where terms have the following meanings:

1. Geometric mean (GM). The geometric mean of all time-averaged samples should not exceed this value. The geometric mean is calculated as the *n*th root of the product of *n* sample values, where *n* is the total number of samples.
2. 10% exceedance value. No more than 10% of all time-averaged samples should exceed this value.
3. 2% exceedance value. No more than 2% of all time-averaged samples should exceed this value.

Table 1-1: Hawaii Inland Water Quality Criteria for Streams

Parameter	Geometric mean not to exceed the given value (Wet Season/Dry Season[1])		Not to exceed the given value more than 10 percent of the time (Wet Season/Dry Season)		Not to exceed the given value more than 2 percent of the time (Wet Season/Dry Season)	
Total Suspended Solids (TSS) (mg/L)	20	10	50	30	80	55
Nitrate + Nitrite as Nitrogen (µg/L)	70	30	180	90	300	170
Total Nitrogen (µg/L)	250	180	520	380	800	600
Total Phosphorus (µg/L)	50	30	100	60	150	80
Turbidity (NTU)	5.0	2.0	15.0	5.5	25.0	10.0

Notes: From DOH Hawaii Administrative Rules Section 11-54-5.2(2)(b)
[1]The Wet Season is from November 1 through April 30 and Dry Season is from May 1 through October 31.
µg/L Micrograms per liter
mg/L Milligrams per liter
NTU Nephelometric turbidity units

For *enterococcus* (bacterial indicator) in inland recreational waters (HAR §11-54-8(a)):

(1) Enterococcus content shall not exceed a geometric mean of 33 per one hundred milliliters in not less than five samples which shall be spaced to cover a period between 25 and 30 days. No single sample shall exceed the single sample maximum of 89 CFU per 100 milliliters or the site-specific one-sided 82 per cent confidence limit. Inland recreational waters in which enterococcus content does not exceed the standard shall not be lowered in quality.
(2) At locations where sampling is less frequent than five samples per twenty-five to thirty days, no single sample shall exceed the single sample maximum nor shall the geometric mean of these samples taken during the 30-day period exceed 33 CFU per 100 milliliters.

Enterococcus sampling was less frequent than five samples per thirty days at each site in the Nawiliwili Bay watershed. Therefore, the regulatory water quality criteria are a geometric mean of 33 CFU per 100 milliliters and a maximum value of 89 CFU per 100 milliliters.

The preamble to a 2004 EPA final rule on Water Quality Standards for Coastal and Great Lakes Recreational Waters (U.S. Environmental Protection Agency, 2004) discusses comments received regarding the implementation of the single sample maximum criterion (SSM) and the intent of EPA's Ambient Water Quality Criteria for Bacteria (Criteria and Standards Division, 1986). EPA expects that SSM values be used for making beach notification and closure decisions. However, in other contexts, EPA recognizes the geometric mean as the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation, and more directly linked to the underlying studies on which the 1986 bacteria criteria were based. Nevertheless, the SSM can play a role in identifying potential pollution episodes, especially in waters that are prone to short-term spikes in bacteria concentrations (e.g., waters that may be affected by combined sewer overflow). The 1986 bacteria criteria document did not discuss using the SSM as a never-to-be-surpassed value for all applications under the CWA, and the State of Hawaii intends to limit the use of the SSM to beach notifications and closures or to where other decisions must be made with limited data. Therefore, based on 2004 EPA explanation of the appropriate use of the SSM criterion, the enterococcus bacteria TMDLs established by the State of Hawaii are generally based on the geometric mean criterion only, and the water quality target is a geometric mean concentration of 33 CFU/100 ml.

Impaired Waters

The DOH (Environmental Health Administration 2008), in its Final 2006 List of Impaired Waters in Hawaii prepared under Clean Water Act §303(d), identified water quality in Nawiliwili Bay as impaired by excessive nutrients and turbidity, perpetuating a listing that has persisted for over 30 years. Three water quality stations in Nawiliwili Bay are also included on this list: Nawiliwili Harbor and Kalapaki Beach (excessive enterococcus) and Nawiliwili Bay offshore embayment station (excessive nitrogen, chlorophyll a, and turbidity).

Based on the persistent listing of Nawiliwili Bay as an impaired water body, DOH began assessing the quality of its contributing stream waters in 1996. According to the 2006 303(d) list, water quality in Huleia Stream, Nawiliwili Stream, and Puali Stream is impaired by elevated turbidity and nitrogen, based on previous visual assessment (see waterbody assessment sheets for Huleia and Nawiliwili in Appendix A) and ongoing numeric assessment (Section 2.2 and

Appendix D). For these three streams, the 2006 303(d) list identified 9 waterbody/pollutant combinations that require TMDLs (see last row in Table 1-2).

Table 1-2: Freshwater Streams on the Hawaii 2006 303(d) List, Nawiliwili bay Watershed

Assessed Waterbody	**Nawiliwili**		**Puali**		**Huleia**	
Geocode ID	2-2-13	2-2-13	2-2-14	2-2-14	2-2-15	2-2-15
Season	Dry	Wet	Dry	Wet	Dry	Wet
Enterococci	unknown	unknown	unknown	unknown	unknown	unknown
Total N (TN)	**Not Attained**	**Not Attained**	**Not Attained**	**Not Attained** (with combined season data)	**Not Attained**	Attained
NO3+NO2	**Not Attained**	**Not Attained**	**Not Attained**	**Not Attained** (by 2 times the standard)	**Not Attained**	Attained (Not Attained in 2004)
Total P (TP)	Attained	Attained	Attained	Attained (with combined season data)	Attained	Attained
Turbidity	**Visual listing** from 2001-2004	Attained (Not Attained in 2004)	**Not Attained** (by 2 times the standard)	**Not Attained** (by combined data, 2 times the standard)	**Visual listing** from 2001-2004	Attained
Other Pollutants	TSS (Attained)	TSS (Attained)	TSS (Attained)	TSS (Attained with combined seasonal data)	TSS (Attained)	TSS (Attained)
Category	3, 5	3, 5	3, 5	3, 5	3, 5	3, 5
303(d) List	**TN, NO3+NO2, Turbidity**		**TN, NO3+NO2, Turbidity**		**TN, NO3+NO2, Turbidity**	

Additional numeric assessment completed during TMDL development (Section 2.3.4 and Appendix D) treats Papakolea Stream, previously considered as a tributary of Huleia Stream, as a distinct, impaired freshwater segment, since it actually flows into the estuarine portion of the Huleia Stream System, not the freshwater portion. The results of this subsequent assessment suggest the attainment of TN criteria in Huleia [no TMDLs required, contrary to the 2006 303(d) list] and establish 12 additional impairments and threats requiring TMDLs:

- elevated enterococcus in all four streams (4 waterbody/pollutant combinations),
- excessive TSS in Papakolea, Puali, and Nawiliwili (3 waterbody/pollutant combinations),
- elevated TP in Papakolea and Nawiliwili (2 waterbody/pollutant combinations), and
- excessive Turbidity, NO3+NO2, TN in Papakolea (3 waterbody/pollutant combinations).

Thus the TMDL decision addresses a total of 20 waterbody/pollutant combinations, as detailed in Table 2-8:

- 3 for Huleia (NO3+NO2, Turbidity, enterococcus)
- 5 for Puali (TN, NO3+NO2, Turbidity, enterococcus, TSS), and
- 6 each for Papakolea and Nawiliwili (TN, NO3+NO2, Turbidity, enterococcus, TSS, TP).

This is explained by our expectation that implementing TMDLs calculated for TSS and nutrients will lead to attainment of the turbidity criteria (TSS and nutrient concentrations as surrogate numeric targets for turbidity) (see Appendix D, Water Quality Impairment Rationale).

1.1.2 Purpose of the TMDL

The purpose of this TMDL decision rationale is (1) to investigate stream systems that flow within the Nawiliwili Bay Watershed by examining their characteristics, land-uses, water quality, and pollutant transport mechanisms; (2) to determine the pollutant load reductions required for these streams to meet the Hawaii water quality criteria; and (3) to suggest whether pollutant load reductions in these streams can be sufficient to meet the State of Hawaii water quality criteria in Nawiliwili Bay.

One of the major components of a TMDL is the establishment of TMDL endpoints, which are the numeric targets for pollutant concentrations in a water body. The endpoint represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for a comparison between observed in-stream conditions and conditions that are expected to restore designated uses. The TMDL endpoints selected for this technical report are based on the Hawaii water quality criteria identified in Table 1-1. The geometric mean (GM) water quality criteria, which vary seasonally, are used as the endpoints for baseline flow conditions. To address critical conditions, we assume that higher concentrations of pollutants occur during storm events; such events occur approximately 20% of the time; and the geometric mean of concentrations occurring during these events should approximate the wet season 10% not to exceed criteria. Therefore, the 10% not to exceed criteria are used as the TMDL target for stormflow conditions.

1.2 PHYSICAL SETTING

The Nawiliwili Bay watershed, located in the southeastern portion of the island, covers about 36.7 square miles (Figure 1-1). The watershed is bordered by Haupu Ridge to the south and west, Kilohana Crater to the northwest, Mt. Kahili to the north, and Lihue town to the east, and is fed by four major stream systems: Huleia, Papakolea, Puali, and Nawiliwili. Many smaller streams and springs provide additional freshwater input along the shoreline. Early Hawaiians developed extensive irrigated pondfield and fishpond complexes along the streams and shoreline, remnants of which persist today. While much of the watershed arable land was devoted to sugarcane cultivation throughout the 20th century, today's more diversified agricultural landscape is increasingly dominated by pasture and forestry, with ongoing conversion to residential and commercial uses in the lower elevations, mostly in the vicinity of the County of Kauai's urban core in the Lihue and Puhi town areas.

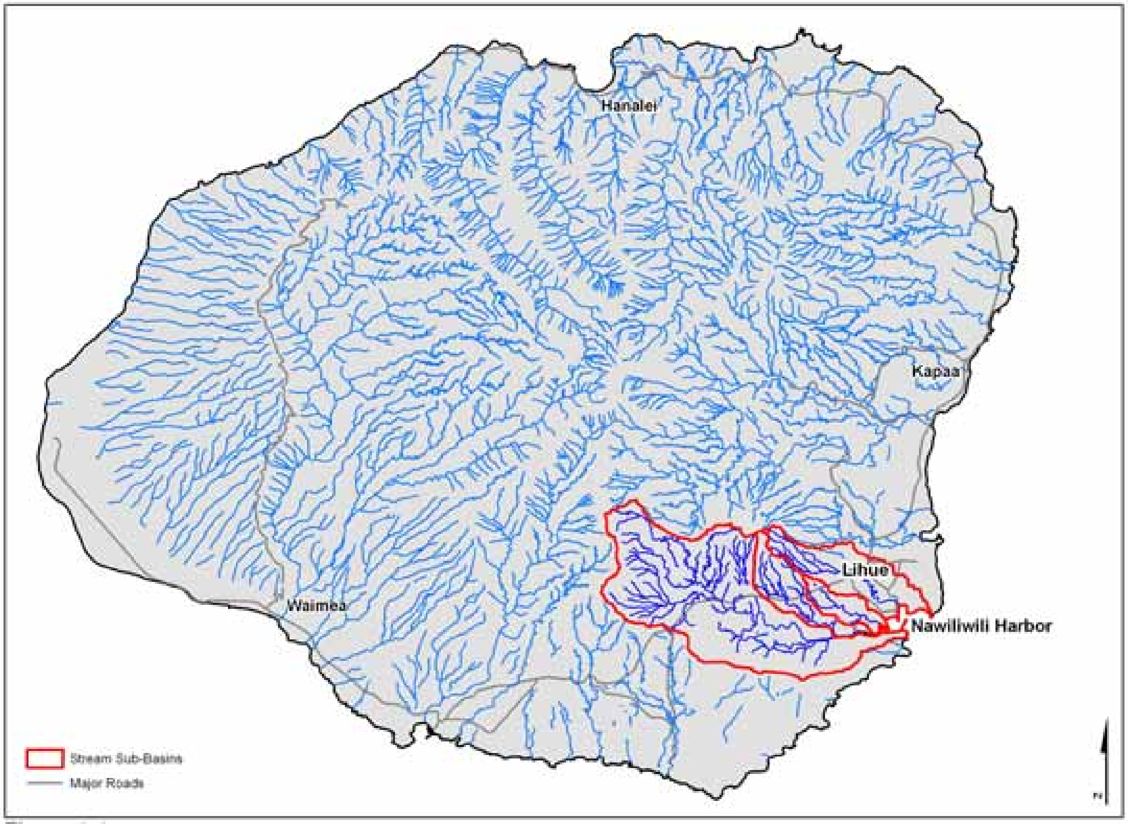
Nawiliwili Harbor, which receives the bulk of watershed runoff, hosts a wide variety of traditional, recreational, and commercial vessels. The greater Nawiliwili Bay provides recreational, aesthetic, cultural, and wildlife resources for the island of Kauai. A resort hotel and public beach park are located near Kalapaki Beach along the northeastern shore of the bay, where surfers, swimmers, boaters, and fishing enthusiasts enjoy the bay's protected waters. The Huleia National Wildlife Refuge, located at the western end of Nawiliwili Bay along Papakolea Stream and the estuary of Huleia Stream, provides habitat for many of Hawaii's endangered native waterbirds. The Alekoko fishpond (also known as Menehune Fishpond), added to the National Register of Historic Places in 1973, is an impoundment of the Huleia estuary adjoining the eastern end of Huleia National Wildlife Refuge. Although wetlands and fishponds persist within the Refuge and other nearby conservation lands, they have disappeared over time from other areas of the coastal zone.

1.2.1 Geology

About 5 million years ago (during the Pliocene Epoch), hot-spot volcanism created a large shield volcano, Kauai. Erosion and faulting of the volcano created large valleys, canyons, and other depressions that were later partly filled with sediments, lava flows, and other igneous rocks. The Nawiliwili Bay watershed includes into two geologic formations that are separated by an erosional unconformity: (1) the Pliocene-age Waimea Canyon Basalt consisting of mostly of thin lava flows that formed during the shield-building stage and (2) Pleistocene-age Koloa Volcanics. The Waimea Canyon Basalt constitutes most of Kauai and forms the basement for overlying younger sediments and volcanic rocks. The younger rocks of the basin obscure most of the Waimea Canyon Basalt, except at outcrops in the ridges and mountains surrounding and within the basin. In the ridges, numerous, near-vertical, sheet-like, volcanic dikes intrude the lava flows of the Waimea Canyon Basalt. The Koloa Volcanics is a heterogeneous unit that filled depressions in the Waimea Canyon Basalt. The volcanic rocks include variably weathered, thick, massive lava flows and pyroclastic deposits. These deposits are characterized by highly alkalic mafic composition and are the result of eruptions from edifices scattered over the old, eroded shield volcano during the rejuvenated stage of volcanism (Izuka and Oki 2002).

At the northwest boundary of the Huleia basin near Mt. Waialeale is an outcrop of the thick-bedded lava flows that have been variously interpreted as caldera-filling lava or lava that accumulated between multiple shield volcanoes. Terrigenous and marine sediments are interlayered with the lava flows. These sediments overlay the Koloa Volcanics in some places and are of Pleistocene and Holocene age that form coastal plains and fill valley bottoms. The Holocene deposits are relatively small in volume (Izuka and Oki 2002).

Figure 1-1: Location Map – Nawiliwili Bay Watershed



1.2.2 Soils

The Nawiliwili Bay Watershed includes five soil-type associations. Figure 1-2 shows the distribution of the soil associations within the watershed, with detailed descriptions presented in Table 1-3. More detailed analysis of soils at the map unit level is commonly used for planning wildland and agricultural best management practices aimed at reducing sediment and nutrient losses and loadings.

Figure 1-2: Soil Associations within the Nawiliwili Bay Watershed

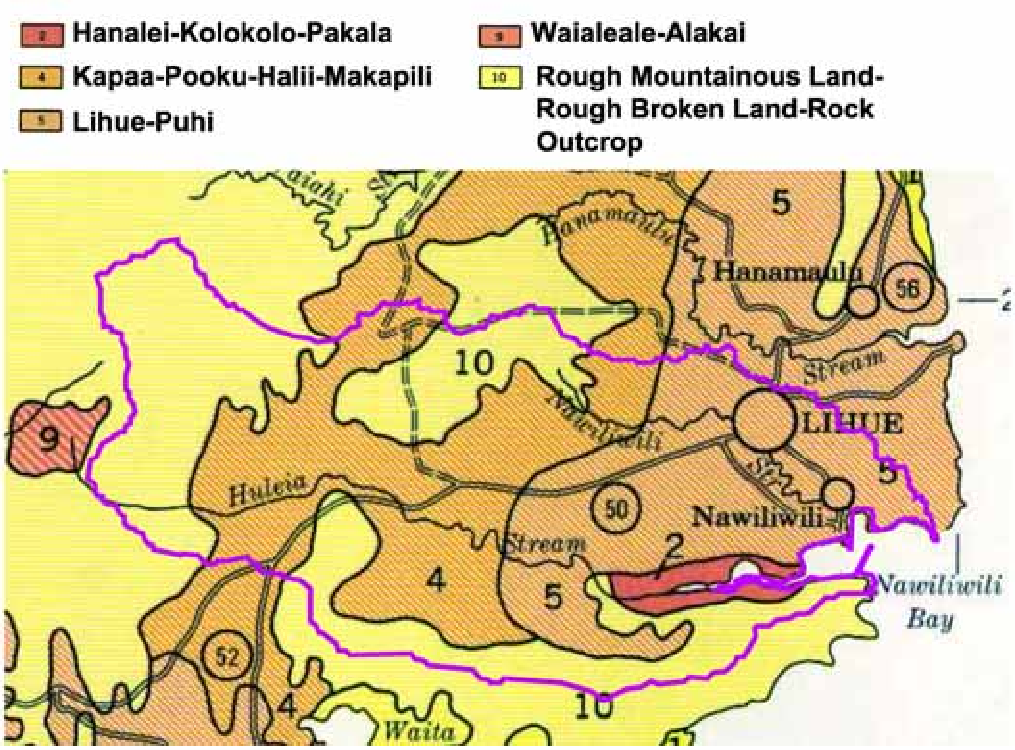


Table 1-3: Soil-Type Associations within the Nawiliwili Bay Watershed

Soil-Type Association	Stream System	Soil-Type Association Description
2. Hanalei-Kolokolo-Pakala	Huleia, and Papakolea	The association consists of deep, nearly level, poorly drained to well drained soils that have moderately fine textured or medium-textured subsoil or underlying material found on bottom land and in alluvium. The association makes up about 2 percent of the island and is found at elevations ranging from near sea level to 500 feet. The annual rainfall within this portion of the island ranges from 25 to 150 inches. The soil is used mainly for irrigated crops and pastureland. Soils consist of silt, silty clay, and clay loam.
4. Kapaa-Pooku-Halii-Makapili	Nawiliwili, Papakolea , Puali, and Huleia	The association consists of well drained and moderately well drained, fine-textured soils on the uplands of East Kauai. The soils are nearly level to steep and were developed in material weathered from basic igneous rock. The association makes up about 10 percent of the island and is found at elevations ranging from 100 to 1,000 feet. This association is used for sugarcane production and pastureland. Soils consist of silty clay loam and weathered igneous rock.
5. Lihue-Puhi	Nawiliwili, Papakolea, Puali, and Huleia	The association consists of deep, nearly level to steep, well drained soils that have a fine-textured or moderately fine-textured subsoil and are found on the upland of South and East Kauai. These soils developed in material weathered from basic igneous rock. The association makes up about 12 percent of the island and is found at elevations ranging from sea level to 800 feet. The annual rainfall within this portion of the island ranges from 40 to 80 inches. The soil is used mainly for irrigated crops and pastureland. Soils consist of silty clay loam and igneous rock.
9. Waialeale-Alakai	Huleia	The association consists of somewhat poorly drained to very poorly drained, organic soils on the uplands of Central Kauai. These soils are level to very deep and were developed in organic debris deposited on basic igneous rock. The association makes up about 3 percent of the island and is found at elevations ranging from 3,500 to 5,000 feet. The annual rainfall within this portion of the island ranges from 150 to 450 inches. This association is used for water supply and wildlife habitat. Soils consist of mucky peat, weathered igneous rock, and clay.
10. Rough mountainous land-Rough broken land-Rock outcrop	Nawiliwili, Papakolea , Puali, and Huleia	This association consists of well drained, medium- and fine-textured soils on the uplands of South and West Kauai. The soils are moderately sloping to very steep and developed in materials weathered from volcanic ash and basic igneous rock. The association makes up about 9 percent of the island and is found at elevations ranging from 1,500 to 4,200 feet. The annual rainfall within this portion of the island ranges from 30 to 70 inches. This association is used for sugarcane production and pastureland. Soils consist of silty clay loam and weathered igneous rock.

Source: Foote et al. 1972

1.2.3 Stream Systems

The Nawiliwili Bay Watershed receives most of its fresh water drainage from the Huleia, Papakolea, Puali, and Nawiliwili streams (see Figures 1-3 and 1-4 below and Appendix B for more detailed information). Biological assessments and surveys conducted across the four streams by various revealed widespread impairment of habitat quality and biotic integrity when compared with high-quality reference stream conditions keyed to the presence of native fish, mollusks, and crustaceans (Section 1.1.1 and Appendix B).

Mouth of Nawiliwili Stream Behind the Beach at Kalapaki Beach

Nawiliwili Stream. Nawiliwili Stream begins at about 800 ft elevation on the east side of Kilohana Crater as a multi-branched system with uncertain connections to plantation-era irrigation systems that can divert water from the stream and add water from both within and outside of the greater Nawiliwili Bay watershed (see Figures 1-3 and 1-4 below). These small streams eventually converge into a South branch, which is joined by the North branch at about 230 ft elevation in a gulch north of Kauai Community College (KCC). After passing through agricultural and rural lands, the stream meanders in a gulch through the center of Lihue, passing beside the old sugar mill and collecting urban runoff from the county drainage infrastructure. The stream enters Nawiliwili Bay at the western end of Kalapaki Beach.

Nawiliwili Stream is continuously flowing and not channelized. Still, Timbol and Maciolek (1978) rated it as having low environmental and biological quality. High concentrations of metals in Nawiliwili bed sediment, near the stream mouth, were reported by the U.S. Geological Survey (Wolff 2005, see Appendix B). At Lihue Plantation, cane washings and other aqueous wastes were formerly disposed of directly into Nawiliwili Stream. As part of a Site Investigation (Office of Hazard Evaluation and Emergency Response and Tetra Tech, Inc. 2006), sediment samples were collected (a) in Nawiliwili Stream downstream of the wastewater influx from the Lihue Mill, and (b) from the north end of a culvert that leads from the Seed Cane Dipping Plant, under Kaumualii Highway, into Nawiliwili Stream where it begins to flow next to Lihue Mill. Analytical results showed that metals, pesticides, and dioxins/furans were present above NOAA SQuiRTs™ values (response.restoration.noaa.gov/book_shelf/122_squirt_cards.pdf). Although detection of mercury and Octachlordibenzodioxin (OCDD, a dioxin congener) in the sediment samples collected downstream from the Lihue Sugar Mill and Seed Dipping Tanks site reveals the migration of a hazardous substance, the source of this substance (including a comparison with background levels from farther upstream) remains uncertain.

Figure 1-3: Streams in the Nawiliwili Bay Watershed

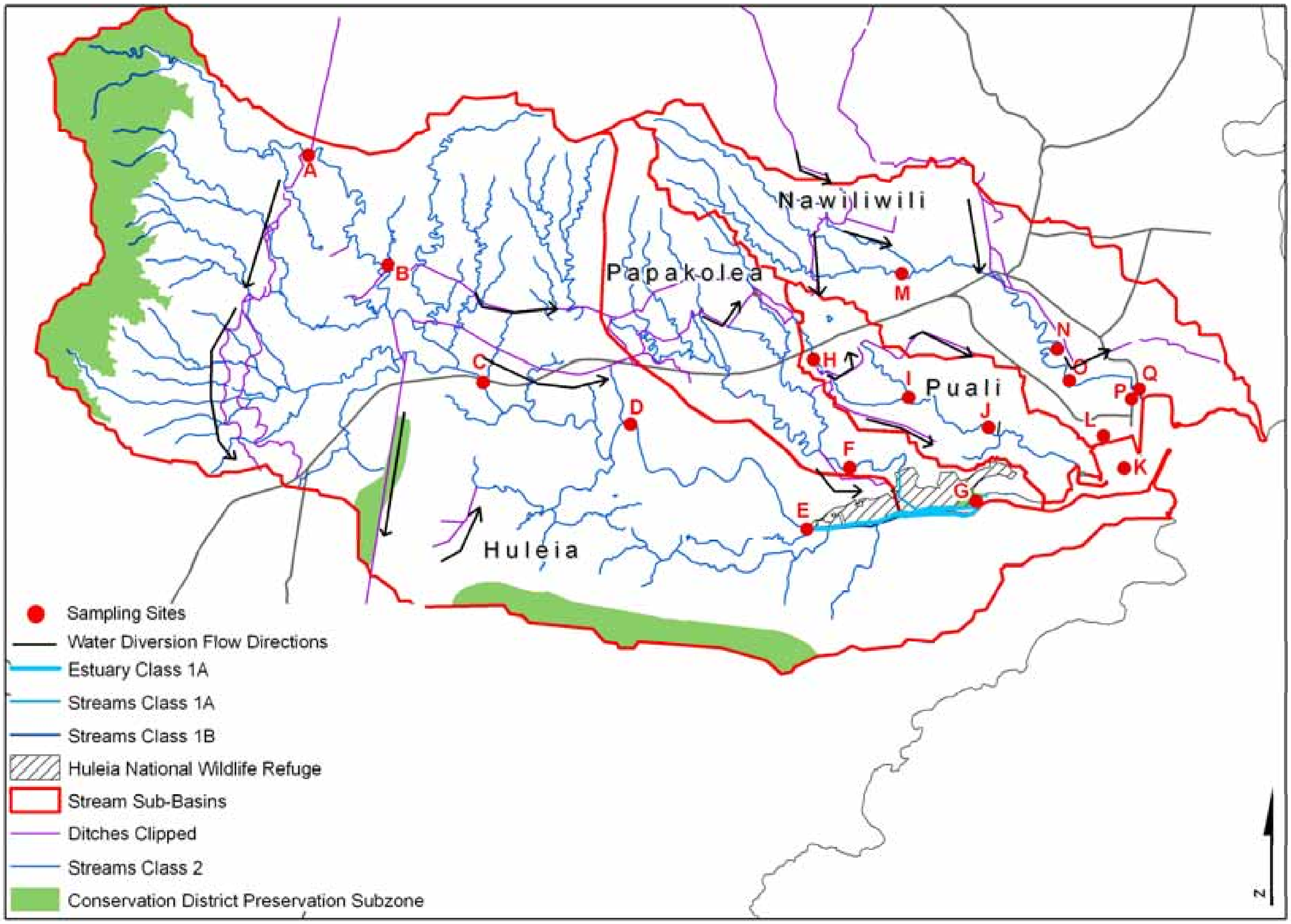
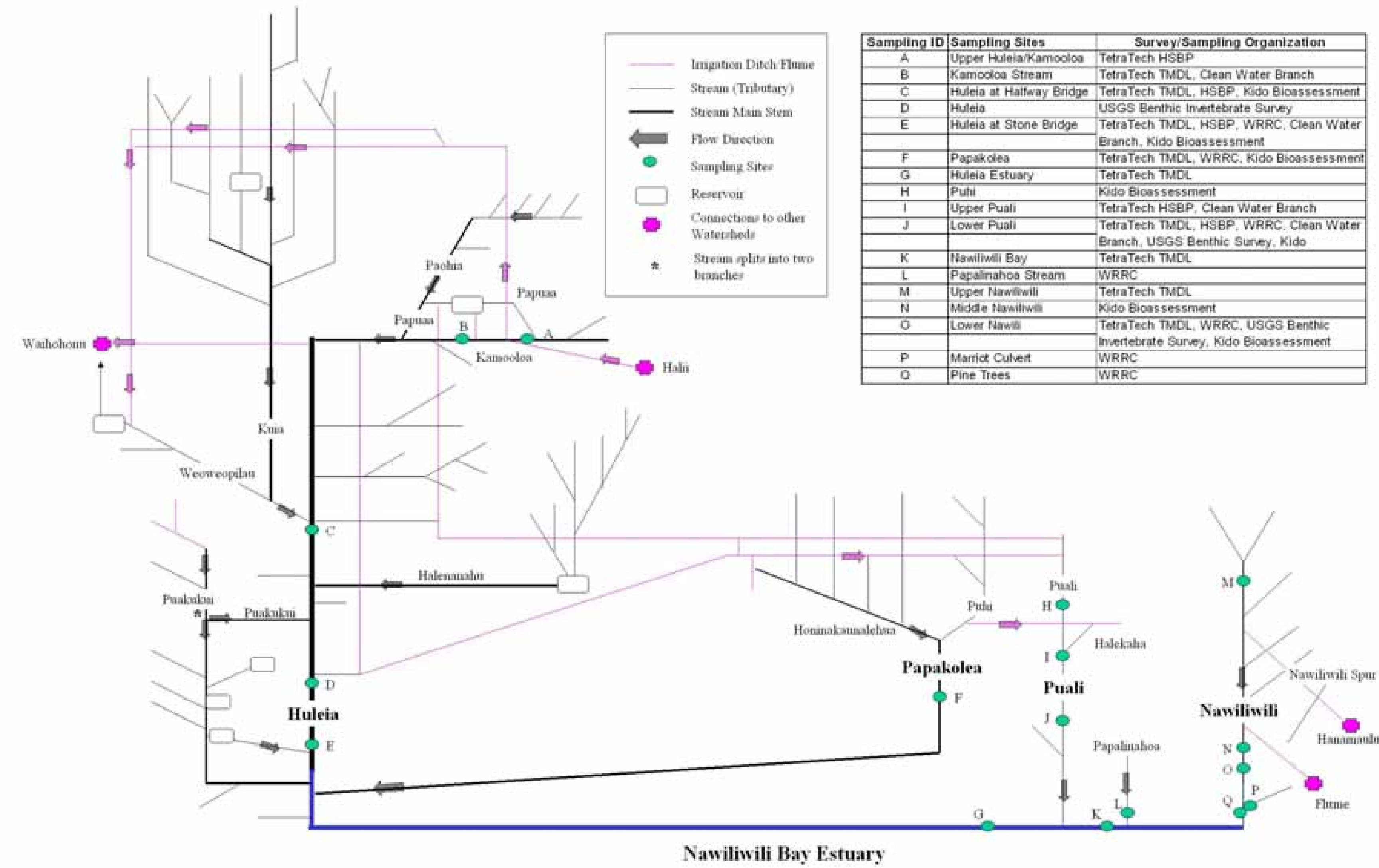


Figure 1-4: Nawiliwili Bay Watershed - Major Streams, Tributaries, and Irrigation Ditches



Sampling ID	Sampling Sites	Survey/Sampling Organization
A	Upper Huleia/Kamooloa	TetraTech HSBP
B	Kamooloa Stream	TetraTech TMDL, Clean Water Branch
C	Huleia at Halfway Bridge	TetraTech TMDL, HSBP, Kido Bioassessment
D	Huleia	USGS Benthic Invertebrate Survey
E	Huleia at Stone Bridge	TetraTech TMDL, HSBP, WRRC, Clean Water Branch, Kido Bioassessment
F	Papakolea	TetraTech TMDL, WRRC, Kido Bioassessment
G	Huleia Estuary	TetraTech TMDL
H	Puhi	Kido Bioassessment
I	Upper Puali	TetraTech HSBP, Clean Water Branch
J	Lower Puali	TetraTech TMDL, HSBP, WRRC, Clean Water Branch, USGS Benthic Survey, Kido
K	Nawiliwili Bay	TetraTech TMDL
L	Papalinahoa Stream	WRRC
M	Upper Nawiliwili	TetraTech TMDL
N	Middle Nawiliwili	Kido Bioassessment
O	Lower Nawili	TetraTech TMDL, WRRC, USGS Benthic Invertebrate Survey, Kido Bioassessment
P	Marriot Culvert	WRRC
Q	Pine Trees	WRRC

Huleia Stream. The Huleia Stream basin comprises the largest portion of the Nawiliwili Bay Watershed, and is hydrologically complex. It includes four ungauged agricultural diversions that move water from the stream out of the Nawiliwili Bay Watershed, two more ungauged diversions that move water to other sub-basins, and two large reservoirs used to store and release diverted water (see Figures 1-3 and 1-4 above). These diversions limit accurate determinations of the volume of water regularly carried by Huleia Stream and its tributaries.

Huleia Stream at Keopaweo (left) and Haupu, peaks along Haupu Ridge. The edge of Alekoko (Menehune) Fishpond is seen at lower right.

Papakolea Stream. Papakolea Stream flows into the Huleia Stream estuary about 1.5 miles upstream from Nawiliwili Harbor. The lowest reach of the stream, within the Huleia National Wildlife Refuge, is the only Class 1.a. stream segment in the entire Nawiliwili Bay watershed. Upstream, in Class 2 waters, waterfalls are becoming a more popular attraction for visiting hikers and swimmers. Although the Papakolea sub-basin, along with Huleia, has far fewer cesspools and septic tanks than the more urbanized sub-basins, and no Large Capacity Cesspools (see Appendix F), microbial testing suggests that Papakolea individual wastewater systems are potential sources of stream contamination (El-Kadi et al. 2003). According to Kido (2002), a segment between Kaumualii Highway and Halehaka is surrounded by abandoned sugarcane land with little or no functional riparian zones adjacent to the stream channel. Natural rock substrate habitat in the stream channel in this reach was rare and stream bottoms were mostly covered with deep layers of sediment. Somewhat better habitat conditions were found in Class 1.a. waters downstream (see Section 1.1.1).

View of Puali Stream

Puali Stream. Puali Stream arises as two branches in the vicinity of KCC, and is also connected with local irrigation and drainage systems in various ways (see Figures 1-3 and 1-4 above). The smaller of the two branches, Halehaka, originates as a broad swale on the Lihue side (east) of campus, with no recognizable streambed present above the Halehaka Reservoir, provided irrigation water to the sugarcane fields located along the north and east sides of the gulch. The larger branch begins in a small reservoir on the west side of campus, fed by various diversions from within the Huleia sub-basin that were once used to irrigate sugarcane fields along the south and west sides of Puali Stream. Just below the highway, the Klussmann Reservoir impounds this branch and is operated as a back-up storage facility for treated sewage effluent from the Lihue-Puhi Wastewater Treatment Works. According to Grove Farm, the irrigation ditch that previously fed into this reservoir has been diverted for other purposes, and the reservoir is no longer in service for irrigation storage. As discussed below, agricultural land within this sub-basin is being rapidly converted to residential, commercial, and golf course uses, and the stream is designated as the receiving water for discharges of industrial stormwater from three facilities regulated by National Pollutant Discharge Elimination System (NPDES) permits (see Table 3-3). Additional information about Puali Stream is provided in various documents associated with these conversions (AECOS 1994a, 1994b & 1996; Bowles 1993a & 1994b; Wilson 1993). DOH clarification of drainage patterns and discharge monitoring information for two of these facilities (Halehaka Landfill and Lihue-Puhi Wastewater Treatment Plant) is continuing.

1.2.4 Historic Activities Within the Nawiliwili Bay Watershed

Early Hawaiians inhabited and intensively cultivated the Nawiliwili Bay Watershed, particularly the floodplains of the streams. These floodplains were used for growing taro, and water from the stream was diverted to flood the taro patches and then returned to the watershed. In addition, the Huleia floodplain is home to the Alekoko fishpond, which served as a complementary source of protein.

In the 1860s, the floodplains began to change dramatically as they were converted to rice cultivation and then again to sugarcane production. Larger stream flow diversions and more elaborate storage and transmission systems were constructed to provide irrigation to the sugarcane fields and hydroelectric power to mill operations. With the demise of the sugar industry, some of these diversions have been abandoned, but other uses for the water, including storm runoff control and irrigation, dictate continued maintenance of the system. Figures 1-3 and 1-4 (above show the locations of recorded diversions and ditches, along with the network and direction of ditch flow into and out of the Nawiliwili Bay Watershed. Of the many written accounts of these efforts, Wilcox (1996) provides a useful and readable synthesis.

In the 1930s, part of Nawiliwili Bay was filled in to build the existing harbor and breakwater. The new harbor furthered agricultural and industrial growth in the surrounding areas as local farmers and industries could more easily ship and receive goods. During World War II, many of the plantations were contracted to provide food for the military personnel stationed on the islands. The military operated a lumber mill in the Nawiliwili Bay Watershed that processed eucalyptus trees for military-related construction. A military hospital was also operated in the watershed during this period.

In the late 20th century, as the profitability of plantation agriculture in the area dwindled, economic activity in the area relied more heavily on real estate development and tourism, and many residential communities, resorts, and golf courses were built. All of these historic changes in land use, land cover, and human activity led to changes in hydrology and water quality within the Nawiliwili Bay Watershed as water was diverted into and out of the watershed to support this growth.

1.2.5 Land Use, Land Cover, and Future Growth

Within the Nawiliwili Bay Watershed, politically-derived State Land Use District Boundaries (Land Use Classification) and County Zoning dictate legally-permissible uses of private and public property (Figure 1-5 and Table 1-4). Scientifically-derived land cover classes indicate the physical characteristics of this property (Figure 1-6 and Tables 1-5 and 1-6), and human activity may ignore legal permissions and alter physical characteristics. As shown in these figures and tables below, the largest stream sub-basin, Huleia (66% of the greater Nawiliwili Bay watershed), contains the bulk of the Agricultural and Conservation District lands in the Nawiliwili Bay watershed, and no Urban district lands. Except for industrial activities at the Glover rock quarry near Halfway Bridge, virtually all of the pollutant loading to Huleia Stream is from nonpoint sources liked with natural background, conservation area management, fallow agricultural lands, and active agricultural production. While land cover mapping suggests that only 4% of the sub-basin area is “Cultivated Land,” portions of the areas mapped as “Grassland,” “Evergreen Forest,” and “Scrub/Shrub” include known locations of livestock (pasture) and forestry (tree farm) activities. A 7,100 kilowatt agriculture biomass-to-energy facility proposed for this area (Earth Tech, Inc., 2007) could result in expanding the acreage planted to invasive, nitrogen-fixing albizzia trees and would also potentially affect Huleia water quality through diversions from and discharges to associated irrigation ditches.

The Papakolea and Nawiliwili stream sub-basins (10% and 18% of the greater Nawiliwili bay watershed, respectively) have roughly equal amounts of land within the Agricultural District, together totaling about 44% of the Huleia Agricultural District lands. While most of Papakolea lies within the Agricultural District, Nawiliwili is equally distributed between the Agricultural and Urban Districts. Except for urban stormwater from about 50 acres of industrial and residential lands (including a point source industrial activity at the County of Kauai Puhi Metals Recycling Center), virtually all of the pollutant loading to Papakolea Stream is from nonpoint sources similar to those in Huleia. However, the Nawiliwili Stream sub-basin contains almost ¾ of the Urban District lands within the entire Nawiliwili Bay watershed. Similar to Nawiliwili (but at a smaller scale), the Puali stream sub-basin (6% of the greater Nawiliwili Bay watershed) is also roughly balanced between the Agricultural and Urban Districts, and includes golf course lands (a permitted use in the Agricultural District). Thus while much of the pollutant loading to Nawiliwili and Puali streams is from non-urban nonpoint sources, the additional loading and impact from nonpoint and point source urban stormwater in these sub-basins (see Appendix E) is critically important to Nawiliwili Bay watershed health.

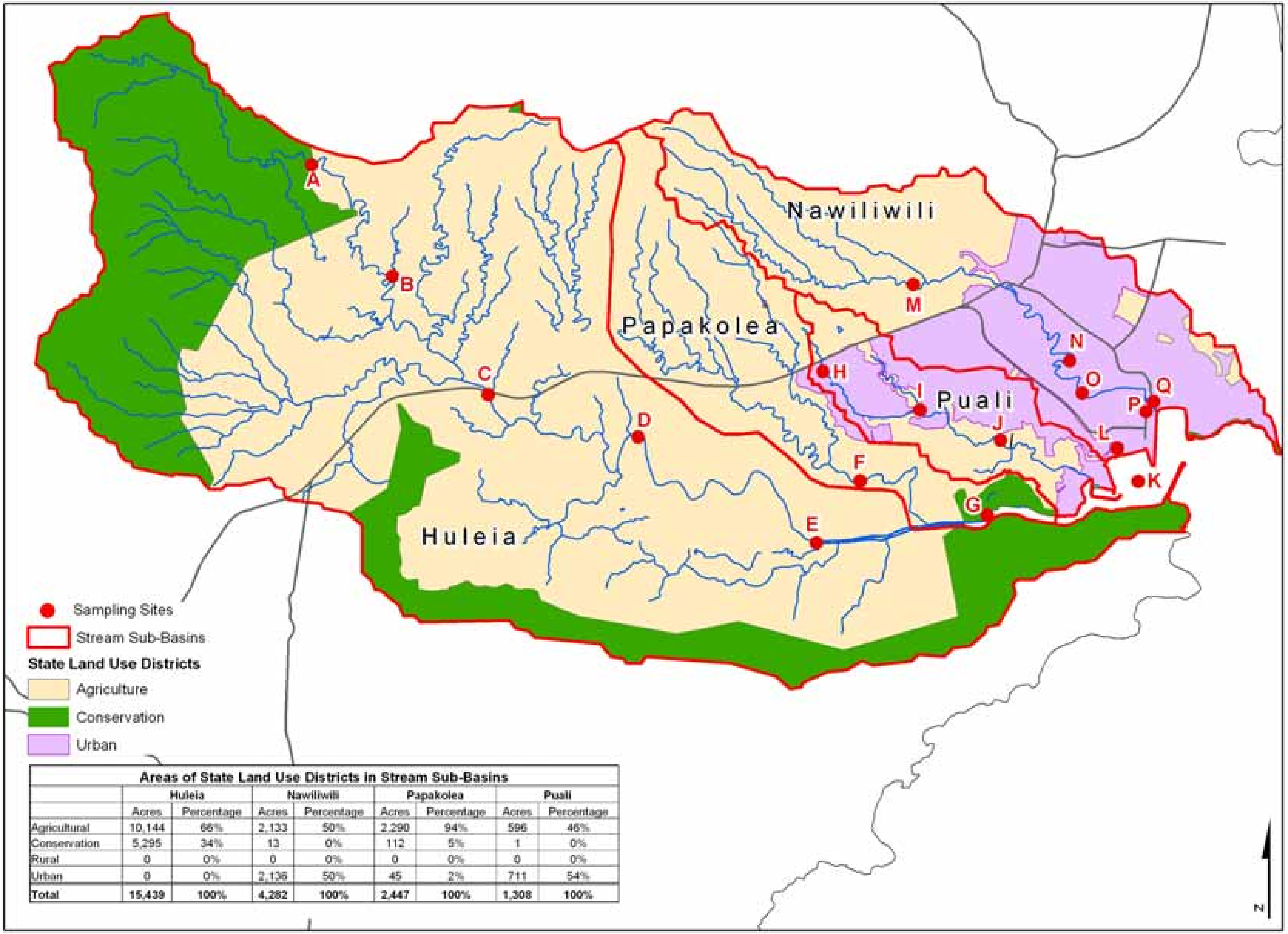
County of Kauai zoning information and U.S. Department of Commerce land cover data (NOAA Coastal Change Analysis Program) provide additional insight on the actual status of lands in the Urban District. For example, in Puali (which is experiencing the most rapid and intense urbanization), about 59% of the land in the Urban District is zoned for commercial, industrial, and residential development, with the remainder zoned for a mix of agricultural and open space uses. However, 50 acres of the area zoned for commercial, industrial, and residential uses appears as undeveloped grassland and scrub in the land cover data (representing conditions in the year 2000). Similarly, of the 55% of land in the Urban District zoned for these uses in the

Nawiliwili stream sub-basin, about 75 acres appear undeveloped based on land cover data. Including undeveloped areas like this in the urban component of pollutant load allocations addresses the future growth component of our TMDL analysis.

Various studies and reports were reviewed as background information for TMDL development. Those relied upon most heavily include the *‘Ainakumuwai: Ahupua'a of Nawiliwili Bay* website (www.hawaii.edu/environment/ainakumuwai); the three-phase *Assessment and Protection Plan for the Nawiliwili Watershed* (Furness et al. 2002; El-Kadi et al. 2003 & 2004); and various biological assessments and surveys (Kido 1995, 1999, & 2002; Paul et al. 2004; Wolff 2005). The State of Hawaii Commission on Water Resource Management maintains records of water source registrations and water use declarations that contain information about instream uses, diversions, and off-stream uses that can be used to piece together hydrologic network architecture, irrigation practices, and existing use support for traditional and customary Native Hawaiian beliefs, values, and practices (Commission on Water Resource Management 1992a & 1992b).

The “Restoration and Protection Plan” published as the third phase of the *Assessment and Protection Plan for the Nawiliwili Watershed* (El-Kadi et al. 2004) serves as a watershed based plan for polluted runoff control and an implementation plan for the nonpoint source load allocations in these TMDLs. Therefore, implementation activities identified in that Plan, as well as those identified in the TMDL implementation framework discussed in this TMDL decision document (Section 5.0) can be eligible to receive “incremental funds” via the CWA 319(h) grant program administered by the DOH. During the development of the TMDLs there were a number of concerns expressed about the uncertainty surrounding specific implementation mandates, timelines, activities, costs, societal impacts, and environmental effectiveness (see Section 7.0 and Appendix I. The watershed based plan, implementation framework, and incremental funding eligibility are not inflexible, and we advocate a community-driven adaptive approach to implementing nonpoint source load allocations based on these documents and on new information that may become available in the future.

Figure 1-5: State Land Use Districts in the Nawiliwili Bay Watershed



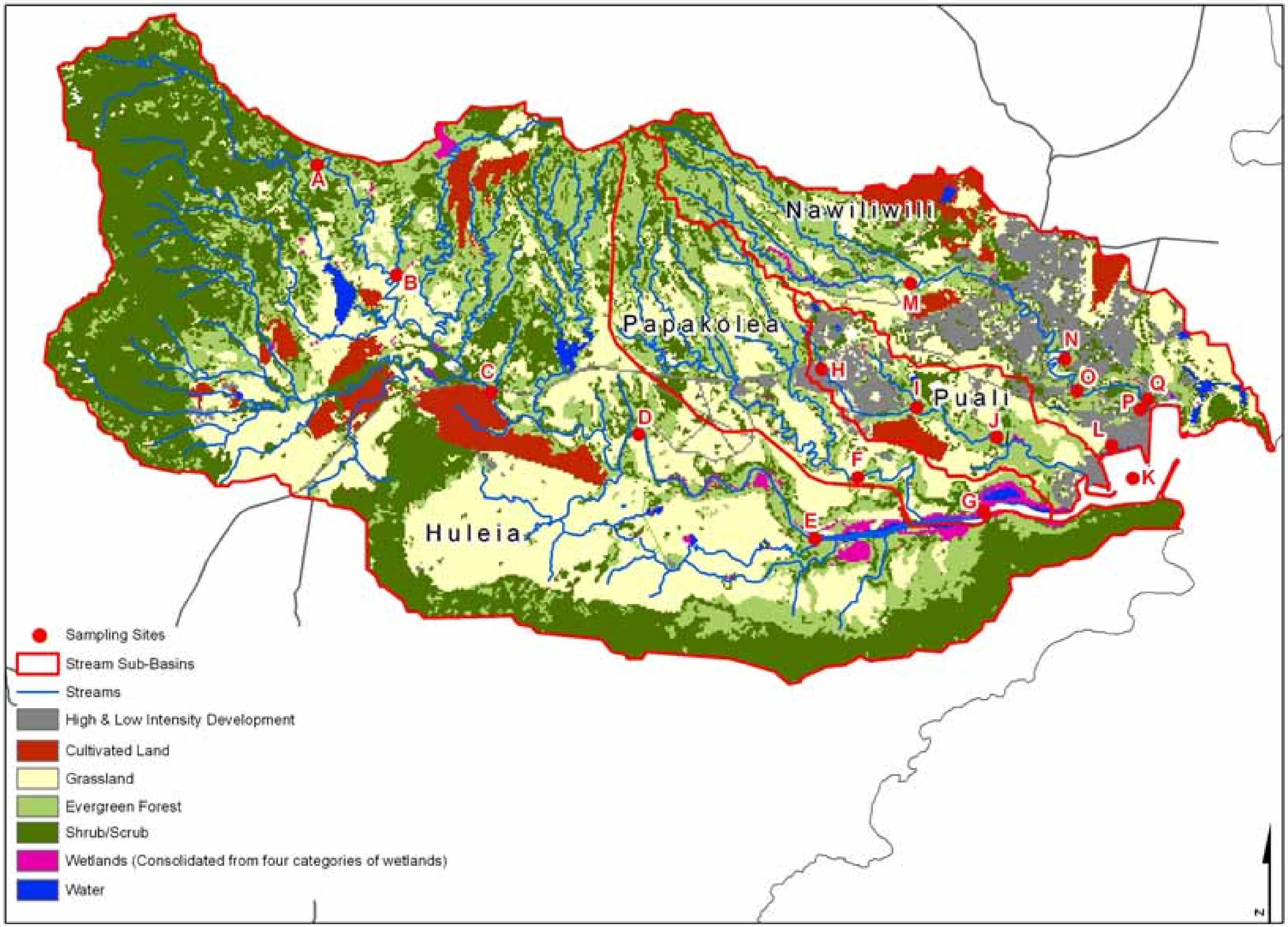
Areas of State Land Use Districts in Stream Sub-Basins

	Huleia		Nawiliwili		Papakolea		Puali	
	Acres	Percentage	Acres	Percentage	Acres	Percentage	Acres	Percentage
Agricultural	10,144	66%	2,133	50%	2,290	94%	596	46%
Conservation	5,295	34%	13	0%	112	5%	1	0%
Rural	0	0%	0	0%	0	0%	0	0%
Urban	0	0%	2,136	50%	45	2%	711	54%
Total	**15,439**	**100%**	**4,282**	**100%**	**2,447**	**100%**	**1,308**	**100%**

Table 1-4: Nawiliwili Bay Watershed - Consolidated Zoning (County of Kauai)

Zoning	Huleia		Nawiliwili		Papakolea		Puali	
	Acres	Percentage	Acres	Percentage	Acres	Percentage	Acres	Percentage
Commercial	0	0%	338	8%	0	0%	7	0%
Industrial	0	0%	140	4%	26	1%	84	6%
Residential	0	0%	690	16%	15	1%	327	26%
URBAN SUB-TOTAL	**0**	**0%**	**1168**	**28%**	**41**	**2%**	**418**	**32%**
Agriculture (Agricultural and Urban State LUD)	0	0%	24	1%	241	10%	351	27%
Open (Agricultural and Urban State LUD)	0	0%	508	12%	119	4%	451	35%
Sub-Urban Sub-total	**0**	**0%**	**532**	**13%**	**360**	**14%**	**802**	**62%**
Total Zoned	0	0%	1700	41%	401	16%	1220	94%
Total Unzoned (Conservation and Agricultural State LUD)	15439	100%	2582	59%	2046	84%	88	6%

Figure 1-6: Land Cover in the Nawiliwili Bay Watershed (NOAA C-CAP)



From NOAA Coastal Change Analysis Program Kauai Landsat ETM 2000

Table 1-5: Distribution of Land Cover Classes in the Nawiliwili Bay Watershed (NOAA C-CAP)

C-CAP Class	Nawiliwili Sub-Basin		Huleia Sub-Basin		Papakolea Sub-Basin		Puali Sub-Basin	
	Acres	Percentage	Acres	Percentage	Acres	Percentage	Acres	Percentage
Unclassified	0	0%	3	0%	0	0%	0	0%
High Intensity Development	263	6%	7	0%	14	1%	56	4%
Low Intensity Development	641	15%	105	1%	83	3%	263	20%
High and Low Intensity Development	**904**	**21%**	**112**	**1%**	**97**	**4%**	**319**	**24%**
Cultivated Land	641	15%	722	4%	11	0%	75	6%
Grassland	879	21%	4,409	30%	888	36%	401	31%
Evergreen Forest	1,040	24%	3,404	24%	897	37%	331	25%
Scrub/Shrub	710	17%	6,486	39%	461	19%	146	11%
Palustrine Forest Wetland	2	0%	14	0%	0	0%	0	0%
Palustrine Shrub/Scrub Wetland	18	0%	84	0%	3	0%	4	0%
Palustrine Emergent Wetland	1	0%	45	0%	0	0%	1	0%
Estuarine Forested Wetland	0	0%	13	0%	54	2%	2	0%
All Wetlands (Consolidated)	21	0%	156	1%	57	2%	7	0%
Unconsolidated Shore	1	0%	0	0%	0	0%	0	0%
Bare Land	38	1%	25	0%	7	0%	19	1%
Water	48	1%	121	1%	29	1%	9	1%
Total	4,282	100%	15,439	100%	2,447	100%	1,308	100%

Table 1-6: C-CAP Land Cover Class Definitions

C-CAP LAND COVER CLASS	DEFINITION
Unclassified	
High Intensity Development	Includes highly developed areas where people reside or work in high numbers. Impervious surfaces account for 80 to 100 percent of the total cover
Low Intensity Development	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 21 to 49 percent of total cover
Cultivated Land	Areas used for the production of annual crops. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
Grassland	Areas dominated by graminoid or herbaceous vegetation, generally greater than 80 percent of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
Scrub/Shrub	Areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes tree shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.
Palustrine Forest Wetland	Includes all tidal and nontidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.
Palustrine Shrub/Scrub Wetland	Includes all tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs, or trees that are small or stunted due to environmental conditions.
Palustrine Emergent Wetland	Includes all tidal and nontidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Plants generally remain standing until the next growing season. Total vegetation cover is greater than 80 percent.
Estuarine Forested Wetland	Includes all tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.
Unconsolidated Shore	Unconsolidated material such as silt, sand, or gravel that is subject to inundation and redistribution due to the action of water. Characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms representing this class.
Bare Land	Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earth material. Generally, vegetation accounts for less than 10 percent of total cover.
Water	All areas of open water, generally with less than 25 percent cover of vegetation or soil.

2.0 FIELD SAMPLING AND DATA ANALYSIS

Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

This section describes field sampling methods, discusses sampling results, and summarizes assessment decisions associated with water quality data obtained from the Huleia, Papakolea, Puali, and Nawiliwili Stream systems that was specifically designed for use in the TMDL analysis (primary data). Field sampling for primary and secondary data collection employed standard professional practice and procedure as guided and dictated by the DOH Quality Assurance (QA) program and various Quality Assurance Project Plans (QAPP). Following the standard practices and procedures, QA Program, and QAPP (Tetra Tech, Inc. 2002 for primary data) assured the desired integrity of the water quality samples and the use of data of known and acceptable quality in DOH decisions, as confirmed for primary data by EPA review of DOH data quality assessments (Kutnink 2005).

2.1 FIELD SAMPLING METHODS

The sampling methodology for primary data collection was designed to collect stream flow measurements and water quality samples from the four streams. Water quality measurements were to be collected from at least two points in each stream: at the mouth of the stream (where the freshwater segment enters the brackish waters of the Nawiliwili Bay estuary system), and at a location upstream above all major human disturbance) or at the location of major changes in surrounding land use. Sampling sites were selected to assess the main sources of nutrients and sediment and to assist in determining load allocations and load reductions associated with the TMDL analysis.

Samples were collected under baseline flow conditions and the across the widest possible variety of storm flow conditions to represent the fullest range of streamflow and runoff conditions. Stream flow was measured using standard area-velocity techniques and used to produce discharge rating curves for the measurement stations.

2.1.1 Selection of Monitoring Locations

Stream monitoring locations were determined based on the following criteria: (1) previous sampling results, (2) ease of access and security of equipment, and (3) upstream sources or land use conditions (such as the quarry above Huleia Stream at Halfway Bridge). Stream sampling locations were located above any estuarine conditions or influences. Table 2-1 lists the monitoring locations and the rationale for their selection. Sample locations are shown on Figures 1-3 and 1-4.

Table 2-1: Stream Monitoring Locations for Primary Data Collection*

Monitoring Location	Rationale for Selection
B - Kamooloa Stream	On a tributary of Huleia Stream above the diversion intake to the Waita reservoir. The tributary area for the sampling location is predominantly conservation lands with minimal agricultural impact.
C - Huleia Stream at Halfway Bridge	Downstream of the Jas A. Glover quarry immediately past the old bridge structure.
E - Huleia Stream at Stone Bridge	This location is immediately above the Huleia Estuary of Nawiliwili Bay.
F - Papakolea Stream	Downstream of fallow agricultural fields and residential housing areas. Below this location the stream flows through the Huleia National Wildlife Refuge and empties directly into the Huleia Estuary.
G - Huleia Estuary	This location is in the estuary across from the fishponds. Following select storm events, shallow and deep samples were collected from the freshwater-saltwater wedge.
J - Puali Stream	Downstream of fallow agricultural fields and residential housing areas. This stream flows through coastal wetlands and empties Nawiliwili Bay.
K - Nawiliwili Bay	This location is at the end of the breakwater. Following select storm events, shallow and deep samples were collected from the freshwater-saltwater wedge.
M - Upper Nawiliwili Stream	Upstream from most housing and agricultural areas along the Nawiliwili Stream.
O - Lower Nawiliwili Stream	Downstream of the former sugar mill and several residential and small agricultural areas. The sampling site is immediately downstream of a large storm water outfall draining Lihue town.

*Monitoring locations are shown on Figures 1-3 and 1-4.

2.1.2 Sample Collection during Baseline Flow Conditions

Water quality samples for evaluating pollutant concentrations during baseline flow conditions were collected monthly at the Kamooloa, Huleia at Halfway Bridge, Huleia at Stone Bridge, Upper Nawiliwili, Lower Nawiliwili, Papakolea, Puali, and Kipu Stream sites. Laboratory analytical results for turbidity, Total Nitrogen (TN), Total Phosphorus (TP), Nitrate+Nitrate Nitrogen (N+N), Total Suspended Solids (TSS), and total dissolved silica, provided by the DOH State Laboratory Division, are presented in Section 2.2.

Baseline flow conditions measured in the field included pH, temperature, conductivity, salinity, dissolved oxygen (DO), and turbidity (Appendix B). At each sample site, ambient conditions including air temperature, weather, and stream flow were also recorded.

2.1.3 Sample Collection during Storm Events

Storm event samples were collected using automated samplers during rain events at the Kamooloa, Huleia at Halfway Bridge, Huleia at Stone Bridge, Upper Nawiliwili, Lower Nawiliwili, Papakolea, and Puali stream locations. Post-storm grab samples were collected at the Huleia Estuary and Nawiliwili Bay locations, from the top and bottom of the freshwater-saltwater wedge.

2.1.3.1 Storm Event Sampling Methods - Streams

At each monitoring location, three of twelve samples collected from each of three separate storm events were to be analyzed. An ISCO 6712 automated sampler was used to collect a series of 12 samples during each storm event, assumed to be four hours long based on a regional rainfall analysis. The first sample was collected following a 0.5-foot increase in the water level of the stream, as measured by an automated differential pressure transducer. The 11 subsequent samples were collected at 20-minute intervals (equally-spaced across the four-hour design event). Any deviations from this sampling scheme, resulting from equipment malfunction, logistical difficulties, or adaptations to initial storm flow targeting objectives, did not adversely impact the TMDL decision, and all data used were deemed representative of true environmental conditions (see Appendix B).

Samples were retrieved following the event, and the hydrograph of the stream level for the event was downloaded from the ISCO sampler onto a laptop computer using ISCO's SAMPLINK™ software. Based on the hydrograph traces, up to three samples were retrieved from the sampler and delivered to the AECOS laboratory on Oahu for analysis. When possible, the samples were retrieved at the first flush, peak flow, and on the receding side of the hydrograph, consistent with the QAPP. The storm samples were analyzed for turbidity, TN, TP, N+N, and TSS.

The remaining nine samples were discarded and all bottles were replaced in the automatic sampler. All sampling equipment was flushed in the field with the water to be sampled, in accordance with standard protocols for such sampling. The automatic sampler was reprogrammed to continue to collect samples during the next storm event. Field technicians conducted any necessary maintenance during this time, including exchanging low batteries with freshly charged batteries, testing equipment operation, and exchanging desiccators.

2.1.3.2 Storm Event Sampling Methods - Huleia Estuary and Nawiliwili Bay

A two-point vertical profile of water column samples was collected at the Huleia Estuary and Nawiliwili Bay monitoring locations (Figures 1-3 and 1-4) as soon as possible after storm events, when the estuary and bay were still noticeably turbid and affected by the event. The distinction between surface (brackish to fresh) and salt-water samples in each profile was identified in the field by observations of changes in the salinity with depth.

Sample collection generally coincided with the falling side of the hydrograph for the stream locations. Samples were collected from the center of the estuary off the side of a boat. The estuarine samples were analyzed for turbidity, TN, TP, N+N, and TSS at the AECOS laboratory on Oahu.

2.1.4 Field Sampling Dates

This section presents the timing of all sampling events that collected primary data as directed by the QAPP. Additional stream, estuary, and spring samples were collected for diagnostic and screening purposes in conjunction with the base flow and storm sampling events. Complete analytical results are included in Appendix C.

Table 2-2: Sampling Events – Baseline Flow Conditions

Sample Collection Date	Stream Sample Locations						
	Upper Nawiliwili	Lower Nawiliwili	Kamooloa	Huleia at Halfway Bridge	Huleia at Stone Bridge	Papakolea	Puali
04/19/03	√	√	√	√	√		√
05/05/03	√	√	√	√	√	√	√
06/02/03	√	√	√	√	√	√	√
07/06/03	√	√	√	√	√	√	√
08/04/03	√	√	√	√	√	√	√
09/07/03		√	√	√	√	√	√
09/24/03							
10/05/03		√	√	√	√	√	√

Table 2-3: Sampling Events – Targeted Storm Flow Conditions

Sample Collection Date	Sample Locations								
	Upper Nawiliwili	Lower Nawiliwili	Kamooloa	Huleia at Halfway Bridge	Huleia at Stone Bridge	Papakolea	Puali	Huleia Estuary	Nawiliwili Bay
01/25/03					X				
02/14/03			X	X		X			X (at sea wall)
03/07/03	X	X	X	X	X	X	X	Y	Y
03/16/03								Y	Y
03/27/03		X		X					
03/30/03					X		X		
04/01/03		X	X	X		X		Y	Y
04/04/03		X	X	X	X	X		Y	Y
04/08/03		X	X		X				

X = Sample collected from automated samplers
Y = Samples collected from the top and the bottom of the water column

2.2 DATA SOURCES FOR WATERBODY IMPAIRMENT ANALYSIS

Water quality data used in this analysis are presented in Appendix C and were collected from the following sources:

- Tetra Tech primary sampling efforts for the TMDL analysis as described above;
- Data compiled by the State of Hawaii Department of Health for the 2006 303(d) list (Environmental Health Administration 2008); and
- Pathogen and turbidity data from the University of Hawaii Water Resources Research Center (WRRC) Assessment and Protection Plan for the Nawiliwili Watershed (El-Kadi et al. 2003).

In addition, only laboratory turbidity was used since there were calibration problems with field turbidity equipment used during the Tetra Tech sampling efforts. Furthermore, nutrient data from the WRRC was not used because the phosphate and nitrate + nitrogen results as reported were not equivalent or comparable to total phosphorus and nitrate + nitrite nitrogen data from other sources.

The data were assigned to three categories - Base, Storm, and Targeted Storm. Storm data were collected during periods of precipitation greater than the 80th percentile in the previous 3 days at one of the reference precipitation gauges (Omao, Lihue, and Lihue Airport) (see Tables 2-5 and 2-6). Targeted Storm data were collected on the dates in Table 2-3 when there was targeted storm sampling; many of these events have three samples collected on one date.

The initial 303(d) listings for these streams (in 2001) represent "legacy" assessment decisions that implied or stated the non-attainment of unspecified nutrient and sediment criteria under various streamflow regimes (and thus of various specific criteria including geomean, 10% NTE, and/or 2% NTE). The 2002-2006 process of validating and invalidating legacy assessment decisions solely on the basis of geomean criteria attainment means that a "delisting" of certain geomean criteria does not implicitly or explicitly delist legacy impairments tied to critical conditions. Thus current 303(d) listings for these streams pertain only to assessing the attainment of geomean criteria, rather than the 10% NTE and 2% NTE, and/or legacy impairment listings that have yet to be re-evaluated with numeric assessments. Due to uncertainty about how to weigh dry-weather baseline samples, wet-weather baseline samples, and targeted storm samples (including auto-sampling of storm events and manual sampling of storm event recession) in assessing attainment of the 10% NTE and 2% NTE numeric criteria, only dry-weather and wet-weather baseline samples were used by DOH in developing the 2006 303(d) list. In addition, listing decisions are based on the number of samples collected in wet and dry seasons, and consider whether photographs and visual assessments of the sampling locations and quality assurance documentation for the numeric data are available. Data from both upstream and downstream stations are aggregated to make listing decisions.

Papakolea Stream was not included in the 2006 303(d) list, however it is considered as a separate waterbody in this analysis since it discharges directly to Huleia Estuary, there is adequate sampling data to make a listing determination, and although there is only data from one monitoring station, the data are deemed representative of the entire stream. More information on the 303(d) listing rationale, including a flow chart of the priority ranking and listing/delisting process for conventional pollutants, can be found in the 2006 303(d) report (Environmental Health Administration 2008). Data used in the 303(d) report analysis for the Nawiliwili Bay watershed is included in Appendix C.

This TMDL analysis evaluated the water quality data with regard to the seasonal geomean (wet and dry) and wet season 10% NTE water quality criteria. Data used for evaluating geomean criteria included the data used in the 2006 303(d) list plus dry-weather and wet-weather baseline grab samples that are scheduled without regard to flow conditions (these are data from the Tetratech sampling efforts that were inadvertently not used in the 2006 303(d) listing decisions) plus turbidity and enterococcus data from the WRRC Phase 2 report (El-Kadi et al. 2003). For each stream, data from all stations were aggregated to determine compliance with water quality criteria.

Data from targeted sampling of stormflow conditions in 2003 (see Table 2-5) was intended to be used for addressing the critical conditions represented by the spectrum of 10% NTE and 2% NTE criteria, with the wet season 10% NTE criterion chosen for simplifying the endpoint at an intermediate critical condition. In addition, wet-weather baseline samples were added to the storm flow dataset; these samples are identified as samples collected on days when either the daily or previous three-day precipitation total is greater than the corresponding 80th percentile values. Two assumptions were made to support this analysis - the highest pollutant concentrations occurred during periods of high flow and high precipitation, and the geomean of the values greater than the 80th percentile would be equivalent to the 90th percentile value that is comparable to the 10% NTE value. This methodology was preferable to taking the 90th percentile value of the current data set; the inclusion of each individual data point from targeted storm sampling data (which resulted in multiple samples collected during a daily storm event) would have skewed the results. Also, since there were few storm flow data collected during the dry season, it was more appropriate to aggregate and compare to the wet season 10% NTE standard.

A waterbody is considered impaired by a pollutant (except for *enterococcus*) if the statistical analysis of the data produces exceedance of any of the 3 decision endpoints: the dry season geomean, wet season geomean, or the wet season 10% NTE criterion. For *enterococcus*, if the geomean of all data exceeds the geomean criterion then the waterbody is impaired. The analysis for the listing determinations is presented in Appendix D and summarized in Section 2.3 and Table 2-8.

Table 2-4: Sampling Dates with Lihue, Omao, and Lihue Airport Precipitation Data

Date	Baseflow, Storm, or Targeted Storm Event	Lihue			Omao			Lihue Airport		
		Precip (day)	3 prev days	7 prev days	Precip (day)	3 prev days	7 prev days	Precip (day)	3 prev days	7 prev days
01/22/01	Base							0.03	0.03	0.03
05/10/01	Base							0	0.07	0.20
07/23/01	Base							0.02	0.02	0.21
10/31/01	Base							0.04	0.05	0.69
11/28/01	Storm	0.12	2.54	2.54				1.03	5.45	5.45
02/27/02	Base	0	0.19	0.39				0	0.03	0.09
03/19/02	Base	0	0.01	1.58				0.03	0.16	0.56
03/20/02	Base	0	0	1.52				0.03	0.06	0.35
04/15/02	Base	0	0.02	0.08				0	0	0.19
04/22/02	Base	0	0.28	0.53				0	0.57	0.72
04/24/02	Base	0	0	0.39				0	0	0.62
05/07/02	Storm	0.42	1.33	1.33				0.11	0.30	0.31
05/14/02	Storm	0.97	2.56	3.18				0.05	1.89	2.31
05/16/02	Storm	0	0.97	2.98				0	0.73	2.69
05/20/02	Base	0.01	0.20	1.19				0.03	0.07	0.80
06/17/02	Base	0.04	0.05	0.51				0	0.16	0.52
06/24/02	Base	0	0.18	0.90				0.05	0.36	0.51
06/26/02	Base	0	0	0.52				0.01	0.06	0.44
07/08/02	Base	0.05	0.10	0.32				0.03	0.04	0.20
07/16/02	Base	0.03	0.19	0.30				0.05	0.06	0.17
07/24/02	Base	0.01	0.13	0.65				0.04	0.09	0.28
08/21/02	Base	0.01	0.15	0.35				0.01	0.06	0.26
09/25/02	Base	0	0	0.32				0	0	0.04
10/16/02	Base	0.17	0.18	0.56	0	0.09	0.41	0	2.22	2.29
11/04/02	Base	0	0.08	0.21	0.07	0.15	0.33	0	0.04	0.39
11/20/02	Base	0.05	0.24	1.58	0.02	0.44	2.14	0.09	0.21	1.47
11/25/02	Base	0.07	0.11	0.21	0	0.01	0.04	0.01	0.02	0.15
12/02/02	Base	0.06	0.06	0.72	0	0.01	0.64	0.03	0.03	0.89
01/13/03	Base	0	0	0.06	0.01	0.02	0.05	0	0.10	0.10
12/03/02	Base	0	0.06	0.71	0	0	0.50	0	0.03	0.89
12/04/02	Base	0	0.06	0.29	0	0	0.15	0	0.03	0.85
01/25/03	Targeted Storm	0.02	0.42	0.57	0.01	0.93	1.57	0.04	0.67	1.43
01/27/03	Base	0	0.02	0.42	0	0.03	0.96	0	0.04	0.67
02/10/03	Base	0	0	0.13	0.01	0.02	0.27	0	0	0.10
02/14/03	Targeted Storm	0.69	3.29	3.29	0.81	2.39	2.42	2.41	2.57	2.57
02/15/03	Storm	0	3.25	3.29	0	2.39	2.42	1.15	3.71	3.72
02/25/03	Base	0.03	0.24	0.37	0.01	0.60	0.71	0.02	0.09	0.14
03/06/03	Targeted Storm	1.90	1.90	2.15	1.68	1.72	2.16	1.87	1.87	2.25
03/07/03	Targeted Storm	0.05	1.95	2.03	0.01	1.71	1.82	0.77	2.64	2.96

Table 2-4 (continued):

Date	Baseflow, Storm, or Targeted Storm Event	Lihue			Omao			Lihue Airport		
		Precip (day)	3 prev days	7 prev days	Precip (day)	3 prev days	7 prev days	Precip (day)	3 prev days	7 prev days
03/10/03	Base	0	0	1.95	0.01	0.02	1.75	0.02	0.02	2.66
03/24/03	Base	0	0.01	0.03	0.01	0.04	0.08	0	0	0.12
03/27/03	Targeted Storm	0.13	0.38	0.39	0.43	0.94	1.00	0.61	0.61	0.66
03/30/03	Targeted Storm	2.00	2.02	2.40	2.33	2.39	3.34	0.07	0.46	1.07
04/01/03	Targeted Storm	0.03	2.32	2.72	0.02	2.73	3.73	0.04	2.33	3.33
04/04/03	Targeted Storm	0.20	1.03	3.37	0.68	1.38	4.16	0.14	0.59	2.92
04/05/03	Targeted Storm	0	0.59	3.35	0.06	0.98	4.17	0.04	0.24	2.96
04/08/03	Targeted Storm	0.01	0.54	1.57	0.01	0.60	2.04	0.13	0.30	0.93
04/19/03	Base	0.04	0.21	0.38	0.51	0.80	1.01	0	0.13	0.19
05/05/03	Base	0.01	0.15	0.22	0.01	0.25	0.34	0	0.01	0.19
06/02/03	Base	0	0	0	0.04	0.04	0.05	0	0	0
07/06/03	Base	0.11	0.14	0.26	0.06	0.11	0.47	0.01	0.06	0.19
07/20/03	Base	0.4	0.41	0.42	0.43	0.47	0.60	0.12	0.12	0.18
07/28/03	Storm	0.04	1.60	1.80	0.02	1.40	1.62	0.04	0.64	0.85
07/29/03	Storm	0.02	1.06	1.76	0.02	0.47	1.59	0	0.60	0.84
08/04/03	Base	0	0.06	0.20	0.07	0.37	0.64	0	0.03	0.12
09/07/03	Base	0	0.05	0.23	0.07	0.29	0.82	0	0.03	0.52
09/24/03	Base	0.08	0.09	0.34	0.30	0.4	0.64	0.02	0.14	0.15
10/05/03	Base	0.08	0.17	1.10	0.06	0.15	0.69	0.06	0.71	0.74
80th Percentile Value		0.14	0.46	1.16	0.16	0.54	1.19	0.08	0.3	0.77
90th Percentile Value		0.25	0.75	1.95	0.32	0.83	1.75	0.18	0.63	1.45
98th Percentile Value		1.08	2.32	3.35	0.82	1.72	3.05	0.99	2.65	4.73

Note: Blank Precipitation Values signifies data not available.

Table 2-5: Baseline Flow and Storm Flow Events By Date, with Data Source

Date	Collected By Tetra Tech	WRRC Phase 2 Report	Compiled for DOH 303(d) List	Baseline, Storm, or Targeted Storm Event
01/22/01			x	Base
05/10/01			x	Base
07/23/01			x	Base
10/31/01		x		Base
11/28/01		x		Storm
02/27/02		x		Base
03/19/02		x		Base
03/20/02		x		Base
04/15/02			x	Base
04/22/02		x		Base
04/24/02		x		Base
05/07/02			x	Storm
05/14/02		x		Storm
05/16/02		x		Storm

Table 2-5 (continued):

Date	Collected By Tetratech	WRRC Phase 2 Report	Compiled for DOH 303(d) List	Baseflow, Storm, or Targeted Storm Event
05/20/02			x	Base
06/17/02			x	Base
06/24/02		x		Base
06/26/02		x		Base
07/08/02			x	Base
07/16/02		x		Base
07/24/02		x		Base
08/21/02		x		Base
09/25/02		x		Base
10/16/02		x		Base
11/04/02			x	Base
11/20/02		x		Base
11/25/02		x		Base
12/02/02			x	Base
01/13/03			x	Base
12/03/02			x	Base
12/04/02			x	Base
01/25/03	x			Targeted Storm
01/27/03			x	Base
02/10/03			x	Base
02/14/03	x			Targeted Storm
02/15/03	x			Storm
02/25/03			x	Base
03/06/03				Targeted Storm
03/07/03	x			Targeted Storm
03/10/03			x	Base
03/24/03			x	Base
03/27/03	x			Targeted Storm
03/30/03				Targeted Storm
04/01/03	x			Targeted Storm
04/04/03	x			Targeted Storm
04/05/03	x			Targeted Storm
04/08/03	x			Targeted Storm
04/19/03				Base
05/05/03	x		x	Base
06/02/03	x		x	Base
07/06/03	x		x	Base
07/20/03			x	Base
07/28/03			x	Storm
07/29/03			x	Storm
08/04/03	x		x	Base
09/07/03	x		x	Base
09/24/03	x		x	Base
10/05/03	x		x	Base

2.3 Water Quality Sampling Results and Analysis

2.3.1 Baseline Flow Sampling Results

Figures 2-1 through 2-5 present the results of laboratory analysis for Total Suspended Solids (TSS), Nitrate + Nitrite (N+N), Total Nitrogen (TN), Total Phosphorus (TP), and Turbidity for samples collected during baseline streamflow conditions.

- Total Suspended Solids – Under baseline flow conditions, TSS values typically did not exceed those established by geometric mean water quality criteria, and did not exhibit much event-to-event variation. Outliers include April 19, 2003 values from the Nawiliwili Upper and Lower sampling locations, with TSS levels also elevated (but less so) at the Kamooloa and Puali sampling locations. This could be an expression of post-storm conditions after a rainfall event on April 11, 2003. TSS levels were also elevated at the Puali location on June 17, 2002 and May 5, 2003.
- Nitrate + Nitrite – N + N concentrations tended to progressively increase downstream. Almost all Dry Season sample values exceeded those established by the geometric mean water quality criterion except for that from Upper Puali on July 7, 2002. In particular, the geometric mean of all samples collected at both Lower and Upper Nawiliwili and Papakolea were at least five times greater than the dry season criterion.
- Total Nitrogen – During baseline flow periods in the Huleia Stream, TN concentrations typically do not exceed those established by geometric mean water quality criteria, except at Stone Bridge. In Nawiliwili, Papakolea, and Puali streams, all TN values are greater than those established by the geometric mean water quality criteria except for two samples from Puali (July 8 and November 4, 2002). TN levels in the Nawiliwili Stream system are generally 5 times those established by the water quality criteria, and are approximately 2-3 times greater than the criteria values in Puali and Papakolea.
- Total Phosphorus – During baseline flow periods, TP concentrations typically do not exceed those established by the geometric mean water quality criteria, with the exception of the Upper Nawiliwili sampling location. Elevated Dry Season levels were also noted once at Lower Nawiliwili and twice at Lower Puali. Most of the sampling results shown in the graph are below the 20μg/L level.
- Turbidity – None of the Upper Nawiliwili sample concentrations exceeded the levels established by the geometric mean water quality criteria. However, all of the remaining samples from all the streams exceeded the value of the Dry Season criterion (except for one sample at Kamooloa and one at Stone Bridge). During wet season, 86% of Lower Nawiliwili samples, half of the Stone Bridge samples and roughly a third of the Kamooloa, Halfway Bridge, and Lower Puali turbidity values were greater than that established by the Wet Season turbidity criterion.

2.3.2 Storm Flow Sampling Results

Figures 2-6 through 2-10 present the results of laboratory analysis for TSS, N+N, TN, TP, and turbidity for samples collected during storm flow conditions in streams. A review of the recorded rainfall indicates that none of the recorded storms were larger than the 1-year storm event (5” in 24 hours). Figures 2-6 through 2-10 also show the daily precipitation recorded for the four rainfall gauges in the area.

- TSS – During sampled storm flow conditions, TSS concentrations exceeded the level established by the Wet Season 10% not to exceed water quality criterion throughout most events. The spatiotemporal variation in TSS concentrations may indicate that channel erosion is a major contributor to suspended sediment loading.
- N+N – During sampled storm flow conditions, all samples from Lower Puali and Papakolea, and most samples from Lower Nawiliwili, exceeded the level established by the Wet Season 10% not to exceed water quality criterion. On the other hand, only four of the 44 samples from the remaining sites (Upper Nawiliwili and Kamooloa, Halfway Bridge, and Stone Bridge in the Huleia sub-basin) exceeded this level. This represents a dilution effect that occurs during stormflows. In Puali and Papakolea, the higher N+N values may indicate enhanced groundwater contributions to streamflow during storm events, with the high ambient groundwater N+N concentrations possibly enhanced by leaching from wastewater disposal systems and surface fertilizer applications.
- TN – During sampled storm flow conditions, TN concentrations exceeded the level established by the Wet Season 10% not to exceed water quality criterion at nearly every location during every sampled storm event in Nawiliwili, Puali, and Papakolea Streams. The Papakolea Stream and Lower Nawiliwili sampling locations consistently have the highest recorded TN. However, roughly a quarter of the samples from Kamooloa, Halfway Bridge, and Stone Bridge in the Huleia sub-basin also exceeded the level established by the Wet Season 10% not to exceed water quality criterion.
- TP – During sampled storm flow conditions, the TP concentrations were usually below the level established by the Wet Season 10% not to exceed water quality criterion. The Lower Nawiliwili and Papakolea locations had the greatest spikes in sampled concentrations above this level.
- Turbidity – During sampled storm conditions, most of the turbidity values exceeded the level established by the Wet Season 10% not to exceed water quality criterion, except those from Stone Bridge, where only 59% of the samples exceeded this level. Turbidity levels were highest in the Nawiliwili and Papakolea watersheds.

Figure 2-1: Water Quality Sampling Results - Baseline Flows, Total Suspended Solids

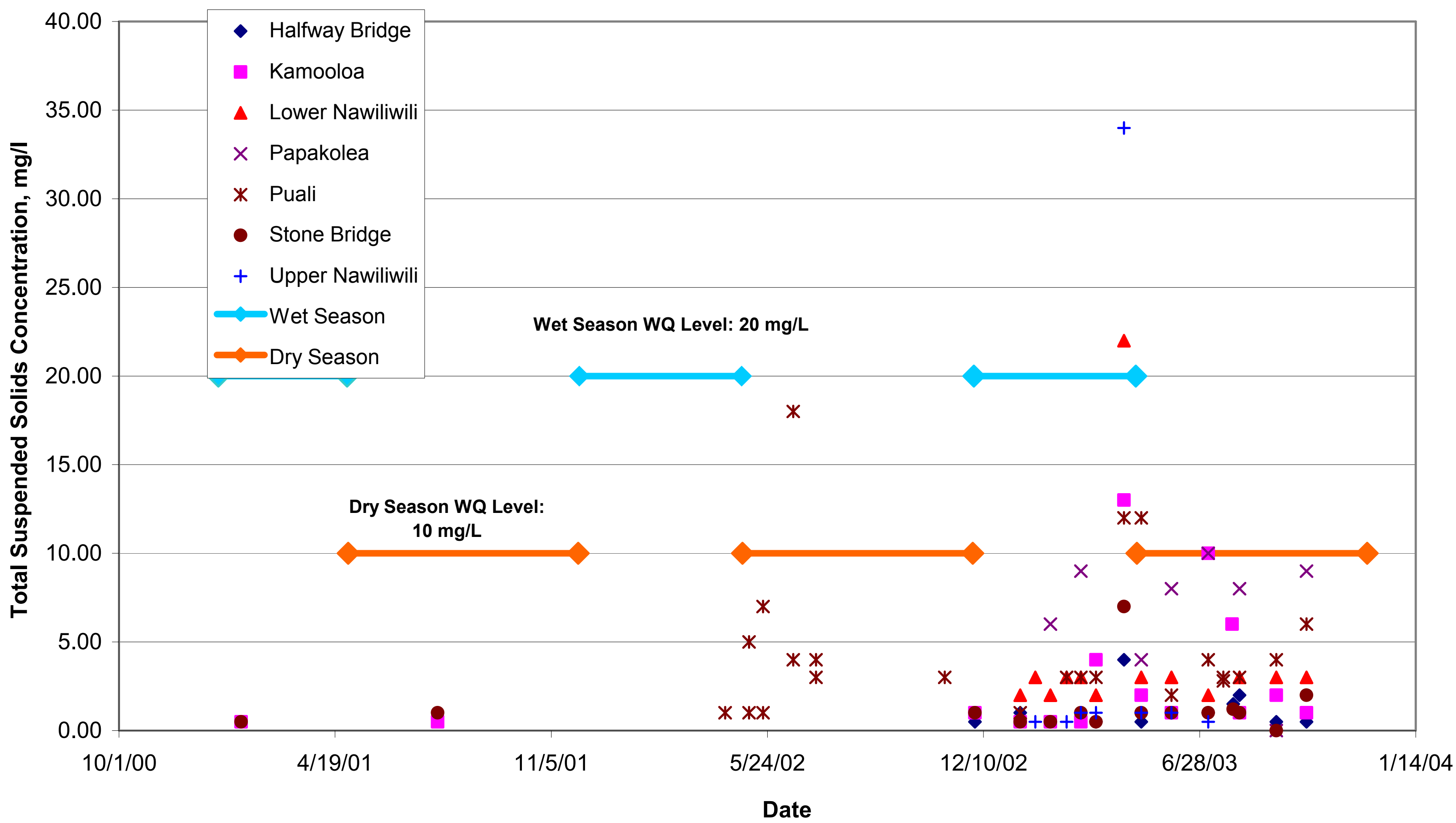


Figure 2-2: Water Quality Sampling Results - Baseline Flows, Nitrate + Nitrite

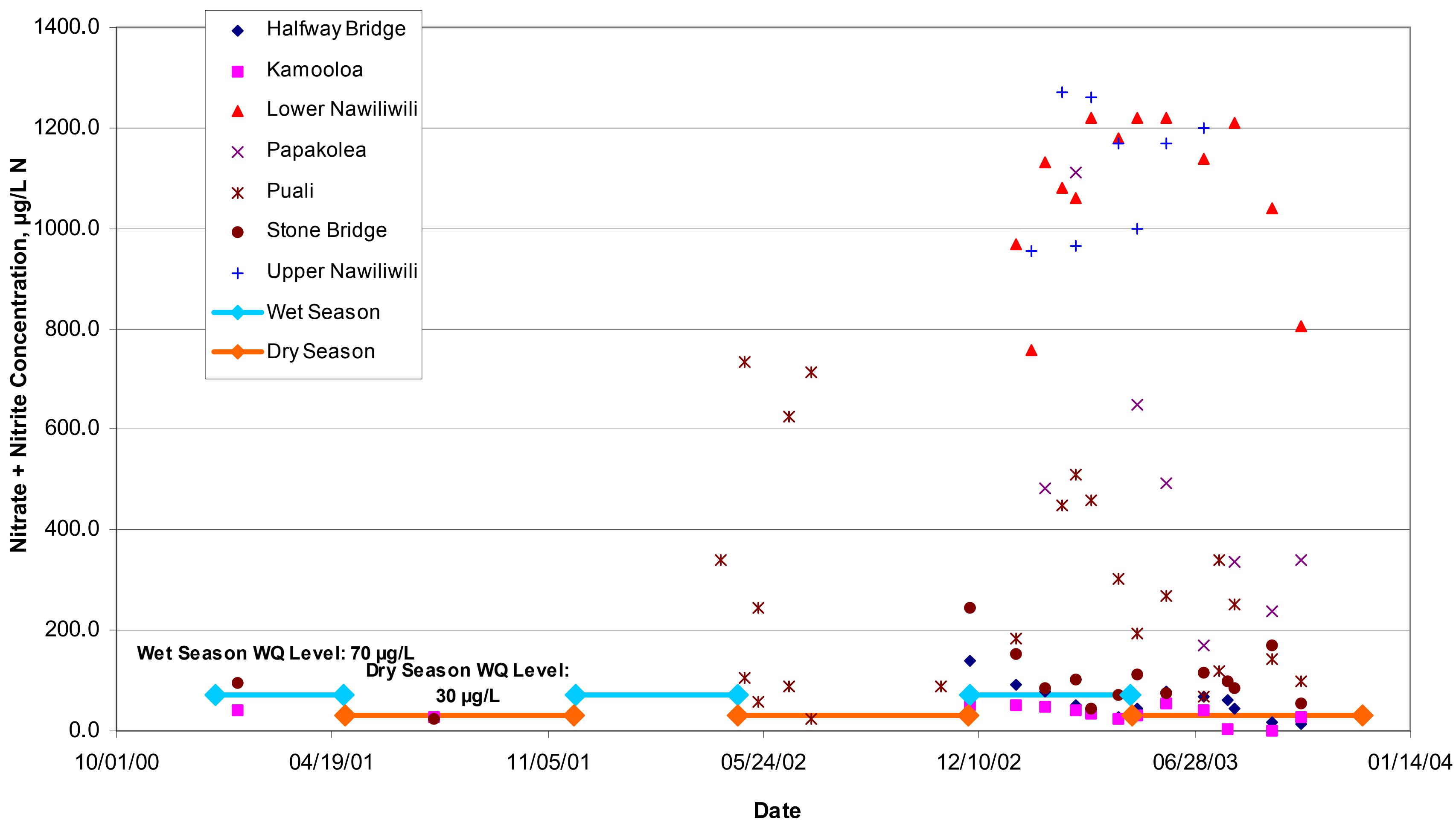


Figure 2-3: Water Quality Sampling Results - Baseline Flows, Total Nitrogen

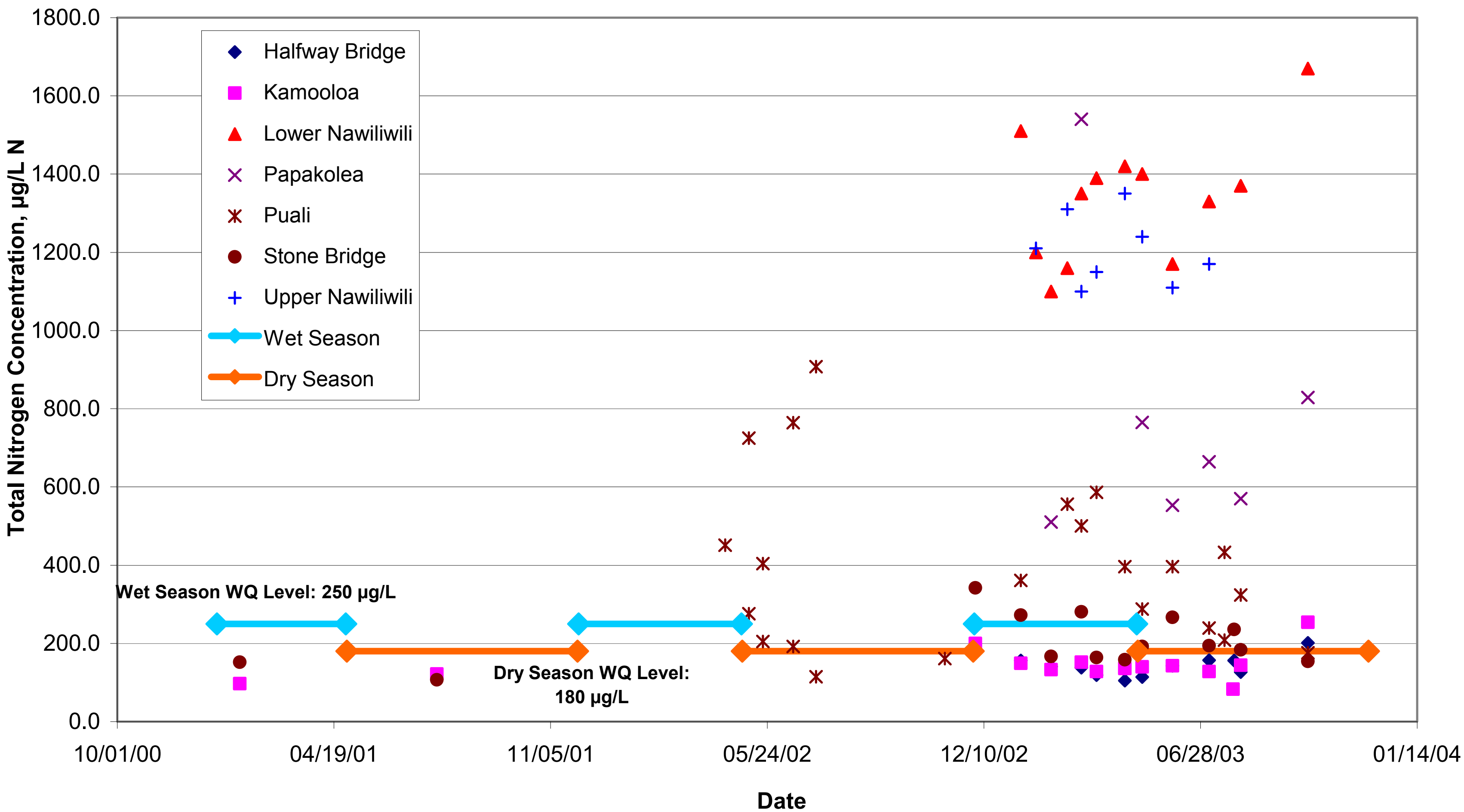


Figure 2-4 Water Quality Sampling Results - Baseline Flows, Total Phosphorus

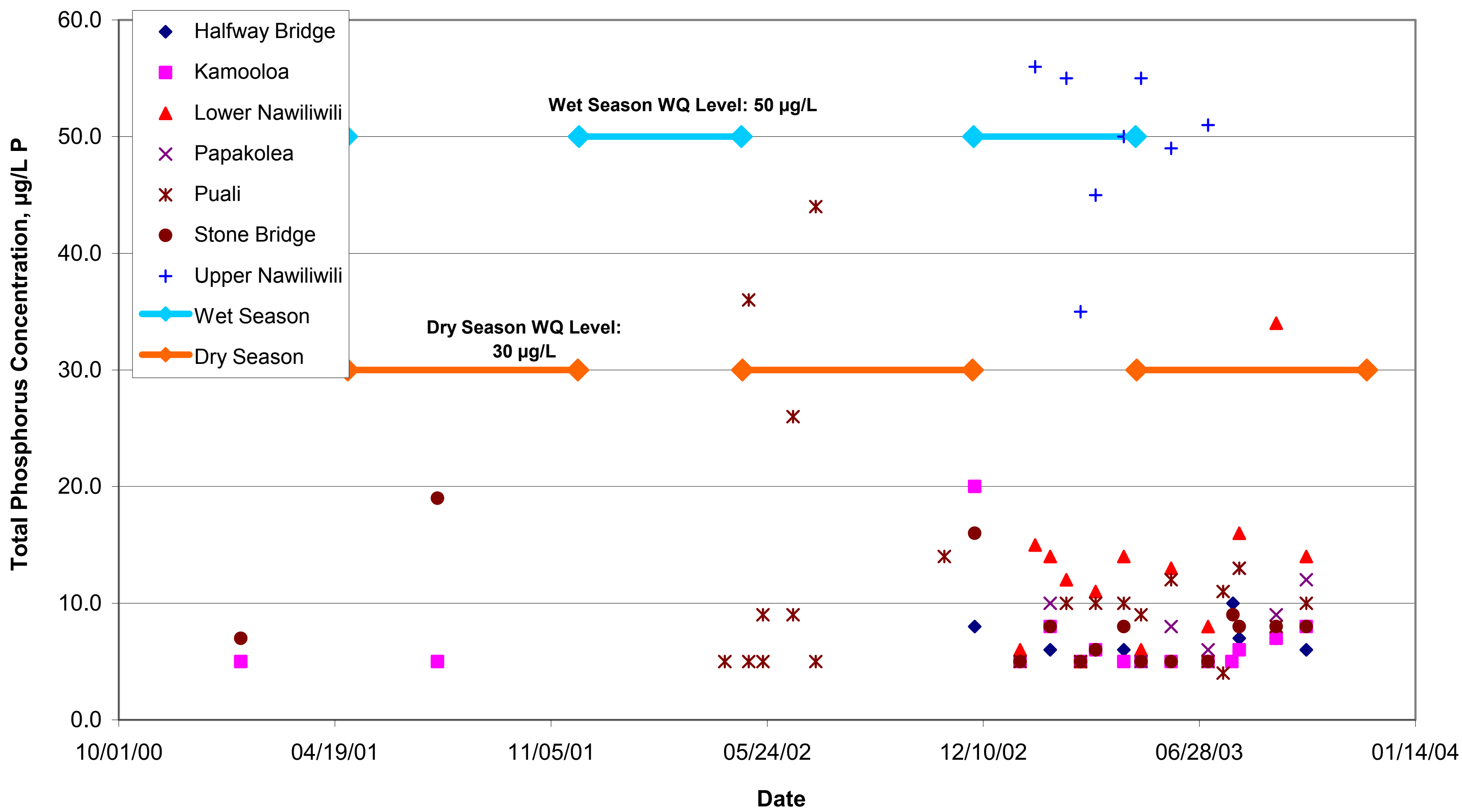


Figure 2-5: Water Quality Sampling Results - Baseline Flows, Lab Turbidity

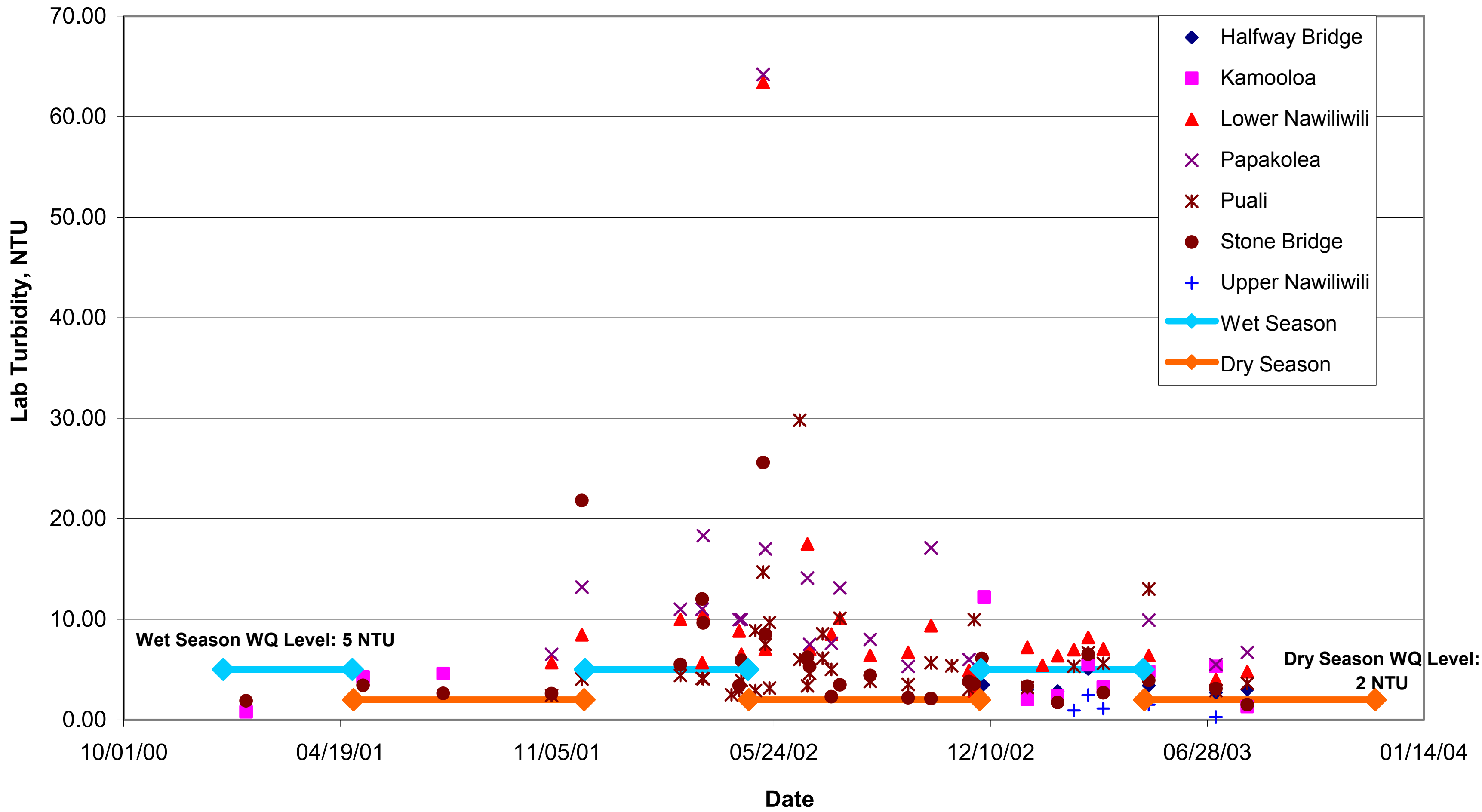


Figure 2-6: Water Quality Sampling Results - Storm Flows, Total Suspended Solids

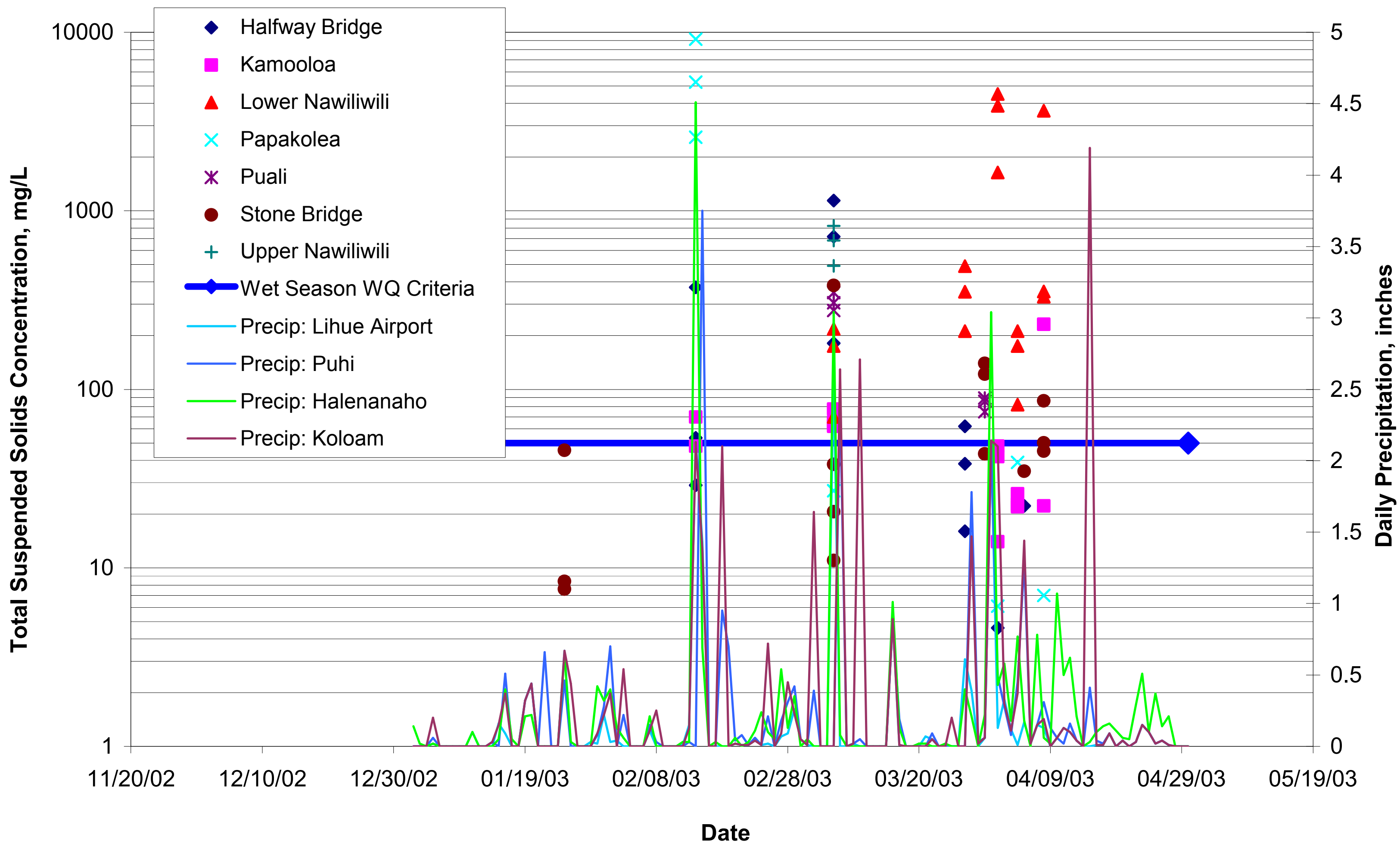


Figure 2-7: Water Quality Sampling Results - Storm Flows, Nitrate + Nitrite

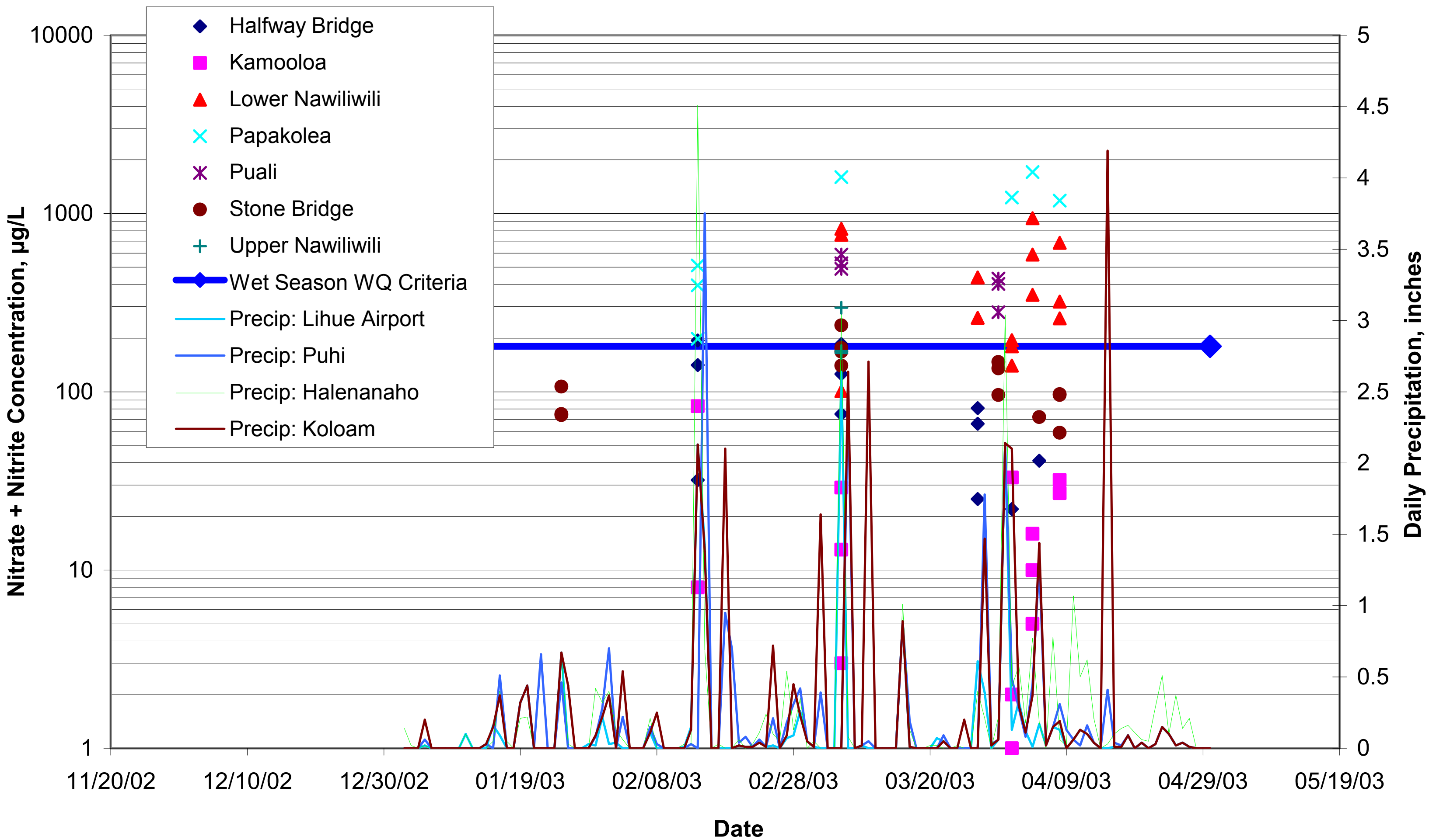


Figure 2-8: Water Quality Sampling Results - Storm Flows, Total Nitrogen

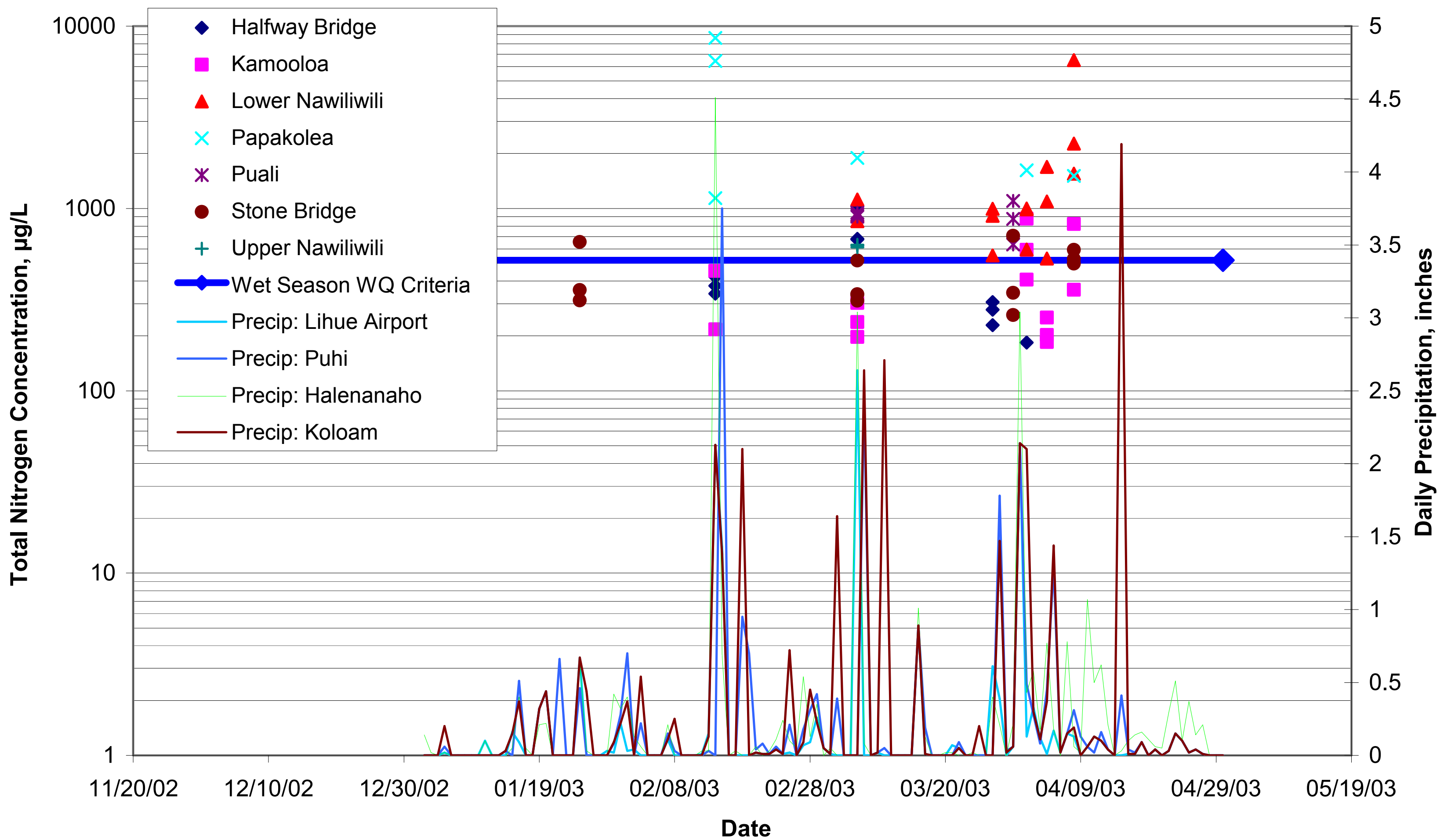


Figure 2-9: Water Quality Sampling Results - Storm Flows, Total Phosphorus

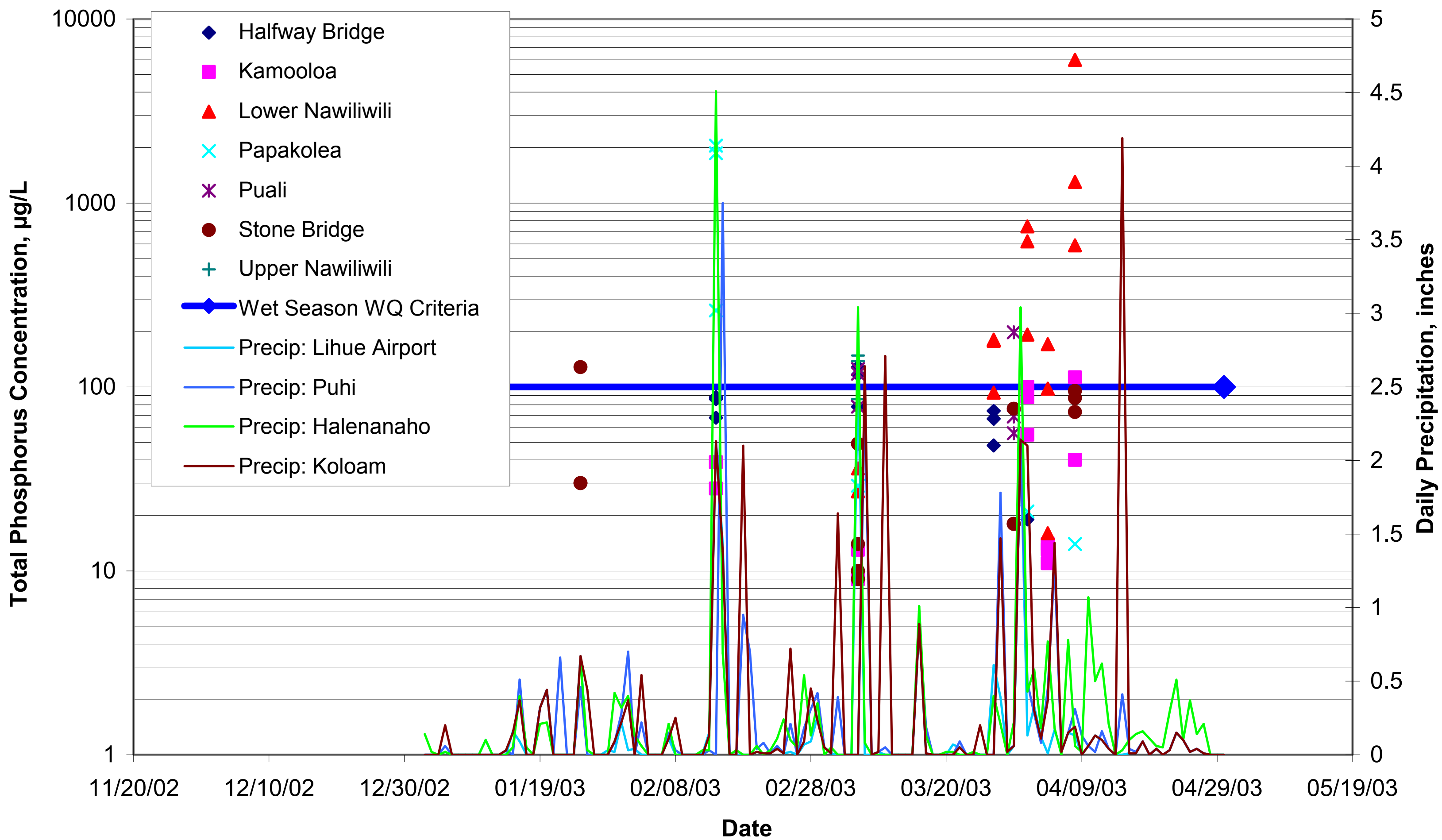
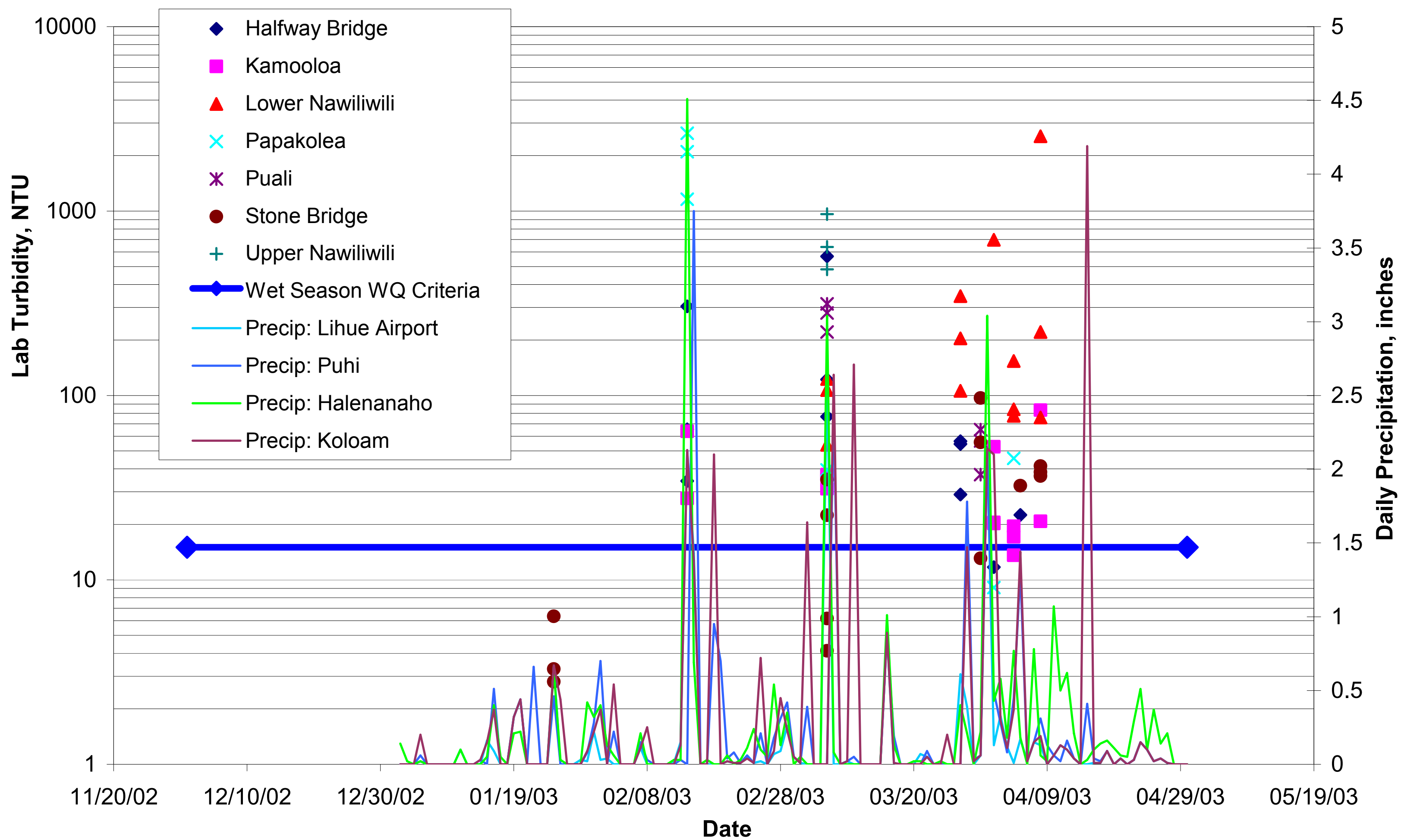


Figure 2-10: Water Quality Sampling Results - Storm Flows, Lab Turbidity



2.3.3 Correlation of Water Quality Parameters

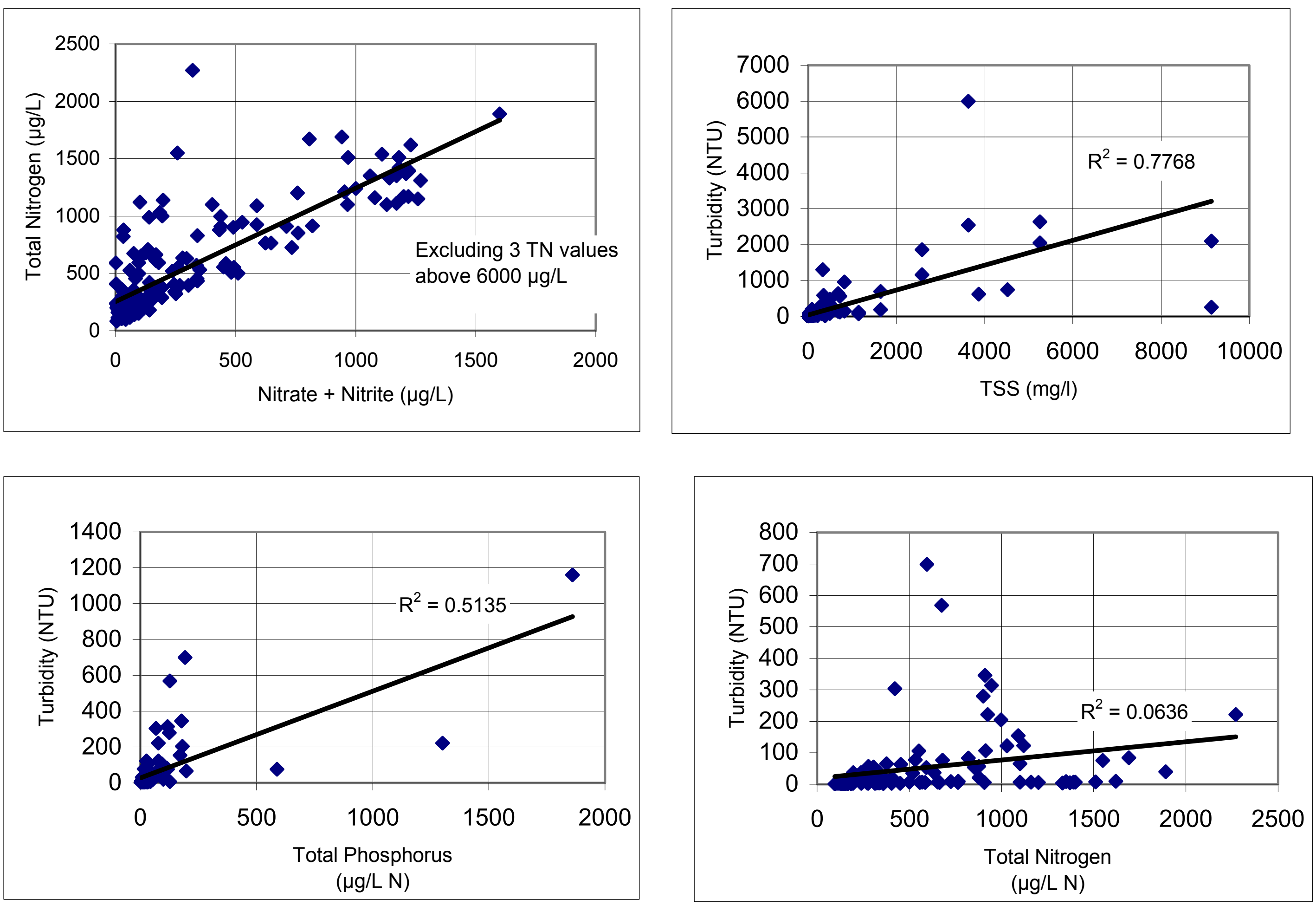
For all streams, the observed N+N level and TN concentration are closely correlated, as shown in Figure 2-12, indicating that efforts to reduce total nitrogen loadings will also result in a reduction in N+N loadings.

Turbidity is caused by suspended solids and nutrient loadings and biogeochemical processes in the stream; reaching TSS and nutrient loading targets will likely result in the attainment of turbidity water quality standards. The figure below also presents the relationship between turbidity and TSS, TP and TN. Turbidity measurements are well correlated with both TSS and TP measurements that occurred during storm events, with R^2 of 0.777 and 0.514, respectively. On the other hand, nitrogen enters the stream through both groundwater inflow and overland runoff; turbidity and total nitrogen aren't well correlated but most elevated turbidity readings occur when TN is above 500 µg/L.

Figure 2-12: Correlation of Water Quality Parameters

TN versus N + N

Turbidity versus TSS



Turbidity versus TP

Turbidity versus TN

2.3.4 Summary of Water Quality Sampling Results

The results indicate that under baseline flow conditions, the geometric mean (GM) water quality criteria were exceeded for TN at Stone Bridge (dry season only), Upper and Lower Nawiliwili Stream, Puali Stream, and Papakolea Stream (see Table 2-6). The N+N GM criteria were exceeded at all stations except for Kamooloa and Halfway Bridge (wet season). The GM criteria for TP were met for all stations except at Upper Nawiliwili in the dry season. The GM water quality criteria for TSS were met at all stations. The dry season turbidity GM criterion was exceeded at all stations except for Upper Nawiliwili. On the other hand all stations met the wet season turbidity GM criterion except for Lower Puali and Upper Nawiliwili.

Under storm flow conditions (see Table 2-7), the storm GM exceeded the wet season 10% NTE criteria for all pollutants at all locations in the Nawiliwili and Papakolea sub-basins, and at Lower Puali[1]. In the Huleia sub-basin, the wet season 10% NTE criteria were exceeded for turbidity at all stations and for TSS at Halfway Bridge; otherwise most of the storm GM met the 10% NTE criteria.

The 303(d) listing determination for each waterbody was made by calculating the GM of the combined data from all stations (see Table 2-8). For baseline flow conditions, all streams met the water quality criteria for TSS and TP. Huleia stream did not meet the GM dry weather criteria for N+N and turbidity. Papakolea, Nawiliwili, and Puali exceeded wet and dry season GM criteria for N+N, TN and turbidity - with the exception of wet season turbidity in Puali. For storm conditions, Nawiliwili, Puali and Papakolea storm GM exceed the wet season 10% NTE levels for all criteria with the exception of Puali TP. Huleia storm GM met the 10% NTE levels for all criteria except for turbidity. Finally, the *Enterococcus* GM standard was exceeded in all four streams (see Appendix D, Table D-14).

A waterbody is considered impaired by a pollutant if it fails to meet any of the three criteria. Papakolea and Nawiliwili streams are impaired for all six conventional pollutants (TSS, N+N, TN, TP, Turbidity, and *Enterococcus*). Puali stream is impaired for five pollutants and meets water quality standards for TP. Huleia stream exceeds standards for N+N, Turbidity and *Enterococcus* and meets standards for TSS, TN, and TP. In all, the four major streams (waterbodies) in the Nawiliwili Bay watershed exceed standards for 20 waterbody-pollutant combinations.

[1] Only one storm sample was taken at Upper Puali.

Table 2-6: Summary of Baseline Water Quality Data for the Nawiliwili Bay Watershed: Geometric Mean, Number of Exceedances, and Number of Samples

Locations	Season	TSS (mg/L)		N + N (μg/L)		TN (μg/L)		TP (μg/L)		Turbidity (NTU)	
		GM	Exceed	GM	Exceed	GM	Exceed	GM	Exceed	GM	Exceed
Huleia Stream											
Kamooloa	Wet	1.18	0 / 7	39.8	0 / 7	139	0 / 7	6.69	0 / 7	3.06	2 / 6
	Dry	1.82	0 / 8	15.9	3 / 7	138	1 / 7	5.66	0 / 8	**3.65**	4 / 5
Halfway Bridge	Wet	0.89	0 / 6	61.8	3 / 6	138	0 / 6	5.92	0 / 6	3.36	1 / 5
	Dry	0.87	0 / 7	**40.6**	5 / 7	147	1 / 6	6.24	0 / 7	**3.02**	3 / 3
Stone Bridge	Wet	0.89	0 / 7	**101**	6 / 7	209	3 / 7	7.27	0 / 7	4.88	7 / 14
	Dry	1.13	0 / 7	**80.1**	7 / 8	**184**	5 / 7	7.58	0 / 8	**3.80**	14 / 15
All Huleia	Wet	0.98	0 / 20	62.8	9 / 20	160	3 / 20	6.64	0 / 20	4.05	10 / 25
	Dry	1.24	0 / 22	**38.6**	15 / 22	156	7 / 20	6.45	0 / 23	**3.66**	21 / 23
Nawiliwili Stream											
Upper Nawiliwili	Wet	1.53	1 / 5	**1115**	5 / 5	**1220**	5 / 5	47.5	2 / 5	1.37	0 / 3
	Dry	0.79	0 / 3	**1120**	3 / 3	**1172**	3 / 3	**51.6**	3 / 3	0.62	0 / 2
Lower Nawiliwili	Wet	3.35	1 / 7	**1046**	7 / 7	**1297**	7 / 7	10.2	0 / 7	**6.75**	12 / 14
	Dry	2.80	0 / 6	**1095**	6 / 6	**1377**	5 / 5	13.0	1 / 6	**8.55**	13 / 13
All Nawiliwili	Wet	2.42	2 / 12	**1074**	12 / 12	**1264**	12 / 12	19.4	2 / 12	**5.10**	12 / 17
	Dry	1.84	0 / 9	**1103**	9 / 9	**1297**	8 / 8	20.6	4 / 9	**6.03**	13 / 15
Puali Stream											
Upper Puali	Wet										
	Dry	4.26	1 / 5	**85.1**	4 / 5	**222**	4 / 5	5.38	0 / 5	**9.20**	4 / 4
Lower Puali	Wet	2.67	0 / 7	**292**	7 / 7	**402**	6 / 7	7.80	0 / 7	4.35	5 / 14
	Dry	3.54	1 / 10	**234**	11 / 11	**382**	9 / 10	13.3	2 / 11	**5.32**	17 / 17
All Puali	Wet	2.67	0 / 7	**292**	7 / 7	**402**	6 / 7	7.80	0 / 7	4.35	5 / 14
	Dry	3.77	2 / 15	**171**	15 / 16	**319**	13 / 15	10.0	2 / 16	**5.90**	21 / 21
Papakolea Stream											
Papakolea (1 station)	Wet	7.35	0 / 2	**731**	2 / 2	**866**	2 / 2	7.07	0 / 2	**9.47**	7 / 8
	Dry	7.46	0 / 5	**377**	6 / 6	**678**	5 / 5	8.34	0 / 6	**10.5**	13 / 13
GM Criterion	Wet	20		70		250		50		5	
	Dry	10		30		180		30		2	

Notes:
Values shown represent GM of WQ sampling effort.
Bold font denotes exceedance
Blank spaces indicate no data was collected

mg/L Milligrams per liter
μg/L Micrograms per liter
TSS Total Suspended Solids
N + N Nitrate + Nitrite
TN Total nitrogen
TP Total phosphorus

Table 2-7: Summary of Storm Water Quality Data for the Nawiliwili Bay Watershed: Geometric Mean, Number of Exceedances, and Number of Samples

Locations	TSS (mg/L)		Nitrate + Nitrite (μg/L)		TN (μg/L)		TP (μg/L)		Turbidity (NTU)	
	GM	Exceed	GM	Exceed	GM	Exceed	GM	Exceed	GM	Exceed
Huleia Stream										
Kamooloa	37.8	5 / 14	10.4	0 / 14	308	3 / 14	25.0	1 / 14	**29.5**	12 / 13
Halfway Bridge	**53.1**	6 / 12	68.9	2 / 12	363	3 / 11	58.4	2 / 11	**64.9**	10 / 11
Stone Bridge	32.9	5 / 15	110	1 / 15	405	4 / 14	31.5	1 / 14	**16.9**	10 / 17
All Huleia	39.7	16 / 41	42.9	3 / 41	356	10 / 39	34.5	4 / 41	**28.9**	32 / 41
Nawiliwili Stream										
Upper Nawiliwili	**651**	3 / 3	**202**	1 / 3	**623**	3 / 3	**121**	2 / 3	**667**	3 / 3
Lower Nawiliwili	**434**	15 / 15	**354**	12 / 15	**1124**	15 / 15	**183**	9 / 15	**112**	14 / 16
All Nawiliwili	**464**	18 / 18	**322**	13 / 18	**1019**	18 / 18	**171**	11 / 18	**148**	17 / 19
Puali Stream										
Upper Puali	1.00	0 / 1	105	0 / 1	276	0 / 1	5.00	0 / 1	2.90	0 / 1
Lower Puali	**97.6**	6 / 6	**475**	7 / 7	**861**	7 / 7	84.9	3 / 7	**40.0**	6 / 9
All Puali	**55.1**	6 / 8	**393**	7 / 8	**747**	7 / 8	59.6	3 / 8	**31.5**	6 / 10
Papakolea Stream										
Papakolea (1 station)	**178**	3 / 7	**769**	7 / 7	**2575**	6 / 6	**143**	3 / 6	**136**	7 / 8
Wet 10% NTE Criterion	50		180		520		100		15	
Dry 10% NTE Criterion	30		90		380		60		5.5	

Notes:
Values shown represent GM of WQ sampling effort.
Bold font denotes exceedance
Blank spaces indicate no data was collected

mg/L	Milligrams per liter
μg/L	Micrograms per liter
TSS	Total Suspended Solids
N + N	Nitrate + Nitrite
TN	Total nitrogen
TP	Total phosphoru

Table 2-8: Waterbody Impairment Summary for Nawiliwili Bay Watershed

	Nawiliwili		**Puali**		**Huleia**		**Papakolea**	
Geocode ID	2-2-13		2-2-14		2-2-15		to be assigned	
Season	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
2006 303(d) List								
Total Nitrogen (TN)	**Not Attained**	**Not Attained**	**Not Attained**	**Not Attained** (with combined season data)	**Not Attained**	Attained		
NO3+NO2 (N+N)	**Not Attained**	**Not Attained**	**Not Attained**	**Not Attained** (by 2 times the standard)	**Not Attained**	Attained (Not Attained in 2004)		
Total Phosphorus (TP)	Attained	Attained	Attained	Attained (with combined season data)	Attained	Attained		
Turbidity	**Visual listing** from 2001-2004	Attained (Not Attained in 2004)	**Not Attained** (by 2 times the standard)	**Not Attained** (by combined data, 2 times the standard)	**Visual listing** from 2001-2004	Attained		
Other Pollutants	TSS (Attained)	TSS (Attained)	TSS (Attained)	TSS (Attained with combined seasonal data)	TSS (Attained)	TSS (Attained)		
Category	3, 5	3, 5	3, 5	3, 5	3, 5	3, 5		
2006 303(d) List	TN, NO3+NO2, Turbidity		TN, NO3+NO2, Turbidity		TN, NO3+NO2, Turbidity			
From TMDL Analysis								
Base	N+N, TN, Turbidity	N+N, TN, Turbidity	N+N, TN, Turbidity	N+N, TN	N+N, Turbidity		N+N, TN, Turbidity	N+N, TN, Turbidity
	Enterococcus		Enterococcus		Enterococcus		Enterococcus	
Storm	TSS, N+N, TN, TP, Turbidity		TSS, N+N, TN, Turbidity		Turbidity		TSS, N+N, TN, TP, Turbidity	
Combined (Base + Storm)	**TSS, N+N, TP, TN, Turbidity, Enterococcus**		**TSS, N+N, TN, Turbidity, Enterococcus**		**N+N, Turbidity, Enterococcus**		**TSS, N+N, TN, TP, Turbidity, Enterococcus**	

3.0 LOAD ANALYSIS

The purpose of this section is to analyze the loading of pollutants into the four major streams of the Nawiliwili Bay watershed. We first assess the known and suspected nonpoint and point sources of sediment, nutrients, and bacterial indicator (Source Assessment). Next, we establish the relationships between these pollutant sources, State water quality goals, and the maximum allowable pollutant loading that will still achieve these goals (Linkage Methodology). The results of a regional hydrologic analysis are used to estimate streamflows, which provides the basis for calculating allowable pollutant loading (TMDL), existing loading conditions, and the reductions in loading required to achieve water quality goals.

3.1 SOURCE ASSESSMENT

3.1.1 Nonpoint Sources – Sediment and Nutrients

Nonpoint sources of pollutants for these streams include natural processes, agricultural activity, construction, urban runoff, and wastewater disposal systems (Table 3-1). Urban runoff flows into a stream directly (overland) and indirectly (through storm drains). In agricultural areas, farming and ranching activities and natural processes that cause erosion increase silt loads and result in elevated TSS concentrations. Nutrient loading may be caused animal wastes and by the use of fertilizers that result in elevated nitrogen and phosphorus concentrations in runoff. In the urban areas of the watershed, increased silt loads are caused by construction activities and related infrastructure maintenance.

Table 3-1: Nonpoint Source Pollutants and their Possible Sources

Pollutant	Sources
Sediment	Streets, lawns, driveways, construction activities, atmospheric deposition, channel erosion
Nitrogen	Fertilizers, atmospheric deposition, wastewater, wildlife
Phosphorus	Fertilizers, detergents, sediment
Enterococcus	Cesspools, septic systems, sewer leaks/spills, wildlife, soils

Groundwater provides a source for base flow to streams and is an important pathway for nitrogen loading. Nitrogen reaches the land surface by rainfall; through fertilizer application and animal wastes; leaching from cesspools, septic tanks, and sewers; erosion of natural deposits; and other practices associated with agriculture and urban areas. Once on the land surface, some of the nitrogen infiltrates into the underlying soil zone and groundwater. Nitrogen is converted into nitrate and moves through the aquifer. Because groundwater in the aquifer is connected to surface water by spring outlets, elevated nitrate concentrations in groundwater may be discharged to streams, increasing the nitrogen load.

Like nitrogen, phosphorus is used in many fertilizer products. In general, phosphorus levels are lower than nitrogen levels in fertilizers. The results of this difference in levels of phosphorus and nitrogen in fertilizer can be seen in the concentrations of the two pollutants in the water quality data supporting this TMDL decision. Phosphorus also tends to attach to solid particles, so it may not become mobile until the sediment is transported by surface runoff or channel erosion. Therefore its base flow concentration is more stable than that of other pollutants.

The Lihue-Hanamaulu and Puhi Water Systems pump groundwater from deep wells in the Nawiliwili Bay watershed. The 2003 water quality report by the Kauai County Department of Water indicates that detected nitrate levels were 0.78 mg/L in the Puhi Water System and 2.1 gm/L in the Lihue-Hanamaulu (www.kauaiwater.org/ce_waterqualitydata.asp). This is a wider range than that of the nitrate + nitrite levels measured in deep wells (Table 3-2), and includes concentrations that are one to two orders of magnitude greater than the stream water quality geometric mean criteria for nitrate plus nitrite (0.070 mg/L in the Wet Season and 0.030 mg/L in the Dry Season). Without additional data from shallow groundwater (that generally feeds middle and lower stream reaches) and high-level dike impounded groundwater (that feeds upper stream reaches), it is difficult to assess the effect of groundwater sources on stream nitrogen concentrations and loading.

Table 3-2: Concentration of Nitrite and Nitrate in Groundwater

Locations	Date	Nitrate and Nitrite, Unfiltered (mg/L)
Kalepa Ridge	02/13/91	1.3
	02/13/91	1.3
	02/13/91	1.3
	02/27/91	1.2
	03/02/91	1.1
	03/04/91	1.1
Kilohana	03/21/77	0.84 (filtered)
	03/21/77	0.72 (filtered)
	05/03/78	1.1 (filtered)
	08/01/81	0.89 (filtered)
Puhi Community College	09/06/1975	1.7

Note: mg/L = Milligrams per liter

3.1.2 Nonpoint Sources – Enterococcus

Enterococcus is a common bacterium normally found in the intestinal tract of warm-blooded animals including humans. The presence of enterococci in surface water samples is used as an indicator of the presence of human sewage. Enterococci have a greater correlation with swimming-associated gastrointestinal illness in both marine and fresh waters than other bacterial indicator organisms, and are less likely to die off in saltwater.

During both wet weather and dry weather periods, multiple sources of bacteria, sediment, and nutrients associated with both natural and anthropogenic activities contribute to overall loads to the impaired waterbodies. Nonpoint sources that may affect streams and estuaries include stormwater discharges that are not subject to regulation under the Clean Water Act (non-MS4) and direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. The forested portion of the watershed includes unknown populations of feral pigs, goats, rodents, and several species of bird - these wildlife populations are also potential sources contributing to elevated bacteria concentrations in the watershed. In addition, a major factor in the high concentrations of enterococci is soils, where these fecal bacteria are able to multiply and may become part of the indigenous soil microflora. Overland and subsurface flows, which are the sources of water for streams, wash the fecal bacteria from the soil into streams. This natural supply cycle for fecal bacteria makes it very difficult to reduce levels of bacteria through management decisions.

Outside of areas served by a sewer system, waste disposal is through onsite septic and cesspool systems, including large capacity cesspools at schools and at public parks (see wastewater disposal system inventory in Appendix F). Many of these cesspools are located close to streams and beaches. Although the construction of cesspools has been restricted since August 1991, and large capacity cesspools were ordered closed in 2003, many older communities on Kauai still use cesspools as their wastewater disposal method. Problems with cesspools may include, but are not limited to, failure due to improper operation and lack of maintenance, and seepage, which may cause contamination of coastal waters, streams, and perhaps even potable groundwater (Whittier et al. 2004). The subsurface flow of wastewater from cesspool pits cannot be easily traced, but since the flow of subsurface water is toward streams and coastal waters, we can reasonably conclude that wastewater from cesspools into stream and ocean waters will affect concentrations of fecal indicator bacteria including fecal coliform, E. coli, and enterococci.

All of the streams known to be sampled on Kauai contained high concentrations of enterococci that greatly exceeded current State recreational water quality standards. Data from the previous investigations indicate that bacterial concentrations are influenced by storm flows and cesspool contamination (El-Kadi et al. 2003, Tetra Tech, Inc. 2007). All but 2 of the 72 water samples collected from Huleia, Nawiliwili, Puali, and Papakolea Streams (El-Kadi et al. 2003) greatly exceeded the current State standards for enterococci, and additional bacterial sampling results indicated potential cesspool waste contamination. In Nawiliwili and Puali Streams, higher counts of *Clostridium perfringens* suggest greater potential for contamination by human sewage, and these two watersheds are higher priority for bacterial TMDL implementation. High FRNA in Papakolea, coupled with low *C. perfringens*, suggests potential for cesspools to be a major source of bacterial contamination. Huleia stream, where *enterococcus* levels were significantly lower than in the other three streams and bacterial contamination from sewage discharge and cesspool waste is less likely, is lowest priority for bacterial TMDL implementation.

3.1.3 Point Sources

There are currently six facilities holding National Pollutant Discharge Elimination system (NPDES) permits that regulate stormwater discharge associated with their industrial activities. The current regulatory effluent limits for stormwater discharged from these facilities are listed in Table 3-3. Information indicating the status of these permits (e.g. records of stormwater pollution control plans, on-site inspections, complaints, and violations) is presented in Appendix E, Table E-1, including information for previously permitted facilities that are no longer in operation. In addition, at any given time there are numerous active NPDES permits regulating stormwater discharge associated with construction activities in the watershed. These permits typically do not impose effluent limits but require the installation, operation, and maintenance of site-specific best management practices to control polluted runoff. Additional information about these permits is presented in Appendix E, Table E-2. The calculation of Waste Load Allocations to the industrial facilities, and a discussion of how they will be incorporated in current and future permit cycles, are presented in Section 3.5 below.

The only permitted discharger of industrial stormwater in the Huleia Stream sub-basin, and the only permittee with Individual permit coverage (as opposed to Notice of General Permit Coverage) for such discharges is Jas W. Glover, Ltd. (NPDES ID HI0020842). At the Glover rock quarry and plant, located just downstream of the confluence of Kuia Stream and Kamooloa Stream, operations include mining, crushing, and screening of rock and gravel. The facility withdraws water for its operations from an irrigation system segment that delivers water to Kamooloa Stream. The NPDES permit authorizes the plant to discharge process wastewater and storm water from settling and containment ponds via seven outfalls - three that discharge into Kuia Stream, two that discharge into Kamooloa Stream, and two that discharge below the confluence of these two streams - during a rainfall event greater than the 10 year, 24-hour event (greater than 10 inches). Although public participants in the TMDL process and related DOH water pollution control and water quality management programs have identified this quarry as a problem discharger, reviews of the files showed that no discharges or monitoring data have been reported by the permittee, except for incidental spills ranging from 150 to 9,000 gallons (see Appendix G). In addition, a review of the 2003 precipitation data shows that no storm event during that year was greater than a 10-year storm, which means there should not have been a record of discharge from the plant during 2003. Correspondence concerning the reissuance of this permit is included as Attachment 1 at the end of Appendix E, and the calculation of Waste Load Allocations to be incorporated in this permit is presented in Section 3.5.2 below. Further investigation of quarry operations and their potential impacts on surface waters could be part of a TMDL implementation framework for point sources (see Section 5.0).

Sewage effluent from two wastewater treatment plants in the Nawiliwili Bay watershed is not discharged to surface water and thus not regulated by NPDES permits. However, disposal of this effluent via injection wells and surface application (reuse facilities) may be a component of nonpoint source loading. Sewage spills from the treatment plants and collection systems, as well wastewater spills from industrial processes, occasionally pollute the inland and marine waters, and usually become the subject of enforcement action by DOH. For example, on January 6, 2002, Lihue WWTP recorded a sewage spill of an estimated 250,000 gallons of treated effluent as a result of pump failure. Additional information on wastewater spill events in the Nawiliwili Bay watershed (since 2000) is located in Appendix G. Further investigation of operations at both treatment plants, and their potential effects on surface waters, are an important part of the TMDL implementation framework for nonpoint sources (see Section 5.0).

Table 3-3: Industrial Stormwater Facilities - Current Permit Limits

Facility Legal Name	File No	Receiving Waters	Facility Area (Acres)	Permit Limits							Comments
				Estimated Discharge	Flow	TSS	N + N	TN	TP	Turbidity	
Polynesian Adventure Tours, Inc. - Lihue Baseyard	R80C508	Nawiliwili Stream	0.55	1611 gal/d	None	None	None	None	None	None	Effluent limitations for Oil, Grease, pH.
Puhi Metals Recycling Center[1]	R60B235	Papakolea (Emergency Discharge Only)	10	N/A	None	**wet 80 mg/l, dry 55 mg/l**	None	None	None	None	Effluent limitations on Chemical Oxygen Demand, Oil and Grease, pH, Metals.
Kauai Commercial Company, Inc. (Alexander & Baldwin, Inc,)	R80A320	Puali Stream	3.27	9360 gal/d	None	None	None	None	None	None	Effluent limitations on pH, metals, oil and grease, and petroleum hydrocarbons.
Halehaka Landfill[1]	R50A540	Puali Stream	22	N/A	None	**wet 80 mg/l, dry 55 mg/l[3]**	None	None	None	None	3 outfalls and 4 basins. Effluent limitations on Oil and Grease, pH, Iron, Ammonia, Alpha Terpineol. Benzoic Acid, p-Cresol, Pheol, Zinc.
Lihue-Puhi Wastewater Treatment Plant (WWTP)[2]	R90A264	Puali Stream (Outfall No. W-1)	13.8	2.84 million gal/d	None	**10 mg/l**	**30 µg/l**	**180 µg/l**	**30 µg/l**	None	4 stormwater outfalls. Effluent limitations on oil and grease, pH. Sewage effluent is reused for golf course irrigation.
Jas W Glover Quarry	HI 0020842	Kamooloa and Kuia Streams	248.1	Discharge permitted for 10-year storm event only.	Flow	**80 mg/l[4]**	None	None	None	**25 NTU[4]**	Located in agriculturally zoned area.

[1] Landowner is County of Kauai
[2] Landowner is Grove Farm Properties
[3] Average Monthly Maximum
[4] Limits associated with discharge from 10-year storm (or greater)

3.2 LINKAGE METHODOLOGY

A key step in developing a TMDL is establishing a relationship between the pollutant sources (indicators), numeric targets (TMDL endpoints), and the estimated loading. This relationship is commonly referred to as the linkage. This linkage can be used to determine the total capacity of the water body to assimilate or dilute the pollutant loads while still meeting water quality criteria and supporting its designated uses. The allowable loads are then allocated among the various sources. A hydrologic gauge analysis was selected as the linkage methodology for this TMDL.

3.2.1 Linkage Method Selection

The linkage can be established through a variety of techniques, from simple mass balance analysis to sophisticated computer modeling. Ideally, the linkage should be developed based on a long-term set of monitoring data that allows the resulting TMDL to associate certain water-body responses to flow and loading conditions. For this TMDL, long term and continuous monitoring data were not available for the decision area. Therefore, the linkage was established using a combination of regional monitoring data and best professional judgment.

Two methods were initially investigated to estimate the TMDLs for the stream systems: hydrologic watershed modeling and statistical gauge analysis. The hydrologic watershed modeling effort incorporated the U.S. Army Corps of Engineer's HEC-HMS program. The HEC-HMS (Hydrologic Engineering Center-Hydrologic Modeling System) model was designed to simulate the event-based and continuous precipitation-runoff process of a dendrite watershed system. The model can be used to simulate a large river basin water supply, flood hydrology, small urban watershed, or natural watershed runoff. The statistical gauge analysis analyzed the relationship between recorded stream flow and recorded precipitation. The gauge analysis used flow and precipitation gauges representing tributary areas with similar hydrologic characteristics to the Huleia, Papakolea, Puali and Nawiliwili sub-basins.

A HEC-HMS model was developed and calibration was attempted using streamflow data collected during the water quality sampling efforts from January to April 2003. Due to the multiple undocumented flow diversions and impoundments throughout the decision area (see Section 1.2.1.3), the model could not be calibrated to the collected flow data. Therefore, a statistical gauge analysis was selected as the linkage methodology.

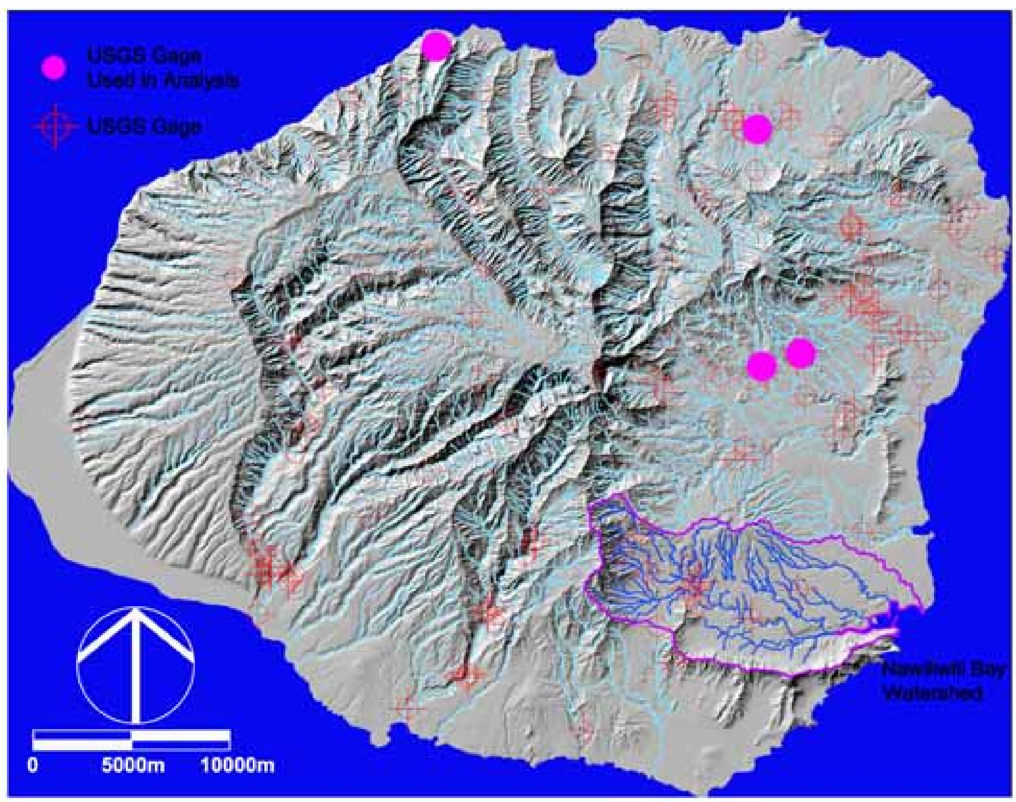
3.3 HYDROLOGIC ANALYSIS

This section discusses the hydrologic gauge analysis conducted for the Huleia, Papakolea, Puali, and Nawiliwili sub-basins. The gauge analysis statistically describes relationship betweens land use, tributary area, and precipitation, and flow volume. United States Geological Survey (USGS) stream flow data and National Weather Service (NWS) precipitation data (obtained from the National Climate Center, NCDC) were used in the analysis. Due to the lack of data regarding controlled diversions, the gauge analysis was conducted assuming no diversion or impoundment of the streams.

3.3.1 Flow Gauge Selection

The selection of stream flow gauges used in the regional hydrologic gauge analysis was based on locating streams similar to the streams under consideration. These similarities included annual precipitation totals, land use within the tributary area, topography, substrate, and conformance with the assumption of no stream diversions or impoundments. The selected gauges also required a nearby precipitation record that coincides with the recorded USGS flow data. On the island of Kauai there are approximately 80 stream gauges operated by the USGS that provide daily average flows. Based on the gauge selection criteria, only four gauges were selected for the analysis (Figure 3-1).

Figure 3-1: Locations of USGS stream gauges on Kauai



Because Lihue-Puhi town is one of the most heavily urbanized areas on Kauai, no stream flow gauges on Kauai could be located that both represented this urban land use component and fulfilled the remaining gauge selection criteria. Therefore, the gauge selection process was expanded to include the island of Oahu to better estimate runoff contributions from urban land uses. Annual precipitation totals are similar between the two islands, as are the topographic features. The applicability of the selected Oahu gauges is based on their representation of this urban land use component (between 7% and 30% of the gauge contributing area) mixed with forested and open/agricultural lands (see Table 3-5), along with their fulfillment of all the remaining gauge selection criteria, save for Nawiliwili-like substrate and soils. Table 3-4 further describes the records from seven USGS flow gauges and five NWS precipitation gauges that were used in the hydrologic analysis.

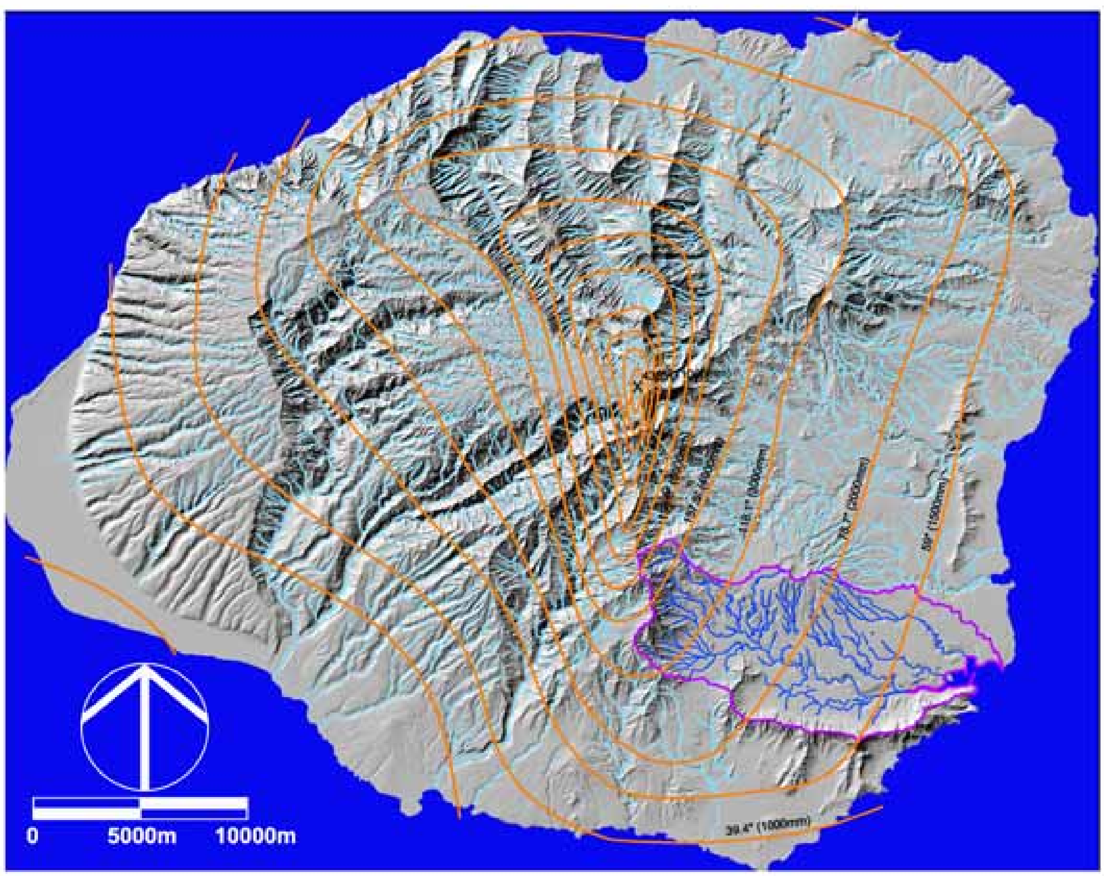
Table 3-4. Stream Flow and Precipitation Records Selected for the Hydrologic Analysis

USGS Gauge Number	Drainage Area mi^2	USGS Gauge Description	NWS Precipitation Gauge	Record Used
16068000	6.27	East Branch of North Fork Wailua River near Lihue, Kauai	Stable Camp	1965-2003
16097500	1.19	Hulaulani Stream at Altitude 400-feet, Near Kilauea, Kauai	Stable Camp	1957-2003
16071500	0.65	Left Branch Opaekaa Stream near Kapaa, Kauai	Hanahanapuni	1965-2003
16114000	1.36	Limahuli Stream near Wainiha, Kauai	Power House Wainiha	1994-2003
16229300	5.18	Kalihi Stream near Kalihi, Oahu	Dowsett	1962-2003
16244000	3.63	Pukele Stream near Honolulu, Oahu	Tantalus Peak	1960-1982
16247000	1.18	Palolo Stream near Honolulu, Oahu	Tantalus Peak	1952-1979

3.3.2 Precipitation Gauge Selection

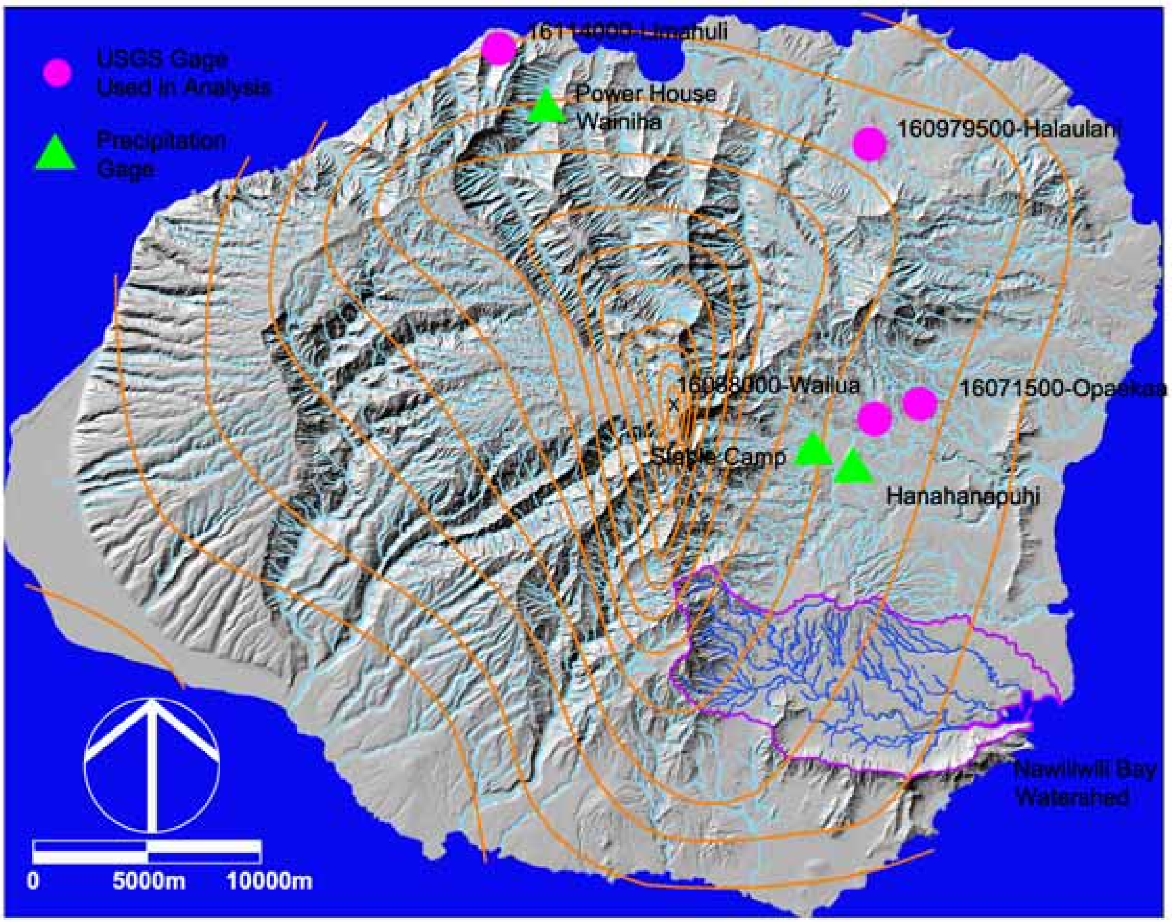
The hydrologic analysis of the Nawiliwili Bay watershed required the development of statistical relationships between precipitation and stream flow. Annual precipitation for the island of Kauai ranges from 433-inches at the summit of Mt. Waialeale (considered one of the wettest spots on Earth) to 20-inches along the leeward coast. Figure 3-2 illustrates the annual average precipitation totals across the island. Annual precipitation in the Nawiliwili Bay watershed varies from about 40 inches at Nawiliwili Bay to near 200 inches at the headwaters.

Figure 3-2: Annual Rainfall Isopluvials for the Island of Kauai



There are 18 precipitation gauges with available data from the NWS on Kauai. There are also numerous other precipitation gauges in operation on the island that are not under the control of the NWS. The period of record for each gauge varies but it generally runs from 1949 to present. The selection of the precipitation gauges to use in the hydrologic analysis required the gauges to be located near the desired USGS gauge and have annual rainfall quantities similar to the gauged watershed. Figure 3-3 illustrates the locations of the selected USGS gauges on Kauai along with the annual precipitation isopluvials and selected NWS Precipitation Gauges.

Figure 3-3: Flow Gauges and Precipitation Gauges Selected for the Hydrologic Analysis



3.3.3 Flow Volume Estimates

The amount (volume) of flow in a stream can be estimated based on the recorded flow rate and the time interval over which the flow was recorded. If a flow gauge recorded 1 cfs (cubic feet per second) for 1 hour, the flow volume for the period is 3,600 cubic feet (1 cfs X 3600 sec/hour). The flow volumes of interest for the TMDL decisions are baseline flow (Wet and Dry Season), and storm flow. The Wet Season is from November 1 through April 30, and the Dry Season is from May 1 through October 31.

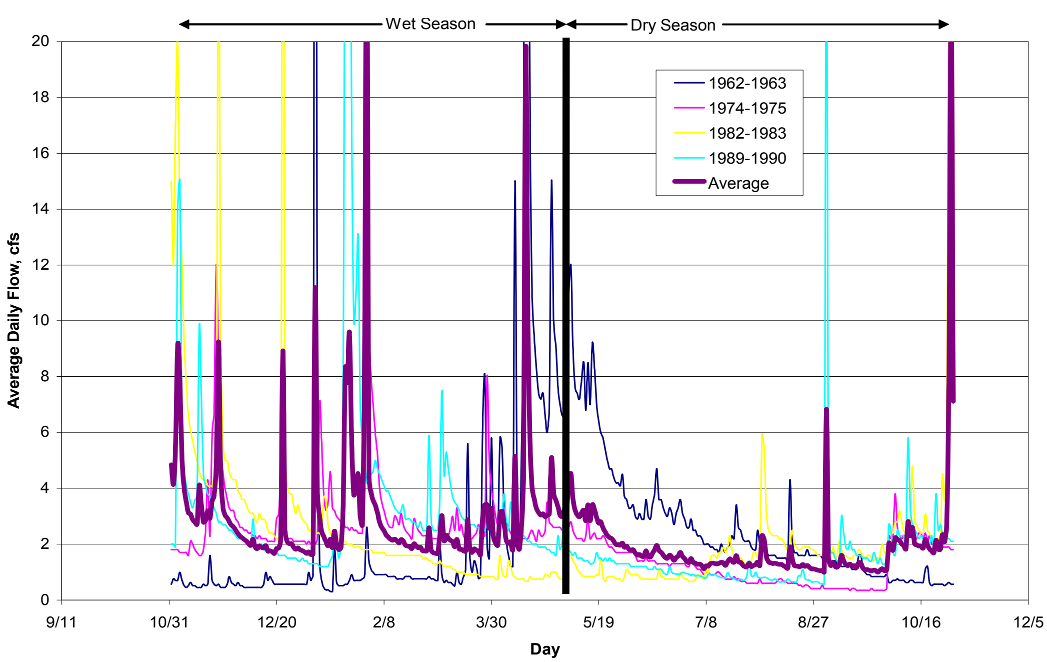
3.3.3.1 Base Flow Determination

Base flow is water that enters a stream from persistent, slowly varying sources that maintain stream flow between rainfall events. Examples of this type of source are groundwater, springs, and controlled reservoir discharge. The base flow at each of the gauges selected for the regional hydrologic analysis area was estimated using the daily average flow data provided by the USGS.

Using the complete period of record for each gauge, the annual mean flow rate was estimated for each water year. The USGS defines the water year as the period of time from October 1 through September 30. To find representative water years to use in the base flow determinations, the average annual flow rate for each water year was determined. If the individual water year had a mean flow value within 10% of the period of record annual mean flow, it was considered representative. In most cases, at least four representative annual hydrographs were found for each USGS gauge.

The representative annual hydrographs for each were combined to generate an average annual hydrograph for that gauge. Inspection of the hydrographs, as shown in Figure 3-4, revealed that base flow during the Dry Season tends to be less than base flow during the Wet Season, which is to be expected due to higher groundwater recharge from Wet Season storm events. Since base flow is variable during the two seasons, an average base flow at each gauge was estimated for each season.

Figure 3-4: Plotted Hydrographs for USGS Gauge 16071500 for Determination of Baseflow



Using the “Average” hydrograph for each USGS gauge, the stream flow data was analyzed to isolate the minimum flow rate values. The minimum flow rate values were then categorized, based on when they occurred, as Wet or Dry Season. For each season, an estimated base flow was assumed. The assumed base flow value was subtracted from each of the minimum flow values. The resulting values were then added together. Since some of the minimum flow rate values were higher than the estimated base flow value and some were lower, the goal was to have the resulting flows add to zero. An iterative process was used until a suitable base flow value was determined. For example, the analysis of the data shown in Figure 3-4 resulted in a base flow value of 2.3 cfs for the Wet Season and 1.6 cfs for the Dry Season at that gauge.

Table 3-5 shows the resulting estimated base flows and unit base flows (flow per unit area) for all the gauges used in the analysis. To approximate the base flows for each of the four major streams in the Nawiliwili Bay watershed, the unit base flows were applied to different Nawiliwili watershed areas based on correspondence between the distribution of land use components in a Nawiliwili area and in the contributing area associated with each unit value calculation.

Table 3-5: Baseflow Estimation for the Selected USGS Flow Gauges

USGS Gauge Number	Land Use Components Represented	Tributary Area mi^2	Wet Season		Dry Season	
			Baseflow cfs	Unit Baseflow cfs/mi^2	Baseflow cfs	Unit Baseflow cfs/mi^2
16068000	Forested	6.27	43.8	7.0	25.2	4.0
16097500	Forested	1.19	10.0	8.4	8.6	7.2
16071500	Agr/Open	0.65	2.3	3.5	1.6	2.5
16114000	Agr/Open	1.36	7.4	5.4	5.3	3.9
16229300	Urban*	5.18	7.5	1.4	3.2	0.6
16244000	Urban*	1.18	2.1	1.8	0.65	0.6
16247000	Urban*	3.63	3.6	1.0	1.8	0.5

*Flows in Forested and Agr/Open areas are influenced by each other, but not by Urban land use components, whereas flows associated with Urban land use components are also influenced by Forested and Agr/Open areas.

3.3.3.2 Storm Flow Volume Determination

Storm flow is water that enters a stream promptly in response to individual water input events. Not all precipitation that falls during a rainfall event becomes surface runoff, and eventually storm flow. There are many intervening factors that impact a watershed's response to a rainfall event, including interception, storage, infiltration/percolation, and evapotranspiration.

Interception: precipitation that does not reach the ground because it is intercepted by trees, shrubs and grasses.

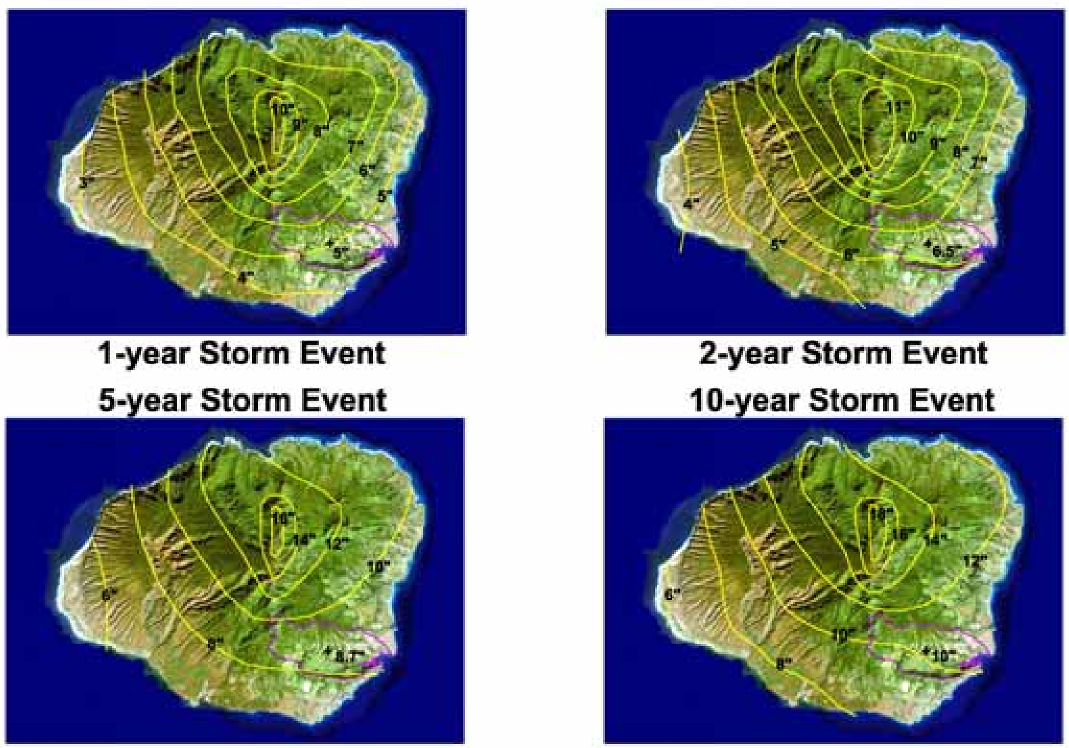
Storage: areas such as depressions within the watershed surface (and even tree canopies) that hold rainfall, intercepted precipitation, and runoff until it is either infiltrated or evaporated.

Infiltration/percolation: water that enters the ground instead of evaporating from the surface or creating surface runoff. If the infiltration rate of soil is greater than the precipitation rate, then no run-off will be created. Infiltrated water may become either shallow subsurface flow (which may resurface at another location) or deep percolating flow that can recharge the aquifer and/or provide base flow to streams.

Evapotranspiration: the transformation of water from the liquid state to water vapor. This process includes evaporation from water exposed to the air (evaporation) and also from plants uptake and release of water (transpiration).

The storm flow pollutant loading analysis was developed for an event-based load determination. Meaning, if x-inches of precipitation falls, how much pollutant loading can be expected. Figure 3-5 shows the isopluvials for 24-hour precipitation totals associated with 1-year through 10-year recurrence interval for Kauai. Also shown are the estimated average 24-hour precipitation totals for each event used in the analysis. No precipitation event larger then the 10-year event was analyzed because the only current Individual NPDES permit holder in the watershed has unrestricted discharge limits above the 10-year event, and because the 10-year event occurs, on a daily basis, less than the 2% of the time, which is interpreted as the flow regime during which the most liberal water quality criteria apply.

Figure 3-5: 24-hour Precipitation Total Isopluvials with 1-year through 10-year Recurrence



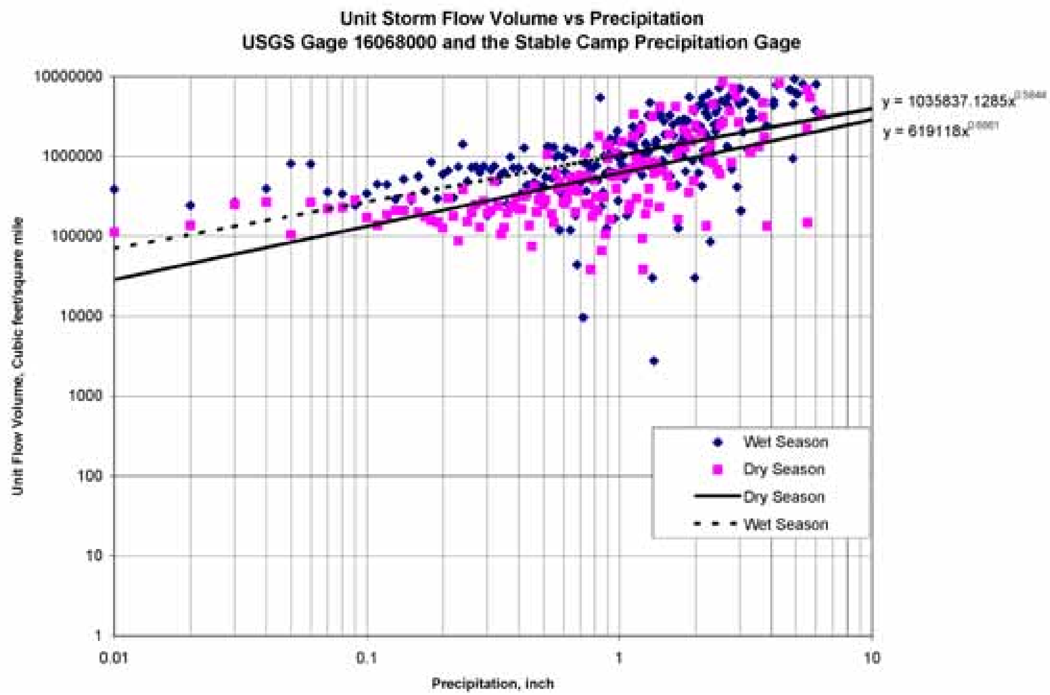
Source: U.S. Weather Bureau 1962

To establish event-based storm flow loadings, a relationship was developed between rainfall and resulting flow volume during both the Wet and Dry Season. The separation of storm flow from the USGS recorded flow data was accomplished by subtracting the estimated base flows (described earlier) from the recorded flow gauge data. The subtracted base flow took into account whether it was the Wet or Dry Season.

The resulting storm flows were compared to recorded precipitation at the corresponding rain gauge. Since not all rain gauges were located in the same watershed as the flow gauge, and rainfall gradients can be steep even within watersheds, there were varying degrees of correlation between recorded rainfall and recorded flow. All occurrences of recorded precipitation and corresponding storm flow were tabulated. The recorded storm flow rate was then converted into a storm flow volume in the same manner as base flow.

The unit storm flow volume for each flow gauge was graphed with its corresponding precipitation amounts (see complete set of graphs in Appendix D, Part A). For example, Figure 3-6 illustrates the relationship between rainfall and storm flow volume for the Stable Camp precipitation gauge and USGS flow gauge 16068000. The storm flow volume per rainfall amount is higher during the Wet Season, likely due to antecedent moisture conditions. During the Wet Season, the soil is usually wetter because of the regular input from frequent rainfall events. The wetter soil has less capacity to store precipitation so more of the rainfall becomes direct runoff entering into the streams.

Figure 3-6: Seasonal Relationship between Stream Flow Volume and Precipitation



Based on the storm flow results for each USGS gauge, Table 3-6 contains the estimated average unit storm volumes for the recurrence intervals used in the TMDL analysis. The unit value is used to determine the storm loading presented in the next section.

Table 3-6: Unit Storm Flow Volumes Based on Recurrence Interval and Season

Land Use	Cubic feet/sq. mile							
	1-Year		2-Year		5-Year		10-year	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Kamooloa	7988806	5118286	8953615	5775963	10199069	6639461	10867066	7108748
Halfway Bridge	33467682	23633793	39234427	28051701	47245430	34250449	51797866	37797930
Stone Bridge	57481914	39735942	66713539	46675104	79382804	56314479	86517398	61790312
Puali Stream	2987204	1247722	3698675	1560785	4704563	2007065	5282891	2265192
Papakolea	8319764	6235881	10034437	7605165	12481220	9566916	13898832	10706610
Upper Nawiliwili	4966431	3181316	5566329	3590246	6340726	4127150	6756072	4418943
Lower Nawiliwili	10624303	5546871	12571605	6548690	15250984	7930773	16761585	8711414

3.4 TMDL METHODOLOGY

TMDLs for Huleia, Papakolea, Puali, and Nawiliwili Streams are the maximum allowable loads of nutrients, sediment, and bacterial indicator that the streams can receive without exceeding the State of Hawaii water quality criteria. This section presents the results of the TMDL calculations for the endpoint target pollutants in the streams - Total Suspended Solids (TSS), Nitrate + Nitrite Nitrogen (N+N), Total Nitrogen (TN), Total Phosphorus (TP), and *Enterococcus* (bacterial indicator) - including load allocations to nonpoint sources, waste load allocations to point sources, and a margin of safety (MOS) reflecting the uncertainty in the analysis. The TMDL decision also addresses seasonal and critical conditions and future growth. Implementation of the TMDLs is expected to result in the attainment of water quality standards in the impaired streams.

This section presents results required to solve the basic TMDL equation:

TMDL = LA + WLA + MOS

Where:

TMDL	=	Total maximum daily load, or load capacity
LA	=	Load allocation for nonpoint sources
WLA	=	Waste load allocation for point sources
MOS	=	Margin of safety

The following equations were used to calculate Margin of Safety (MOS) and Overall Percent Loading Reduction:

Explicit MOS = Explicit MOS percentage * Load Capacity

Overall Percent Loading Reduction = 1 – (Load capacity – MOS) / overall current load

3.5 TMDL CALCULATION: TSS AND NUTRIENTS

3.5.1 TMDL Load Capacity

The TMDL or load capacity was determined for sediment and nutrient-related pollutants of concern (TSS, N+N, TN, TP) by multiplying the total flow volumes presented in Tables 3-6 and 3-7 by the pollutant concentrations corresponding to the TMDL endpoints presented in Section 1.1.2. The TMDL load capacity results for baseline flow conditions are presented below in Table 3-7.

Table 3-7: Baseline Flow TMDL Load Capacity for Four Major Streams - Nawiliwili Bay Watershed

Pollutant	Allocation	Huleia Stream						Nawiliwili Stream				Puali Stream		Papakolea Stream	
		Kamooloa		Halfway Bridge		Stone Bridge		Upper Nawiliwili		Lower Nawiliwili					
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Total Suspended Solids	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (mg/L)	20	10	20	10	20	10	20	10	20	10	20	10	20	10
	Base flow - Load (lb/d)	**1992**	**729**	**7282**	**2617**	**12922**	**4665**	**1239**	**453**	**1638**	**532**	**211**	**41.6**	**1637**	**579**
Nitrate + Nitrite	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	70	30	70	30	70	30	70	30	70	30	70	30	70	30
	Base flow - Load (lb/d)	**6.97**	**2.19**	**25.5**	**7.85**	**45.2**	**14.0**	**4.33**	**1.36**	**5.73**	**1.60**	**0.74**	**0.12**	**5.73**	**1.74**
Total Nitrogen	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	250	180	250	180	250	180	250	180	250	180	250	180	250	180
	Base flow - Load (lb/d)	**24.9**	**13.1**	**91.0**	**47.1**	**162**	**84.0**	**15.5**	**8.20**	**20.5**	**9.60**	**2.64**	**0.75**	**20.5**	**10.4**
Total Phosphorus	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	50	30	50	30	50	30	50	30	50	30	50	30	50	30
	Base flow - Load (lb/d)	**4.98**	**2.19**	**18.2**	**7.85**	**32.3**	**14.0**	**3.10**	**1.36**	**4.10**	**1.60**	**0.53**	**0.12**	**4.09**	**1.74**

The load capacity for storm flow was estimated in the same fashion as for base flow, and the total loading values are for a 24-hour period (Table 3-8). As described in Section 3.3.3, only storm events up to the 10-year recurrence interval were investigated. Although it may be useful to establish load capacity for events greater than the 10-year recurrence interval (since these events may contribute large proportions of long-term loadings, i.e. see Doty et al. 1981), such an exercise would require the establishment of new TMDL endpoint concentrations that further extrapolate from those specified in the current water quality standards and for which there may not be sufficient data available to adequately support the analysis.

Table 3-8: Storm Event TMDL Load Capacity for Four Major Streams - Nawiliwili Bay Watershed

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
Total Suspended Solids	Storm flow - Conc (mg/L)	50	50	50	50	50	50	50
	Storm Loads (lb/event)							
	1-Year	24884	104247	179048	15470	33093	9305	25915
	2-Year	27889	122209	207803	17338	39159	11521	31256
	5-Year	31769	147163	247266	19750	47505	14654	38877
	10-Year	33849	161343	269489	21044	52210	16455	43293
Nitrate +Nitrite	Storm flow - Conc (µg/L)	180	180	180	180	180	180	180
	Storm Loads (lb/event)							
	1-Year	89.6	375	645	55.7	119	33.5	93.3
	2-Year	100	440	748	62.4	141	41.5	113
	5-Year	114	530	890	71.1	171	52.8	140
	10-Year	122	581	970	75.8	188	59.2	156
Total Nitrogen	Storm flow - Conc (µg/L)	520	520	520	520	520	520	520
	Storm Loads (lb/event)							
	1-Year	259	1084	1862	161	344	96.8	270
	2-Year	290	1271	2161	180	407	120	325
	5-Year	330	1530	2572	205	494	152	404
	10-Year	352	1678	2803	219	543	171	450
Total Phosphorus	Storm flow - Conc (µg/L)	100	100	100	100	100	100	100
	Storm Loads (lb/event)							
	1-Year	49.8	208	358	30.9	66.2	18.6	51.8
	2-Year	55.8	244	416	34.7	78.3	23.0	62.5
	5-Year	63.5	294	495	39.5	95.0	29.3	77.8
	10-Year	67.7	323	539	42.1	104	32.9	86.6

3.5.2 Waste Load Allocation

All NPDES-regulated industrial facilities in the Papakolea, Puali, and Lower Nawiliwili sub-basins are located in the urban land use district. Jas W. Glover Quarry is located in the agricultural land use district and its waste load allocation (WLA) is based on the lesser of the allocations required to meet water quality standards at Halfway Bridge and at Stone Bridge in the Huleia sub-basin. Although some of these waterbodies meet various storm event water quality criteria for TSS, TN and TP, all waterbodies exceed the storm criterion for turbidity. Therefore, to address turbidity impairment, the storm event WLAs for industrial facilities are based on TMDL load capacities for TSS, TN and TP. WLAs are based on the facility area (obtained from the permit files), the contributing watershed area of the land use district in which the facility is located, and the TMDL storm loading capacity for that land use (presented in Table 4-6). The WLAs shown below (Table 3-9) are based on the following equation:

Facility Stormwater WLA = (Facility Area/Urban Contributing Land Use) * Urban TMDL Loading Capacity

Note: Agricultural Land Use for Jas W. Glover Quarry

The TSS waste load allocation for Jas W. Glover Quarry is based on the TMDL loading capacity for Halfway Bridge, while the TN and TP waste load allocations are based on the TMDL loading capacities for Stone Bridge. There was insufficient information available to characterize how nitrate + nitrite loading varies with land use, therefore an alternate method was used to estimate the nitrate + nitrite waste load allocation from each facility, based on an assumed relationship between nitrate+nitrite and nitrogen loadings across different land uses:

Nitrate+Nitrite Stormwater Allocation = (Facility Nitrogen Stormwater Allocation/TMDL Nitrogen) * TMDL Nitrate+Nitrite

The one, two, five and ten-year storm event waste load allocations for the NPDES-regulated industrial facilities, and the nonpoint source load allocation for the remaining non-permitted land use area, are presented below in Table 3-9.

Note: WLA Implementation

The manner in which DOH addresses WLA implementation will be determined on a permit-specific basis, while providing a mechanism for permittees to play an active role in specifying how WLAs will be implemented. For all but the Glover WLAs, condition 6.(a) of NPDES General Permits Authorizing Discharges of Storm Water Associated with Industrial Activities [Hawaii Administrative Rule §11-55 Appendix B, Storm Water Pollution Control Plan Requirements] requires that "**the permittee shall develop and implement a storm water pollution control plan** to minimize the discharge of pollutants in storm water runoff and to maintain compliance with conditions of this general permit" (p. 55-B-7, emphasis added), and the storm water pollution control plan shall include nine enumerated components, including (emphasis added below):

> (9) If the industrial facility discharges storm water to a state water for which a total maximum daily load has been approved by the EPA, the permittee shall develop and submit an implementation and monitoring plan with the notice of intent or within ninety days after the issuance date of the notice of general permit coverage or by the date the permittee claimed automatic coverage as specified in section 11-55-34.09(e)(2). **The permittee shall incorporate the total maximum daily load into the facility's storm water pollution control plan within sixty days of the date of submittal of the plan and implement necessary steps to meet the plan.**

This means that WLA implementation requirements for general permit coverage don't take effect within a current permit cycle, they only take effect upon the initiation of a new permit cycle as triggered by applicant action (filing Notice of Intent or claiming automatic coverage) or DOH action (issuing Notice of General Permit Coverage). For individual permit coverage (as with the Glover WLAs), permittees are generally required to submit a WLA implementation and monitoring plan, and to begin conducting the planned activities, within one year of TMDL approval by EPA. Regardless, permittees and other interested parties should contact the DOH Clean Water Branch to verify the operative steps and timelines of this process for any particular permits and WLAs.

Although NPDES permittees requested greater specificity about how numerical WLAs will be implemented in permit conditions, DOH and EPA view this as a post-TMDL decision in which "the NPDES permitting authority will review the information provided by the TMDL … and determine whether the effluent limit is appropriately expressed using a BMP approach … or a numeric limit" (Wayland and Hanlon, 2002). According to our TMDL methodology, these numeric limits change based on the size of rainfall events. Therefore, translating the WLAs into numerical NPDES permit requirements might be accomplished by establishing a sliding scale or frequency distribution of permit limits as a function of rainfall event size.

Table 3-9: Waste Load Allocations to Facilities with NPDES-Regulated Industrial Stormwater Discharge

	1-Year Event (lb/d)			2-Year Event (lb/d)			5-Year Event (lb/d)			10-Year Event (lb/d)		
	TSS	TN	TP	TSS	TN	TP	TSS	TN	TP	TSS	TN	TP
Halfway Bridge Agricultural Load	26,771	780	165	31,384	914	194	37,792	1101	233	41,434	1207	256
Jas W Glover Quarry	3,297	79.9	16.6	3,866	92.7	19.3	4,656	110	23.0	5,104	120	25.0
Other Agricultural	23,474	700.1	148.4	27,518	821.3	174.7	33,136	991	210	36,330	1087	231
Stone Bridge Agricultural Load	62,032	1,445	301	71,994	1,677	349	85,667	1,995	415	93,366	2,174	453
Jas W Glover Quarry	3,297	79.9	16.6	3,866	92.7	19.3	4,656	110	23.0	5,104	120	25.0
Other Agricultural	58,735	1,365	284.4	68,128	1,584	329.7	81,011	1,885	392	88,262	2,054	428
Lower Nawiliwili Urban Load	8,286	237	38.8	9,804	280	45.9	11,894	340	55.7	13,072	374	61.2
Polynesian Adventure Tours	9.19	0.263	0.043	10.9	0.311	0.051	13.2	0.377	0.062	14.5	0.414	0.068
Other Urban	8277	236.7	38.76	9793	279.7	45.85	11881	339.6	55.64	13058	373.6	61.13
Puali Urban Load	3,096	67.7	11.0	3,833	83.8	13.7	4,876	107	17.4	5,475	120	19.5
Kauai Commercial Company	44.3	0.969	0.158	54.9	1.20	0.196	69.8	1.53	0.249	78.3	1.71	0.279
Halehaka Landfill	298	6.52	1.06	369	8.07	1.32	469	10.3	1.67	527	11.5	1.88
Lihue-Puhi WWTP	187	4.09	0.666	231	5.06	0.825	294	6.44	1.05	331	7.23	1.18
Other Urban	2,567	56.1	9.1	3,178	69.5	11.4	4,043	88.7	14.4	4,539	99.6	16.2
Papakolea Urban Load	1,796	86.8	12.1	2,166	105	14.6	2,694	130	18.1	3,000	145	20.2
Puhi Metals Recycling Center	169	8.19	1.14	204	9.88	1.38	254	12.3	1.71	283	13.7	1.91
Other Urban	1,627	78.6	11.0	1,962	95.1	13.2	2,440	118	16.4	2,717	131	18.3

Note: There are no separate, land-use specific Nitrate + Nitrite load targets due to lack of information for characterizing N + N loading. Therefore, Nitrate + Nitrite Load Allocations are based on the proportion of N + N to TN in measured concentrations, as presented in the TMDL Storm Flow Summary Table.

3.5.3 Margin of Safety

Section 303(d) of the Clean Water Act and EPA's regulation (40 CFR 130.7) state "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality criteria with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitation and water quality." MOS can be implicitly incorporated based on conservative assumptions used to develop TMDLs and/or added as an explicit component of the TMDL calculation. This TMDL analysis incorporates both an implicit MOS and a 5% explicit MOS. Factors contributing to the implicit MOS include conservative assumptions employed in problem definition (e.g. watershed boundaries and drainage patterns), establishing numeric targets (for turbidity impairment and for critical conditions), source analysis (land use, land cover, and future growth), allocations (including waste load allocations to stormwater discharges from industrial facilities), and linkage analysis (reflecting the cumulative effect of these assumptions).

3.5.4 Load Allocation

Load allocations for a TMDL are defined as: "The portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading…" [40 CFR 130.2(g)]

The load allocation is determined by subtracting the WLA and MOS values from the TMDL load capacity results. The TMDL loading capacity, LA, WLA, and MOS for each stream are summarized below in Tables 3-10 and 3-11.

Table 3-10: TMDL Base Flow Summary*

Pollutant	Allocation	Huleia Stream						Nawiliwili Stream				Puali Stream		Papakolea Stream	
		Kamooloa		Halfway Bridge		Stone Bridge		Upper Nawiliwili		Lower Nawiliwili					
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
TSS (lb/day)	TMDL	1,992	729	7,282	2,617	12,922	4,665	1,239	453	1,638	532	211	41.6	1,637	579
	Load Allocation	1,892	692	6,918	2,486	12,276	4,432	1,177	430	1,556	505	201	39.5	1,555	550
	Waste Load Allocation	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	Margin Of Safety	99.6	36.4	364	131	646	233	61.9	22.7	81.9	26.6	10.6	2.1	81.8	29.0
Nitrate + Nitrite (lb/day)	TMDL	6.97	2.19	25.5	7.85	45.2	14.0	4.33	1.36	5.73	1.60	0.74	0.12	5.73	1.74
	Load Allocation	6.62	2.08	24.2	7.46	43.0	13.3	4.12	1.29	5.45	1.52	0.70	0.12	5.44	1.65
	Waste Load Allocation	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	Margin Of Safety	0.35	0.11	1.27	0.39	2.26	0.70	0.22	0.07	0.29	0.08	0.04	0.01	0.29	0.09
Total Nitrogen (lb/day)	TMDL	24.9	13.1	91.0	47.1	162	84.0	15.5	8.20	20.5	9.60	2.60	0.75	20.5	10.4
	Load Allocation	23.7	12.4	86.5	44.7	153.4	79.8	14.7	7.79	19.5	9.12	2.47	0.71	19.5	9.88
	Waste Load Allocation	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	Margin Of Safety	1.25	0.66	4.55	2.36	8.08	4.20	0.78	0.41	1.03	0.48	0.13	0.04	1.03	0.52
Total Phosphorus (lb/day)	TMDL	4.98	2.19	18.2	7.85	32.3	14.0	3.10	1.36	4.10	1.60	0.53	0.12	4.09	1.74
	Load Allocation	4.73	2.08	17.3	7.46	30.7	13.3	2.95	1.29	3.90	1.52	0.50	0.11	3.89	1.65
	Waste Load Allocation	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	Margin Of Safety	0.25	0.11	0.91	0.39	1.62	0.70	0.16	0.07	0.21	0.08	0.03	0.01	0.20	0.09

Notes:
TSS = Total Suspended Solids
TMDL = LA + WLA + MOS
*Waste Load Allocations (WLA) entered as “0” indicate that WLA=0 (no industrial facilities discharging to the receiving segment)
WLA entered as “0.0” for mathematical purposes indicate that WLA>0 (“de minimis”) since the total area of the NPDES-permitted facilities in a sub-basin is so small (compared to the total area sub-basin for which each TMDL is calculated) that it yields an extremely low WLA (though greater than zero) when an areal-proportional computation is employed. For regulatory purposes, the WLA under baseline flow conditions are “de minimis,” representing loads from rain-induced polluted runoff that is controlled as required by a facility Storm Water Pollution Control Plan, site-specific Best-Management Practices, federally-established effluent limits, and related NPDES permit conditions.

Table 3-11: TMDL Storm Flow Summary

1-Year Storm Flow Event

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
TSS (lb/day)	TMDL	24,884	104,247	179,048	15,470	33,093	9,305	25,915
	Load Allocation	23,640	95,738	166,798	14,696	31,429	8310	24,450
	Waste Load Allocation	0	3,297	3,297	0	9.19	529	169
	Margin Of Safety	1,244	5,212	8,952	773	1655	465	1296
Nitrate + Nitrite (lb/day)	TMDL	89.6	375	645	55.7	119	33.5	93.3
	Load Allocation	85.1	328.9	584.7	52.9	113.1	27.8	85.8
	Waste Load Allocation	0	27.7	27.7	0	0.091	4.01	2.84
	Margin Of Safety	4.48	18.8	32.2	2.78	5.96	1.67	4.66
Total Nitrogen (lb/day)	TMDL	259	1,084	1,862	161	344	96.8	270
	Load Allocation	245.9	950.1	1,689	152.8	326.7	80.4	247.8
	Waste Load Allocation	0	79.9	79.9	0	0.263	11.6	8.19
	Margin Of Safety	12.9	54.2	93.1	8.04	17.21	4.84	13.48
Total Phosphorus (lb/day)	TMDL	49.8	208	358	30.9	66.2	18.6	51.8
	Load Allocation	47.3	181.5	323.6	29.4	62.8	15.8	48.1
	Waste Load Allocation	0	16.6	16.6	0	0.043	1.88	1.14
	Margin Of Safety	2.49	10.4	17.9	1.55	3.31	0.93	2.59

2-Year Storm Flow Event

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
TSS (lb/day)	TMDL	27,889	122,209	207,803	17,338	39,159	11,521	31,256
	Load Allocation	26,495	112,233	193,547	16,471	37,190	10290	29,489
	Waste Load Allocation	0	3,866	3,866	0	10.9	655	204
	Margin Of Safety	1,394	6,110	10,390	867	1958	576	1563
Nitrate + Nitrite (lb/day)	TMDL	100.0	440	748	62.4	141	41.5	113.0
	Load Allocation	95.0	380.4	673.0	59.3	133.8	33.3	103.2
	Waste Load Allocation	0	37.6	37.6	0	0.127	6.15	4.14
	Margin Of Safety	5.00	22.0	37.4	3.12	7.05	2.08	5.65
Total Nitrogen (lb/day)	TMDL	259	1,084	1,862	161	344	96.8	270
	Load Allocation	245.9	937.3	1,676	152.8	326.6	77.6	246.2
	Waste Load Allocation	0	92.7	92.7	0	0.311	14.3	9.88
	Margin Of Safety	12.9	54.2	93.1	8.04	17.2	4.84	13.5
Total Phosphorus (lb/day)	TMDL	55.8	244	416	34.7	78.3	23.0	62.5
	Load Allocation	53.0	212.5	375.9	33.0	74.3	19.5	46.2
	Waste Load Allocation	0	19.3	19.3	0	0.051	2.34	13.20
	Margin Of Safety	2.79	12.2	20.8	1.74	3.92	1.15	3.13

5-Year Storm Flow Event

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
TSS (lb/day)	TMDL	31,769	147,163	247,266	19,750	47,505	14,654	38,877
	Load Allocation	30,181	135,149	230,247	18,763	45,117	13089	36,679
	Waste Load Allocation	0	4,656	4,656	0	13.2	833	254
	Margin Of Safety	1,588	7,358	12,363	988	2375	733	1944
Nitrate + Nitrite (lb/day)	TMDL	114.0	530	890	71.1	171	52.8	140.0
	Load Allocation	108.3	465.4	807.4	67.5	162.3	43.8	128.7
	Waste Load Allocation	0	38.1	38.1	0	0.131	6.35	4.26
	Margin Of Safety	5.70	26.5	44.5	3.56	8.55	2.64	7.00
Total Nitrogen (lb/day)	TMDL	330	1,530	2,572	205	494	152	404
	Load Allocation	313.5	1,344	2,333	194.8	468.9	126.1	371.5
	Waste Load Allocation	0	110	110	0	0.377	18.3	12.3
	Margin Of Safety	16.5	76.5	129	10.3	24.7	7.60	20.2
Total Phosphorus (lb/day)	TMDL	63.5	294	495	39.5	95.0	29.3	77.8
	Load Allocation	60.3	256.3	447.3	37.5	90.2	24.9	72.2
	Waste Load Allocation	0	23.0	23.0	0	0.062	2.97	1.71
	Margin Of Safety	3.18	14.7	24.8	1.98	4.75	1.47	3.89

10-Year Storm Flow Event

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
TSS (lb/day)	TMDL	33,849	161,343	269,489	21,044	52,210	16,455	43,293
	Load Allocation	32,157	148,172	250,911	19,992	49,585	14696	40,845
	Waste Load Allocation	0	5,104	5,104	0	14.5	936	283
	Margin Of Safety	1,692	8,067	13,474	1052	2611	822.8	2165
Nitrate + Nitrite (lb/day)	TMDL	122.0	581	970	75.8	188	59.2	156.0
	Load Allocation	115.9	510.4	880.0	72.0	178.5	49.2	143.5
	Waste Load Allocation	0	41.5	41.5	0	0.143	7.08	4.75
	Margin Of Safety	6.10	29.1	48.5	3.79	9.40	2.96	7.80
Total Nitrogen (lb/day)	TMDL	352	1,678	2,803	219	543	171.0	450
	Load Allocation	334.4	1,474	2,543	208.1	515.4	142.0	413.8
	Waste Load Allocation	0	120	120	0	0.414	20.4	13.7
	Margin Of Safety	17.6	83.9	140	11.0	27.2	8.55	22.5
Total Phosphorus (lb/day)	TMDL	67.7	323	539	42.1	104.0	32.9	86.6
	Load Allocation	64.3	281.9	487.1	40.0	98.7	27.9	80.4
	Waste Load Allocation	0	25.0	25.0	0	0.068	3.34	1.91
	Margin Of Safety	3.39	16.2	27.0	2.11	5.20	1.65	4.33

Notes:
TSS = Total Suspended Solids
TMDL = LA + WLA + MOS

3.6 TMDL CALCULATION: ENTEROCOCCUS

3.6.1 Methodology

Pathogen concentrations in runoff and receiving waters are highly variable due to many factors. While *enterococcus* from cesspool, septic, and sewer systems may contribute to bacterial loading in both wet and dry weather, wash-off from land surfaces during wet weather events is considered a major mechanism for transport. Due to the lack of statewide, regional, and site-specific coefficients for surface wash-off and pollutant loading, and given the complex hydrology of the Nawiliwili Bay watershed, the percentage reduction of bacterial loading required was not allocated to each individual land use district and is therefore applied equally to conservation, agricultural, and urban land uses. In addition, direct contributions from illicit discharges, livestock, pets, and wildlife (including waterfowl) were not estimated based on the lack of site-specific information needed to represent these sources. Population estimates, bacterial source tracking and production rates, and detailed transport and fate information would be needed to obtain detailed estimates of contributions from these sources. For purposes of addressing potential threats to human health from full-body contact recreation in streams, the samples collected at one station within the stream are considered sufficiently representative of the bacterial loadings within the entire stream segment.

Factors affecting the survival of *enterococcus* bacteria include soil moisture content, pH, solar radiation, and available nutrients. In-stream bacteria dynamics can be extremely complex, and accurate estimation of bacteria concentrations relies on a host of interrelated environmental factors. Bacteria concentrations in the water column are influenced by die-off, re-growth, partitioning of bacteria between water and sediment during transport, settling, and re-suspension of bottom materials. First-order die-off is likely the most important dynamic process to simulate as it represents all unknown bacteria losses, despite observations that bacteria can re-grow in sub-tropical soil under certain conditions (Byappanahalli and Fujioka 1998).

3.6.2 TMDL Analysis and Margin of Safety

Pathogen load percent reductions required were calculated by comparing the geometric mean of measurements obtained from the four streams with the TMDL target geometric mean concentration of 33 CFU/100 ml. The maximum enterococci concentration recorded for each stream during the entire period of record was compared to the TMDL target maximum concentration (33 cfu/100 ml). Load capacities were the loads remaining after applying the required reductions to the current loads. Since NPDES-permitted industrial facilities are not expected to be a source of human sewage, no waste load allocations are assigned for enterococcus. In addition, 5% of the load capacity was considered as the explicit MOS (see example below). The percent reduction specified for each stream system was applied equally to potential pathogen source areas in each watershed. There was no land-use specific data available to allocate loadings between land use categories.

Table 3-12: TMDL Enterococcus Summary

Allocation	Huleia Stream - Stone Bridge		Upper Nawiliwili		Puali Stream		Papakolea Stream	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Base flow - Daily Vol (ac-ft)	120.0	86.7	3.9	1.5	22.8	16.7	30.2	19.6
Base flow - GM Conc (colonies/100 ml)	338	338	1,748	1,748	851	851	839	839
Base flow - Existing Load (colonies/d)	5.00.E+11	3.61.E+11	8.38.E+10	3.31.E+10	2.40.E+11	1.75.E+11	3.12.E+11	2.03.E+11
Percent Reduction	90.2%		98.1%		96.1%		96.1%	
Reduction Required (colonies/d)	4.52.E+11	3.26.E+11	8.23.E+10	3.25.E+10	2.30.E+11	1.68.E+11	3.00.E+11	1.95.E+11
TMDL Load (colonies/d)	4.88.E+10	3.52.E+10	1.58.E+09	6.25.E+08	9.29.E+09	6.80.E+09	1.23.E+10	7.98.E+09
WLA (colonies/d)	0	0	0	0	0	0	0	0
LA (colonies/d)	4.64.E+10	3.35.E+10	1.50.E+09	5.93.E+08	8.82.E+09	6.46.E+09	1.17.E+10	7.58.E+09
MOS (colonies/d)	2.44.E+09	1.76.E+09	7.92.E+07	3.12.E+07	4.64.E+08	3.40.E+08	6.15.E+08	3.99.E+08

3.7 SEASONAL VARIATION

EPA regulations require that TMDL decisions consider seasonal variation to help ensure that water quality criteria for target pollutants are met during throughout the year. Because this TMDL is based, where dictated, on the Wet Season and Dry Season water quality criteria established by the State of Hawaii water quality standards, it therefore meets the seasonal variation requirement.

3.8 CURRENT LOAD ESTIMATION

The existing base flow load for each TMDL endpoint target pollutant (TN, TSS, TP, N+N) was calculated by multiplying the base flow volume by the seasonal GM of the measured concentration shown in Table 2-4. The storm flow load was calculated by multiplying the storm flow volume by the GM of measured storm event concentrations (not the 10% not to exceed value for the measured data, since the load estimation was based on total volumes, not flow rates). Tables 3-13 and 3-14 show the estimated current pollutant loads for the segments defined by sampling locations in the four streams. The storm flow volumes shown in Table 3-13 include the runoff generated from excess precipitation as well as the volume of base flow that exists in the stream during non-rainfall periods.

Table 3-13: Estimated Base Flow Pollutant Loads for Four Major Streams in the Nawiliwili Bay Watershed

Pollutant	Allocation	Huleia Stream						Nawiliwili Stream				Puali Stream*		Papakolea Stream	
		Kamooloa		Halfway Bridge		Stone Bridge		Upper Nawiliwili		Lower Nawiliwili					
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
TSS	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (mg/L)	1.18	1.82	0.89	0.87	0.89	1.13	1.53	0.79	3.35	2.80	2.67	3.54	7.35	7.46
	Base flow - Load (lb/d)	**118**	**133**	**324**	**228**	**575**	**527**	**94.7**	**35.8**	**274**	**149**	**28.2**	**14.7**	**601**	**432**
Nitrate + Nitrite	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	39.8	15.9	61.8	40.6	101	80.1	1115	1120	1046	1095	292	234	731	377
	Base flow - Load (lb/d)	**3.96**	**1.16**	**22.5**	**10.6**	**65.3**	**37.4**	**69.0**	**50.7**	**85.7**	**58.2**	**3.08**	**0.97**	**59.8**	**21.8**
Total Nitrogen	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	139	138	138	147	209	184	1220	1172	1297	1377	402	382	866	678
	Base flow - Load (lb/d)	**13.8**	**10.1**	**50.2**	**38.5**	**135**	**85.8**	**75.5**	**53.1**	**106**	**73.2**	**4.24**	**1.59**	**70.9**	**39.3**
Total Phosphorus	Base flow - Vol (ac-ft)	36.7	26.9	134.2	96.4	238.1	171.9	22.8	16.7	30.2	19.6	3.9	1.5	30.2	21.4
	Base flow - Conc (µg/L)	6.69	5.66	5.92	6.24	7.27	7.58	47.5	51.6	10.2	13.0	7.80	13.3	7.07	8.34
	Base flow - Load (lb/d)	**0.67**	**0.41**	**2.16**	**1.63**	**4.70**	**3.54**	**2.94**	**2.34**	**0.84**	**0.69**	**0.08**	**0.06**	**0.58**	**0.48**

*Note: At Upper Puali, only five samples were collected under baseline flow conditions, and only during the dry season. Therefore, the current load is only estimated for Lower Puali.

For Tables 3-13 and 3-14:
ac-ft = Acre-feet
mg/L = Milligrams per liter
lb/d = Pounds per day

Table 3-14: Estimated Storm Event Pollutant Loads for Four Major Streams in the Nawiliwili Bay Watershed

Pollutant	Allocation	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
		Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
Total Suspended Solids	Storm flow - Conc (mg/L)	37.8	53.1	32.9	651	590	97.6	178
	Storm Loads (lb/event)							
	1-Year	18,812	110,710	117,813	201,416	390,234	18,163	92,257
	2-Year	21,084	129,786	136,734	225,745	461,759	22,489	111,271
	5-Year	24,017	156,287	162,701	257,151	560,174	28,605	138,403
	10-Year	25,590	171,346	177,324	273,995	615,659	32,121	154,122
Nitrate + Nitrite	Storm flow - Conc (µg/L)	10.4	68.9	110	202	354	475	769
	Storm Loads (lb/event)							
	1-Year	5.18	144	394	62.5	234	88.4	399
	2-Year	5.80	168	457	70.0	277	109	481
	5-Year	6.61	203	544	79.8	336	139	598
	10-Year	7.04	222	593	85.0	370	156	666
Total Nitrogen	Storm flow - Conc (µg/L)	308	363	405	663	1,124	861	2,575
	Storm Loads (lb/event)							
	1-Year	153	757	1,450	205	744	160	1,335
	2-Year	172	887	1,683	230	880	198	1,610
	5-Year	196	1,068	2,003	262	1,068	252	2,002
	10-Year	209	1,171	2,183	279	1,174	283	2,230
Total Phosphorus	Storm flow - Conc (µg/L)	25.0	58.5	31.5	121	183	84.9	143
	Storm Loads (lb/event)							
	1-Year	12.4	122	113	37.4	121	15.8	74.1
	2-Year	13.9	143	131	42.0	143	19.6	89.4
	5-Year	15.9	172	156	47.8	174	24.9	111
	10-Year	16.9	189	170	50.9	191	27.9	124

3.9 ESTUARY LOADING

Nawiliwili Bay is listed for turbidity and nutrient impairment from breakwater to shore, and for N+N, ammonium, turbidity, and chlorophyll-a at the offshore embayment station. Water quality measurements from various depths at this station were recorded from over 100 different sampling events between 1990 and 1997. The GM of the TN and chlorophyll-a data exceeded Hawaii water quality criteria. During the 2003 Wet Season, when water quality samples were collected at the Nawiliwili Harbor site (Seaflite Jetty) during three storm events, measured values of turbidity and TN exceeded the levels established by the GM water quality criteria. Appendix H presents the modeling approach used to evaluate the extent to which current pollutant loading contributes to the impairment of the estuary. This preliminary diagnosis is based on limited water quality data and minimal temporal and spatial resolution within the waterbody. A complete hydrodynamic analysis that incorporates tidal circulation and comprehensive water quality sampling would be required in order to develop a TMDL for the Nawiliwili Bay and its estuaries.

4.0 DISCUSSION AND CONCLUSIONS

Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

This section presents a load analysis of the watershed based on land use in the stream sub-basins. This section also identifies the load reductions required to achieve the TMDLs and attain water quality standards in the four streams. In Section 5.0, we outline a TMDL implementation framework and load reduction strategy, including potential Best Management Practices (BMP) for polluted runoff and diffuse pollution control. The reduction strategy is based on literature reviews and values for removal rates and is presented in a qualitative manner.

4.1 LOAD ANALYSIS

A load analysis for each sampling location and TMDL endpoint (pollutant) was conducted for each of the four major streams in the Nawiliwili Bay watershed. The analysis was based on an evaluation of calculated load allocations and existing and future land uses. Using the water quality sampling data, we explored for correlations between land use and pollutant loading at each of the sampling locations, but found no strong correlations. We then conducted a literature review to approximate relationships between TSS, TP, and TN loading (as indicated by pollutant concentrations occurring under baseline flow conditions and storm flow conditions) with general land use categories (Table 4-1).

Table 4-1: Relationships between Pollutant Loading and Land Use*

Land Use	TSS (mg/L)		Total P (mg/L)		Total N (mg/L)	
	Base[1]	Storm[2]	Base[4]	Storm[3]	Base[4]	Storm[3]
Urban	9	101	0.2	0.2	2	3
Agriculture	12	70	0.2	0.085	3	0.77
Conservation	8.5	70	0.01	0.006	0.1	0.06

*Data for estimating the relative distribution of Nitrate + Nitrite between land uses were not readily available

1. Based on data from the Chattahoochee River 1993-98 (Frick and Buell 1999)
2. EPA Nationwide Urban Runoff Program (Water Planning Division 1983)
3. U.S. Department of Agriculture (Natural Resources Conservation Service)
4. USGS National Water Quality Assessment program (U.S. Geological Survey 1999)

We used the values shown in the above table to estimate the relative distribution of pollutants based on land use. Through a four-step process, we estimated pollutant loading for each sampling location based on the distribution of land uses tributary to the sampling point. An example of these calculations is shown in Table 4.2, using the Storm Flow estimation for TSS at the Kamooloa sampling location.

- In Step 1, the three literature values (pollutant concentrations associated with Urban, Agriculture, and Conservation loading) for each pollutant under each flow regime (as shown in each column of Table 4.1) are normalized to a scale of 0-100.

- In Step 2, the total area of each land use (within the tributary area for each sampling location) is calculated, then multiplied by the respective land use percentage from Step 1. These values (Area-weighted concentration factors) are totaled, for use in Step 3.

- In Step 3, each Area-weighted concentration factor is divided by the total (both from Step 2) and multiplied by the geometric mean of the measured water quality values. This produces a concentration for each pollutant and land use at each sampling point under each flow regime.

- In Step 4, the estimated concentration for each land use is multiplied by the total flow volume (in this example, for the daily storm event) and a load conversion factor. This results in the daily loading for each land use at each sampling location. This procedure was completed for each pollutant at each sampling point under each flow regime (baseline conditions and 4 storm flow events). The results of this process are present in Tables 4-3 through 4-6 below.

Table 4-2: Estimating Pollutant Loading By Land Use

Example: TSS at Kamooloa Station, Existing Conditions
Tributary Area = 2.406 mi^2
1-Year, 24-hour Storm Flow = 183 ac-ft/d
TSS Geometric Mean (Storm Flow Conditions) = 37.8 mg/l

Step 1. Normalize the Literature Values	Urban	Ag	Conserv	Total
*TSS, mg/L	101	70	70	241
Normalized TSS (TSS/241 X 100)	42	29	29	100
*From EPA Nationwide Urban Runoff Program (Water Planning Division 1983)				

Step 2. Calculate the Area-Weighted (by Land Use) Concentration Factors	Urban	Ag	Conserv	Total
Percent of Total Area	0.13%	6.95%	92.92%	100%
Area mi^2 (% of total)	0.003	0.167	2.236	**2.406**
Weighting (from Step 1 normalized values)	0.42	0.29	0.29	1.00
Area-weighted factor (Area x Weighting)	0.0013	0.0485	0.6484	0.6982

Step 3. Calculate Concentration for Each Land Use				
Area-weighted concentration factor (Step 2)	0.0013	0.0485	0.6484	0.6982
Loading factor (Area-weighted/Total)	.0019	.0695	0.9287	1
Storm Event Concentrations	TSS (mg/L)			
Kamooloa Storm GM	**37.8**			
	Urban	Ag	Conserv	Total
Concentration (Loading factor x 37.8)	0.07	2.63	35.1	37.8

Step 4. Estimate Storm Event Loading (lb/day)				
Kamooloa 1-Year Event (Flow)	**183 ac-ft/d**			
Load conversion factor	2.714 (lb/mg) (l/ac-ft)			
	Urban	Ag	Conserv	Total
Storm Event Concentrations TSS (mg/l)	0.07	2.63	35.1	37.8
Loading (lb/day)				
Flow x Concentration x conversion factor	35	1,307	17,470	18,812

Table 4-3: Current Pollutant Loading By Land Use – Baseline Flow Conditions

Wet Season	Total Suspended Solids (lb/day)				Total Phosphorous (lb/day)				Total Nitrogen (lb/day)			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	0.16	11.6	106	118	0.01	0.43	0.23	0.67	0.12	9.4	4.28	13.8
Halfway Bridge	2.21	109	213	324	0.05	1.89	0.22	2.16	0.80	45.1	4.36	50.2
Stone Bridge	2.57	127	160	290	0.11	4.26	0.32	4.70	2.21	125	7.83	135
Upper Nawiliwili	0	2.34	92.4	94.7	0	0.88	2.07	2.94	0	25.5	50.0	75.5
Lower Nawiliwili	49.5	97.3	128	274	0.32	0.48	0.04	0.84	31.3	70.3	4.58	106
Puali Stream	6.60	13.4	8.14	28.2	0.03	0.05	0.00	0.08	1.25	2.91	0.09	4.24
Papakolea Stream	28.0	258	316	601	0.07	0.48	0.03	0.58	5.8	61.3	3.73	70.9

Dry Season	Total Suspended Solids (lb/day)				Total Phosphorous (lb/day)				Total Nitrogen (lb/day)			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	0.18	13.1	119	133	0.00	0.26	0.14	0.41	0.08	6.86	3.11	10.1
Halfway Bridge	1.55	76.7	149	228	0.04	1.43	0.17	1.63	0.61	34.5	3.34	38.5
Stone Bridge	2.35	116	147	266	0.09	3.21	0.24	3.54	1.40	79.5	4.98	85.8
Upper Nawiliwili	0	0.88	34.9	35.8	0	0.70	1.64	2.34	0	17.9	35.2	53.1
Lower Nawiliwili	26.9	52.8	69.3	149	0.27	0.39	0.03	0.69	21.6	48.5	3.16	73.2
Puali Stream	3.45	7.03	4.26	14.7	0.02	0.03	0.00	0.06	0.47	1.1	0.03	1.59
Papakolea Stream	20.1	185	227	432	0.06	0.40	0.03	0.48	3.23	34.0	2.07	39.3

Table 4-4: Load Allocations By Land Use - Baseline Flow Conditions

Wet Season	Total Suspended Solids (lb/day)				Total Phosphorous (lb/day)				Total Nitrogen (lb/day)			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	2.78	196	1,793	1,992	0.06	3.18	1.74	4.98	0.21	17.0	7.70	24.9
Halfway Bridge	49.7	2,452	4,781	7,282	0.43	15.9	1.86	18.2	1.45	81.7	7.90	91.0
Stone Bridge	114	5,662	7,145	12,922	0.78	29.3	2.21	32.3	2.64	150	9.36	162
Upper Nawiliwili	0	30.6	1,208	1,239	0	0.92	2.17	3.10	0	5.23	10.3	15.5
Lower Nawiliwili	296	581	762	1,638	1.57	2.34	0.18	4.10	6.04	13.6	0.88	20.5
Puali Stream	49.4	101	61.0	211	0.20	0.31	0.01	0.53	0.78	1.81	0.05	2.64
Papakolea Stream	76.2	701	859	1,637	0.48	3.36	0.25	4.09	1.68	17.7	1.08	20.5

Dry Season	Total Suspended Solids (lb/day)				Total Phosphorous (lb/day)				Total Nitrogen (lb/day)			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	1.02	71.8	656	729	0.03	1.40	0.76	2.19	0.11	8.95	4.06	13.1
Halfway Bridge	17.8	881	1,718	2,617	0.18	6.87	0.80	7.85	0.75	42.3	4.09	47.1
Stone Bridge	41.3	2,044	2,580	4,665	0.34	12.7	0.96	14.0	1.37	77.7	4.87	84.0
Upper Nawiliwili	0	11.2	442	453	0	0.40	0.95	1.36	0	2.76	5.40	8.16
Lower Nawiliwili	96.0	188.6	247	532	0.61	0.91	0.07	1.60	2.82	6.34	0.41	9.57
Puali Stream	9.75	19.9	12.0	41.6	0.05	0.07	0.00	0.12	0.22	0.51	0.02	0.75
Papakolea Stream	27.0	248	304	579	0.21	1.43	0.10	1.74	0.86	9.02	0.55	10.4

Table 4-5: Current Pollutant Loading By Land Use - Storm Flow Conditions

Total Suspended Solids (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	35.4	1,307	17,470	18,812	39.7	1,465	19,580	21,084	45.2	1,668	22,304	24,017	48.2	1,777	23,764	25,590
Halfway Bridge	1,103	28,431	81,176	110,710	1,293	33,330	95,164	129,786	1,557	40,135	114,594	156,287	1,707	44,003	125,636	171,346
Stone Bridge	1,580	40,817	75,416	117,813	1,834	47,372	87,528	136,734	2,182	56,369	104,150	162,701	2,378	61,435	113,511	177,324
Puali Stream	6,043	6,422	5,697	18,163	7,482	7,952	7,054	22,489	9,517	10,115	8,973	28,605	10,687	11,358	10,076	32,121
Papakolea Stream	6,394	30,731	55,133	92,257	7,711	37,064	66,495	111,271	9,592	46,102	82,709	138,403	10,681	51,338	92,104	154,122
Upper Nawiliwili	0	3,424	197,991	201,416	0	3,838	221,907	225,745	0	4,372	252,779	257,151	0	4,658	269,337	273,995
Lower Nawiliwili	97,771	100,218	192,511	390,499	115,691	118,587	227,795	462,073	140,348	143,861	276,345	560,554	154,249	158,110	303,717	616,077
Total Phosphorus (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	0.28	6.33	5.83	12.4	0.32	7.09	6.54	13.9	0.36	8.08	7.45	15.9	0.38	8.61	7.94	16.9
Halfway Bridge	6.17	96.8	19.1	122	7.23	113	22.3	143	8.70	137	26.9	172	9.54	150	29.5	189
Stone Bridge	6.02	94.7	12.1	113	6.99	110	14.0	131	8.32	131	16.7	156	9.07	143	18.2	170
Puali Stream	9.37	6.06	0.37	15.8	11.6	7.50	0.46	19.6	14.8	9.54	0.58	24.9	16.6	10.7	0.66	27.9
Papakolea Stream	17.3	50.6	6.26	74.1	20.8	61.0	7.55	89.4	25.9	75.9	9.39	111	28.9	84.5	10.5	124
Upper Nawiliwili	0	7.51	29.9	37.4	0	8.41	33.5	42.0	0	9.58	38.2	47.8	0	10.2	40.7	50.9
Lower Nawiliwili	71.0	44.3	5.87	121	84.0	52.4	6.94	143	102	63.6	8.42	174	112	69.9	9.26	191
Total Nitrogen (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	4.64	63.6	85.0	153	5.20	71.3	95.3	172	5.92	81.2	109	196	6.31	86.5	116	209
Halfway Bridge	56.9	544	155	757	66.7	638	182	887	80.3	769	219	1,068	88.0	843	241	1,171
Stone Bridge	117	1,125	208	1,450	136	1,306	241	1,683	162	1,554	287	2,003	177	1,693	313	2,183
Puali Stream	112	44.2	3.92	160	139	54.8	4.86	198	177	69.7	6.18	252	198	78.2	6.94	283
Papakolea Stream	430	767	138	1,335	518	925	166	1,610	645	1,151	206	2,002	718	1,282	230	2,230
Upper Nawiliwili	0	30.2	175	205	0	33.9	196	230	0	38.6	223	262	0	41.1	238	279
Lower Nawiliwili	512	195	37.4	744	606	230	44.3	880	735	280	53.7	1,068	807	307	59.0	1,174

Table 4-6: Storm Load Allocations By Land Use[1] – Storm Flow Conditions

Total Suspended Solids (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	46.8	1,728	23,109	24,884	52.5	1,937	25,900	27,889	59.8	2,207	29,502	31,769	63.7	2,351	31,434	33,849
Halfway Bridge	1,039	26,771	76,437	104,247	1,217	31,384	89,608	122,209	1,466	37,792	107,904	147,163	1,607	41,434	118,302	161,343
Stone Bridge	2,402	62,032	114,614	179,048	2,787	71,994	133,021	207,803	3,317	85,667	158,283	247,266	3,615	93,366	172,508	269,489
Puali Stream	3,096	3,290	2,919	9,305	3,833	4,074	3,614	11,521	4,876	5,182	4,597	14,654	5,475	5,819	5,162	16,455
Papakolea Stream	1,796	8,632	15,487	25,915	2,166	10,411	18,678	31,256	2,694	12,950	23,233	38,877	3,000	14,421	25,872	43,293
Upper Nawiliwili	0	263	15,207	15,470	0	295	17,044	17,338	0	336	19,415	19,750	0	358	20,686	21,044
Lower Nawiliwili	8,286	8,493	16,314	33,093	9,804	10,050	19,305	39,159	11,894	12,192	23,419	47,505	13,072	13,399	25,739	52,210
Total Phosphorus (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	1.13	25.3	23.3	49.8	1.26	28.4	26.2	55.8	1.44	32.3	29.8	63.5	1.53	34.4	31.7	67.7
Halfway Bridge	10.5	165	32.6	208	12.4	194	38.2	244	14.9	233	46.0	294	16.3	256	50.4	323
Stone Bridge	19.1	301	38.3	358	22.2	349	44.5	416	26.4	415	52.9	495	28.8	453	57.7	539
Puali Stream	11.0	7.14	0	18.6	13.7	8.84	0.54	23.0	17.4	11.2	0.69	29.3	19.5	12.6	0.77	32.9
Papakolea Stream	12.1	35.4	4	51.8	14.6	42.7	5.28	62.5	18.1	53.1	6.56	77.8	20.2	59.1	7.31	86.6
Upper Nawiliwili	0	6.00	24.7	30.9	0	6.95	27.7	34.7	0	7.92	31.6	39.5	0	8.44	33.7	42.1
Lower Nawiliwili	38.8	24.2	3.21	66.2	45.9	28.6	3.79	78.3	55.7	34.7	4.60	95.0	61.2	38.2	5.06	104
Total Nitrogen (lb/day)	1-Year Event				2-Year Event				5-Year Event				10-Year Event			
	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total	Urban	Ag	Conserv	Total
Kamooloa	7.83	107	144	259	8.78	120	161	290	10.0	137	183	330	10.7	146	195	352
Halfway Bridge	81.5	780	223	1,084	95.5	914	261	1,271	115	1,101	314	1,530	126	1,207	345	1,678
Stone Bridge	151	1,445	267	1,862	175	1,677	310	2,161	208	1,995	369	2,572	227	2,174	402	2,803
Puali Stream	67.7	26.7	2.37	96.8	83.8	33.1	2.93	120	107	42.1	3.73	152	120	47.2	4.19	171
Papakolea Stream	86.8	155	27.8	270	105	187	33.5	325	130	232	41.7	404	145	259	46.4	450
Upper Nawiliwili	0	23.7	137	161	0	26.6	154	180	0	30.3	175	205	0	32.3	187	219
Lower Nawiliwili	237	90.1	17.3	344	280	107	20.5	407	340	129	24.8	494	374	142	27.3	543

[1] Includes WLAs, LAs, and MOS for each land use allocation.

4.2 LOAD REDUCTIONS

Four streams in the Nawiliwili Bay watershed are listed as impaired under the State of Hawaii's Clean Water Act Section 303(d) list (see Section 1 and Appendix A). Historic and new water quality data were used to re-evaluate these impairments (see Section 2). Water quality data and a hydrologic analysis were linked to estimate pollutant loading (see Section 3). The evaluation of TMDL allocations and current loading in Section 4.1 indicates that pollutant load reductions are required in order to achieve water quality criteria in the streams. Tables 4-7 through 4-10 illustrate the estimated percent reductions in current pollutant loads that are required to implement the TMDLs and attain water quality standards in the stream reaches defined by the various sampling points. The ensuing discussion summarizes the reductions required for each pollutant.

Table 4-7: Pollutant Load Reductions Required - Baseline Flow, Wet Season

Pollutant	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
	Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
Total Suspended Solids	None	None	None	None	None	None	None
Nitrate + Nitrite	None	None	31%	94%	93%	76%	90%
Total Nitrogen	None	None	None	80%	81%	38%	71%
Total Phosphorus	None	None	None	None	None	None	None

Table 4-8: Pollutant Load Reductions Required - Baseline Flow, Dry Season

Pollutant	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
	Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
Total Suspended Solids	None	None	None	None	None	None	None
Nitrate + Nitrite	None	None	63%	97%	97%	87%	92%
Total Nitrogen	None	None	2.2%	85%	87%	53%	73%
Total Phosphorus	None	None	None	None	42%	None	None

Table 4-9: Pollutant Load Reductions Required - Storm Flow Conditions

Pollutant	Huleia Stream			Nawiliwili Stream		Puali Stream	Papakolea Stream
	Kamooloa	Halfway Bridge	Stone Bridge	Upper Nawiliwili	Lower Nawiliwili		
Total Suspended Solids	None	6%	None	None	92%	49%	72%
Nitrate + Nitrite	None	None	None	11%	49%	62%	77%
Total Nitrogen	None	None	None	22%	54%	40%	80%
Total Phosphorus	None	None	None	17%	45%	None	None

- **Total Suspended Solids.** Load reductions for TSS are required for all sampling locations during storm events. The large increase in TSS concentration associated with storm events suggests that in-channel erosion is occurring. In some areas, such as lower Puali Stream, such erosion appears to be linked with hydraulic modifications and impacts caused by urbanization.

- **Nitrate + Nitrite.** Load reductions for Nitrate + Nitrite are required in Nawiliwili Stream (primarily in the lower sub-basin), Puali Stream, and Papakolea Stream. In addition, load reductions are required for lower Huleia Stream under Dry Season Baseflow Conditions.

- **Total Nitrogen.** Load reductions for TN are required primarily in the lower elevation areas (Huleia Stone Bridge and Lower Nawiliwili), with base flow reduction requirements identified primarily with urban land use. The lower stream reaches are impacted by groundwater which is suspected to have high Nitrate+Nitrite levels (Table 3-2).

- **Total Phosphorous.** Load reductions for TP are required in Nawiliwili Stream, primarily in the lower sub-basin. TP reductions are generally required at much lower levels than for other target pollutants. Phosphorus is generally applied in smaller quantities to crops than other agents, such as nitrogen.

5.0 IMPLEMENTATION FRAMEWORK

Activities that reduce pollutant loading, improve water quality, and restore aquatic ecosystem integrity are frequently completed regardless of TMDL status. However, one of the first steps for continuing these activities after a TMDL is completed can be to develop a detailed TMDL Implementation Plan based on the TMDL decision and related information. States are generally not required to prepare TMDL implementation plans, but are expected to support TMDL implementation through point and nonpoint source control programs and other relevant watershed management processes.

The implementation framework and reasonable assurances (Section 6.0) discussed below identify how various aspects of TMDL implementation will be or could be conducted and supported, and refers to the Watershed Based Plan (Section 5.1) as an important foundation for implementation efforts. Further specification of implementation plans, projects, and activities - whether they are completed individually and independently or collaboratively and inter-dependently - is beyond the scope of the TMDL decision document. As DOH does not anticipate writing a distinct "TMDL Implementation Plan" for the Nawiliwili Bay Watershed any time in the near future, development of a more comprehensive implementation strategy and detailed implementation plan would have to be driven by community and/or local government efforts, ideally including major landowners (Figure 5-1), urban areas, and riparian properties.

Implementation of TMDL Waste Load Allocations (WLAs) for point sources is accomplished through compliance with conditions attached to NPDES permits. WLAs are assigned to facilities regulated under NPDES individual or general permit coverage. While WLA implementation requirements for individual permits generally require direct permittee action within one year of TMDL approval, WLA implementation requirements for general permit coverage don't take effect until they are triggered by subsequent applicant action (filing a Notice of Intent or claiming automatic permit coverage) or DOH action (issuing a Notice of General Permit Coverage). Regardless, the manner in which DOH addresses the development of WLA implementation and monitoring requirements will be determined on a permit-specific basis, while providing a mechanism for permittees to play an active role in specifying how their own Waste Load Allocations (WLAs) will be implemented. This mechanism and its timelines are further discussed in Section 3.5.2 (Waste Load Allocation) and Section 5.3 (Other Implementation Considerations and Priorities) below.

TMDL implementation within the Nawiliwili Bay Watershed is primarily a nonpoint source management concern. Our TMDL implementation framework and Watershed Based Plan (Section 5.1) are intended to inform and guide the manner in which the watershed community chooses to achieve the nonpoint source pollutant load reductions required to meet water quality standards. Public comments on this section of the draft TMDL included recommendations for an integrated implementation framework and load reduction strategy that incorporates modified aspects of the Watershed Based Plan (Section 5.1), cost-effectively targets known sources, and includes:

- a phased load reduction schedule,
- periodic review of the TMDL load reduction objectives,

- coordination with the development of a phased and integrated BMP implementation approach, and
- a concurrent BMP effectiveness assessment process.

5.1 WATERSHED BASED PLAN

The University of Hawaii Water Resources Research Center developed a comprehensive restoration and protection plan for the Nawiliwili Bay Watershed (El-Kadi et al. 2004). The plan identifies the causes and sources of pollution that should be controlled; estimates the load reductions expected for the proposed management measures; identifies the critical areas where the measures should be implemented; and estimates the amount of financial and technical assistance needed. In addition, the plan identifies program management tools including an implementation schedule for non-point source measures; describes interim measurable milestones; addresses a monitoring component to evaluate the effectiveness of implementation efforts; and suggests criteria for determining whether loading reductions are being achieved over time.

The plan established four overarching goals:

1) Improve water quality in the Nawiliwili watershed to the point where it meets both state and federal standards, thereby allowing for the de-listing of the impaired segments from the 303(d) list;
2) Enhance current instream flows;
3) Enhance biological integrity of waterways; and
4) Enhance sustainability of the watershed. Specific goals were also defined for each basin in the watershed.

The plan identified several strategies for improving water quality in the watershed, including:

- Managing Stormwater Runoff and Water Quality
- Enforcing Current Water Quality Policies and Regulations
- Reviewing and Revising Current Water Quality Policies and Regulations
- Integrating the Ahupuaʻa Concept with Modern Watershed Management
- Controlling Invasive and Non-native Species
- Encouraging Collaboration Among Various Agencies
- Developing and Implementing Education and Outreach Programs
- Developing a Water Budget for the Watershed

The plan also introduces specific restoration activities as part of a multi-year, multi-million dollar implementation strategy to improve water quality. Activities proposed include:

- Developing and Implementing Education and Outreach Programs to target schools as well as activities to change behavior related to water quality (vegetation plantings; Low Impact Design workshop, as well as workshops that target eco-tour and agricultural operators).
- Reducing Soil Erosion from Agricultural Land by relocating cattle water troughs away from streams and improving both water recycling and conservation practice implementation.

- Implementing Capital Improvement Projects with an initial focus on stormwater catch basin inserts and the use of constructed wetlands to assist with stormwater management.
- Controlling Non-Native/Invasive Species such as mangroves and feral ungulates by establishing programs to monitor and abate these threats through physical removal (mangroves) or hunting (feral ungulates).
- Eliminating Cesspools.
- Implementing Low Impact Development Practices that reduce both the amount of impervious surface and runoff and utilize natural land features to achieve stormwater management objectives.
- Protecting and Restoring Habitats.
- Improving Huleia Estuary through sandbar dredging and relocation of the boat mooring area.

Source: El-Kadi et al. 2004 (Table 20)
hawaii.gov/health/environmental/water/cleanwater/prc/pdf/WatershedBasedPlanNawiliwili.pdf

5.2 Best Management Practices (BMPs) For Reducing Pollutant Loads

To help guide the implementation of pollutant load reductions for achieving the stream TMDLs, we compiled, from various sources, a list of BMPs and their typical removal efficiencies (Table 5-1). These BMPS are not necessarily tested under Hawaii conditions, and final selection of BMPs must also consider site-specific conditions. Sources of additional information and assistance are listed below. Technical assistance for agricultural producers is available from various organizations, primarily the U.S. Department of Agriculture (Natural Resources Conservation Service), the East Kauai Soil and Water Conservation District (State of Hawaii Department of Land and Natural Resources), and the University of Hawaii College of Tropical Agriculture and Human Resources.

Table 5-1: Typical Pollutant Removal by BMPs

BMP	Typical Pollutant Removal (Percent)		
	TSS	Total Phosphorus	Total Nitrogen
Dry Detention Basins	30 - 65	15 - 45	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65
Constructed Wetlands	50 - 80	15 - 45	< 30
Infiltration Basins	50 - 80	50 - 80	50 - 80
Dry Wells	50 - 80	15 - 45	50 - 80
Porous Pavement	65 - 100	30 - 65	65 - 100
Grassed Swale	30 - 65	15 - 45	15 - 45
Vegetated Filter Strip	50 - 80	50 - 80	50 - 80
Agricultural Practices	8 - 25	5 - 25	3 - 8
Runoff Control - Livestock Areas	~ 40	~ 10	~ 10
Cover Crops	~ 20	~ 15	~ 45
Stream Protection for Grazing	~ 75	~ 60	~ 60
Stream Restoration/Stabilization	2.5 lb/ft	0.0035 lb/ft	0.02 lb/ft

Using the removal efficiencies presented in the BMP table above and the loading results presented in Table 3-6 and 3-7, it is possible to estimate the impacts on pollutant loading from BMP implementation. It is important to remember that not all BMPs shown in the table can be used for all land uses and that most of the BMPs shown impact only surface water runoff generated from storm events. Also, removal efficiencies are not additive, meaning if a grass swale removes 65% of the TSS loading of receiving waters and then discharges to a filter strip, the strip will not remove an additional 80% of the remaining TSS.

Given the potential for nutrient and bacterial loading from cesspools and septic tanks, their conversion to conventional sanitary sewer collection, as well as improving and upgrading the design and construction of new and existing individual wastewater systems, should be included as BMPs. A recently published Onsite Wastewater Treatment Survey and Assessment (Water Resources Research Center and Engineering Solutions, Inc., 2008) provides guidance as to the various treatment and disposal systems that are currently available and to describe their advantages and constraints so that those involved in the selection, design, construction, operation, maintenance, and permitting of these facilities can make informed decisions.

Sources of Additional Information and Assistance for Polluted Runoff Control Implementation

East Kauai Soil and Water Conservation District offers technical assistance to all land users in our community. And in addition to the traditional mission of SWCDs, the East Kauai SWCD is involved in related areas, such as erosion control and conservation planning, control of nonpoint source pollution, watershed planning, habitat preservation and conservation education. http://www.hacdhawaii.org/districts/eastkauai.html

Garden Island Resource Conservation& Development works to carry out a plan for the orderly conservation, development and prudent use of natural and human resources to improve economic, social and environmental opportunities for the people of Kauai County. http://www.gircd.org/

U.S. Department of Agriculture, Natural Resources Conservation Service provides technical assistance with conservation planning (Kauai District Office), cost-sharing for plan implementation (Farm Bill programs), and related information (technical guide and notes). http://www.hi.nrcs.usda.gov/programs/

U.S. Department of Agriculture, Animal and Plant Health Inspection Service provides contractual services to protect agriculture, human health and safety, natural resources, and property from damage or threats posed by wildlife (Hawaii Wildlife Services program). http://www.aphis.usda.gov/wildlife_damage

University of Hawaii College of Tropical Agriculture and Human Resources – Water Quality Extension Program: Includes Conservation System Guides for Pacific Basin Beginning and Limited Resource Farmers and Ranchers; The HAPPI (Hawaii's Pollution Prevention Information) Home Series and Farm Series informational worksheets and assessment materials developed to address different water pollution issues; and publications on various topics by the Regional Water Quality Program.
http://www.ctahr.hawaii.edu/wq/publications/publications.htm

State of Hawaii Department of Land and Natural Resources
Division of Forestry and Wildlife http://www.dofaw.net/
Forestry Best Management Practices http://www.state.hi.us/dlnr/dofaw/wmp/bmps.htm

The Kauai Watershed Alliance (KWA), formed in 2003 on the island of Kaua'i, is part of the Hawaii Association of watershed Partnerships (HAWP). KWA members include public and private landowners within the forest reserve boundary.
http://www.kauaiwatershed.org/index.html
http://hawp.org/AboutHAWP.php

Hawaii Low Impact Development Guide (produced by CZM, 2006)
http://www.hawaii.gov/dbedt/czm/initiative/lid_pdf/lid_guide_2006.pdf

EPA Green Infrastructure: Covers everything from conservation easements and Transfer of Development Rights to pervious pavements and green roofs.
http://cfpub.epa.gov/npdes/home.cfm?program_id=298

> **Stormwater BMP menu** (green infrastructure link accesses some of this information)
> http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

Green Roof Information
http://www.greenroofs.org (click on 'About Green Roofs' and scroll down for runoff information)
http://www.caseytrees.org/programs/planning-design/gbo.html (Green Build Out Model)
http://www.greeninfrastructure.net/

Guam/CNMI stormwater management plan link
http://new.deq.gov.mp/artdoc/Sec6art55ID136.pdf

Center for Watershed Protection http://www.cwp.org/

> Codes & Ordinances Worksheet
> The Codes & Ordinances Worksheet, or COW, is a simple worksheet that you can use to see how the local development rules in your community stack up against the model development principles outlined in Better Site Design. Answer the questions and see how environmentally-friendly your community is!
> http://www.cwp.org/COW_worksheet.htm
>
> Watershed Protection Audit
> One of the most important tasks in establishing a watershed baseline is to conduct an audit of local watershed protection capabilities. The audit establishes a baseline of current strategies and practices within the watershed. By understanding the current state of development, watershed groups can assess strategies, practices, strengths and weaknesses can better plan future efforts. This document can help watershed organizations conduct an audit of the watershed protection tools currently available in their watershed.
> http://www.cwp.org/Community_Watersheds/Watershed_Protection_Audit2.pdf

Stormwater Center
http://www.stormwatercenter.net/

Hawaii Coastal Nonpoint Pollution Control Program information
Program Documents
http://www.hawaii.gov/dbedt/czm/initiative/nonpoint.shtml
http://www.hawaii.gov/health/environmental/water/cleanwater/prc/implan-index.html

Management Measures

Urban (similar to the stormwater site but slightly different focus)
http://www.epa.gov/owow/nps/urbanmm/index.html

Agriculture
http://www.epa.gov/owow/nps/agriculture.html
http://www.epa.gov/owow/nps/agmm/index.html

Forestry
http://www.epa.gov/owow/nps/forestrymgmt/

Hydromodification
http://www.epa.gov/owow/nps/hydromod/index.htm

Marinas and Recreational Boating
http://www.epa.gov/owow/nps/mmsp/index.html

5.3 Other Implementation Considerations and Priorities

The watershed area covered by the Watershed Based Plan (used for calculating the stream TMDLs) extends beyond the boundaries of the contributing areas for the four freshwater streams. Given that water quality impairments in the Nawiliwili Bay watershed extend into the brackish and marine receiving waters for these streams, and that nonpoint sources are the overwhelming concern throughout the watershed (with many known sources that can be immediately targeted for direct action), any implementation activities completed within the larger watershed area are expected to benefit these receiving waters, and should be considered part of the TMDL implementation framework.

Details about the structure and mechanics of the hydrologic network remain uncertain throughout the watershed. Further refining the network diagram and flow routing information developed for the TMDL analysis (which DOH will continue to pursue even after TMDL approval) will lead to better understanding of hydrologic routing, watershed function, and pollutant loading. Areas where immediate improvements seem possible include water use reporting by stream diverters (as required by the State Water Code), access to historic information from Grove Farm and other irrigation system operators, access to maps and specifications for County storm drain systems, and clarification of reservoir locations, boundaries, and uses.

In order to best organize the information used in this TMDL analysis, perpetuate its value, and link it with existing and new information as such becomes available, the ongoing delineation of waterbody segments and their contributing area boundaries should be incorporated into a new, local-resolution National Hydrography Dataset (NHD) for Hawaii. The DOH 2006 Water Quality Monitoring and Assessment Report (EHA 2008) outlines a tiered approach to defining and georeferencing attainment decision units, waterbody segments, and NHD reaches to represent a combination of hydrologic and regulatory truth.

Detailed sub-basin boundaries for targeted coastal and inland contributing areas are a high priority for such efforts, particularly at the eastern and western margins of the Nawiliwili Bay watershed and for the smaller streams not yet assessed by DOH that were not included in the present analysis (but should be assessed in future impairment decision cycles). At the eastern margin of the watershed, the Kauai WWTP, the Kauai Lagoons/Kauai Marriott complex, and portions of Lihue town form a distinct source area for the estuarine portion of Nawiliwili Stream (via the Marriott Culvert previously sampled by UH-WRRC) and the adjacent Kalapaki Beach. Sewage effluent from the Lihue WWTP is disposed via injection wells and surface application and may be a component of nonpoint source loading. Along the southwestern margin of the watershed, there is uncertainty to be resolved about the routing of Kipu-area streamflows and ditch flows to fresh and brackish water portions of the Huleia stream system and to other waterbodies within and beyond the greater Nawiliwili Bay watershed. Decision boundaries supporting future TMDL development in the Nawiliwili Bay embayment and estuaries might also include marine bottom type delineations.

While much of the pollutant loading to Nawiliwili and Puali streams is from non-urban nonpoint sources, biological surveys and assessments indicate that the additional loading and impact from nonpoint and point source urban stormwater in these sub-basins is critically important to stream and watershed health. Thus management of the storm drainage systems in the Lihue-Puhi urban core should be a focus for County and State polluted runoff control (nonpoint sources) and water pollution control (NPDES) implementation efforts. Management approaches to consider include:

- Working with County authorities to implement urban stormwater management measures (including, if necessary, local stormwater management regulations) as expected by EPA and NOAA under the Coastal Zone Act Reauthorization Amendments (CZARA Section 6217);
- Exercising DOH discretion to regulate the urbanized area under municipal separate storm sewer system (MS4) authority;
- Employing a watershed approach to county and state permitting, particularly with regard to the cumulative impacts of concurrent county grading permit and NPDES general permit coverage issuance for widespread land disturbance tied to construction activities;
- Further facilitating cross-program access to permitting and compliance databases for DOH TMDL staff; and
- Including TMDL staff in internal, pre-public notice review of proposed NPDES permit issuance.

Public comments from the NPDES-regulated community requested more detailed information about WLA implementation requirements, strategy, and process. Currently, the WLA requirements for general permit coverage don't take effect within a current permit cycle, they only take effect upon the initiation of a new permit cycle as triggered by applicant action (filing Notice of Intent or claiming automatic coverage) or DOH action (issuing Notice of General Permit Coverage). Thus, depending upon NPDES permit cycles and TMDL timing, a currently permitted facility could have anywhere between five years and ninety days to begin complying with these conditions. The operative steps and definitive timelines for this process are arranged between each permittee and the DOH Clean Water Branch (CWB). For NPDES individual permits, permittees are generally required to submit a WLA implementation and monitoring plan, and to begin conducting the planned activities, within one year of TMDL approval by EPA.

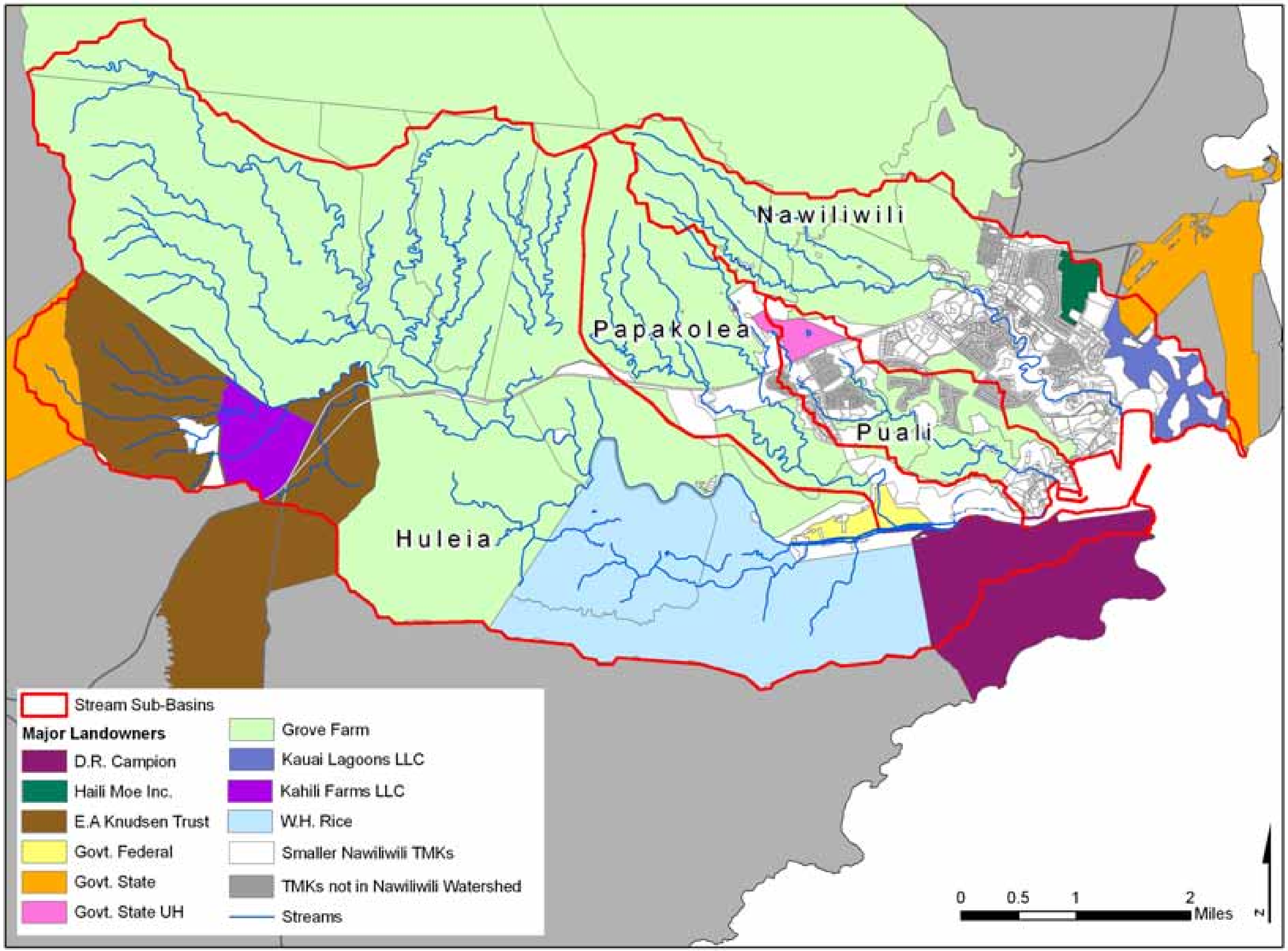
Although the DOH Clean Water Branch website includes weekly permit application updates (http://hawaii.gov/health/environmental/water/cleanwater/pubntcs/index.html), only proposed individual permits (not Notices of General Permit Coverage) are open to a formal public review, and actual dates of permit issuance and coverage are generally not reported online. For both point source and nonpoint source implementation planning, please refer to the TMDL decision document and contact the CWB to identify NPDES permittees for inclusion in this process.

Although NPDES permittees requested greater specificity about how numerical WLAs will be implemented in permit conditions, DOH and EPA view this as a post-TMDL decision in which "the NPDES permitting authority will review the information provided by the TMDL … and determine whether the effluent limit is appropriately expressed using a BMP approach … or a numeric limit" (Wayland and Hanlon, 2002). According to our TMDL methodology, these numeric limits change based on the size of rainfall events. Therefore, translating the WLAs into numerical NPDES permit requirements might be accomplished by establishing a sliding scale or frequency distribution of permit limits as a function of rainfall event size.

EPA Source Water Assessment Program (SWAP) efforts for Kauai, conducted by the DOH and the University of Hawaii Water Resources Research Center (Whittier et al. 2004) included the delineation of capture zones for potable groundwater wellheads and the identification potential contaminating activities (PCAs) within each capture zone. Acquiring the PCA inventory and linking it with surface water management program activities is another cross-program objective for DOH, along with developing a similar capture zone and PCA inventory approach for all groundwater that is a potential source of surface water quality impairments (non-potable and potable shallow and deep aquifers). The PCAs identified in the SWAP efforts include individual wastewater systems (IWS) and underground injection wells regulated by the EPA/State underground injection control program (UIC). Improving access to and the utility of IWS and UIC databases would help support for TMDL development and implementation.

While chronic sedimentation of stream bottoms appears to be a major cause of biological impairment (poor habitat quality and absence of key native organisms), sediment contamination and the bioaccumulation of toxins in fish are emerging as associated concerns. Any future work to repair stream habitat and restore stream biota should carefully consider the broader relationships between pollutant loading and the biological, chemical, and physical integrity of the receiving waters, including the adjoining brackish and marine waters. To better support future water quality assessment, TMDL development and implementation, and stream repair/restoration, it may also be useful to further develop reference stream approaches that characterize and quantify the hydrologic and hydraulic conditions necessary for satisfactory ecosystem health, and to clarify how these conditions (and ecosystem health) change due to linkages between urban drainage, sediment loading, channel-forming processes, bank erosion, bed scour, and deposition. Some states and local governments have formally instituted these kinds of approaches through regulatory "Hydraulic Codes," while others are exploring the development of "Hydraulic TMDLs" that address the pollutant loading directly resulting from hydrologic and hydraulic modifications, even though the flows delivered to the hydrologic system may not be load-bearing in the conventional sense.

Figure 5-1: Major Land Owners (100+ acres) in the Nawiliwili Bay Watershed



6.0 REASONABLE ASSURANCE

Reasonable assurances may be provided through use of regulatory, non-regulatory, or incentive based implementation mechanisms as appropriate. The State uses a combination of all three mechanisms to protect and restore designated uses, attain water quality criteria, and prevent unwarranted degradation of water quality.

The State will assure implementation of the approved TMDL WLAs through the enforcement of NPDES permit conditions (HAR §11-55) and will pursue implementation of load allocations through Hawaii's Implementation Plan for Polluted Runoff Control (Coastal Zone Management Program and Polluted Runoff Control Program, 2000) and Hawaii's Coastal Nonpoint Pollution Control Program Management Plan (Hawaii Coastal Zone Management Program, 1996), and the State of Hawaii Water Pollution Control Revolving Fund Intended Use Plan (Clean Water State Revolving Fund Loan Program, 2008), all of which serve the State Water Quality Standards (HAR § 11-54).

A watershed based plan (existing), and any future TMDL implementation plan for the Nawiliwili Bay watershed, bolsters these assurances by describing specific, planned implementation actions or, where appropriate, specific processes and schedules for determining future implementation actions**.** As guidance for incentive based implementation, these plans define mechanisms for implementing nonpoint source load allocations over reasonable periods of time.

7.0 PUBLIC PARTICIPATION

TMDL development in the Nawiliwili watershed is an outcome of many years of public participation in initiating and sustaining environmental protection programs. Public nomination of the Huleia and Nawiliwili streams led to 1996 waterbody assessments by DOH, and the results of these assessments formed the basis for adding these two streams to the State's Clean Water Act §303(d) list of impaired waters in 2001.

At that time, through a grant from the DOH Clean Water Branch (Polluted Runoff Control Program), the non-profit Pacific Island Sustainable Community Ecosystems (PISCES) group began collaborating with the Nawiliwili Bay Watershed Council, Kauai High School, the U.S. Geological Survey, the University of Hawaii Stream Research Center, and others to conduct various water quality monitoring, public education, and outreach activities. This led to the formation of the Nawiliwili Bay Water Quality Committee, which provided a point of entry for the DOH TMDL program to begin working in the Nawiliwili Bay watershed in 2002, including DOH presentations to the Committee that were broadcast on public access television. At the same time, the University of Hawaii Water Resources Research Center (WRRC), through a grant from the DOH Clean Water Branch (Polluted Runoff Control Program), conducted a three-year (2002-2004), three-phase watershed planning process addressing a wide range of water quality concerns, including TMDLs, in the Nawiliwili Bay Watershed. Since the adoption of the WRRC Phase 3 report as a watershed based plan for Clean Water Act §319(h) funding, the DOH Clean Water Branch (Polluted Runoff Control Program) and DOH-EPO have worked together to promote the implementation of actions from this plan to reduce pollutant loading, improve water quality, repair habitat quality, and restore ecosystem integrity.

During the TMDL development process, staff from Tetra Tech, Inc., AECOS, Inc., and DOH-EPO staff discussed the TMDLs with various other interested parties and sources of information, including:

- State of Hawai'i Department of Health (Clean Water Branch, Wastewater Branch, Safe Drinking Water Branch, Office of Hazard Evaluation and Emergency Response)
- U.S. Environmental Protection Agency (Region 9)
- University of Hawai'i (Sea Grant Extension Program, Center for Conservation Research and Training, College of Tropical Agriculture and Human Resources, Water Resources Research Center)
- County of Kauai (Planning Dept., Public Works Dept., Dept. of Water)
- State of Hawaii Department of Transportation, Kauai District (Airports, Harbors, and Highways Divisions)
- East Kauai Soil and Water Conservation District
- State of Hawaii Department of Land and Natural Resources (Division of Aquatic Resources, Division of Forestry and Wildlife, Commission on Water Resource Management)
- Kawaikini New Century Public Charter School #565
- State of Hawaii Office of Hawaiian Affairs

- Private land owners and property managers, and in particular Tadao Suemori, Grove Farm Company (and tenants, primarily on agricultural lands), Jan TenBruggencate, Carolyn Larson, Kaipo Nishibata, Don Heacock, Kauai Marriott, and Nuhou Corp.
- U.S. Department of Agriculture Natural Resources Conservation Service – Lihue Field Office
- U.S. Fish and Wildlife Service (Huleia National Wildlife Refuge)
- U.S. Geological Survey (Pacific Water Science Center)
- The Garden Island (Kauai-based newspaper)

After internal review and preliminary DOH approval, a draft TMDL submittal was published for public review on July 30, 2008. We provided public notice of this draft submittal, the public information meeting, and public comment opportunity via a legal notice in local and statewide newspapers; personalized letters to twenty-two parties with known interests in the proposed decision (including NPDES permittees, large landowners, and local governmental and non-governmental organizations); email bulletins to mailing lists for the DOH-EPO TMDL intergovernmental work group, TMDL public interest, and Nawiliwili TMDL; the DOH-EPO website; and everyday informal professional communication with our colleagues and customers.

A public information meeting was held within the Nawiliwili Bay watershed on August 13, 2008 to present and discuss the results. The sign-in sheet for this meeting indicates that at least twenty people attended, and The Garden Island newspaper reported the following day about the meeting, the draft TMDL decision, and the public comment period ("Input sought on Nawiliwili pollution"). Follow-up discussions and meetings with interested parties were held as requested.

As of the September 2, 2008 deadline for public comment, we received written comments on the draft decision document from seven interested parties:

Alexander & Baldwin, Inc.
Andrew F. Bushnell
Grove Farm Company, Inc.
Hawaii Farm Bureau Federation
Jas W. Glover Ltd.
Kauai Lagoons LLC
The Kauai Marriott Resort and Beach Club

A response was mailed to each party, explaining how their comments were considered in the final TMDLs. Documentation of the public participation process in Appendix I includes the public notice (with its affidavits of publication), a table listing the twenty-three addressees receiving personalized notice letters, the public information meeting sign-in sheet and DOH-EPO handout, the public comments received, and the DOH-EPO response to each of these comments.

In response to comments received about "limited opportunity for public involvement" in submittal of the proposed TMDL, we explained that these opportunities are frequently a function of the extent to which a watershed community helps create them throughout the process. Despite the fact that the TMDL program has statewide responsibilities and no neighbor island staffing, we met individually, and sometimes repeatedly, with watershed partners and participated in several public events (such as Kauai Earth Day, Soil and Water Conservation District meetings, and Nawiliwili Watershed Council and University of Hawaii forums) on Kauai, resulting in many significant public contributions to the TMDL decision. The public comment period for this TMDL was the same as that regularly provided for all proposed DOH TMDL decisions, with DOH meeting all federal requirements and fulfilling all EPA Region 9 review criteria for TMDL public participation. The consideration of public comments did not lead to fundamental changes in the TMDL methodology or results, therefore we believe that conducting a second comment period (as requested in the comments received and at the public information meeting) would unduly delay the overall TMDL process and would not lead to significant improvements in the TMDL decision.

In response to comments received about appearances that DOH-EPO downplayed the importance of the TMDL document in EPA's TMDL decision making process and gave the wrong impression to members of the public about the potential impacts of an EPA-approved TMDL, we explained that:

- the entire TMDL document and DOH's submittal letter are the basis for EPA approval, and are evaluated by EPA using the checklist found in Appendix A.
- the actual impacts of an EPA-approved TMDL that we intend to highlight for public participants are the associated modifications of NPDES permit conditions (to implement Waste Load Allocations) and the increased opportunities to obtain Clean Water Act §319 grant funds (to implement nonpoint source Load Allocations).
- commonly-feared potential impacts of an EPA-approved TMDL are mostly beyond DOH control, such as government and private action (including legislation, approval and permitting conditions, lease conditions, and third-party lawsuits) to require the implementation of nonpoint source Load Allocations.
- DOH enforcement actions against nonpoint sources that cause or contribute to non-attainment of the water quality standards are generally complaint-driven, are not systematically pursued in conjunction with TMDL approval, and tend to focus on repeat and egregious offenders.

Many of the other comments received during the public comment period questioned the TMDL technical approach, recommended or requested that TMDL implementation be delayed in order to develop more complete technical understanding of pollutant loading dynamics, and/or asked for more detailed information about the TMDL implementation requirements, strategy, and process for both point source WLAs and nonpoint source LAs. In reply, we provided additional detail about the WLA implementation process, and emphasized that this TMDL decision is a starting point for nonpoint source implementation activities that can be adapted as new information becomes available, including, if warranted, future revision of the TMDL decision. DOH expects that TMDL implementation will be community-driven, not DOH-imposed. Thus, further specification of implementation plans, projects, and activities is beyond the scope of the TMDL decision document.

8.0 REFERENCES

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APPENDIX A – DOH WATERBODY ASSESSMENT SHEETS, 2006 303(d) LIST, AND EPA TMDL APPROVAL CHECKLIST

Waterbody Information Sheet: Streams

Stream Name & Location: Huleia Stream

Inspected By: Adrian Palomino

Date: May 23, 1996 and December 3, 1996

I. RESEARCH
1. Why is this stream being inspected? (choose all that apply) **Public Nomination,** Watershed Target, Other (explain)
2. What land use zoning areas are within this stream's watershed? (choose all that apply) **Urban,** Rural, **Agriculture, Conservation**
3. Is there water quality data available for this stream? Yes **No**
3a. Is there evidence of criteria violations? Yes No (If "yes," list pollutants.)
4. Has this stream ever been subject to fish consumption advisories, or health warnings (excluding leptospiroses)? Yes **No** (If "yes," describe the action and attach documentation to this sheet.)
5. Has this stream ever suffered any fish kills? **Yes** No (If "yes," list their date and magnitude, and attach documentation to this sheet.) *Date: approximately 9/5/94. Magnitude: unknown.*
II. FIELD ASSESSMENT
1. If there are criteria violations for this stream, are the sources of these pollutants readily apparent? **Yes** No Discuss. Rock quarry.
2. Is this stream being impaired by point source discharges? **Yes** No (If "yes," discuss.) *The Halfway Bridge Rock Quarry is a past and likely existing source of sediments to the river. The Quarry now as an NPDES permit that limits the turbidity of their discharge.*
3. Are any of the following activities occurring in the watershed: **agriculture, commercial enterprise,** construction, or residential development?(choose all that apply)

4. If so, are any of these activities occurring on such a scale as to be significant pollutant sources for this waterbody? **Yes** No (If "yes," discuss, listing pollutants and transport mechanisms.) *Sugar cane agriculture leaves bare earth that is mobilized by rainfall and is deposited into the stream.* *The above-mentioned rock quarry, a significant source of sediments in the past, may still be a source even now.*
5. Is there evidence of nutrient enrichment, including algal blooms or excessive amounts of nuisance vegetation? Yes **No**
6. Is there a significant amount of debris or litter? Yes **No** *The stream appeared very clean.*
7. Has the stream channel been channelized with concrete or substantially modified or straightened? Yes **No**
8. Has the riparian area been cleared of vegetation? Yes **No**
9. Is there evidence of significant erosion in the stream channel? Yes *No*
10.Evaluate the visual water quality. *Excellent. This is a good candidate to view in the rainy season.* Good even in rainy season.
11. How is this water used, and by whom? *Kayakers, boat moorage. Likely used for fishing, although none observed. Wildlife habitat (it is adjacent tot he Huleia National Wildlife Refuge).*
12. Comments *This stream suffers from water diversions, as do many of the streams on this island. Lack of water concentrates any pollutants that may be in the water.*

13. Is this stream of high enough quality that it should not be considered impaired? Discuss.
If this stream is to be listed, it would have to be a seasonal listing. When I visited the stream with Don Heacock and Gary Uenten on May 22, the stream appeared to be in excellent condition: clear, plenty of mullet and some gobis, a few kayakers enjoying the stream. O May 23, I made my way up the watershed, looking at many different sites. All had the same clear water quality. There was a good riffle-run-pool ratio to the stream, riparian veg was excellent, no downcutting (the problem is lack of water). Stream embededness, however, did appear to be high, evidence of past sediment loads. Again, this stream should be visited after a heavy rainfall.
Stream appeared in good shape on December 3, 1996.

05/23/1996 Huleia Stream
Notice water clarity

/Vaterbody Information Sheet: Streams

Stream Name & Location: Nawiliwili Stream, Lihue, Kauai

Inspected By: Adrian Palomino

Date: May 23, 1996 and December 3, 1996

I. RESEARCH
1. Why is this stream being inspected? (choose all that apply) **Public Nomination, Watershed Target,** Other (explain)
2. What land use zoning areas are within this stream's watershed? (choose all that apply) **Urban,** Rural, **Agriculture,** Conservation
3. Is there water quality data available for this stream? Yes **No**
3a. Is there evidence of criteria violations? Yes No (If "yes," list pollutants.)
4. Has this stream ever been subject to fish consumption advisories, or health warnings (excluding leptospiroses)? Yes **No** (If "yes," describe the action and attach documentation to this sheet.)
5. Has this stream ever suffered any fish kills? **Yes** No (If "yes," list their date and magnitude, and attach documentation to this sheet.) 1) August 21, 1995. Approximately 100 fish, most likely due to low DO caused by low stream flow and warm temperature.
II. FIELD ASSESSMENT
1. If there are criteria violations for this stream, are the sources of these pollutants readily apparent? **Yes** No Discuss. Urban runoff, nutrients from upstream ag.
2. Is this stream being impaired by point source discharges? Yes **No** (If "yes," discuss.)
3. Are any of the following activities occurring in the watershed: **agriculture, commercial enterprise, construction, or residential development**?(choose all that apply)

4. If so, are any of these activities occurring on such a scale as to be significant pollutant sources for this waterbody? **Yes** No (If "yes," discuss, listing pollutants and transport mechanisms.)
1) Sugar cane cultivation creates bare soil which is mobilized during rainfall and flows into Nawiliwili stream.
2) Nawiliwili Stream drains the town of Lihue and receives most of its stormwater runoff.
3) Sugar cane water diversions reduce flow in the stream, reducing flushing action and raising temperatures.
4) Occasional spills from the Lihue WWTP flow into the stream.

5. Is there evidence of nutrient enrichment, including algal blooms or excessive amounts of nuisance vegetation? Yes **No**

6. Is there a significant amount of debris or litter? Yes **No**

7. Has the stream channel been channelized with concrete or substantially modified or straightened? Yes **No**

8. Has the riparian area been cleared of vegetation? Yes **No**

9. Is there evidence of significant erosion in the stream channel? Yes **No**

10.Evaluate the visual water quality.
Very poor. Nawiliwili is plagued by very high turbidity. The water is very brown.

11. How is this water used, and by whom?
Nawiliwili is used to drain the town of Lihue.

12. Comments
Nawiliwili suffers from three problems: water diversions, agricultural siltation and urban runoff. Flow is poor, water color is green red. The stream has been the site of at least one fish kill and a sewage spill. The water was nominated by Don Heacock, DLNR.

Nawiliwili Stream drains into Kalapaki Bay, which is part of Nawiliwili Bay, and the water quality of Nawiliwili Stream affects that of Kalapaki Bay.

13. Is this stream of high enough quality that it should not be considered impaired? Discuss.
This is the worst-quality stream that I saw on Kauai. The combination of low flow and pollutant inputs from agriculture and Lihue town are enough to severely degrade this system.

Management Options:
1) Sugar cane BMPs.
2) Flow restoration.
3) Urban runoff control.

5/23/1996 Nawiliwili Stream
Upper Lihue
Notice brown color

5/23/1996 Nawiliwili Stream
Near stream mouth
Notice vegetation & brown color

5/23/1996 Nawiliwili Stream
At stream mouth

2006 Waterbody Assessment Decisions [Integrated 303(d) List/305(b) Report for Hawaii]

- New 303(d) listing are shaded, **bold** and ***italicized*** in the table, as are any changes for previously listed waters. 2004 303(d) listings are **blue and bold**.
- **Stream codes:** EN = Entire Network, EE = Entire Estuary, ER = Entire Reservoir, EW = Entire Wetland, EL = Entire Lake.
- **Marine Codes:** B = Bay (as specified within HAR 11-54-6), C = Open Coastal (fronting areas within 1000' and 100 fathoms of specified area), E = Estuary, K = Kona (All marine waters of Hawaii Island from Loa Point, South Kona District, clockwise to Malae Point, North Kona District, excluding Kawaihae Harbor and Honokohau Harbor, and for all areas from the shoreline at mean lower low water to a distance 1000m seaward (see HAR 11-54-6), P = Pearl Harbor; * = Listings from previous reporting cycles which, at that time, were then listed as separate entities from similar named sampling stations, convention continued for this cycle.
- **Decision Codes:** ? = unknown, N = not attained, A = Attained, Ac = Attained (with combined season data), Nc = Not attained (with combined season data), N1 = not attained (by 2 times the standard), N1c = not attained (by combined data, 2 times the standard), V = visual listing from 2001-2004, L = previous listing from 1998 or earlier.
- **Parameter Codes:** Total N = total nitrogen; NO3+NO2 = nitrite+nitrate nitrogen; Total P = total phosphorus; TURB = turbidity; TSS = total suspended solids; chl-a = chlorophyll a; NH4 = ammonium nitrogen.
- **TMDL Priority Codes:** High (H), Medium (M), and Low (L) priority for initiating TMDL development within the current monitoring and assessment cycle (through April 15, 2008), based on the prioritization criteria described in the Integrated Report and on current and projected resource availability for completing the TMDL development process. IP = TMDL development in progress.
- **Notes:** Assessment results for enterococci microbiological sampling in embayments and open coastal waters are only applicable within the 300 meter (one thousand feet) boundary from the shoreline (HRS 11-54-8(b)).
- For this report, assessed water bodies were sorted by island (north to south), then into the streams category (salinity below 0.5 ppt) or the coastal category (salinity above 0.5 ppt).

KAUAI Stream Waters												
Assessed Waterbody	**Waterbody Type**	**Scope of Assessment**	**Geocode ID**	**Season**	**enterococci**	**Total N**	**NO_3+NO_2**	**Total P**	**TURB**	**Other Pollutants**	**Category**	TMDL Priority
Nawiliwili	Stream	EN	2-2-13	Dry	?	N	N	A	V	TSS (A)	3, 5	H (IP)
Nawiliwili	Stream	EN	2-2-13	Wet	?	N	N	A	~~N~~ A	TSS (A)	3, 5	H (IP)
Puali	Stream	EN	2-2-14	Dry	?	N	N	A	N1	TSS (A)	3, 5	H (IP)
Puali	Stream	EN	2-2-14	Wet	?	Nc	N1	Ac	Nc	TSS (Ac)	3, 5	H (IP)
Huleia	Stream	EN	2-2-15	Dry	?	N	N	A	V	TSS (A)	3, 5	H (IP)
Huleia	Stream	EN	2-2-15	Wet	?	A	~~N~~ A	A	A	TSS (A)	3, 5	H (IP)
Uhelekawawa	Stream	EN	2-2-Uhelekawawa		?	?	?	?	V	TSS (?)	3, 5	~~M~~ L
Kipu	Stream	EN	2-3-01		?	?	?	?	?	TSS (?)	3	
Waikomo	Stream	EN	2-3-02	Dry	?	Nc	N1	Ac	N1	TSS (Ac)	3, 5	L
Waikomo	Stream	EN	2-3-02	Wet	?	Nc	Nc	Ac	Nc	TSS (Ac)	3, 5	L
Lawai	Stream	EN	2-3-04	Dry	?	N	N	A	N	TSS (A)	3, 5	~~M~~ L
Lawai	Stream	EN	2-3-04	Wet	?	Ac	Ac	Ac	N	TSS (Ac)	3, 5	~~M~~ L
Wahiawa	Stream	EN	2-3-06	Dry	?	N1	N1	A	N1	TSS (A)	3, 5	L
Wahiawa	Stream	EN	2-3-06	Wet	?	Nc	Nc	Ac	Nc	TSS (Ac)	3, 5	L
Hanapepe	~~River~~ Stream	EN	2-3-07	Dry	?	A	A	A	N	TSS (A)	3, 5	~~M~~ L
Hanapepe	~~River~~ Stream	EN	2-3-07	Wet	?	Ac	Ac	Ac	V	TSS (Ac)	3, 5	~~M~~ L
Mahinauli	Stream	EN	2-4-01		?	?	?	?	?	TSS (?)	3	
Aakukui	Stream	EN	2-4-02		?	?	?	?	?	TSS (?)	3	
Waimea	Stream	EN	2-4-04	Dry	?	A	A	N	~~V~~ N	TSS (A)	3, 5	~~M~~ L
Waimea	Stream	EN	2-4-04	Wet	?	Ac	Ac	Ac	V	TSS (Ac)	3, 5	~~M~~ L
Waimea	~~River~~Estuary	~~EN~~ EE	2-4-04-E		?	?	?	?	V	TSS (?)	3, 5	~~M~~ L

KAUAI Marine Waters											
Waterbody Type	Scope of Assessment	Geocode ID	Season	enterococci	Total N	NO_3+NO_2	Total P	TURB	Other Pollutants	Category	TMDL Priority
C	Kalihiwai Bay	HI264001	wet	N	?	?	?	?		3,5	L
C	Kapa'a Beach Co. Park	HI972832	wet	N	?	?	?	?		3,5	L
C	Kauapea Beach (Secret Beach)	HI669328	wet	?	?	?	?	?		3	
C	Kawailoa Beach	HI698776	dry	?	?	?	?	?		3	
C	Kealia	HI402035	wet	?	?	?	?	?		3	
C	Kee Beach	HI124511	wet	A	?	?	?	A		2,3	
C	Kekaha Beach Co. Pk.	HI530569	dry	A	?	?	?	?		2,3	
C	Kepuhi Beach	HI344813	wet	?	?	?	?	?		3	
B	Kikiaola Boat Harbor	HIW00112	dry	?	?	?	?	?		3	
C	Kilauea Pt. Nat. Wildlife Ref.	HI471488	wet	?	?	?	?	?		3	
C	Kipu Kai	HI266627	wet	?	?	?	?	?		3	
C	Koloa Landing	HI955435	dry	N	?	?	?	?		3,5	L
B	Kukuiula Bay	HIW00113	dry	?	?	?	?	?		3	
C	Larsens Beach	HI860960	wet	?	?	?	?	?		3	
C	Lawa'i Kai	HI434882	wet	?	?	?	?	?		3	
C	Waimea Bay Beach (Near River station)	HI862821	na	N	?	?	?	?		3,5	
C	Lumaha'i Beach	HI889639	wet	?	?	?	?	?		3	
C	Lydgate Park	HI798758	wet	N	?	?	?	?		3,5	L
C	Maha'ulepu Beach	HI533799	dry	?	?	?	?	?		3	
C	Miloli'I	HI333210	dry	?	?	?	?	?		3	
C	Moloa'a Bay	HI547745	wet	?	?	?	?	?		3	
C	Na Pali Coast State Park	HI709808	dry	?	?	?	?	?		3	
B	Nawiliwili Bay (Kalapaki Beach)	HIW00114	wet	N	?	?	?	?		3,5	~~H~~ M
B	Nawiliwili Bay (Offshore)	HIW00116	wet	?	?	N	?	N	chl-a(N), NH4(N)	3,5	~~H~~ M
B	Nawiliwili Bay (Nawiliwili Harbor)	HIW00115	wet	N	?	?	?	?		3,5	~~H~~ M
B	Nawiliwili Bay- from breakwater to shore	HIW00059	wet	?	L	L	L	L	nutrients	3,5	~~H~~ M
C	Nu'alolo	HI945520	dry	?	?	?	?	?		3	

EPA Region 9 TMDL Review Checklist

EPA Region 9 uses this checklist to review TMDLs submitted for EPA Region 9 approval to ensure that the TMDLs meet all the requirements of the Clean Water Act and EPA's regulations concerning TMDL content. Because many TMDL submissions from California and other states also include TMDL implementation measures pursuant to EPA's regulatory requirements at 40 CFR 130.6, the checklist also includes review criteria for TMDL implementation measures. EPA regulations do not require the submission of implementation measures at the same time as TMDLs are submitted.

State: Waterbodies:
Pollutant(s): Date of State Submission:
Date Received By EPA: EPA Reviewer:

TMDL Review Criteria (per Clean Water Act Section 303(d) and 40 CFR 130.2 and 130.7)	**Approved**	**Comments**
1. Submittal Letter: State submittal letter indicates final TMDL(s) for specific water(s)/pollutant(s) were adopted by state and submitted to EPA for approval under 303(d).		
2. Water Quality Standards Attainment: TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards.		
3. Numeric Target(s): Submission describes applicable water quality standards, including beneficial uses, applicable numeric and/or narrative criteria. Numeric water quality target(s) for TMDL identified, and adequate basis for target(s) as interpretation of water quality standards is provided.		
4. Source Analysis: Point, nonpoint, and background sources of pollutants of concern are described, including the magnitude and location of sources. Submittal demonstrates all significant sources have been considered.		
5. Allocations: Submittal identifies appropriate wasteload allocations for point sources and load allocations for nonpoint sources. If no point sources are present, wasteload allocations are zero. If no nonpoint sources are present, load allocations are zero.		
6. Link Between Numeric Target(s) and Pollutant(s) of Concern: Submittal describes relationship between numeric target(s) and identified pollutant sources. For each pollutant, describes analytical basis for conclusion that sum of wasteload allocations, load allocations, and margin of safety does not exceed the loading capacity of the receiving water(s).		
7. Margin of Safety: Submission describes explicit and/or implicit margin of safety for each pollutant.		
8. Seasonal Variations and Critical Conditions: Submission describes method for accounting for seasonal variations and critical conditions in the TMDL(s)		

9. Public Participation: Submission documents provision of public notice and public comment opportunity; and explains how public comments were considered in the final TMDL(s).		
10. Technical Analysis: Submission provides appropriate level of technical analysis supporting TMDL elements.		
Note: **The following criteria do not apply to all TMDLs, but must be applied in the situations noted.**		
11. Monitoring Plan for TMDLs Under Phased Approach (where phased approach is used): TMDLs developed under phased approach identify implementation actions, monitoring plan and schedule for considering revisions to TMDL.		
12. Reasonable Assurances (for waters affected by both point and nonpoint sources): Where point source(s) receive less stringent wasteload allocations because nonpoint source reductions are expected and reflected in load allocations, implementation plan provides reasonable assurances that nonpoint implementation actions are sufficient to result in attainment of load allocations in a reasonable period of time. Reasonable assurances may be provided through use of regulatory, non-regulatory, or incentive based implementation mechanisms as appropriate.		
Implementation Plan Review Criteria (per Clean Water Act Section 303(e) and 40 CFR 130.6)		
13. Clear Implementation Plan: Submittal describes planned implementation actions or, where appropriate, specific process and schedule for determining future implementation actions **.** Plan is sufficient to implement all wasteload and load allocations in reasonable period of time. TMDL(s) and implementation measures are incorporated into the water quality management plan. Water quality management plan revisions are consistent with other existing provisions of the water quality management plan.		

APPENDIX B – STREAM CHARACTERISTICS, BIOLOGICAL ASSESSMENT RESULTS, AND DATA QUALITY ASSESSMENTS

Figures summarizing various biological assessments conducted in four major streams the Nawiliwili Bay watershed appear at the end of this Appendix. The following detailed description stream conditions was originally prepared by Tetra Tech, Inc. and AECOS, Inc. for the State of Hawaii Department of Health.

NAWILIWILI STREAM SYSTEM CONDITIONS

The Nawiliwili Stream system flows in a southeasterly direction towards Nawiliwili Bay. The upper reach of the Nawiliwili Stream system consists of a north and south tributary.The land surrounding the north and south forks of Nawiliwili Stream system in the upper reach is primarily undeveloped former sugarcane land. The upper Lihue Ditch crosses both tributaries and eventually discharges to a reservoir north of Kauai Community College.

The middle reach of the Nawiliwili Stream system arises from the convergence of the north and south tributaries off the slopes of Kilohana Crater. In general, the middle reach is a small, shallow, slow-flowing stream that flows through mostly open land with only a few trees. Downstream from where Kaumualii Highway (Hwy 50) crosses the middle reach of the stream, the watershed is primarily urban (north side) and suburban (south side). The stream flows through the south edge of Lihue town in a wide gulch between Nawiliwili Road (Hwy 58) and Rice Street (Hwy 51). The Lihue sugar mill is adjacent to Nawiliwili Stream, just downstream from the Kaumualii Highway Bridge. In addition, a small tributary flows southward, parallel with Kuhio Highway and passes under Kaumualii Highway to join Nawiliwili Stream in the vicinity of the mill entrance road. This small tributary does not appear on the USGS topographic map (7.5-minute series, Lihue quadrangle, 1996). The flow of this small tributary dwindles rapidly upstream from its confluence with Nawiliwili Stream. The source of the water for this stream includes springs, and its drainage basin includes a large area within and above the sugar mill operations area. This unnamed tributary may experience considerable fluctuation in water flow – from nearly dry with isolated pools, to substantial freshet flows. To reduce silt loading to the stream, sediment deposited from mill operations (presumably washings from the harvested cane) was dried, and drainageways were fitted with detention ponds (AECOS, 1994a).

The land surrounding the middle reach section of the Nawiliwili Stream system is primarily agriculture and low density residential. The streambed is incised and the banks support a forest.

In places, walls of the gulch are more than 30 ft high, and the gulch is more than 60 ft across. At and below the confluence of the unnamed tributary and Nawiliwili Stream, both streams flow through mostly forested areas. The

View of the Middle Reach of Nawiliwili Stream forest is composed entirely of introduced species and has largely grown up since the present highway intersection was constructed, as evidenced by the fact that much of the growth occurs on the steep highway embankments. The streambed in the middle reach consists of silt and clay. The water is usually clear; however, during a large storm the water becomes turbid. When the middle reach section of the stream is not influenced by a storm, the wetted width is often less than 10 ft wide and 1 ft deep.

Downstream from the sugar mill, the lower reach Nawiliwili Stream flows in a steeply incised gulch, although the floodplain is over 600 ft wide in some places. In other places, 25-ft-high banks rise directly adjacent to the stream. A large storm drain enters the stream along the left bank at the Lower Nawiliwili TMDL sampling station (see Section 2.1.1). The streambed consists of a layer of silt, with scattered patches of gravel and boulders. The water appears to be more turbid here than further upstream.

The lower reach of the Nawiliwili Stream system widens as it flows under the Hwy 51 Bridge onto the coastal floodplain and then discharges into Nawiliwili Bay at the west end of Kalapaki Beach. The streambed in the lower reach consists of silt and clay, which becomes very thick; a dense growth of para grass impedes access to and flow of the stream.

Many shrubs, grasses, and other herbaceous plants grow along on the banks on both sides of the stream. In addition, the stream provides some habitat of limited value for aquatic species, although no native species were observed. The dominant flora and fauna observed within the Nawiliwili Stream system is presented below.

- **Terrestrial Vegetation –** Kukui, java plum (*Syzgium cumini*), hau trees, African tulip (*Spathodea campanulata*), *Macaranga tanarius*, banana (*Musa* x *paradisica*), bamboo (*Bambusa vulgaris*), koa haole (*Leucaena leucocephala*), scrambled egg plant (*Senna surattensis*), ornamental hibiscus (*Malvaviscus* cf. *arboreus*), and wood rose vine (*Merremia tuberosa*)

- **Terrestrial Fauna –** Star or crab spider, Japanese white eye (*Zosterops japonica japonica*), rats (probably *Rattus exulans*), and Thiarid snails

- **Aquatic Fauna –** Guppies, mollies, rainbow fish ((family Poeceliidae), swordtails (*Xiphophorus helleri*), and mosquitofish (*Gambusia affinis*); bullfrogs (*Rana catesbeiana*); and crayfish (*Procambarus clarkii*)

HULEIA STREAM SYSTEM CONDITIONS

The Huleia Stream system flows in a southeasterly direction and includes nine tributary streams: Kamooloa , Paohia, Papuaa , Papakolea , Kuia , Weoweopilau , Puakukui/Kipu Area segments, Helenanahu, and Puakukui. The Huleia Stream system also includes two large reservoirs. The Waiahi-Kuia Aqueduct, Koloa Ditch, and an unnamed tunnel, divert water from Papuaa Stream and Kuia Stream out of the Nawiliwili Bay Watershed to Waita Reservoir (Koloa Watershed). Two other ditches downstream from Papuaa Reservoir divert water to Puhi Stream and beyond.

Huleia Stream Reaches

- **Huleia Stream - Upper Reach**. The upper reach of Huleia Stream system arises in the backbone ridge of southeastern Kauai in the part known as Mt. Kahili (3,089 ft). The ridgeline forming the upper watershed boundary begins near Puu Kolo (~1,850 ft) in the south and extends as a steep-faced ridgeline reaching 3,170 ft at the north end of the Huleia watershed. Palikea (2,090 ft) ridge separates the northern boundary of the watershed from tributaries of the Wailua River. Kilohana Crater (maximum elevation 1,149 ft) divides the Huleia watershed from the Wailua River watershed and is the origin of many small tributaries to the Huleia system and the Papakolea, Puali, and Nawiliwili Stream systems. Numerous tributary streams flow from the mountains through former sugar cane lands.

- **Huleia Stream - Middle Reach.** The middle reach of Huleia Stream arises from the confluence of Kamooloa and Kuia Streams. It extends downstream to the upper end of the estuary (at the upstream boundary of the Huleia National Wildlife Refuge). Not far downstream from the confluence of Kamooloa and Kuia streams, Huleia Stream flows under Hwy 50 at Halfway Bridge. The stream is fairly wide and deep and the streambed consists of gravel, rock, and silt. Large stands of umbrella sedge are present upstream and downstream of the bridge.

  Helenanahu Stream, Puakukui Stream, and several small, unnamed tributaries and springs enter Huleia Stream along the middle reach. The surrounding watershed is primarily former sugar cane land, and the reach is mostly incised and contained within fairly large canyon walls. The hydrophyte, Job's tears (*Coix lachrymal-jobi*), is common in the stream, and elephant grass grows along the steep banks.

  Huleia Stream is the only stream in the Nawiliwili Bay Watershed that is gauged by the USGS, although currently the only station is a crest-stage gauge with a partial-record. A crest-stage gauge can be used to estimate annual maximum discharge from the stream. USGS station No. 16055000 is located at Kipu Road in Kipu, at about 220 ft elevation, 4.5 miles upstream from the mouth and downstream from all major tributaries (except for drainages from the Kipu Reservoirs).

- **Huleia Stream – Lower Reach and Estuary.** The estuarine segment of the Huleia Stream System is about 2 miles long. Tidal influence extends from Nawiliwili Bay to just downstream from Stone Bridge at the very upper end of the Huleia National Wildlife Refuge. The Huleia National Wildlife Refuge was established in 1973 to provide open, productive wetlands for endangered Hawaiian waterbirds. The refuge is located on 240 acres of the Huleia valley and extends along its left bank, and the streambed is included within the refuge. The refuge has plans to replace introduced plants with native vegetation, create open water habitats, restore old taro patches, and create predator-free nesting areas. Waterbirds that the refuge is attempting to protect include the endangered Hawaiian stilt or aeo (*Himantopus mexicanus knudseni*), coot or alae keokeo (*Fulicia alai*), moorhen or alae ula (*Gallinula chloropus sanvicensis*), and Hawaiian duck or koloa maoli (*Anas wyvilliana*). The Hawaiian hoary bat or opeapea (*Lasirus cinereus semotus*) may also live in the refuge. The area was once used to grow taro and rice, and currently there are some efforts to resume these agricultural activities. To protect wildlife, there is no public access into the refuge, although kayakers may paddle in the estuary alone or on tours.

View of the Lower Reach of Huleia Stream at Stone

Crabbers and fishermen ply the lower estuary The Alekoko Fishpond, also known as the Menehune Fishpond, is located on the north side of this segment. The fishpond was built 1,600 years ago and is a registered National Historic Landmark. The introduced red mangrove (*Rhizophora mangle*) has invaded the fishpond and the lower reach of Huleia Stream. The mangrove may contribute a significant amount of organic material and increase the turbidity and nutrient concentrations in the fishpond and stream (Furness et al. 2002).

At Stone Bridge, Huleia Stream is wide and shallow, and the streambed is comprised of boulders, silt, and sand. Stone Bridge appears to have the most extensive population of native fauna in the watershed, including oopu nakea (*Awaous guamensis*), oopu naniha (*Stenogobius hawaiiensis*), oopu akupa (*Eleotris sandwicensis*), opae oehaa (*Macrobrachium grandimanus*), aholehole (*Kuhlia sandvicensis*), mullet (*Mugil cephalus*). The introduced Mexican molly (*Poecilia mexicana*) is also present. Umbrella sedge and Job's tears grow in the stream, and elephant grass, guava trees, coffee, and Java plum grow on the banks. Extensive stands of mangroves occur downstream of the bridge.

Other Streams in the Huleia Sub-Basin

- **Kamooloa Stream.** Kamooloa Stream arises along the central mountain ridge above about 3,000 ft elevation. The southern fork arises near Kapalaoa peak (3,310 ft) in the Lihue-Koloa Forest Reserve. An irrigation system diversion located at about 860 ft elevation directs water to a long flume that feeds Papuaa Stream above the reservoir of the same name, Paohia Stream above the same reservoir. The diversion more or less parallels the Waiahi-Kuia Ditch to Mauka Reservoir in the Koloa watershed. Further downstream, a diversion tunnel from Papuaa Reservoir feeds into Kamooloa Stream. Near the 435 ft elevation, a diversion directs water through a long tunnel south about 3 miles to Waita Reservoir (in the Koloa watershed). When flow is reduced in the tunnel to Waita. Water diverted out of Kamooloa Stream may re-enter the watershed where the ditch to Waita Reservoir intersects with Kuia Stream.

Several tributaries of Kamooloa Stream originate on the southwestern side of Kilohana Crater between 520 and 1,000 ft elevation. These tributaries converge to join Kamooloa Stream on the left back below 400 ft elevation. Other tributaries enter along the right bank, including Papuaa Stream downstream from the reservoir and Paohia Stream. Another diversion at about 390 ft elevation carries water eastward as far as Puhi Camp Reservoir and is the source of much of the flow in Puali Stream (Bowles 1993). At about 330 ft elevation, between two rock quarries and the Halfway Bridge (Hwy 50), Kamooloa Stream joins Kuia Stream to form Huleia Stream.

Downstream from the diversions, but upstream from the confluence with the Kilohana tributaries, Kamooloa Stream is a relatively narrow and shallow stream. The streambed primarily consists of boulders, but silt and organic matter (including algae) are prominent. Small, unidentified fish in the family Poeceliidae were observed in December 2002, although they were uncommon. Crayfish (*Procambarus clarkii*) were also uncommon. The introduced ramshorn snail (Family Planorbidae) was the only abundant animal. The introduced damselfly (*Ischnura posita*), along with the indigenous dragonfly (*Pantalla flavescens*), was observed near the stream. Guava and Moluccan albizia trees line banks with a thick growth of Guinea grass.

- **Paohia Stream.** Paohia Stream originates at about 2,400 ft elevation in the Lihue-Koloa Forest Reserve as two tributaries on the eastern flank of Mt. Kahili. Although not indicated on topographic maps, it is likely that water in Paohia Stream is diverted from the channel at about 740 ft elevation into the Waiahi-Kuia Ditch or the Kamooloa Ditch that parallels it. At about 600 ft elevation, an overflow diversion ditch connects to Paohia Stream from the same Kamooloa Ditch. Paohia Stream receives the overflow from the Papuaa Reservoir spillway. The stream eventually joins Papuaa Stream and Kamooloa Stream downstream of Papuaa Reservoir. Paohia Stream only flows during periods of heavy rains or overflow from the reservoir. A eucalyptus plantation is present on the hill between Papuaa Reservoir and Paohia Stream.

- **Papuaa Stream.** Papuaa Stream arises at about 840 ft elevation, where it is fed by a diversion from Kamooloa Stream. The stream flows into Papuaa Reservoir (spillway elevation at 532 ft), which is 50-acre irrigation water storage feature at the base of Mt. Kahili. The reservoir is popular for bass fishing. Native waterbirds, including coots and moorhens, feed in the reservoir, and horses and cattle come down the banks to drink. Below the reservoir, Papuaa Stream is joined by Paohia Stream before flowing into Kamooloa Stream. A diversion at the dam carries water all the way to Puhi Stream, above the diversion into Puhi Camp Reservoir and Puali Stream.

- **Papakolea Stream.** Two tributaries, Hoinakaunalehua and Puhi, join at 200 ft elevation to form Papakolea Stream. The tributaries to Puhi Stream originate in a series of normally dry gulches at about 700 ft elevation. The stream is perennial from the convergence of these gulches just above 400 ft elevation. Below this point, the stream is used as part of the irrigation system constructed by Grove Farm. Water from Papuaa Reservoir (in the Huleia watershed) is added at one point and is then diverted out to Puhi Camp Reservoir and Puali Stream a short distance downstream. An unnamed tributary on the right bank has its confluence at about 270 ft, just up from the Kaumualii Highway; it may also receive overflow irrigation water diverted out of Papuaa Reservoir.

The other significant tributary of Papakolea Stream is Hoinakaunalehua Stream. This stream arises in gulches along the southeast slope of Kilohana Crater, the longest branch having its origin at about 800 ft elevation. Water from the Papuaa Reservoir may be diverted into this tributary to divert storm flows out of the irrigation system. Two other branches arise close to the longest branch and just below 800 ft elevation in the same part of Kilohana Crater's southeast slope. Hoinakaunalehua Stream passes under Kaumualii Highway adjacent to the Brewer Chemical property.

At about 200 ft elevation, immediately downstream from the confluence of Puhi and Hoinakaunalehua streams, water from Papakolea Stream is diverted to a powerplant located just outside of the boundaries of the Huleia National Wildlife Refuge. This water is flushed into Huleia Stream. Papakolea Stream flows through wetlands in the refuge and discharges to the estuarine portion of Huleia Stream.

Upstream from the Huleia National Wildlife Area and a waterfall, the stream passes under Hulemalu Road, and is relatively narrow and shallow. The base flow depth of the stream appears to be about 6 inches, and the stream is about 10 ft wide. The stream has a silt bottom, and a large turbid pool is located upstream of the bridge. Java plum, kukui, and African tulip trees are common on the steep banks that are otherwise covered with Guinea grass.

- **Kuia Stream.** Kuia Stream arises from numerous tributaries along the eastern flanks of Mt. Kahili and Puu Kolo ridge. A large, unnamed southern tributary converges with Kuia Stream at about 520 ft elevation. On the north tributary, at about 680 ft elevation and downstream from the convergence of five small tributary streams, the Waiahi-Kuia Aqueduct intersects with Kuia Stream. The aqueduct reportedly diverts all of the stream water (10 million gallons per day [mg/d]) out of the watershed via the Koloa Ditch (Furness et al. 2002). The main branch of Kuia Stream converges with Weoweopilau Stream, tumbles over waterfalls at the 400 ft elevation, and joins Huleia Stream.

- **Weoweopilau Stream.** Weoweopilau Stream drains the Knudsen (Koloa) Gap to the north, with at least one small tributary arising on the west side of Hapua Ridge at the 680 ft elevation. The stream also receives overflow from the Koloa Ditch above where the ditch discharges into Mauka Reservoir. Weoweopilau Stream joins Kuia Stream upstream from the waterfalls and the tributary's convergence with Huleia Stream.

- **Kipu Area Segments.** The north slopes of Haupu Ridge in the Kipu area drain to reservoirs and at least one wetland These stream features eventually enter along the right bank of Huleia Stream near the upper end of the estuary and the Huleia National

Wildlife Refuge. This area is mostly used for cattle ranching. Another stream arises further east beneath Queen Victoria's Profile in the Haupu Ridge, before flowing into Huleia Stream within the boundaries of the refuge.

- **Helenanahu Stream.** Helenanahu Stream originates between 800 and 900 ft elevation as seven tributaries on the southern flank of Kilohana Crater. Water from these tributaries is stored in Helenanahu Reservoir and then released into Helenanahu Stream, which flows into Huleia Stream at 310 ft elevation. Helenanahu Reservoir is located close to Hwy 50 and is provides significant waterbird habitat.

- **Puakukui Stream.** Puakukui Stream is a series of small tributaries and springs at the base of Omoe peak (1300 ft) and the north side of Haupu Ridge. At 355 ft elevation, water is diverted out of the eastern branch into reservoirs further east in the Kipu area. The stream confluence with Huleia Stream is at 250 ft elevation.

PUALI STREAM CONDITIONS

Puali Stream system flows in a southeasterly direction and arises as two branches in the vicinity of KCC. Puali Stream has been used to supply and discharge irrigation water to and from sugar cane fields since 1865 (Bowles 1993a). Over 80 percent of Puali Stream is located on Grove Farm property (AECOS 1994b). All of the water in Halehaka Stream and Puali Stream above Halehaka Road Bridge (at about 110 ft elevation) originates from outside of the watershed. The water is brought in via the ditch systems of Grove Farm and Lihue Plantation (Bowles 1993a). High flows are common in Puali Stream as a result of irrigation practices from surrounding lands.

- **Halehaka Stream.** Halehaka Stream consists of a dry swale and a large mowed area adjacent to Kauai Community College, located above Kaumualii Highway. Below the highway, a diversion ditch from the Klussman Reservoir feeds into a small reservoir, as does a diversion weir from an irrigation ditch that leaks into Halehaka Stream. Below the reservoir, Halehaka Stream enters a gulch, part of which is overgrown with hau down to Haiku 4B reservoir, where the stream flows into Puali Stream (AECOS 1994b).

- **Upper Reach.** Because of the low elevation of this drainage, the upper reach of Puali Stream is not significant. Evidence of a stream first manifests itself as Puhi Camp Reservoir, a small irrigation water storage pond at 340 ft elevation. The reservoir is fed by an irrigation ditch system belonging to Grove Farm. Vegetation in the area consists of tall grasses and an open canopy of trees. Guinea grass (*Panicum maximum*), para grass (*Brachiaria mutica*), albizia trees (*Falcataria moluccana*), macaranga trees (*Macaranga tanarius*), and silk oak trees (*Grevillea robusta*) are common (AECOS 1994b).

- **Middle Reach.** Downstream from the reservoir, the middle reach of the stream flows through a dense growth of para grass, then passes under Kaumualii Highway (Hwy 50) in a small box culvert, and on through a series of modified channels and culverts. The stream is shallow and narrow, and the streambed is flat and consists mostly of gravel. Further downstream, the stream enters a culvert that passes underneath the old industrial area and then emerges in a vegetation-removed/realigned channel. The stream flows in this earthen trapezoidal channel through a housing development and Puhi Industrial Park. Downstream, it enters a dense growth of hau (*Hibiscus tiliaceus*) and then a steep-sided canyon (AECOS 1994b).

View of the Middle Reach of Puali Stream near the TMDL Monitoring

  The middle reach of the stream flows mostly through a narrow canyon that is overgrown with hau until the Halehaka Road Bridge. Downstream from the bridge, the stream becomes more open, although much of the gulch is covered in moderately dense forest, except where cleared by property owners along the stream (AECOS 1994b). Puali Stream leaves Grove Farm property, and the middle reach ends after it tumbles over a 15-ft waterfall.

  The now-closed Halehaka landfill lies on the left bank of Puali Stream near Halehaka Road. The landfill was in operation from 1973 until 1991, and during that time, an average of 43 feet of garbage was disposed of in the landfill (Mink & Yuen, Inc. 1983). Hydrogeological and geotechnical investigations of the landfill site concluded that Puali Stream does not exhibit contamination with heavy metals and volatile organics from the landfill, although high levels of nutrients in the stream may be attributed to the landfill (Mink & Yuen, Inc. 1983). The studies also determined that the groundwater sufficiently dilutes constituents in leachate, although after furrow irrigation in the adjacent sugar cane fields ceases, the concentration of leachate constituents could increase in the groundwater. The Lihue-Puhi wastewater treatment works, a reuse facility that stores treated effluent and uses it on the nearby Puakea Golf Course, is also located uphill on the left side of Puali Stream (Furness et al. 2002).

- **Lower Reach.** The lower reach of Puali Stream flows through the coastal lowlands known as Niumalu Flat, whose potential restoration could affect nutrient and sediment assimilation. This flat is a remnant of a coastal wetland (AECOS 1994b) and is now used for agriculture, including wetland taro and pastureland. Puali Stream is estuarine at the Waawa Road Bridge in Niumalu. Vegetation at the upper end of the estuary is marsh cyperus (*Cyperus javanicus*) and primrose willow (*Ludwigia octovalvus*), transitioning to hau and mangrove (AECOS 1994b). Cesspools in the area may be a source of pollutants to the stream (Furness et al. 2002; Appendix F).

DATA QUALITY ASSESSMENTS (excerpted from Environmental Planning Office, 2004)

Deviations from the Sampling Program

The following deviations to the sampling program were noted:

- The original scope of work included the goal of capturing three distinct storm events at each sampler location. Limitations of stream flow and automated sampler execution resulted in some locations rendering less than three events and some more than three events. One storm event was collected at each of the Upper Nawiliwili and Papakolea locations. Two storm events were collected at the Puali location. Four storm events were collected at the Huleia at Stone Bridge location. Five storm events were collected at the Kamooloa and Lower Nawiliwili locations. This deviation did not adversely impact the preparation of the TMDL report because the amount of data collected exceeded the amount originally scoped and loading estimates were calculated consistent with the scope of work.
- The sampling plan identified three samples to be collected from each automated sampler per storm event; however, at the Kamooloa location, two samples were submitted out of the three planned samples during two storm events. This deviation did not adversely impact the preparation of the TMDL report because additional samples were collected from five events at this location and loading estimates were calculated consistent with the scope of work.
- Grab samples were collected from the turbid stream water after the storm events at the Huleia at Halfway Bridge, Huleia at Stone Bridge, and the Papakolea locations. The sampling plan did not specify the collection of grab samples at these locations. This deviation did not adversely impact the preparation of the TMDL report because the grab sample results provide additional data not originally estimated.

Analytical Data Quality Assessment

A final review of the data set with respect to EPA data quality parameters indicated that the data are of high overall quality and deemed usable to meet the project data quality objectives presented in the scope of work and project plans. Based on the overall assessment of the sampling program, quality assurance/quality control (QA/QC) data, data review, and data validation results, the data obtained between January and October 2003 are of acceptable quality, as described in guidance for quality assurance project plans [with exceptions as noted].

Representativeness

Representativeness refers to the ability of sample data to reflect true environmental conditions. Factors that affect representativeness include sampling locations, frequency, collection procedures, and possible compromises to sample integrity (such as cross-contamination) that can occur during collection, transport, and analysis. Selection of sampling sites is important to ensure that the parameters measured will be representative in all samples collected at that site. Correct sample collection, transport, and analytical procedures were important to ensure that samples closely resemble the medium sampled and to minimize contamination. All data were deemed representative.

Habitat and Biological Assessment of Nawiliwili Streams

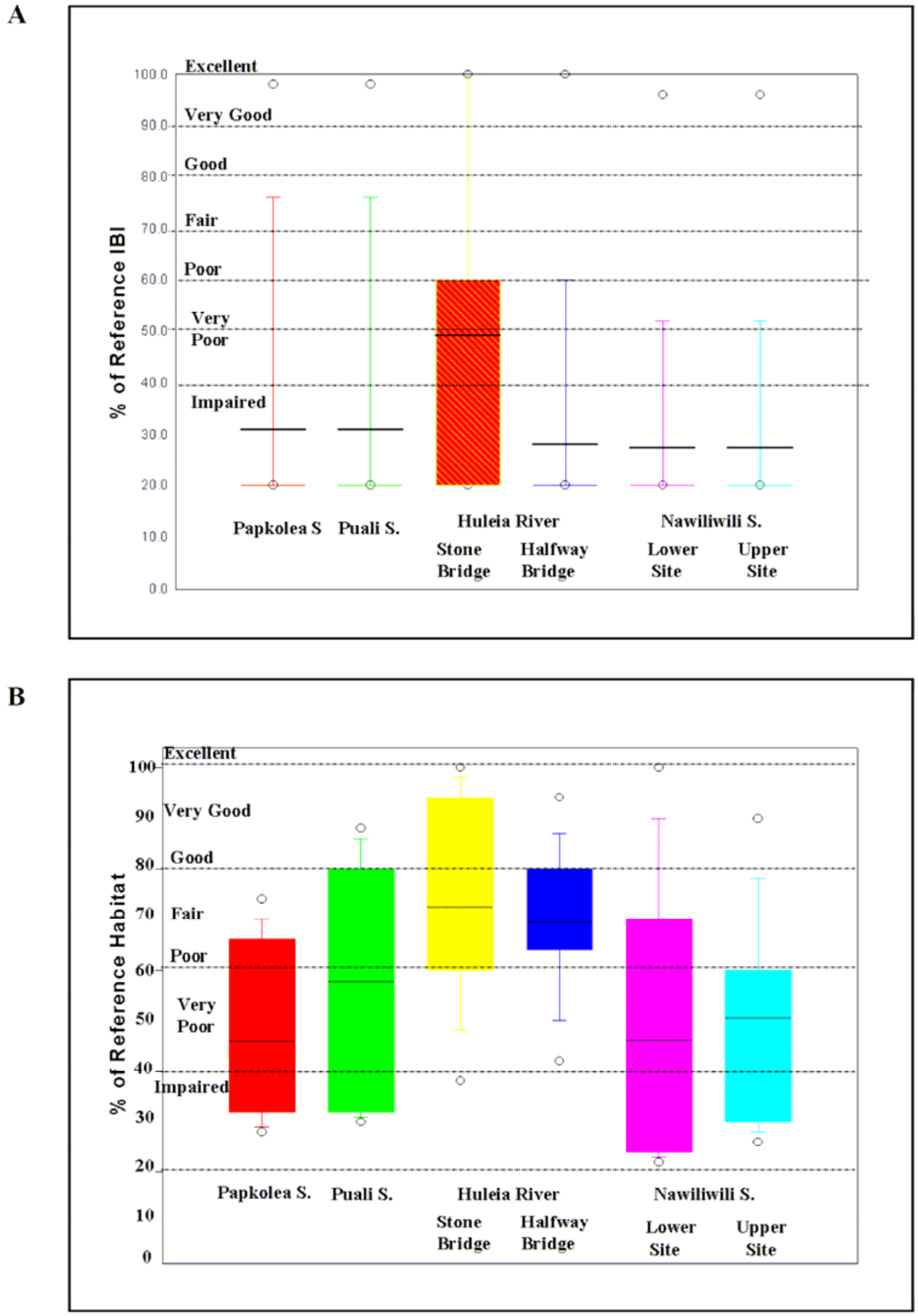


Figure 4. Box plots of HSBP metric ratings for Nawiliwili Watershed streams (upper and lower lines of box indicate 90th and10th percentiles respectively; solid black line inside box is the mean); A. Biotic Integrity Ratings (mean of point scores of eleven metrics); B. Habitat Quality Ratings (mean of point scores for ten metrics).

Kido, Michael. The Nawiliwili Watershed Restoration Project; A Habitat and Biological Assessment of Nawiliwili Streams, Kauai. University of Hawaii; Manoa, December 2002.

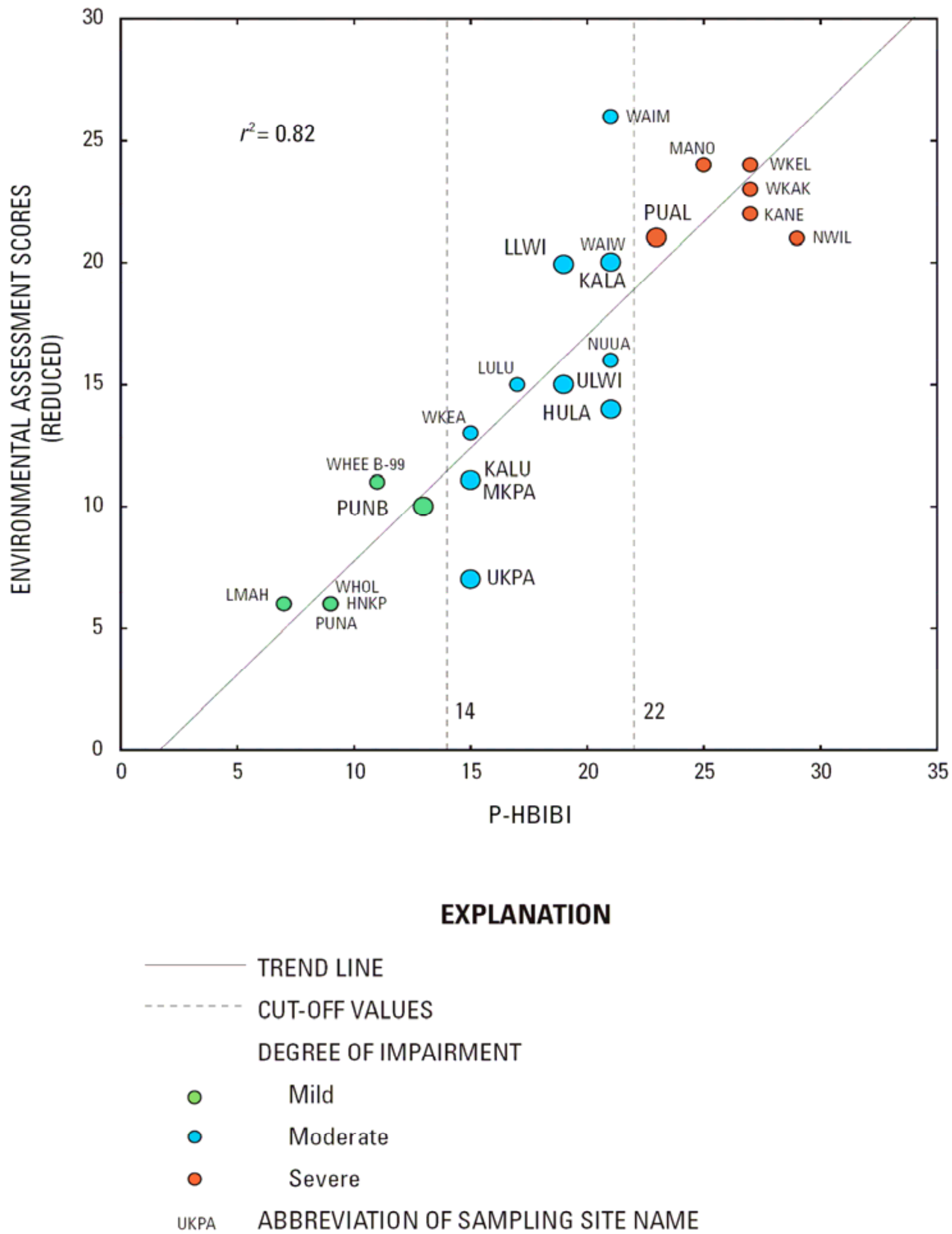


Figure 20. Relationship between the environmental assessment scores and the Preliminary Hawaiian Benthic Index of Biotic Integrity (P-HBIBI) scores for all the sites with vertical divisions demarking the cut-off values of the scoring range for impairment categories. Small markers represent the calibration sites; large markers represent the test sites. See table 1 for site names. (r^2, coefficient of determination).

Wolff, R.H. 2005. Feasibility of using benthic invertebrates as indicators of stream quality in Hawaii: U.S. Geological Survey Scientific Investigations Report 2005-5079.

APPENDIX C – WATER QUALITY DATA

Table C-1: Data from "Assessment and Protection Plan for the Nawiliwili Watershed: Phase 2-Assessment of Contamination Levels" (El-Kadi et al., 2003)

Site	Location	Date	Turbidity (NTU)	Salinity (ppt)	Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Fecal Coliform (CFU/100 ml)	Clostridium perfringens (CFU/100 ml)	Enterococci (CFU/100 ml)	FRNA (PFU/100 ml)	Somatic (PFU/100 ml)	Coliphage Enrichment	
												FRNA	Somatic
1	Upper Nawiliwili	10/31/01	5.7	1	0.035	1.9	6400	12	3600	520	2100	NA	NA
1	Upper Nawiliwili	11/28/01	8.45	0.2	0.129	1.2	6800	32	2080	1060	1420	NA	NA
1	Upper Nawiliwili	02/27/02	10	0	0.004	0.3	5160	68	2200	6460	3180	NA	NA
1	Upper Nawiliwili	03/20/02	10.5	0.2	0.017	0.3	3440	32	3760	100	60	NA	NA
1	Upper Nawiliwili	04/22/02	8.85	0.1	0.016	0.4	14400	228	11200	20	200	NA	NA
1	Upper Nawiliwili	05/14/02	63.4	0.2	0.03	0.2	27200	72	1560	600	600	NA	NA
1	Upper Nawiliwili	06/24/02	17.5	0.5	0.102	0.3	3080	16	1640	0	180	positive	NA
1	Upper Nawiliwili	07/24/02	10.1	0.1	0.292	0.5	6760	0	1680	0	120	positive	NA
1	Upper Nawiliwili	10/16/02	9.37	0.1	0.132	0.3	3480	16	1680	0	0	positive	negative
1	Upper Nawiliwili	11/25/02	2.86	0.4	0.025	0.2	35200	20	8800	1040	3340	NA	NA
1A	Upper Nawiliwili	03/19/02	5.7	1	0.022	0.4	4240	16	4400	40	120	NA	NA
1A	Upper Nawiliwili	04/24/02	6.5	1	0.031	0.4	1104	4	1040	460	200	NA	NA
1A	Upper Nawiliwili	05/16/02	7	2	0.038	0.3	2560	0	1320	120	80	NA	NA
1A	Upper Nawiliwili	06/26/02	7	1	0.202	0.6	2640	8	720	160	200	NA	NA
1A	Upper Nawiliwili	07/16/02	8.5	1	0.128	0.3	4360	12	32	160	460	NA	NA
1A	Upper Nawiliwili	08/21/02	6.4	2	0.156	0.3	3560	8	1440	0	0	positive	negative
1A	Upper Nawiliwili	09/25/02	6.7	0.5	0.187	0.3	5400	8	1680	120	0	NA	negative
1A	Upper Nawiliwili	11/20/02	4.9	0	0.034	0.2	2720	24	1560	0	440	negative	NA
2	Marriott Culvert	10/31/01	4.8	1	0.091	1.9	9080	0	4400	0	140	positive	NA
2	Marriott Culvert	11/28/01	4.35	0.3	0.39	2.4	4240	0	2160	0	80	positive	NA
2	Marriott Culvert	02/27/02	3.1	0	0.056	1	4160	0	2200	0	40	positive	NA
2	Marriott Culvert	03/20/02	2.2	0.2	0.079	1	968	0	1320	0	20	positive	NA
2	Marriott Culvert	04/22/02	3.65	0.2	0.062	0.7	2400	4	720	20	20	NA	NA
2	Marriott Culvert	05/14/02	163	0.1	0.274	0.1	72400	100	108000	1080	1600	NA	NA
2	Marriott Culvert	06/24/02	3.68	0.3	0.305	1	3000	40	1120	0	0	positive	positive
2	Marriott Culvert	07/24/02	2.47	0.3	0.45	0.8	9000	0	1160	0	420	positive	NA
2	Marriott Culvert	10/16/02	3.05	0.3	0.301	1	4040	0	960	0	0	positive	positive
2	Marriott Culvert	11/25/02	4.02	1.3	0.253	0.1	2800	0	280	120	220	NA	NA

Site	Location	Date	Turbidity (NTU)	Salinity (ppt)	Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Fecal Coliform (CFU/100 ml)	Clostridium perfringens (CFU/100 ml)	Enterococci (CFU/100 ml)	FRNA (PFU/100 ml)	Somatic (PFU/100 ml)	Coliphage Enrichment	
												FRNA	Somatic
3	Pine Trees	10/31/01	2.6	3	0.052	0.9	5560	120	1440	0	80	positive	NA
3	Pine Trees	11/28/01	3.75	1.3	0.166	1.8	3200	48	188	220	940	NA	NA
3	Pine Trees	02/27/02	6.8	2	0.042	0.2	2080	960	3200	1220	1580	NA	NA
3	Pine Trees	03/20/02	4.22	0.3	0.039	0.3	2160	528	1560	40	320	NA	NA
3	Pine Trees	04/22/02	7.49	0.2	0.028	0.2	3320	800	2400	100	400	NA	NA
3	Pine Trees	05/14/02	66.2	0.4	0.13	0.2	48800	0	27200	280	1900	NA	NA
3	Pine Trees	06/24/02	9.05	0.6	0.104	0.2	1600	336	1160	0	40	positive	NA
3	Pine Trees	07/24/02	8.49	5.4	0.153	0.3	6440	920	11200	0	320	negative	NA
3	Pine Trees	10/16/02	5.82	1.6	0.123	0.2	2200	92	640	0	4	positive	NA
3	Pine Trees	11/25/02	13.2	3.2	0.132	0.2	3320	44	920	660	640	NA	NA
4	Kalapaki Beach	10/31/01	2.7	28	0.011	1.4	0	0	4	0	0	negative	positive
4	Kalapaki Beach	11/28/01	5.93	32.7	0.043	1.7	304	16	244	0	0	positive	positive
4	Kalapaki Beach	02/27/02	3.8	35	0.001	0.2	0	0	4	0	0	negative	negative
4	Kalapaki Beach	03/20/02	2.82	34.8	0.015	0.2	16	12	4	0	0	negative	negative
4	Kalapaki Beach	04/22/02	4.01	34	0.019	0.1	44	20	80	0	0	negative	positive
4	Kalapaki Beach	05/14/02	51.9	21.5	0.053	0.3	22400	0	14800	0	300	negative	NA
4	Kalapaki Beach	06/24/02	3.75	31.8	0.095	0.3	16	16	20	0	0	positive	negative
4	Kalapaki Beach	07/24/02	5.82	33.6	0.032	0.3	80	12	60	0	0	positive	positive
4	Kalapaki Beach	10/16/02	3.9	34.4	0.045	0.3	0	0	0	0	0	positive	positive
4	Kalapaki Beach	11/25/02	1.97	34.4	0.041	0.2	4	0	0	0	0	negative	negative
5	SeaFlite Jetty	10/31/01	3.7	28	0.015	2.5	0	0	0	0	0	positive	positive
5	SeaFlite Jetty	11/28/01	5.37	28.4	0.042	0.9	372	4	232	0	380	negative	NA
5	SeaFlite Jetty	02/27/02	9	35	0.001	0.2	4	0	0	0	0	negative	negative
5	SeaFlite Jetty	03/20/02	2.18	34.6	0.012	0.2	0	0	4	0	0	negative	negative
5	SeaFlite Jetty	04/22/02	4.84	34	0.012	0.1	0	0	4	0	0	negative	positive
5	SeaFlite Jetty	05/14/02	10.2	27.7	0.016	0.2	404	0	348	0	20	positive	NA
5	SeaFlite Jetty	06/24/02	3.14	21.7	0.103	0.2	20	0	16	0	0	positive	positive
5	SeaFlite Jetty	07/24/02	4.01	29.5	0.049	0.2	4	4	0	0	0	negative	positive
5	SeaFlite Jetty	10/16/02	1.98	34.8	0.235	0.2	0	0	0	0	0	positive	positive
5	SeaFlite Jetty	11/25/02	1.58	34.4	0.013	0.2	12	0	4	0	0	negative	negative

Site	Location	Date	Turbidity (NTU)	Salinity (ppt)	Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Fecal Coliform (CFU/100 ml)	Clostridium perfringens (CFU/100 ml)	Enterococci (CFU/100 ml)	FRNA (PFU/100 ml)	Somatic (PFU/100 ml)	Coliphage Enrichment	
												FRNA	Somatic
6	Papalinahoa Stream	10/31/01	7.3	2	0.044	0.8	3320	0	6400	0	140	negative	NA
6	Papalinahoa Stream	11/28/01	9.54	0.2	0.051	0.7	244	0	11200	1160	560	NA	NA
6	Papalinahoa Stream	02/27/02	9.4	1	0.006	0.1	1120	8	1400	20	6500	NA	NA
6	Papalinahoa Stream	03/20/02	7.88	0.3	0.046	0.1	632	0	6400	400	260	NA	NA
6	Papalinahoa Stream	04/22/02	7.84	0.1	0.034	0	1200	12	2200	0	160	negative	NA
6	Papalinahoa Stream	05/14/02	38.9	0.2	0.042	0.1	7560	8	8	280	740	NA	NA
6	Papalinahoa Stream	06/24/02	5.71	0.2	0.194	0.1	3560	0	2280	0	20	positive	NA
6	Papalinahoa Stream	07/24/02	6.67	0.1	0.212	0.1	5720	0	6800	360	600	NA	NA
6	Papalinahoa Stream	11/25/02	5.36	4.1	0.039	0.1	44080	24	4400	60	120	NA	NA
7	Small Boat Harbor	10/31/01	2.7	24	0.013	1.2	116	0	48	0	0	positive	positive
7	Small Boat Harbor	11/28/01	29.4	6.8	0.316	0.3	5080	0	2440	0	1380	positive	NA
7	Small Boat Harbor	02/27/02	4.2	16	0.019	0.1	172	0	64	0	0	negative	positive
7	Small Boat Harbor	03/20/02	4.33	20.1	0.016	0.1	72	0	36	0	60	positive	NA
7	Small Boat Harbor	04/22/02	23	19.8	0.026	0.1	76	16	64	0	0	negative	positive
7	Small Boat Harbor	05/14/02	29.3	3.1	0.026	0	1240	0	1080	0	20	negative	NA
7	Small Boat Harbor	06/24/02	12.8	4	0.101	0	244	4	312	0	40	positive	NA
7	Small Boat Harbor	07/24/02	12.2	9.7	0.088	0.1	160	0	92	0	0	negative	positive
7	Small Boat Harbor	10/16/02	6.05	23.7	0.093	0.1	176	0	108	0	3	positive	NA
7	Small Boat Harbor	11/25/02	2.95	0.1	0.023	0.1	288	0	140	0	0	negative	negative
8	Puali Stream	10/31/01	2.4	2	0.023	0.7	596	4	840	0	40	negative	NA
8	Puali Stream	11/28/01	4.06	0.1	0.032	1.2	744	0	920	20	100	NA	NA
8	Puali Stream	02/27/02	4.4	0	0.005	0.2	640	0	840	400	440	NA	NA
8	Puali Stream	03/20/02	4.09	0.2	0.027	0.1	592	0	960	540	680	NA	NA
8	Puali Stream	04/22/02	2.92	0.1	0.033	0.2	736	0	840	220	320	NA	NA
8	Puali Stream	05/14/02	14.7	0.1	0.066	0.3	4040	4	2600	20	160	NA	NA
8	Puali Stream	06/24/02	3.37	0.1	0.225	0.4	1064	0	840	20	100	NA	NA
8	Puali Stream	07/24/02	10.1	0.1	0.182	0.4	1056	0	1440	20	240	NA	NA
8	Puali Stream	10/16/02	5.67	0.2	0.214	0.4	512	0	560	0	19	positive	NA
8	Puali Stream	11/25/02	9.96	0.1	0.079	0.2	584	0	560	120	60	NA	NA

Site	Location	Date	Turbidity (NTU)	Salinity (ppt)	Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Fecal Coliform (CFU/100 ml)	Clostridium perfringens (CFU/100 ml)	Enterococci (CFU/100 ml)	FRNA (PFU/100 ml)	Somatic (PFU/100 ml)	Coliphage Enrichment	
												FRNA	Somatic
8A	Puali Stream	03/19/02	4.1	0.5	0.044	0.2	708	0	1960	500	500	NA	NA
8A	Puali Stream	04/24/02	3.9	2	0.022	0.1	304	0	760	60	120	NA	NA
8A	Puali Stream	05/16/02	7.5	0	0.031	0.2	828	8	328	0	240	negative	NA
8A	Puali Stream	06/26/02	4.6	10	0.188	0.3	604	0	520	20	20	NA	NA
8A	Puali Stream	07/16/02	5	1	0.103	0.2	2960	0	3120	0	240	positive	NA
8A	Puali Stream	08/21/02	3.8	1	0.091	0.1	856	40	920	0	220	positive	NA
8A	Puali Stream	09/25/02	3.5	1	0.101	0.2	556	0	280	20	80	NA	NA
8A	Puali Stream	11/20/02	3	1	0.035	0.1	368	0	520	60	200	NA	NA
9	Papakolea Stream	10/31/01	6.5	2	0.026	1	804	0	920	2160	5740	NA	NA
9	Papakolea Stream	11/28/01	13.2	0.1	0.684	1.7	524	0	1480	3900	4500	NA	NA
9	Papakolea Stream	02/27/02	11	0	0.006	0.2	1160	20	1320	4140	1160	NA	NA
9	Papakolea Stream	03/20/02	18.3	0.1	0.033	0.4	1052	8	1080	660	800	NA	NA
9	Papakolea Stream	04/22/02	9.95	0.1	0.046	0.4	2720	4	1280	240	420	NA	NA
9	Papakolea Stream	05/14/02	64.2	0.1	0.048	0.3	3360	8	2320	560	640	NA	NA
9	Papakolea Stream	06/24/02	14.1	0.1	0.089	0.3	640	0	536	0	60	positive	NA
9	Papakolea Stream	07/24/02	13.1	0.1	0.09	0.2	676	0	800	40	100	NA	NA
9	Papakolea Stream	10/16/02	17.1	0.1	0.074	0.3	2600	0	760	0	31	positive	NA
9	Papakolea Stream	11/25/02	3.72	0.1	0.029	0.2	3120	0	1200	320	1240	NA	NA
9A	Papakolea Stream	03/19/02	11	0.5	0.019	0.4	1080	4	1560	460	720	NA	NA
9A	Papakolea Stream	04/24/02	10	2	0.021	0.3	788	0	360	400	600	NA	NA
9A	Papakolea Stream	05/16/02	17	1	0.024	0.4	1168	4	568	420	600	NA	NA
9A	Papakolea Stream	06/26/02	7.5	1	0.075	0.3	664	0	680	60	220	NA	NA
9A	Papakolea Stream	07/16/02	7.6	1	0.09	0.2	1000	0	1320	500	180	NA	NA
9A	Papakolea Stream	08/21/02	8	1	0.086	0.1	472	0	600	140	220	NA	NA
9A	Papakolea Stream	09/25/02	5.3	1	0.083	0.1	408	0	272	80	360	NA	NA
9A	Papakolea Stream	11/20/02	6	1	0.021	0.2	604	8	400	0	480	negative	NA

Site	Location	Date	Turbidity (NTU)	Salinity (ppt)	Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Fecal Coliform (CFU/100 ml)	Clostridium perfringens (CFU/100 ml)	Enterococci (CFU/100 ml)	FRNA (PFU/100 ml)	Somatic (PFU/100 ml)	Coliphage Enrichment	
												FRNA	Somatic
10	Huleia Stream	10/31/01	2.6	3	0.015	1.5	212	8	144	0	20	positive	NA
10	Huleia Stream	11/28/01	21.8	0.1	0.029	0.7	2200	8	1360	100	460	NA	NA
10	Huleia Stream	02/27/02	5.5	0	0.001	0.1	200	16	152	0	180	positive	NA
10	Huleia Stream	03/20/02	9.62	0.1	0.01	0.1	120	8	164	20	120	NA	NA
10	Huleia Stream	04/22/02	3.4	0.1	0.013	0.1	180	8	288	0	40	positive	NA
10	Huleia Stream	05/14/02	25.6	0.1	0.023	0	1760	0	2440	20	1000	NA	NA
10	Huleia Stream	06/24/02	6.2	0.1	0.106	0	316	4	376	0	40	positive	NA
10	Huleia Stream	07/24/02	3.47	0.1	0.066	0.1	148	0	260	0	0	negative	positive
10	Huleia Stream	10/16/02	2.12	0.1	0.083	0.1	232	0	148	0	0	positive	positive
10	Huleia Stream	11/25/02	3.55	0.1	0.021	0.1	528	0	360	0	0	negative	negative
10A	Huleia Stream	03/19/02	12	0.5	0.031	0.1	272	0	720	20	60	NA	NA
10A	Huleia Stream	04/24/02	5.9	1	0.037	0.1	108	0	356	0	0	negative	positive
10A	Huleia Stream	05/16/02	8.5	1	0.022	0.1	692	0	396	0	40	negative	NA
10A	Huleia Stream	06/26/02	5.3	0	0.079	0.1	2121	0	360	0	0	negative	positive
10A	Huleia Stream	07/16/02	2.3	0	0.097	0.1	296	0	760	0	80	negative	NA
10A	Huleia Stream	08/21/02	4.4	1	0.109	0.1	280	0	440	0	0	negative	negative
10A	Huleia Stream	09/25/02	2.2	0	0.084	0.1	184	0	176	0	20	negative	NA
10A	Huleia Stream	11/20/02	3.8	0	0.021	0.1	120	0	88	0	80	negative	NA

Table C-2: Data Used by State of Hawaii Department of Health for the 2006 303(d) List of Impaired Waters

* - result is not reported due to instrument problem and limitations
< - result is at or below the laboratory reporting limit

Sample Number	Sampler	Station Name	Station No	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Chlor-a	Turbidity (NTU)
Nawiliwili													
7	M.M.	Low Nawiliwili	Nawiliwili - L	05/05/03	0830	3.00	0.024	1.22	1.40	0.006	9.04		6.4
11	M.M.	Low Nawiliwili	Nawiliwili - L	06/02/03	0810	3.00	0.016	1.22	1.17	0.013	10.5		
7	M.M.	Low Nawiliwili	Nawiliwili - L	07/06/03	1000	2.00	0.011	1.14	1.33	0.008	9.74		4.0
10	M.M.	Low Nawiliwili	Nawiliwili - L	08/04/03	0812	3.00	0.012	1.21	1.37	0.016	9.60		4.8
8	M.M.	Low Nawiliwili	Nawiliwili - L	09/07/03	1055	3.00	*	1.04	*	0.034	11.7		
7	M.M.	Low Nawiliwili	Nawiliwili - L	10/05/03	1125	3.00	0.016	0.807	1.67	0.014	10.2		
KK01130304	GU/LM	Nawiliwili Lower	2-2-13-L	01/13/03	9:15	2.00	0.018	0.969	1.510	0.006	10.2		
KK01270304	GU/LM	Nawiliwili Lower	2-2-13-L	01/27/03	11:43	3.00	0.023	0.758	1.200	0.015	9.30		
KK02100303	GU/LM	Nawiliwili Lower	2-2-13-L	02/10/03	8:45	2.00	0.012	1.130	1.100	0.014	9.20		
KK02250303	GU/LM	Nawiliwili Lower	2-2-13-L	02/25/03	10:30	3.00	0.050	1.080	1.160	0.012	9.20		
KK03100304	GU/LM	Nawiliwili Lower	2-2-13-L	03/10/03	9:35	3.00	0.032	1.060	1.350	0.005	9.50		
KK03240304	GU/LM	Nawiliwili Lower	2-2-13-L	03/24/03	9:00	2.00	0.028	1.220	1.390	0.011	9.10		
KK01270303	GU/LM	Nawiliwili Upper	2-2-13-U	01/27/03	11:13	< 0.50	0.003	0.954	1.210	0.056	13.4		
KK02250304	GU/LM	Nawiliwili Upper	2-2-13-U	02/25/03	11:20	< 0.50	0.013	1.270	1.310	0.055	14.8		
KK03100305	GU/LM	Nawiliwili Upper	2-2-13-U	03/10/03	10:08	1.00	0.001	0.966	1.100	0.035	14.3		
KK03240305	GU/LM	Nawiliwili Upper	2-2-13-U	03/24/03	9:30	1.00	< 0.001	1.260	1.150	0.045	15.1		
14	M.M.	Nawiliwili Upper	Nawiliwili - U	05/05/03	1335	1.00	0.019	1.00	1.24	0.055	14.5		1.5
18	M.M.	Nawiliwili Upper	Nawiliwili - U	06/02/03	1430	1.00	0.005	1.17	1.11	0.049	16.8		
9	M.M.	Nawiliwili Upper	Nawiliwili - U	07/06/03	1155	< 0.50	< 0.001	1.20	1.17	0.051	13.1		0.26

Sample Number	Sampler	Station Name	Station No	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Chlor-a	Turbidity (NTU)
Puali													
13	M.M.	Puali	Puali	05/05/03	1255	12.0	0.008	0.193	0.288	0.009	5.65		13
17	M.M.	Puali	Puali	06/02/03	1345	2.00	0.002	0.268	0.396	0.012	5.76		
8	M.M.	Puali	Puali	07/06/03	1105	4.00	< 0.001	0.067	0.239	< 0.005	6.34		2.9
11	M.M.	Puali	Puali	08/04/03	0845	3.00	< 0.001	0.251	0.324	0.013	7.28		3.6
7	M.M.	Puali	Puali	09/07/03	1020	4.00	*	0.143	*	0.008	7.33		
6	M.M.	Puali	Puali	10/05/03	1055	6.00	0.004	0.098	0.176	0.010	5.70		
KK04150203	GU/LM	Puali Lower	2-2-14-L	04/15/02	10:15	1.00	0.002	0.339	0.451	0.005	5.40		
KK05070201	GU/LM	Puali Lower	2-2-14-L	05/07/02	7:05	5.00	0.001	0.734	0.725	0.036	5.20		
KK05200201	GU/LM	Puali Lower	2-2-14-L	05/20/02	7:47	1.00	< 0.001	0.244	0.404	0.009	5.10		
KK06170201	GU/LM	Puali Lower	2-2-14-L	06/17/02	7:00	4.00	< 0.001	0.624	0.764	0.026	5.40		
KK07080203	GU/LM	Puali Lower	2-2-14-L	07/08/02	10:50	3.00	0.010	0.712	0.908	0.044	4.90		
KK11040203	GU/RA	Puali Lower	2-2-14-L	11/04/02	11:47	3.00	0.011	0.090	0.161	0.014	5.20		
KK01130303	GU/LM	Puali Lower	2-2-14-L	01/13/03	8:36	1.00	< 0.001	0.185	0.361	< 0.005	4.80		
KK02250305	GU/LM	Puali Lower	2-2-14-L	02/25/03	12:00	3.00	0.005	0.450	0.556	0.010	5.70		
KK03100301	GU/LM	Puali Lower	2-2-14-L	03/10/03	7:40	3.00	0.006	0.510	0.500	< 0.005	4.90		
KK03240301	GU/LM	Puali Lower	2-2-14-L	03/24/03	7:15	3.00	< 0.001	0.460	0.586	0.010	5.60		
	Gradient Study	Puali Lower	2-2-14-L	07/20/03	9:15	3.00	0.001	0.119	0.208	0.011			
	Gradient Study	Puali Middle	2-2-14-M	07/20/03	14:00	2.80	0.001	0.340	0.433	0.004			
KK05070202	GU/LM	Puali Upper	2-2-14-U	05/07/02	7:52	1.00	0.161	0.105	0.276	< 0.005	7.60		
KK05200202	GU/LM	Puali Upper	2-2-14-U	05/20/02	8:45	7.00	0.096	0.058	0.205	< 0.005	5.60		
KK06170202	GU/LM	Puali Upper	2-2-14-U	06/17/02	7:53	18.00	0.020	0.090	0.192	0.009	4.30		
KK07080204	GU/LM	Puali Upper	2-2-14-U	07/08/02	11:35	4.00	0.040	0.024	0.115	< 0.005	4.10		

Sample Number	Sampler	Station Name	Station No	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Chlor-a	Turbidity (NTU)
Huleia													
8	M.M.	Halfway Bridge	Huleia-M	05/05/03	0930	< 0.50	0.002	0.045	0.114	< 0.005	5.66		3.4
12	M.M.	Halfway Bridge	Huleia-M	06/02/03	0935	1.00	0.006	0.079	0.143	0.005	7.14		
5	M.M.	Halfway Bridge	Huleia-M	07/06/03	0828	1.00	0.005	0.068	0.157	< 0.005	6.92		2.7
12	M.M.	Halfway Bridge	Huleia-M	08/04/03	0945	2.00	< 0.001	0.045	0.127	0.007	8.26		3.0
3	M.M.	Halfway Bridge	Huleia-M	09/07/03	0811	< 0.50	*	0.018	*	0.007	9.12		
3	M.M.	Halfway Bridge	Huleia-M	10/05/03	0850	< 0.50	0.004	0.015	0.201	0.006	7.65		
KK01220105	GU/LM	Huleia Lower	2-2-15-L	01/22/01	13:50	< 0.50	0.003	0.096	0.152	0.007	7.10	0.46	
KK07230103	GU/LM	Huleia Lower	2-2-15-L	07/23/01	11:10	1.00	0.014	0.023	0.107	0.019	4.70	0.78	
KK12020201	GU/LM	Huleia Lower	2-2-15-L	12/02/02	8:30	1.00	0.006	0.246	0.342	0.016	8.30		
KK01130302	GU/LM	Huleia Lower	2-2-15-L	01/13/03	8:10	< 0.50	0.003	0.152	0.272	0.005	7.60		
KK02100302	GU/LM	Huleia Lower	2-2-15-L	02/10/03	7:50	< 0.50	0.001	0.086	0.167	0.008	5.70		
KK03100303	GU/LM	Huleia Lower	2-2-15-L	03/10/03	8:55	1.00	0.004	0.103	0.281	0.005	6.20		
KK03240303	GU/LM	Huleia Lower	2-2-15-L	03/24/03	8:20	< 0.50	< 0.001	0.045	0.164	0.006	4.40		
	Gradient Study	Huleia Lower	2-2-15-L	07/29/03	12:00	1.20	0.001	0.098	0.236	0.009			
KK12020202	GU/LM	Huleia Middle	2-2-15-M	12/02/02	9:25	< 0.50	0.006	0.141	0.188	0.008	7.80		
KK01130305	GU/LM	Huleia Middle	2-2-15-M	01/13/03	10:15	1.00	0.003	0.091	0.156	< 0.005	7.70		
KK02100304	GU/LM	Huleia Middle	2-2-15-M	02/10/03	9:20	< 0.50	< 0.001	0.078	0.141	0.006	7.60		
KK03100306	GU/LM	Huleia Middle	2-2-15-M	03/10/03	10:40	1.00	0.002	0.050	0.138	< 0.005	5.90		
KK03240306	GU/LM	Huleia Middle	2-2-15-M	03/24/03	10:05	< 0.50	0.002	0.043	0.119	0.006	6.60		
	Gradient Study	Huleia Middle	2-2-15-M	07/29/03	17:30	1.50	0.001	0.062	0.156	0.010			
KK01220106	GU/LM	Huleia Upper	2-2-15-U	01/22/01	15:00	< 0.5	0.009	0.042	0.097	< 0.005	9.90	0.25	
KK07230106	GU/LM	Huleia Upper	2-2-15-U	07/23/01	14:05	< 0.5	0.004	0.028	0.122	< 0.005	6.20	0.29	
KK12020203	GU/LM	Huleia Upper	2-2-15-U	12/02/02	9:55	1.00	0.012	0.050	0.200	0.020	6.10		
KK01130306	GU/LM	Huleia Upper	2-2-15-U	01/13/03	10:38	< 0.50	0.006	0.050	0.149	< 0.005	9.60		
KK02100305	GU/LM	Huleia Upper	2-2-15-U	02/10/03	9:40	< 0.50	0.005	0.048	0.133	0.008	7.00		
KK03100307	GU/LM	Huleia Upper	2-2-15-U	03/10/03	11:00	< 0.50	0.007	0.041	0.152	< 0.005	5.80		
KK03240307	GU/LM	Huleia Upper	2-2-15-U	03/24/03	10:25	4.00	0.007	0.033	0.128	0.006	7.30		
	Gradient Study	Huleia Upper	2-2-15-U	07/28/03	15:30	0.60	0.001	0.005	0.083	0.005			
9	M.M.	Kamooloa	Huleia-U	05/05/03	1005	2.0	0.009	0.031	0.140	< 0.005	5.50		4.8
13	M.M.	Kamooloa	Huleia-U	06/02/03	1002	1.0	0.007	0.053	0.143	< 0.005	8.16		
6	M.M.	Kamooloa	Huleia-U	07/06/03	0900	10.0	0.005	0.042	0.128	< 0.005	7.45		5.3

Sample Number	Sampler	Station Name	Station No	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Chlor-a	Turbidity (NTU)
13	M.M.	Kamooloa	Huleia-U	08/04/03	1004	1.0	0.014	*	0.144	0.006	10.2		1.3
9	M.M.	Kamooloa	Huleia-U	09/08/03	1025	2.0	*	< 0.001	*	0.007	8.18		
1	M.M.	Kamooloa	Huleia-U	10/05/03	0815	1.0	0.024	0.027	0.254	0.008	8.68		
12	M.M.	Papakolea	Papakolea	05/05/03	1140	4.0	0.022	0.648	0.765	< 0.005	7.18		9.9
14	M.M.	Papakolea	Papakolea	06/02/03	1055	8.0	0.019	0.493	0.553	0.008	8.52		
10	M.M.	Papakolea	Papakolea	07/06/03	1310	10.0	0.006	0.169	0.664	0.006	7.57		5.5
7	M.M.	Papakolea	Papakolea	08/04/03	1140	8.0	0.005	0.337	0.570	0.013	7.54		6.7
6	M.M.	Papakolea	Papakolea	09/07/03	0950	8.0	*	0.237	*	0.009	9.40		
5	M.M.	Papakolea	Papakolea	10/05/03	1025	9.0	0.009	0.340	0.829	0.012	8.41		
11	M.M.	Kipu	Kipu	05/05/03	1110	1.0	0.005	0.111	0.209	< 0.005	6.09		4.7
15	M.M.	Kipu	Kipu	06/02/03	1155	4.0	0.001	0.061	0.142	0.007	8.83		
12	M.M.	Kipu	Kipu	07/06/03	1400	1.0	0.001	0.012	0.101	0.005	8.82		1.7
8	M.M.	Kipu	Kipu	08/04/03	1210	1.0	< 0.001	*	0.108	0.010	9.22		1.8
4	M.M.	Kipu	Kipu	09/07/03	0910	< 0.5	*	0.008	*	0.008	11.7		
2	M.M.	Kipu	Kipu	10/05/03	0940	1.0	0.006	0.010	0.161	0.015	9.79		
10	M.M.	Stone Bridge	Huleia-L	05/05/03	1040	1.0	0.004	0.112	0.192	< 0.005	5.33		3.9
16	M.M.	Stone Bridge	Huleia-L	06/02/03	1130	1.0	0.007	0.074	0.267	0.005	6.59		
11	M.M.	Stone Bridge	Huleia-L	07/06/03	1345	1.0	< 0.001	0.117	0.194	< 0.005	5.67		3.1
9	M.M.	Stone Bridge	Huleia-L	08/04/03	1220	1.0	< 0.001	0.084	0.184	0.008	6.61		1.5
5	M.M.	Stone Bridge	Huleia-L	09/07/03	0925	1.0	*	0.170	*	0.008	8.62		
4	M.M.	Stone Bridge	Huleia-L	10/05/03	0955	2.0	0.003	0.054	0.154	0.008	7.66		

Table C-3: Data from Baseline Flow Sampling Events (Samples collected by Tetra Tech)

* - result is not reported due to instrument problem and limitations

< - result is at or below the laboratory reporting limit

Sample No	Lab No	Station Name	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Turbidity (NTU)	Sampler
8	W5-03-15/16	Halfway Bridge	05/05/03	0930	< 0.5	0.002	0.045	0.114	< 0.005	5.66	3.4	M.M.
9	W5-03-17/18	Kamooloa	05/05/03	1005	2	0.009	0.031	0.140	< 0.005	5.50	4.8	M.M.
7	W5-03-13/14	Low Nawiliwili	05/05/03	0830	3	0.024	1.22	1.40	0.006	9.04	6.4	M.M.
12	W5-03-23/24	Papakolea	05/05/03	1140	4	0.022	0.648	0.765	< 0.005	7.18	9.9	M.M.
11	W5-03-21/22	Kipu	05/05/03	1110	1	0.005	0.111	0.209	< 0.005	6.09	4.7	M.M.
13	W5-03-25/26	Puali	05/05/03	1255	12	0.008	0.193	0.288	0.009	5.65	13	M.M.
10	W5-03-19/20	Stone Bridge	05/05/03	1040	1.0	0.004	0.112	0.192	< 0.005	5.33	3.9	M.M.
14	W5-03-27/28	Upper Nawiliwili	05/05/03	1335	1.0	0.019	1.00	1.24	0.055	14.5	1.5	M.M.
12	W6-03-23/24	Halfway Bridge	06/02/03	0935	1.0	0.006	0.079	0.143	0.005	7.14		M.M.
13	W6-03-25/26	Kamooloa	06/02/03	1002	1.0	0.007	0.053	0.143	< 0.005	8.16		M.M.
11	W6-03-21/22	Low Nawiliwili	06/02/03	0810	3	0.016	1.22	1.17	0.013	10.5		M.M.
14	W6-03-27/28	Papakolea	06/02/03	1055	8	0.019	0.493	0.553	0.008	8.52		M.M.
15	W6-03-29/30	Kipu	06/02/03	1155	4	0.001	0.061	0.142	0.007	8.83		M.M.
17	W6-03-33/34	Puali	06/02/03	1345	2	0.002	0.268	0.396	0.012	5.76		M.M.
16	W6-03-31/32	Stone Bridge	06/02/03	1130	1	0.007	0.074	0.267	0.005	6.59		M.M.
18	W6-03-35/36	Upper Nawiliwili	06/02/03	1430	1.0	0.005	1.17	1.11	0.049	16.8		M.M.
5	W7-03-9/10	Halfway Bridge	07/06/03	0828	1.0	0.005	0.068	0.157	< 0.005	6.92	2.7	M.M.
6	W7-03-11/12	Kamooloa	07/06/03	0900	10	0.005	0.042	0.128	< 0.005	7.45	5.3	M.M.
7	W7-03-13/14	Lo Nawili	07/06/03	1000	2	0.011	1.14	1.33	0.008	9.74	4.0	M.M.
10	W7-03-19/20	Papakolea	07/06/03	1310	10	0.006	0.169	0.664	0.006	7.57	5.5	M.M.
12	W7-03-23/24	Kipu	07/06/03	1400	1.0	0.001	0.012	0.101	0.005	8.82	1.7	M.M.
8	W7-03-15/16	Puali	07/06/03	1105	4	< 0.001	0.067	0.239	< 0.005	6.34	2.9	M.M.
11	W7-03-21/22	Stone Bridge	07/06/03	1345	1.0	< 0.001	0.117	0.194	< 0.005	5.67	3.1	M.M.
9	W7-03-17/18	UP Nawiliwili	07/06/03	1155	< 0.5	< 0.001	1.20	1.17	0.051	13.1	0.26	M.M.
12	W8-03-23/24	Halfway Bridge	08/04/03	0945	2	< 0.001	0.045	0.127	0.007	8.26	3.0	M.M.
13	W8-03-25/26	Kamooloa	08/04/03	1004	1.0	0.014	*	0.144	0.006	10.2	1.3	M.M.
10	W8-03-19/20	Lo Nawiliwili	08/04/03	0812	3	0.012	1.21	1.37	0.016	9.60	4.8	M.M.
7	W8-03-13/14	Papakolea	08/04/03	1140	8	0.005	0.337	0.570	0.013	7.54	6.7	M.M.
8	W8-03-15/16	Kipu	08/04/03	1210	1	< 0.001	*	0.108	0.010	9.22	1.8	M.M.

Sample No	Lab No	Station Name	Date	Time	TSS (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	TN (mg/l)	TP (mg/l)	Silicon (mg/l)	Turbidity (NTU)	Sampler
11	W8-03-21/22	Puali	08/04/03	0845	3	< 0.001	0.251	0.324	0.013	7.28	3.6	M.M.
9	W8-03-17/18	Stone Bridge	08/04/03	1220	1	< 0.001	0.084	0.184	0.008	6.61	1.5	M.M.
3	W9-03-4/5	Halfway Bridge	09/07/03	0811	< 0.5	*	0.018	*	0.007	9.12		M.M.
8	W9-03-14/15	Lo Nawiliwili	09/07/03	1055	3	*	1.04	*	0.034	11.7		M.M.
6	W9-03-10/11	Papakolea	09/07/03	0950	8	*	0.237	*	0.009	9.40		M.M.
4	W9-03-6/7	Kipu	09/07/03	0910	< 0.5	*	0.008	*	0.008	11.7		M.M.
7	W9-03-12/13	Puali	09/07/03	1020	4	*	0.143	*	0.008	7.33		M.M.
5	W9-03-8/9	Stone Bridge	09/07/03	0925	1.0	*	0.170	*	0.008	8.62		M.M.
9	W9-03-16/17	Kamooloa	09/08/03	1025	2	*	< 0.001	*	0.007	8.18		M.M.
19	W9-03-78/79	Makaaiai Spring	09/24/03	1145	58	*	0.015	0.247	0.043	16.6		M.M.
18	W9-03-76/77	Waiaka Spring	09/24/03	1154	< 0.5	*	0.021	2.17	0.005	8.42		M.M.
3	W10-03-5/6	Halfway Bridge	10/05/03	0850	< 0.5	0.004	0.015	0.201	0.006	7.65		M.M.
1	W10-03-1/2	Kamooloa	10/05/03	0815	1	0.024	0.027	0.254	0.008	8.68		M.M.
7	W10-03-13/14	Nawiliwili Lo	10/05/03	1125	3	0.016	0.807	1.67	0.014	10.2		M.M.
5	W10-03-9/10	Papakolea	10/05/03	1025	9	0.009	0.340	0.829	0.012	8.41		M.M.
2	W10-03-3/4	Kipu	10/05/03	0940	1.0	0.006	0.010	0.161	0.015	9.79		M.M.
6	W10-03-11/12	Puali	10/05/03	1055	6	0.004	0.098	0.176	0.010	5.70		M.M.
4	W10-03-7/8	Stone Bridge	10/05/03	0955	2	0.003	0.054	0.154	0.008	7.66		M.M.

Note: Data for 4/19/03 not included in this table.

Table C-4: Data Used for TMDL Analysis
Note – Sample ID "#" indicates number from bottle in 12-bottle event sampling sequence (#1 = first bottle)

A. Nawiliwili Including Upper Nawiliwili Stream, Lower Nawiliwili Stream

Sample ID/Station Name	Date Sampled	Total Susp. Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet Season						
Lower Nawiliwili	01/13/03	2.00	970.0	1510.0	6.0	
Lower Nawiliwili	01/27/03	3.00	760.0	1200.0	15.0	
Lower Nawiliwili	02/10/03	2.00	1130.0	1100.0	14.0	
Lower Nawiliwili #1	02/21/03	218.00	101.0	1120.0	27.0	123.00
Lower Nawiliwili #4	02/21/03	175.00	820.0	913.0	36.0	107.00
Lower Nawiliwili #6	02/21/03	70.00	760.0	852.0	27.0	54.00
Lower Nawiliwili	02/25/03	3.00	1080.0	1160.0	12.0	
Lower Nawiliwili	03/10/03	3.00	1060.0	1350.0	5.0	
Lower Nawiliwili	03/24/03	2.00	1220.0	1390.0	11.0	
Lower Nawiliwili #1	03/27/03	352.00	437.0	997.0	181.0	204.00
Lower Nawiliwili #3	03/27/03	490.00	438.0	910.0	178.0	346.00
Lower Nawiliwili #6	03/27/03	212.00	260.0	552.0	93.0	106.00
Lower Nawiliwili #1	04/01/03	1640.00	180.0	595.0	193.0	699.00
Lower Nawiliwili #3	04/01/03	3870.00	195.0	1000.0	618.0	
Lower Nawiliwili #5	04/01/03	4520.00	140.0	990.0	747.0	
Lower Nawiliwili #1	04/04/03	175.00	942.0	1690.0	98.0	84.10
Lower Nawiliwili #3	04/04/03	82.20	350.0	532.0	16.0	77.60
Lower Nawiliwili #5	04/04/03	212.00	588.0	1090.0	171.0	154.00
Lower Nawiliwili #1	04/06/03	353.00	258.0	1550.0	588.0	75.80
Lower Nawiliwili #4	04/06/03	3630.00	685.0	6520.0	6000.0	2545.00
Lower Nawiliwili #6	04/06/03	331.00	321.0	2270.0	1300.0	221.00
Lower Nawiliwili	04/19/03	22.00	1180.0	1420.0	14.0	4.30
Upper Nawiliwili	01/27/03	0.50	950.0	1210.0	56.0	
Upper Nawiliwili	02/25/03	0.50	1270.0	1310.0	55.0	
Upper Nawiliwili #4	03/07/03	822.00	165.0	625.0	148.0	962.00
Upper Nawiliwili #5	03/07/03	682.00	169.0	612.0	138.0	638.00
Upper Nawiliwili #7	03/07/03	492.00	296.0	631.0	86.0	482.80
Upper Nawiliwili	03/10/03	1.00	966.0	1100.0	35.0	
Upper Nawiliwili	03/24/03	1.00	1260.0	1150.0	45.0	
Upper Nawiliwili	04/19/03	34.00	1170.0	1350.0	50.0	
Dry Season						
Lower Nawiliwili	05/05/03	3.00	1220.0	1400.0	6.0	6.40
Lower Nawiliwili	06/02/03	3.00	1220.0	1170.0	13.0	
Lower Nawiliwili	07/06/03	2.00	1140.0	1330.0	8.0	4.00
Lower Nawiliwili	08/04/03	3.00	1210.0	1370.0	16.0	4.80
Lower Nawiliwili	09/07/03	3	1040.00		34.00	6.30
Lower Nawiliwili	10/05/03	3.00	807.00	1670.00	14.00	
Upper Nawiliwili	05/05/03	1.00	1000.0	1240.0	55.0	1.50
Upper Nawiliwili	06/02/03	1.00	1170.0	1110.0	49.0	
Upper Nawiliwili	07/06/03	0.50	1200.0	1170.0	51.0	0.26

B. Puali

Sample ID/Station Name	Date Sampled	Total Susp. Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet Season						
Puali	04/15/02	1.00	340.0	451.0	5.0	
Puali	11/04/02	3.00	90.0	161.0	14.0	
Puali	01/13/03	1.00	190.0	361.0	5.0	
Puali	02/25/03	3.00	450.0	556.0	10.0	
Puali #1	03/06/03	306.00	588.0	925.0	78.0	221.00
Puali #11	03/06/03	348.00	527.0	946.0	118.0	314.00
Puali #12	03/06/03	277.00	490.0	901.0	125.0	280.00
Puali	03/10/03	3.00	510.0	500.0	5.0	
Puali	03/24/03	3.00	460.0	586.0	10.0	
Puali #1	03/30/03	74.80	280.0	635.0	56.0	37.20
Puali #3	03/30/03	85.60	403.0	1100.0	198.0	65.30
Puali #5	03/30/03	89.50	432.0	877.0	69.0	56.60
Puali	04/19/03	12.00	304.0	396.0	10.0	
Dry Season						
Puali	05/07/02	5.00	730.0	725.0	36.0	
Puali	05/20/02	1.00	240.0	404.0	9.0	
Puali	06/17/02	4.00	620.0	764.0	26.0	
Puali	07/08/02	3.00	710.0	908.0	44.0	
Puali	05/05/03	12.00	193.0	288.0	9.0	13.00
Puali	06/02/03	2.00	268.0	396.0	12.0	
Puali	07/06/03	4.00	67.0	239.0	5.0	2.90
Puali	08/04/03	3.00	251.0	324.0	13.0	3.60
Puali	09/07/03	4	143.00		8.00	5.80
Puali	10/05/03	6.00	98.00	176.00	10.00	

C. Huleia Including Kamooloa Stream, Huleia Stream at Halfway Bridge, and Kipu

Sample ID/Station Name	Date Sampled	Total Susp. Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet Season						
Kamooloa	01/22/01	0.5	40.0			
Kamooloa	12/02/02	1.0	50.0	200.0	20.0	
Kamooloa	01/13/03	0.5	50.0	149.0	5.0	
Kamooloa	02/10/03	0.5	48.0	133.0	8.0	
Kamooloa #1	02/14/03	48.0	8.0	217.0	28.0	27.6
Kamooloa #2	02/14/03	70.0	83.0	454.0	39.0	63.8
Kamooloa #1	02/24/03	77.5	3.0	238.0	13.0	36.8
Kamooloa #2	02/24/03	62.0	29.0	303.0	9.0	31.2
Kamooloa #5	03/06/03	65.6	13.0	197.0	13.0	37.2
Kamooloa	03/10/03	0.5	41.0	152.0	5.0	
Kamooloa	03/24/03	4.0	33.0	128.0	6.0	
Kamooloa #1	03/30/03	42.0	33.0	879.0	100.0	20.5
Kamooloa #4	03/31/03	14.0	2.0	407.0	55.0	20.2
Kamooloa #5	03/31/03	48.0	1.0	592.0	88.0	52.6
Kamooloa #1	04/01/03	22.0	5.0	202.0	11.0	17.1
Kamooloa #2	04/01/03	22.6	16.0	252.0	13.0	13.6
Kamooloa #3	04/01/03	26.0	10.0	185.0	14.0	19.5
Kamooloa #1	04/04/03	232.0	32.0	821.0	113.0	83.4
Kamooloa #2	04/04/03	22.2	27.0	358.0	40.0	20.8
Kamooloa	04/19/03	13.0	23.0	136.0	5.0	
Halfway Bridge	12/02/02	0.50	140.0	181.0	8.0	
Halfway Bridge	01/13/03	1.00	90.0	156.0	5.0	
Halfway Bridge	02/10/03	0.50	78.0	141.0	6.0	
Halfway Bridge #1	02/14/03	29.00	32.0	341.0	88.0	34.40
Halfway Bridge #12	02/14/03	373.00	141.0	421.0	68.0	304.00
Halfway Bridge #6	02/14/03	53.50	194.0	377.0	86.0	35.50
Halfway Bridge #1	03/07/03	181.00	185.0	1030.0	78.0	122.00
Halfway Bridge #10	03/07/03	718.00	75.0	675.0	128.0	568.00
Halfway Bridge #7	03/07/03	1140.00	126.0	680.0	117.0	76.80
Halfway Bridge	03/10/03	1.00	50.0	138.0	5.0	
Halfway Bridge	03/24/03	0.50	43.0	119.0	6.0	
Halfway Bridge #1	03/27/03	62.00	25.0	278.0	67.0	56.40
Halfway Bridge #3	03/27/03	38.30	81.0	306.0	74.0	54.60
Halfway Bridge #7	03/27/03	16.00	66.0	229.0	48.0	29.00
Halfway Bridge Grab	04/01/03	4.60	22.0	184.0	19.0	11.70
Halfway Bridge Grab	04/05/03	22.20	41.0			22.50
Halfway Bridge	04/19/03	4.00	26.0	105.0	6.0	
Stone Bridge	01/22/01	0.50	100.0			
Stone Bridge	12/02/02	1.00	250.0	342.0	16.0	
Stone Bridge	01/13/03	0.50	150.0	272.0	5.0	
Stone Bridge #1	01/25/03	7.60	74.0	313.0	30.0	3.28
Stone Bridge #12	01/25/03	8.40	75.0	357.0	30.0	2.80

Sample ID/Station Name	Date Sampled	Total Susp. Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Stone Bridge #4	01/25/03	45.50	107.0	654.0	128.0	6.35
Stone Bridge	02/10/03	0.50	86.0	167.0	8.0	
Stone Bridge #1	02/27/03	382.00	140.0	312.0	14.0	22.40
Stone Bridge #3	02/27/03	38.00	176.0	337.0	10.0	4.12
Stone Bridge #5	02/27/03	20.60	168.0	339.0	9.0	6.18
Stone Bridge Grab	03/07/03	11.00	236.0	518.0	49.0	34.90
Stone Bridge	03/10/03	1.00	103.0	281.0	5.0	
Stone Bridge	03/24/03	0.50	45.0	164.0	6.0	
Stone Bridge #1	03/30/03	43.40	96.0	260.0	18.0	13.10
Stone Bridge #3	03/30/03	122.00	147.0	344.0	18.0	55.60
Stone Bridge #5	03/30/03	140.00	135.0	707.0	76.0	96.80
Stone Bridge Grab	04/05/03	34.80	72.0			32.40
Stone Bridge #1	04/07/03	50.20	59.0	527.0	87.0	38.30
Stone Bridge #3	04/07/03	86.30	96.0	594.0	95.0	36.50
Stone Bridge #5	04/07/03	45.00	97.0	499.0	73.0	41.40
Stone Bridge	04/19/03	7.00	73.0	158.0	8.0	
Dry Season						
Kamooloa	07/23/01	0.5	30.0			
Kamooloa	05/05/03	2.0	31.0	140.0	5.0	4.8
Kamooloa	06/02/03	1.0	53.0	143.0	5.0	
Kamooloa	07/06/03	10.0	42.0	128.0	5.0	5.3
Kamooloa	08/04/03	1.0		144.0	6.0	1.3
Kamooloa	09/07/03	2	1.0		7.0	2.5
Kamooloa	10/05/03	1.0	27.0	254.0	8.0	
Halfway Bridge	05/05/03	0.50	45.0	114.0	5.0	3.40
Halfway Bridge	06/02/03	1.00	79.0	143.0	5.0	
Halfway Bridge	07/06/03	1.00	68.0	157.0	5.0	2.70
Halfway Bridge	08/04/03	2.00	45.0	127.0	7.0	3.00
Halfway Bridge	09/07/03	0.5	18.00		7.00	3.30
Halfway Bridge	10/05/03	0.50	15.00	201.00	6.00	
Stone Bridge	07/23/01	1.00	20.0			
Stone Bridge	05/05/03	1.00	112.0	192.0	5.0	3.90
Stone Bridge	06/02/03	1.00	74.0	267.0	5.0	
Stone Bridge	07/06/03	1.00	117.0	194.0	5.0	3.10
Stone Bridge	08/04/03	1.00	84.0	184.0	8.0	1.50
Stone Bridge	09/07/03	1	170.00		8.00	0.90
Stone Bridge	10/05/03	2.00	54.00	154.00	8.00	

D. Papakolea

Sample ID/Station Name	Date Sampled	Total Susp. Solids (mg/L)	Nitrate + Nitrite (μg/L N)	Total Nitrogen (μg/L N)	Total Phosphorus (μg/L P)	Turbidity (NTU)
Wet Season						
Papakolea	02/10/03	6.00	482.0	510.0	10.0	
Papakolea #1	02/13/03	9140.00	198.0	1140.0	260.0	2100.00
Papakolea # 5	02/14/03	5250.00	395.0	8610.0	2050.0	2640.00
Papakolea #6	02/14/03	2580.00	512.0	6430.0	1860.0	1160.00
Papakolea Grab	03/07/03	27.00	1600.0	1890.0	29.0	3.00
Papakolea	03/10/03	9.00	1110.0	1540.0	5.0	
Papakolea Grab	04/01/03	6.10	1230.0	1620.0	21.0	9.07
Papakolea Grab	04/04/03	39.00	1710.0			45.50
Papakolea	04/08/03	7.00	1180.0	1510.0	14.0	
Dry Season						
Papakolea	05/05/03	4.00	648.0	765.0	5.0	9.90
Papakolea	06/02/03	8.00	493.0	553.0	8.0	6.70
Papakolea	07/06/03	10.00	169.0	664.0	6.0	5.50
Papakolea	08/04/03	8.00	337.0	570.0	13.0	6.70
Papakolea	09/07/03	8	237.00		9.00	11.40
Papakolea	10/05/03	9.00	340.00	829.00	12.00	

Table C-5: Enterococci Data

Site	Location	Date	Enterococci (CFU/100 ml)		Site	Location	Date	Enterococci (CFU/100 ml)
1	Upper Nawiliwili	10/31/01	3600		9	Papakolea Stream	10/31/01	920
1	Upper Nawiliwili	11/28/01	2080		9	Papakolea Stream	11/28/01	1480
1	Upper Nawiliwili	02/27/02	2200		9	Papakolea Stream	02/27/02	1320
1	Upper Nawiliwili	03/20/02	3760		9	Papakolea Stream	03/20/02	1080
1	Upper Nawiliwili	04/22/02	11200		9	Papakolea Stream	04/22/02	1280
1	Upper Nawiliwili	05/14/02	1560		9	Papakolea Stream	05/14/02	2320
1	Upper Nawiliwili	06/24/02	1640		9	Papakolea Stream	06/24/02	536
1	Upper Nawiliwili	07/24/02	1680		9	Papakolea Stream	07/24/02	800
1	Upper Nawiliwili	10/16/02	1680		9	Papakolea Stream	10/16/02	760
1	Upper Nawiliwili	11/25/02	8800		9	Papakolea Stream	11/25/02	1200
1A	Upper Nawiliwili	03/19/02	4400		9A	Papakolea Stream	03/19/02	1560
1A	Upper Nawiliwili	04/24/02	1040		9A	Papakolea Stream	04/24/02	360
1A	Upper Nawiliwili	05/16/02	1320		9A	Papakolea Stream	05/16/02	568
1A	Upper Nawiliwili	06/26/02	720		9A	Papakolea Stream	06/26/02	680
1A	Upper Nawiliwili	07/16/02	32		9A	Papakolea Stream	07/16/02	1320
1A	Upper Nawiliwili	08/21/02	1440		9A	Papakolea Stream	08/21/02	600
1A	Upper Nawiliwili	09/25/02	1680		9A	Papakolea Stream	09/25/02	272
1A	Upper Nawiliwili	11/20/02	1560		9A	Papakolea Stream	11/20/02	400
8	Puali Stream	10/31/01	840		10	Huleia Stream	10/31/01	144
8	Puali Stream	11/28/01	920		10	Huleia Stream	11/28/01	1360
8	Puali Stream	02/27/02	840		10	Huleia Stream	02/27/02	152
8	Puali Stream	03/20/02	960		10	Huleia Stream	03/20/02	164
8	Puali Stream	04/22/02	840		10	Huleia Stream	04/22/02	288
8	Puali Stream	05/14/02	2600		10	Huleia Stream	05/14/02	2440
8	Puali Stream	06/24/02	840		10	Huleia Stream	06/24/02	376
8	Puali Stream	07/24/02	1440		10	Huleia Stream	07/24/02	260
8	Puali Stream	10/16/02	560		10	Huleia Stream	10/16/02	148
8	Puali Stream	11/25/02	560		10	Huleia Stream	11/25/02	360
8A	Puali Stream	03/19/02	1960		10A	Huleia Stream	03/19/02	720
8A	Puali Stream	04/24/02	760		10A	Huleia Stream	04/24/02	356
8A	Puali Stream	05/16/02	328		10A	Huleia Stream	05/16/02	396
8A	Puali Stream	06/26/02	520		10A	Huleia Stream	06/26/02	360
8A	Puali Stream	07/16/02	3120		10A	Huleia Stream	07/16/02	760
8A	Puali Stream	08/21/02	920		10A	Huleia Stream	08/21/02	440
8A	Puali Stream	09/25/02	280		10A	Huleia Stream	09/25/02	176
8A	Puali Stream	11/20/02	520		10A	Huleia Stream	11/20/02	88

Source: El-Kadi et al. 2003

Figures C-1 through C-27: Hydrographs and Samples Collected from Targeted Storm Flow Events at various Stream Locations.

The following figures show the hourly average water levels during the sampled events; the points during the events when samples were collected; and which of the samples collected were selected for laboratory analysis of pollutant concentrations (TN, N+N, TP, TSS) and turbidity levels.

Figure C-1: Hydrograph and Samples Collected from the February 14, 2003 Event at the Kamooloa Stream Location.

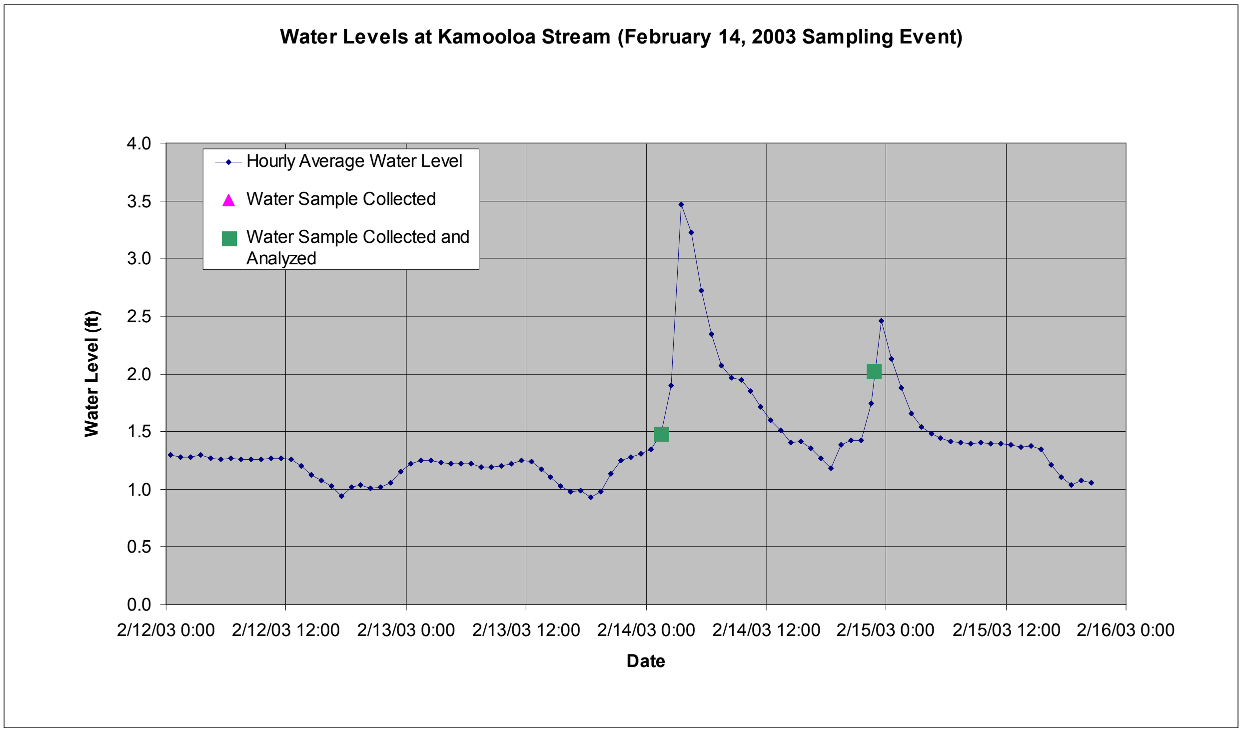


Figure C-2: Hydrograph and Samples Collected from the February 14, 2003 Event at the Huleia Stream at Halfway Bridge Location.

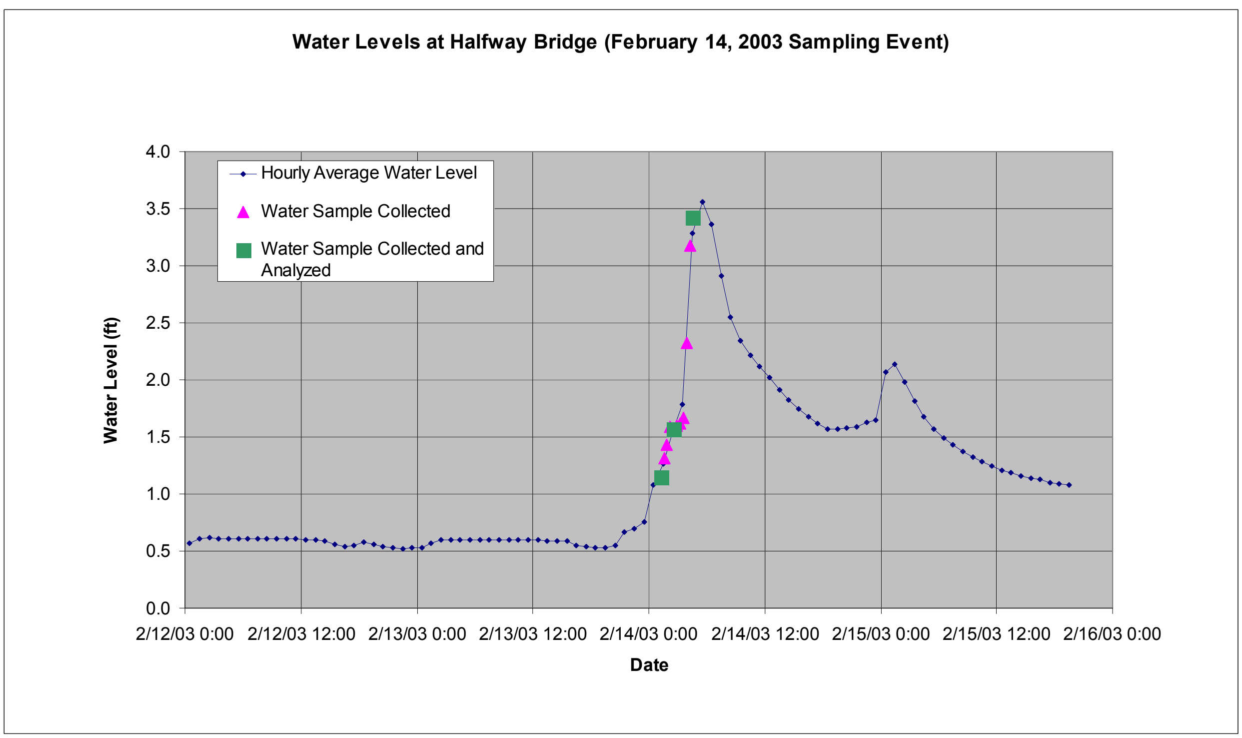


Figure C-3: Hydrograph and Samples Collected from the February 14, 2003 Event at the Papakolea Stream Location.

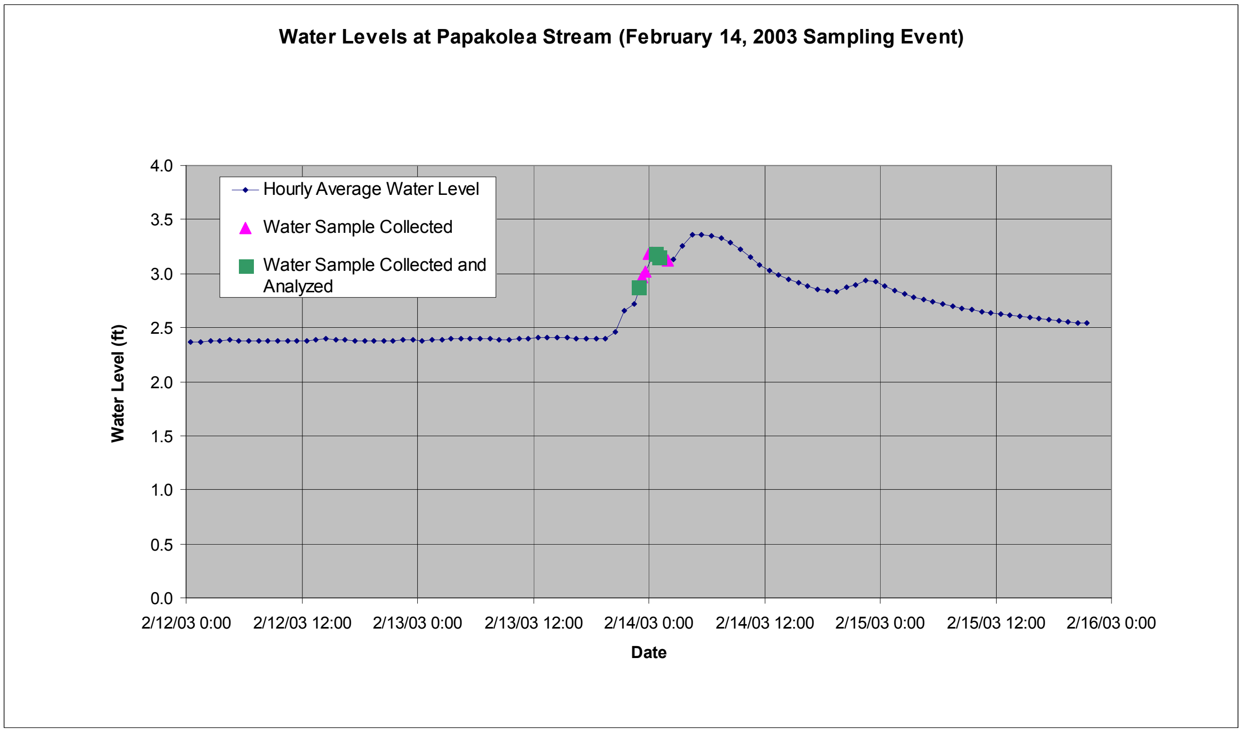


Figure C-4: Hydrograph and Samples Collected from the March 6, 2003 Event at the Upper Nawiliwili Stream Location.

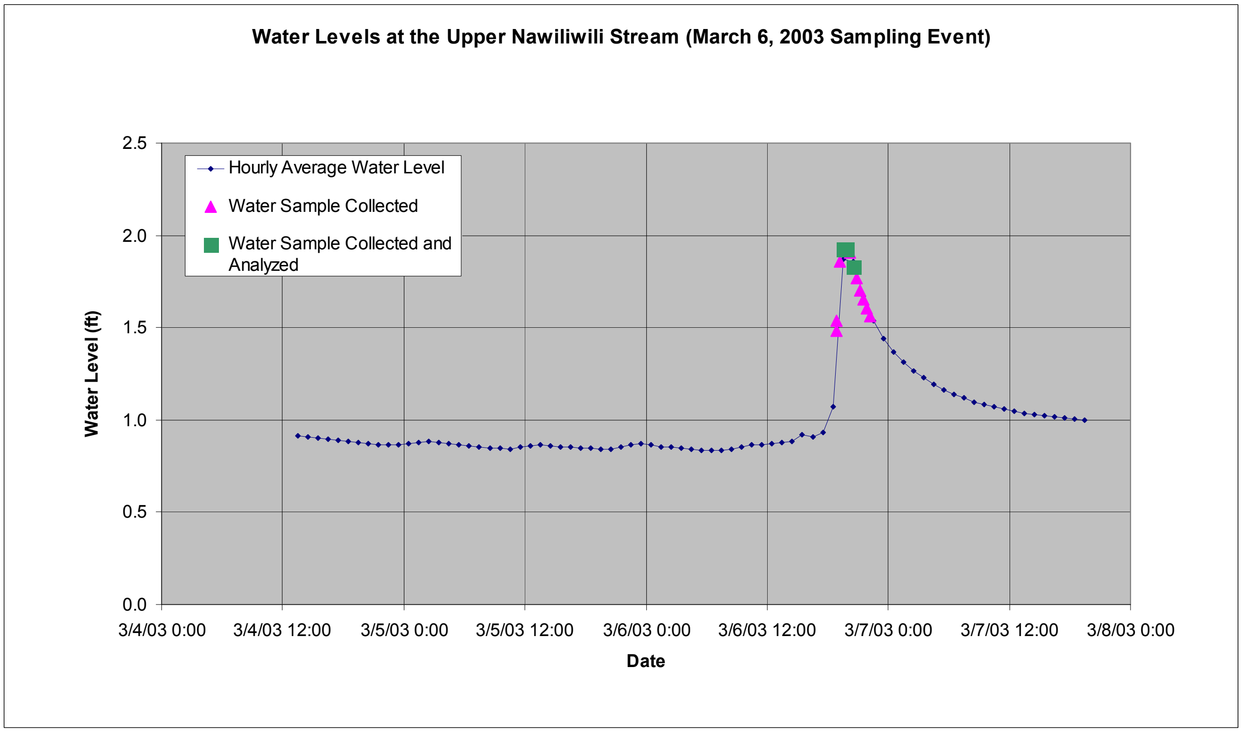


Figure C-5: Hydrograph and Samples Collected from the March 6, 2003 Event at the Lower Nawiliwili Stream Location.

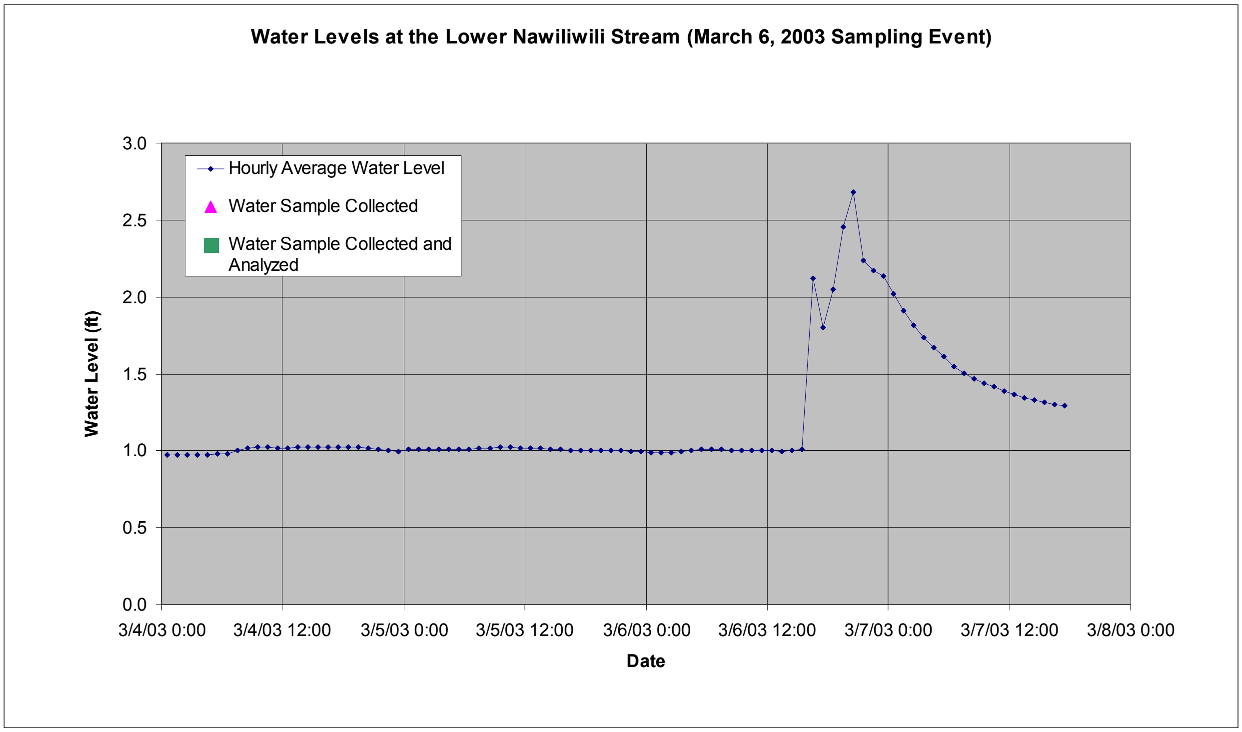


Figure C-6: Hydrograph and Samples Collected from the March 6, 2003 Event at the Huleia Stream at Halfway Bridge Location.

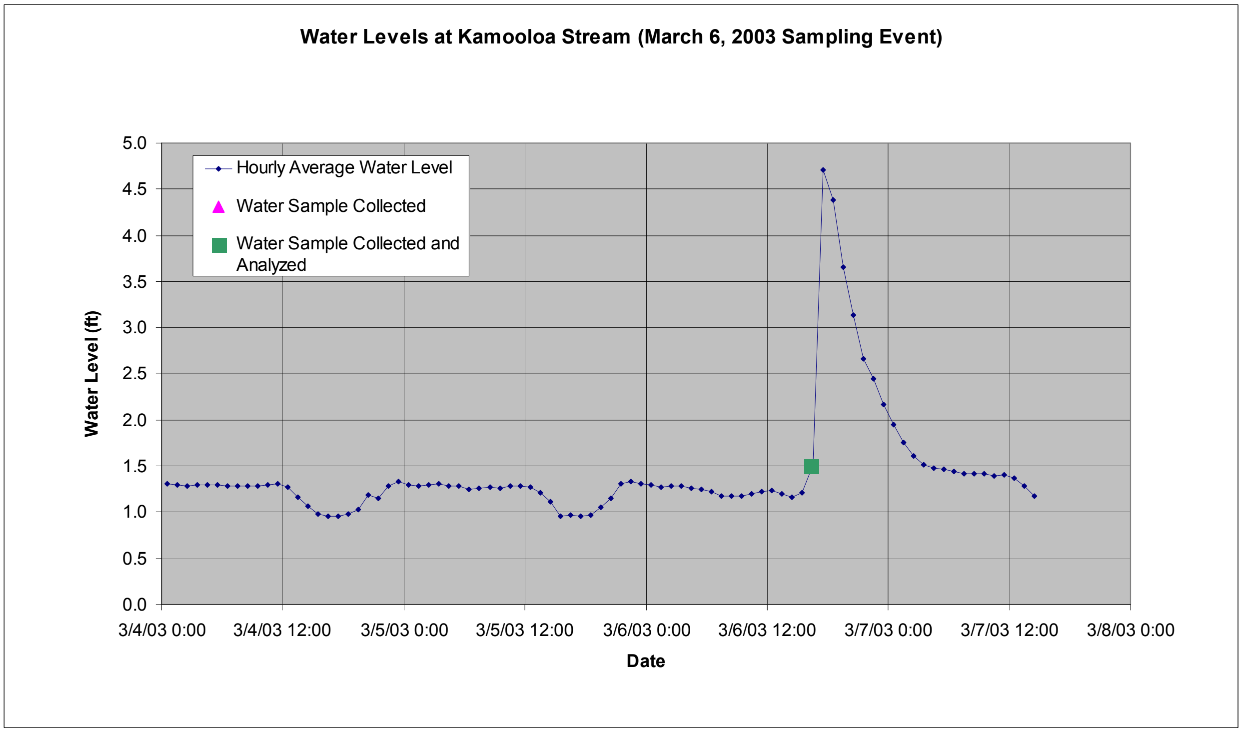


Figure C-7: Hydrograph and Samples Collected from the March 6, 2003 Event at the Huleia Stream at Halfway Bridge Location.

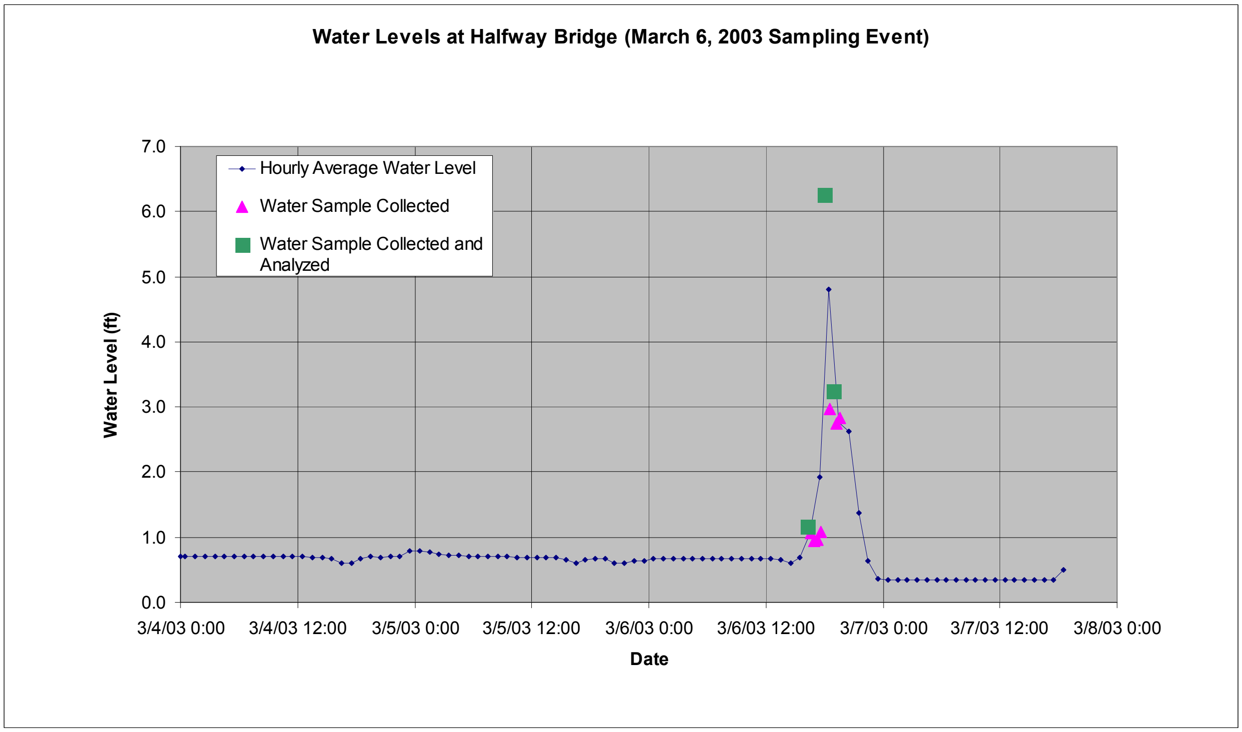


Figure C-8: Hydrograph and Samples Collected from the March 6, 2003 Event at the Huleia Stream at Stone Bridge Location.

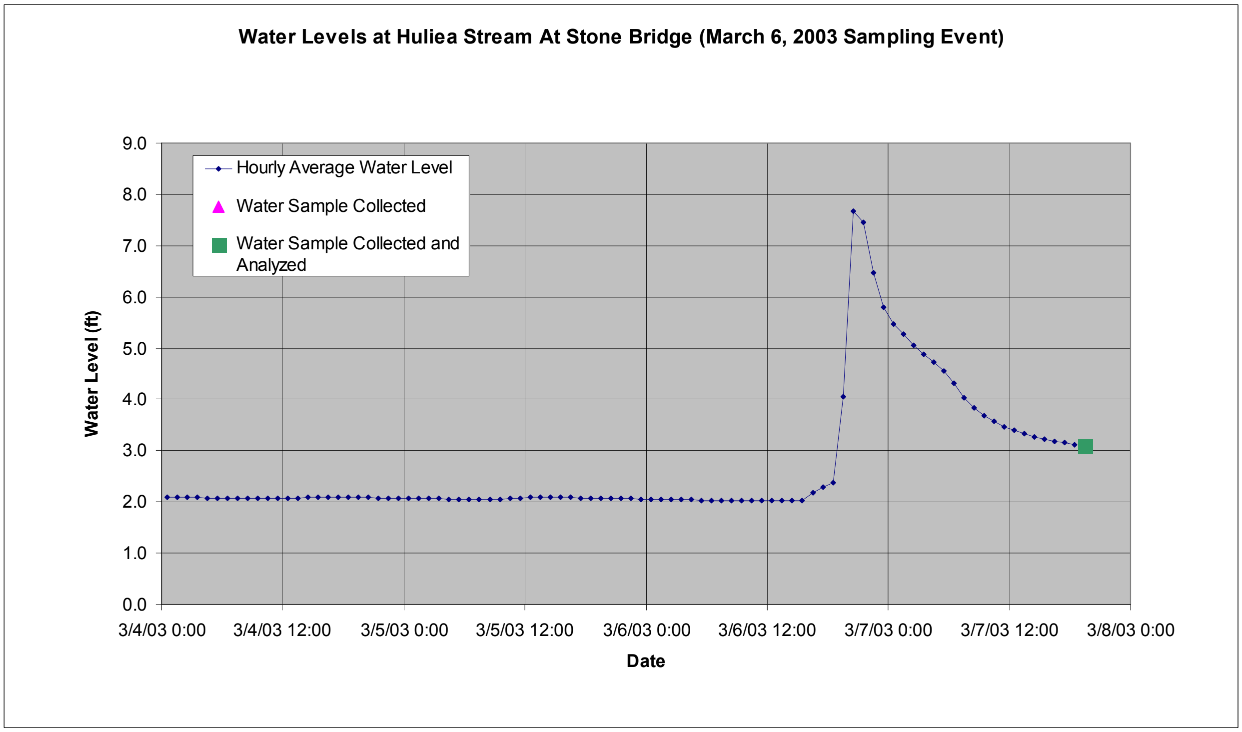


Figure C-9: Hydrograph and Samples Collected from the March 6, 2003 Event at the Papakolea Stream Location.

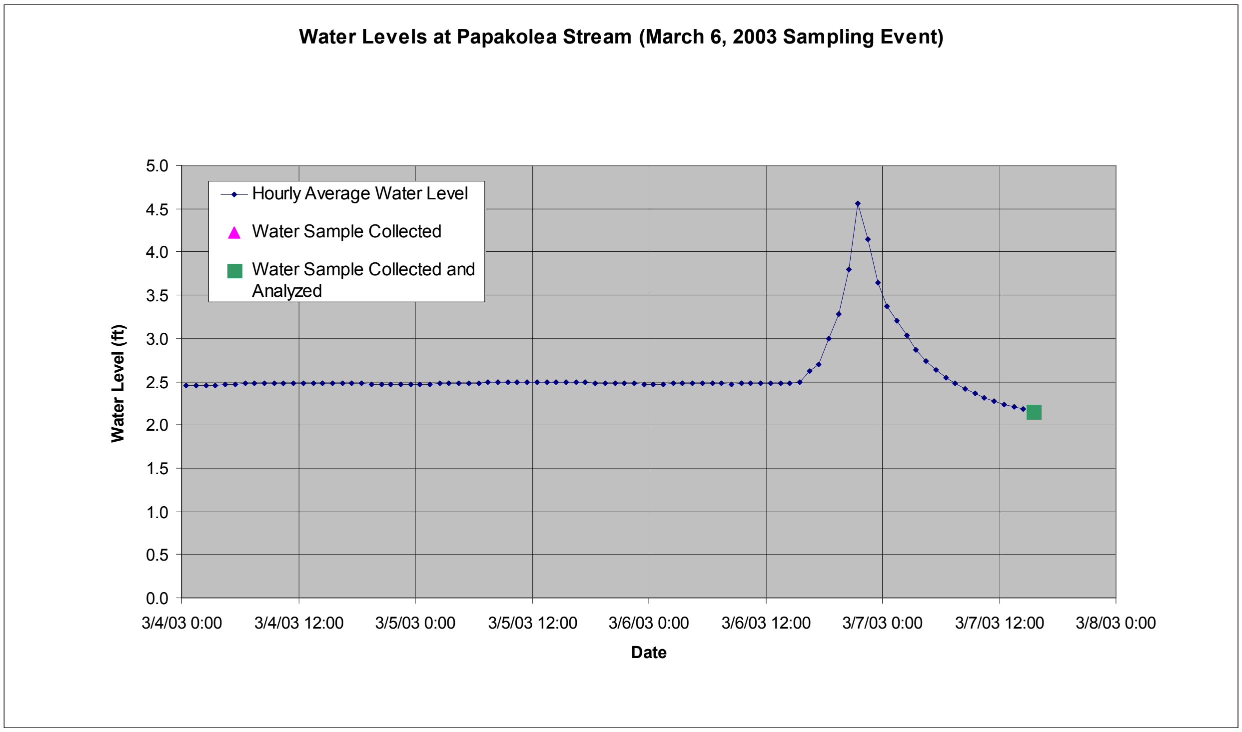


Figure C-10: Hydrograph and Samples Collected from the March 6, 2003 Event at the Puali Stream Location.

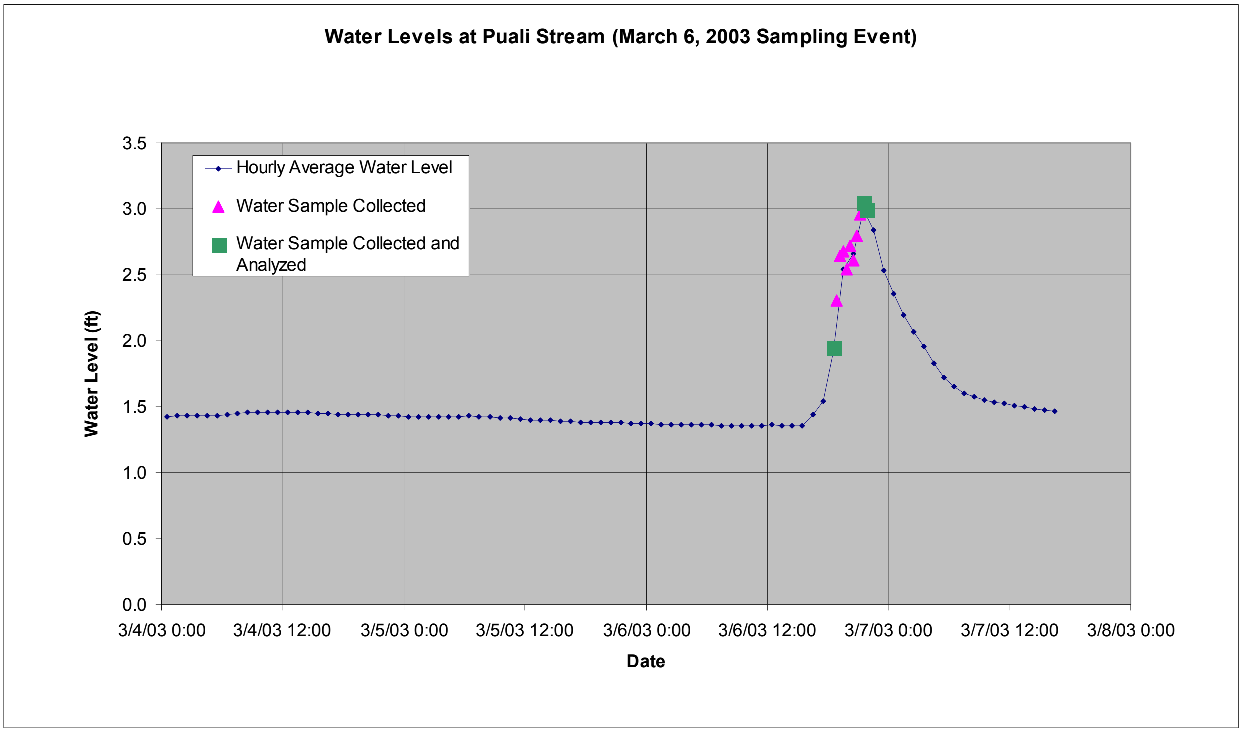


Figure C-11: Hydrograph and Samples Collected from the March 27, 2003 Event at the Lower Nawiliwili Stream Location.

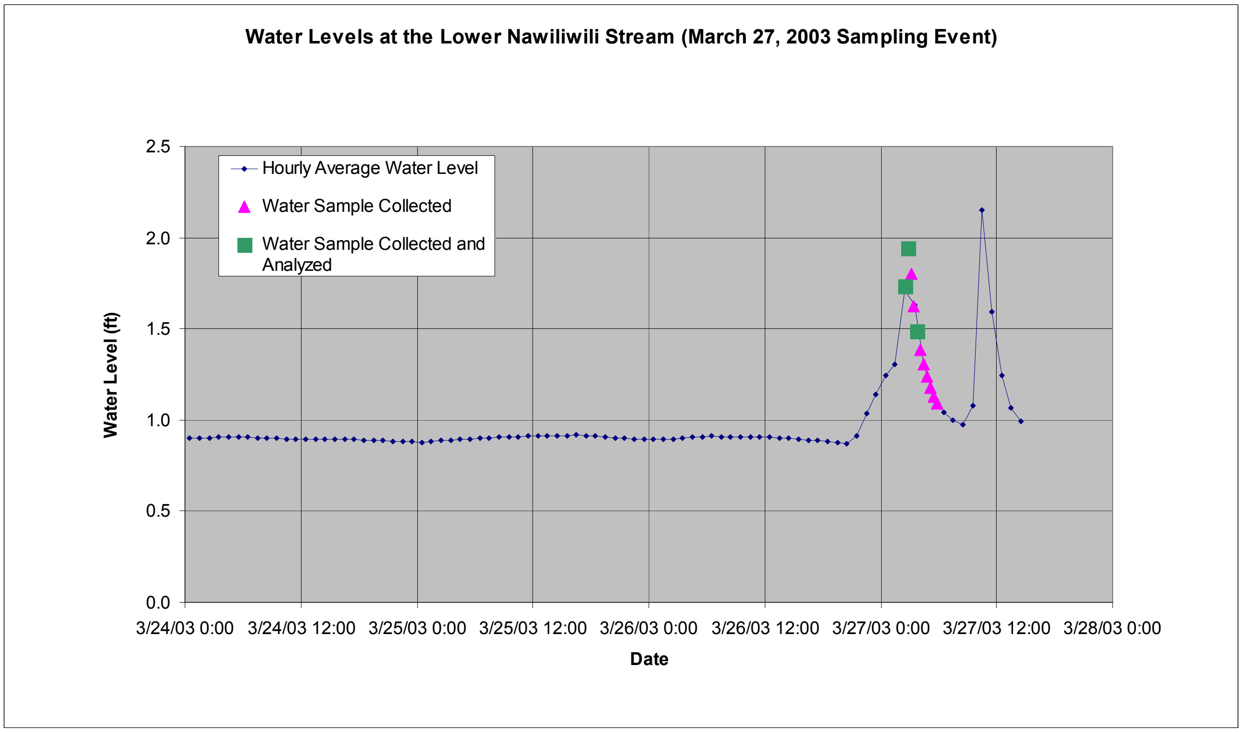


Figure C-12: Hydrograph and Samples Collected from the March 27, 2003 Event at the Huleia Stream at Halfway Bridge Location.

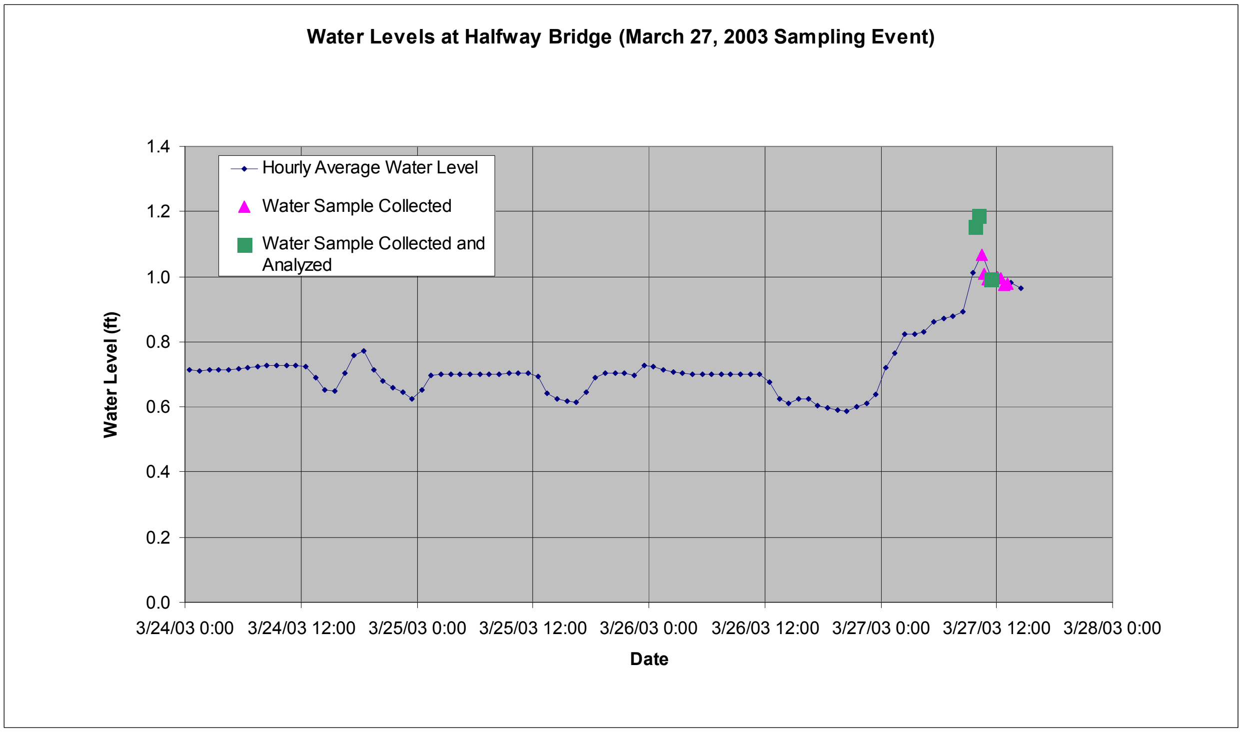


Figure C-13: Hydrograph and Samples Collected from the March 30, 2003 Event at the Lower Nawiliwili Stream Location.

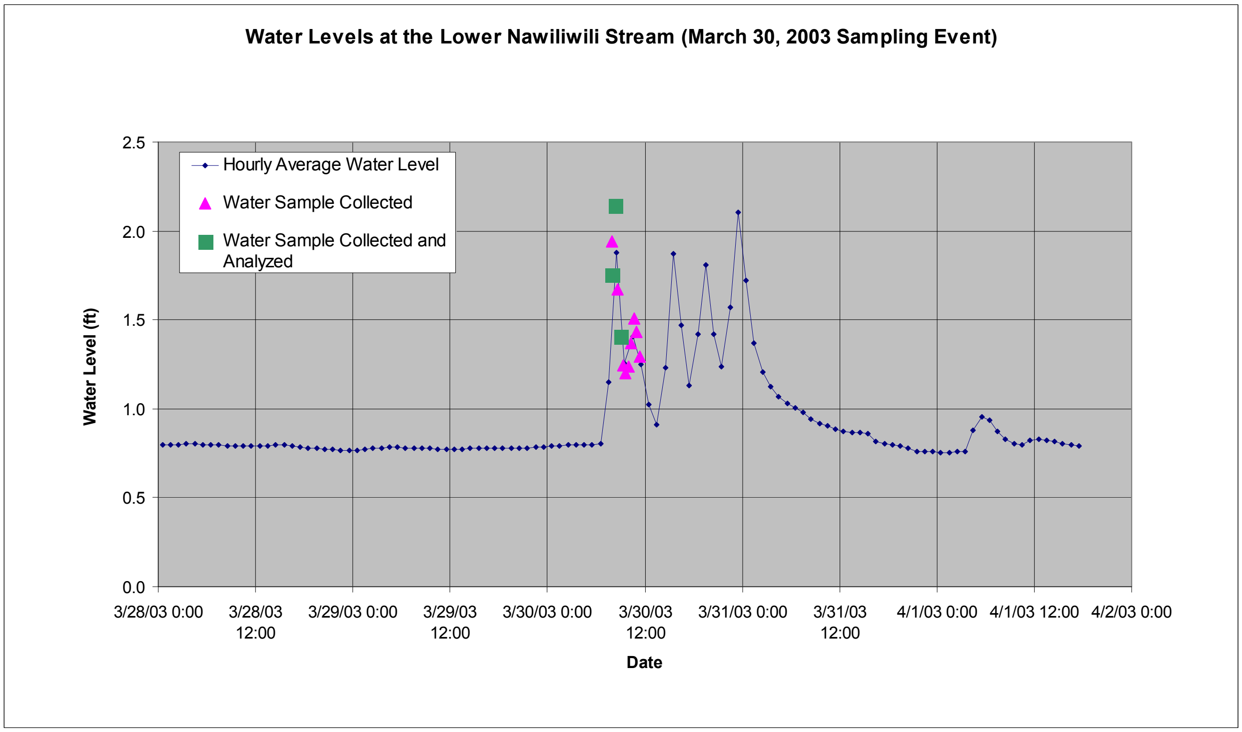


Figure C-14: Hydrograph and Samples Collected from the March 30, 2003 Event at the Kamooloa Stream Location.

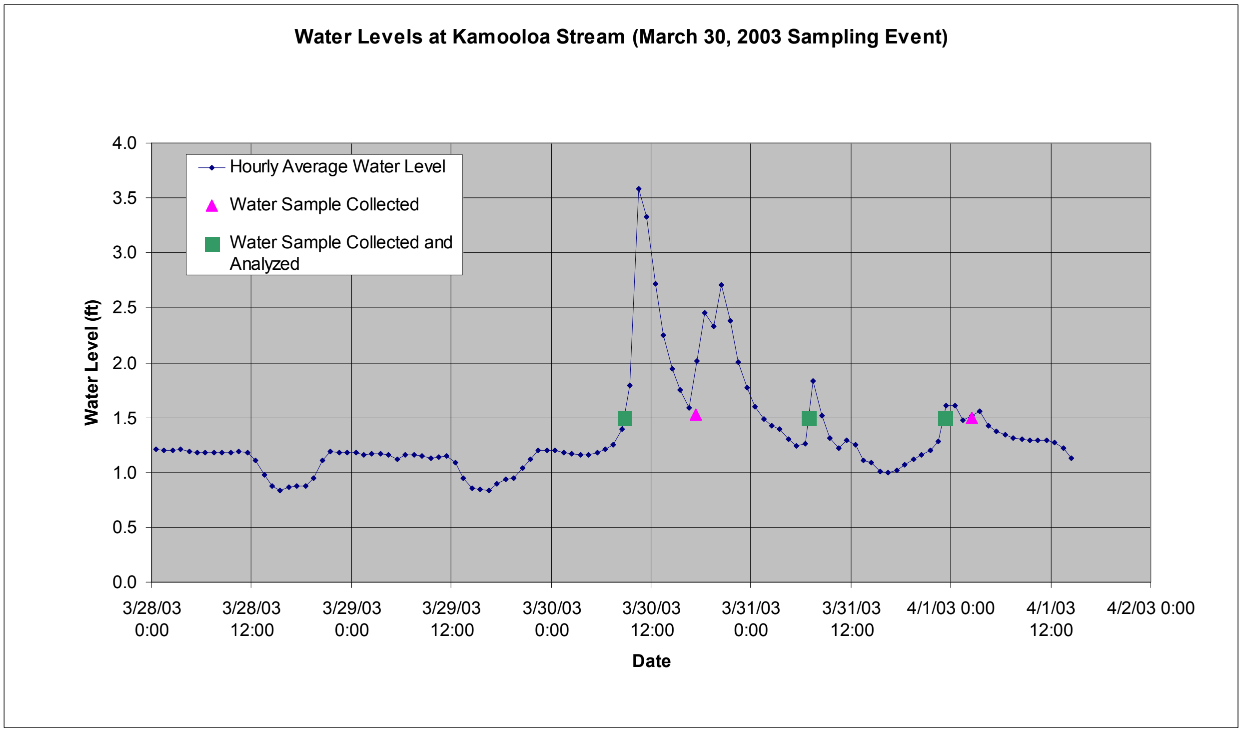


Figure C-15: Hydrograph and Samples Collected from the March 30, 2003 Event at the Huleia Stream at Halfway Bridge Location.

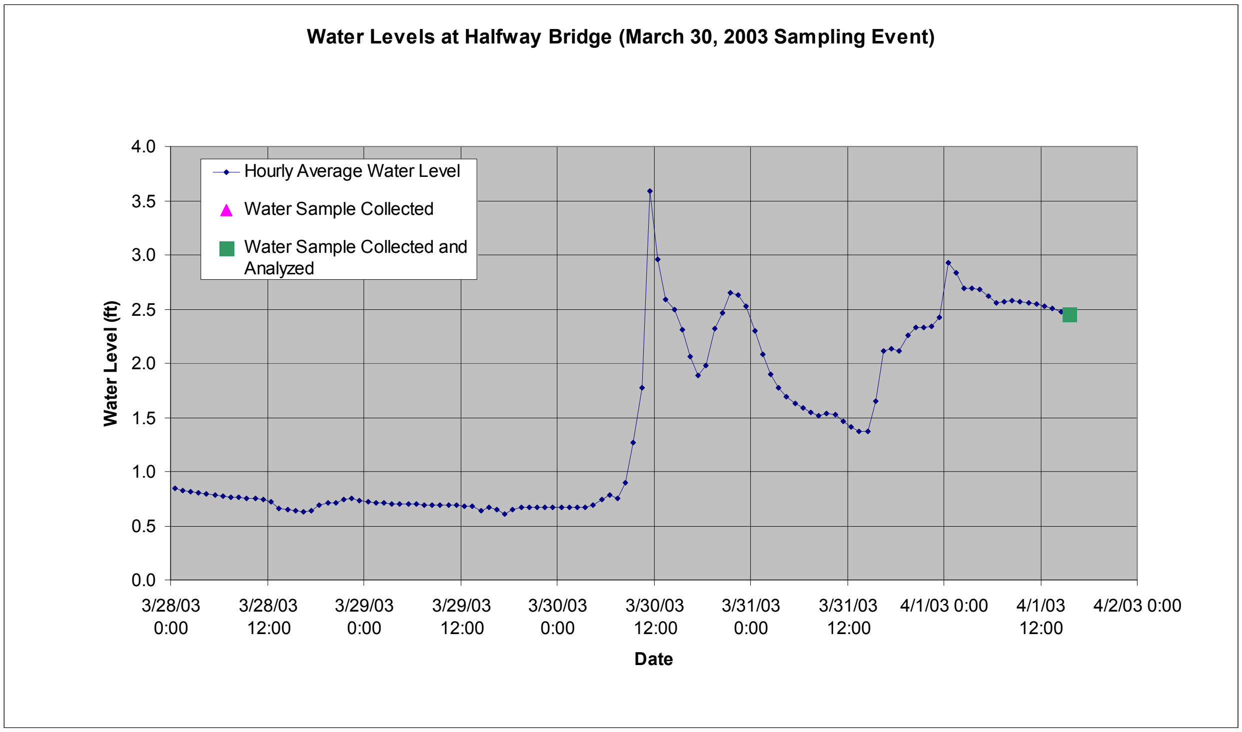


Figure C-16: Hydrograph and Samples Collected from the March 30, 2003 Event at the Huleia Stream at Stone Bridge Location.

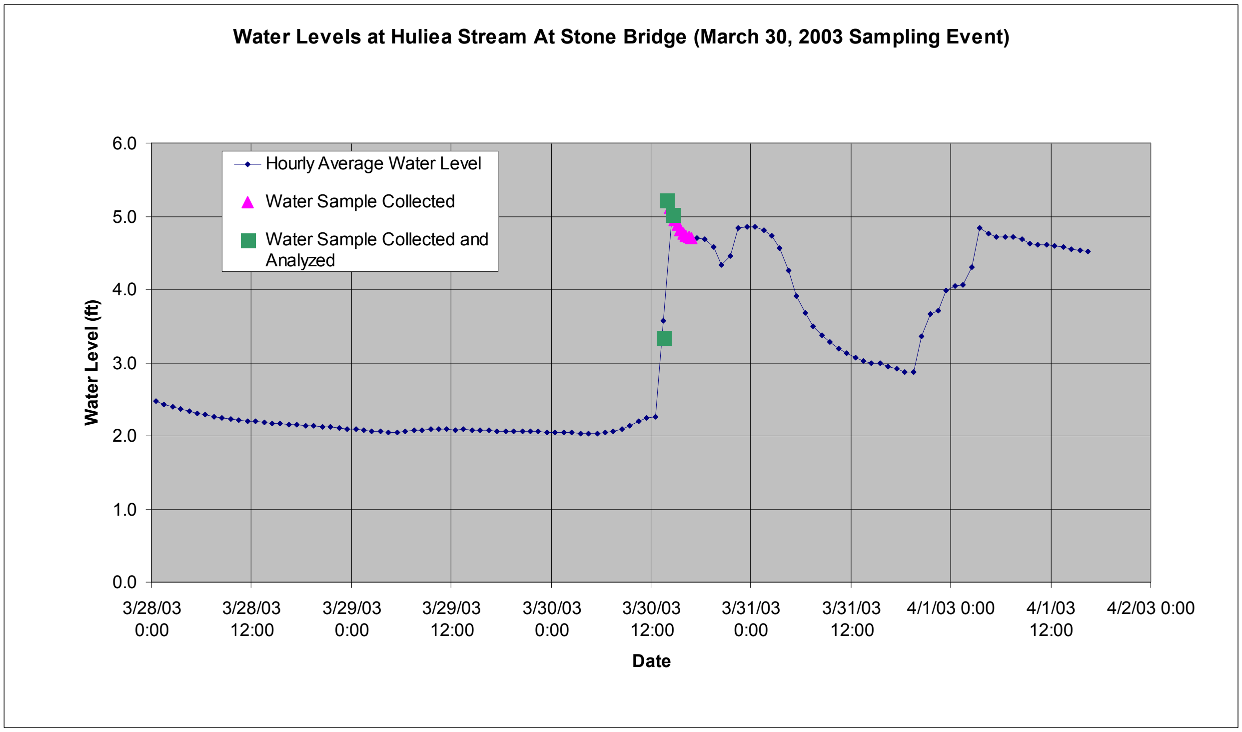


Figure C-17: Hydrograph and Samples Collected from the March 30, 2003 Event at the Papakolea Stream Location.

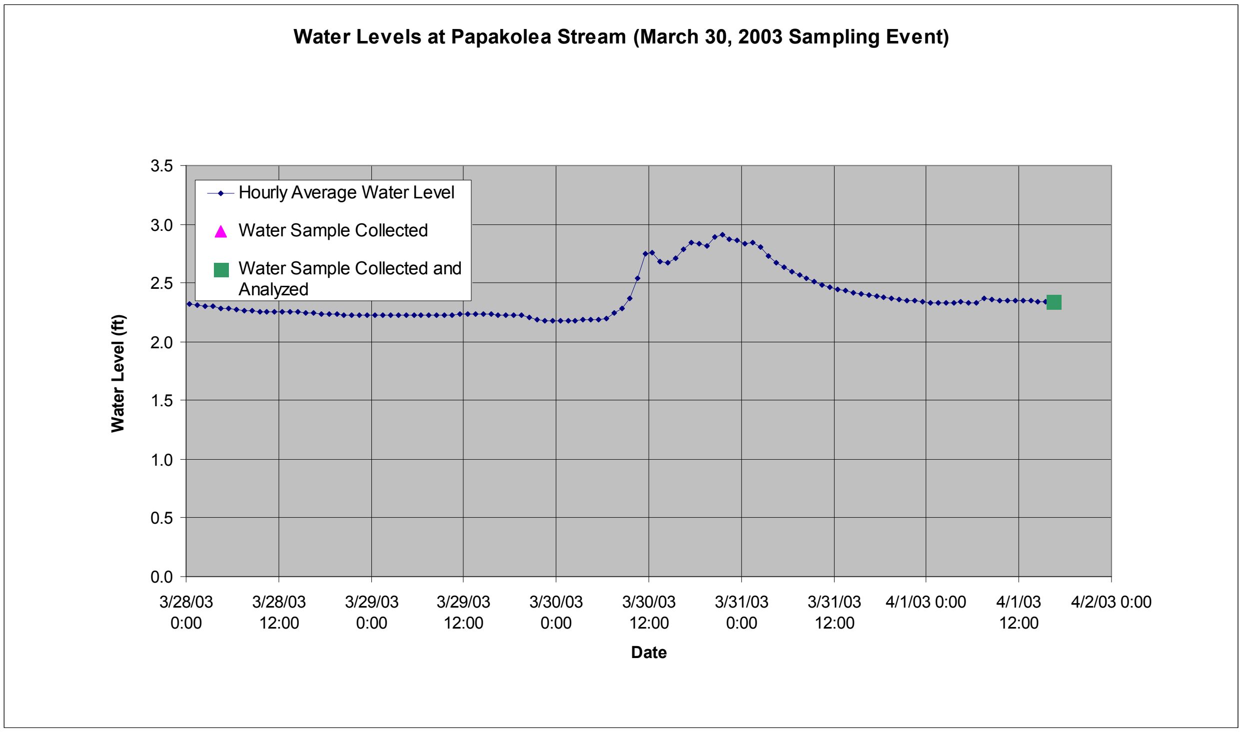


Figure C-18: Hydrograph and Samples Collected from the March 30, 2003 Event at the Puali Stream Location.

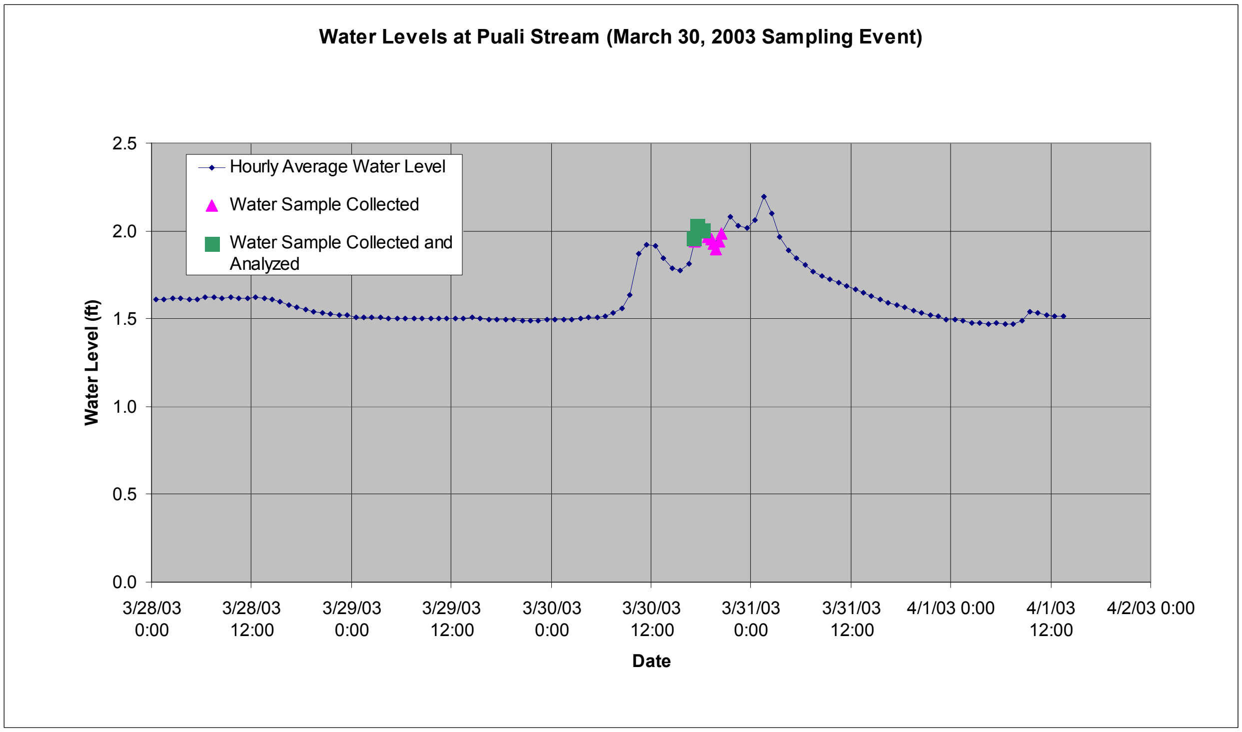


Figure C-19: Hydrograph and Samples Collected from the April 1, 2003 Event at the Kamooloa Stream Location.

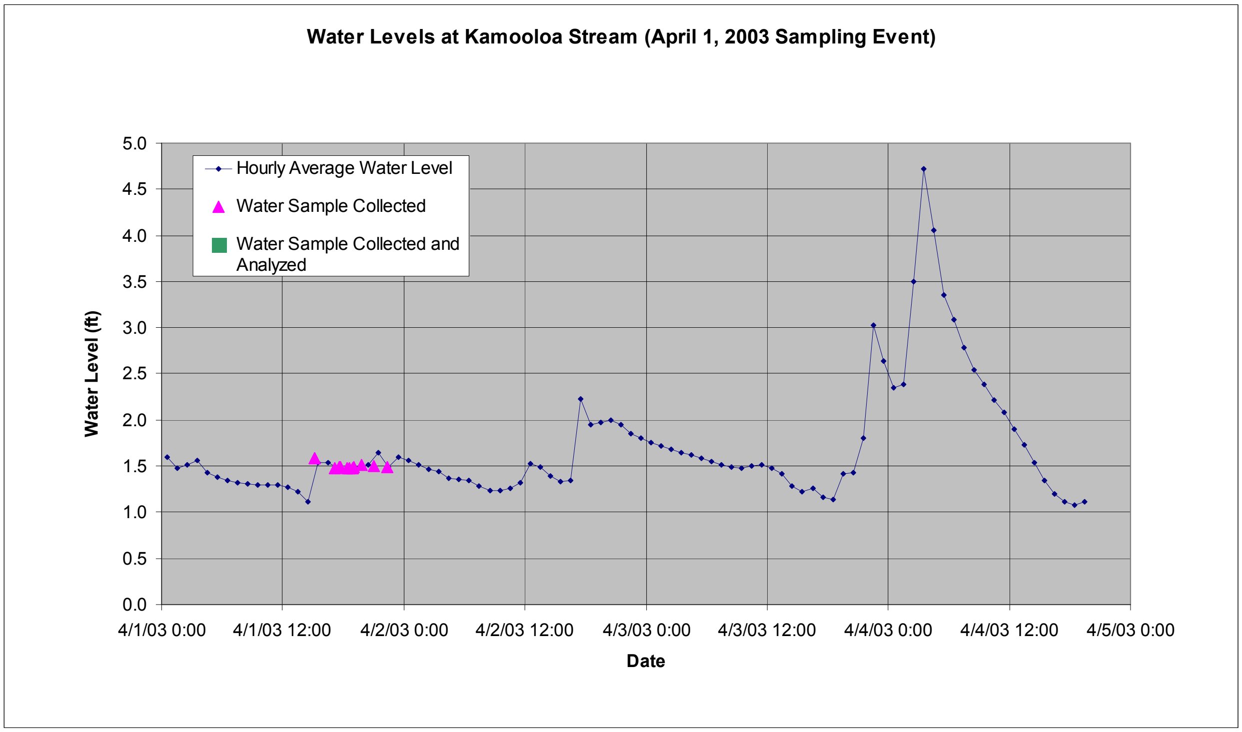


Figure C-20: Hydrograph and Samples Collected from the April 4, 2003 Event at the Lower Nawiliwili Stream Location.

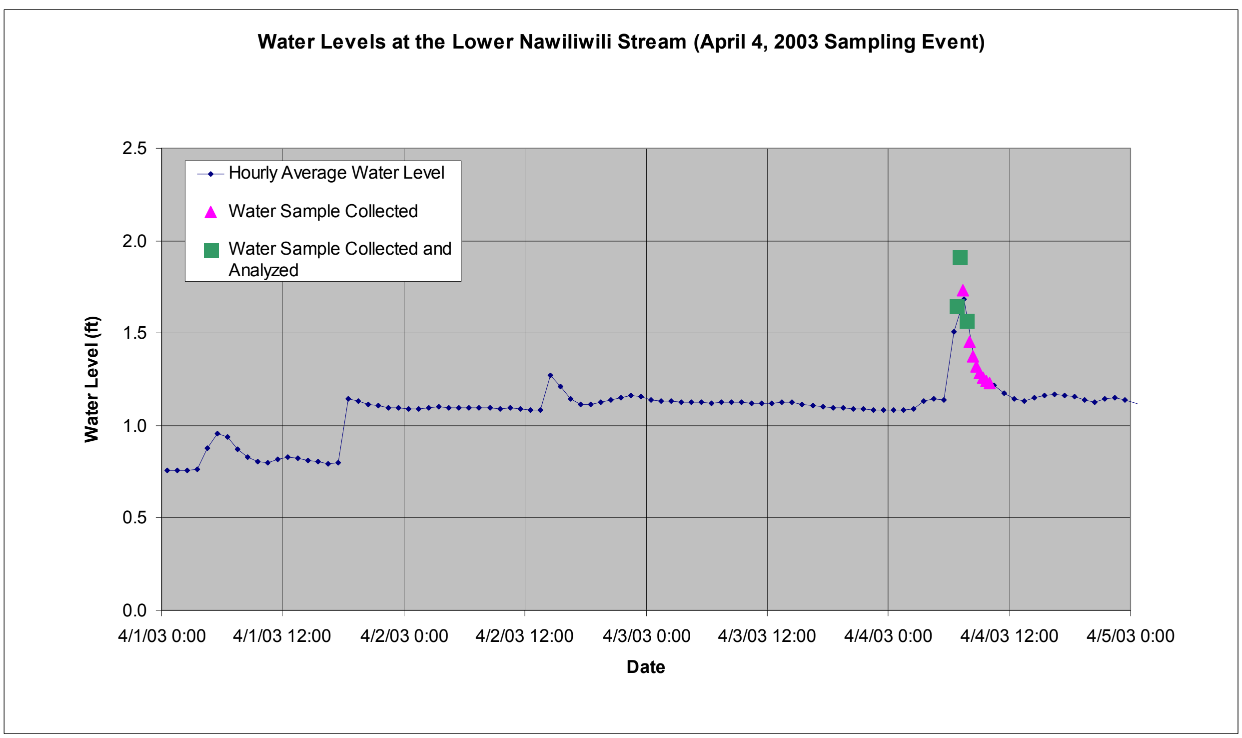


Figure C-21: Hydrograph and Samples Collected from the April 5, 2003 Event at the Huleia Stream at Stone Bridge Location.

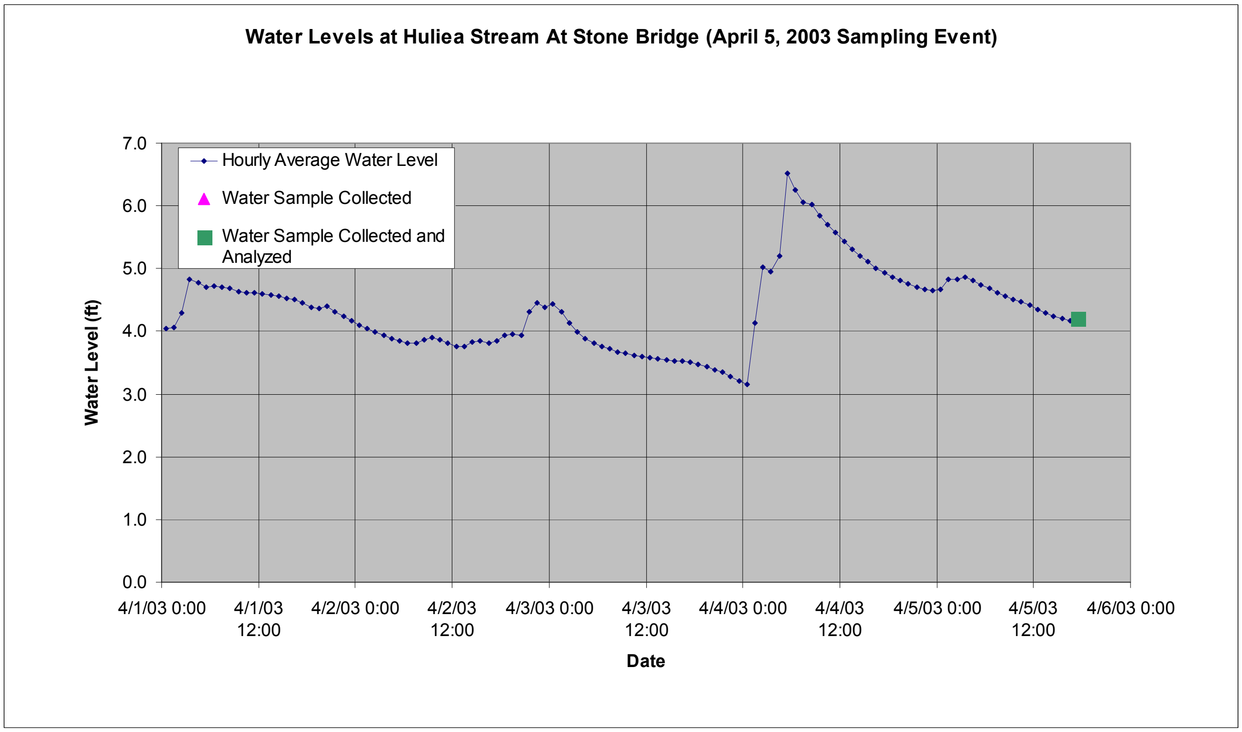


Figure C-22: Hydrograph and Samples collected from the April 5, 2003 event at the Papakolea Stream Location.

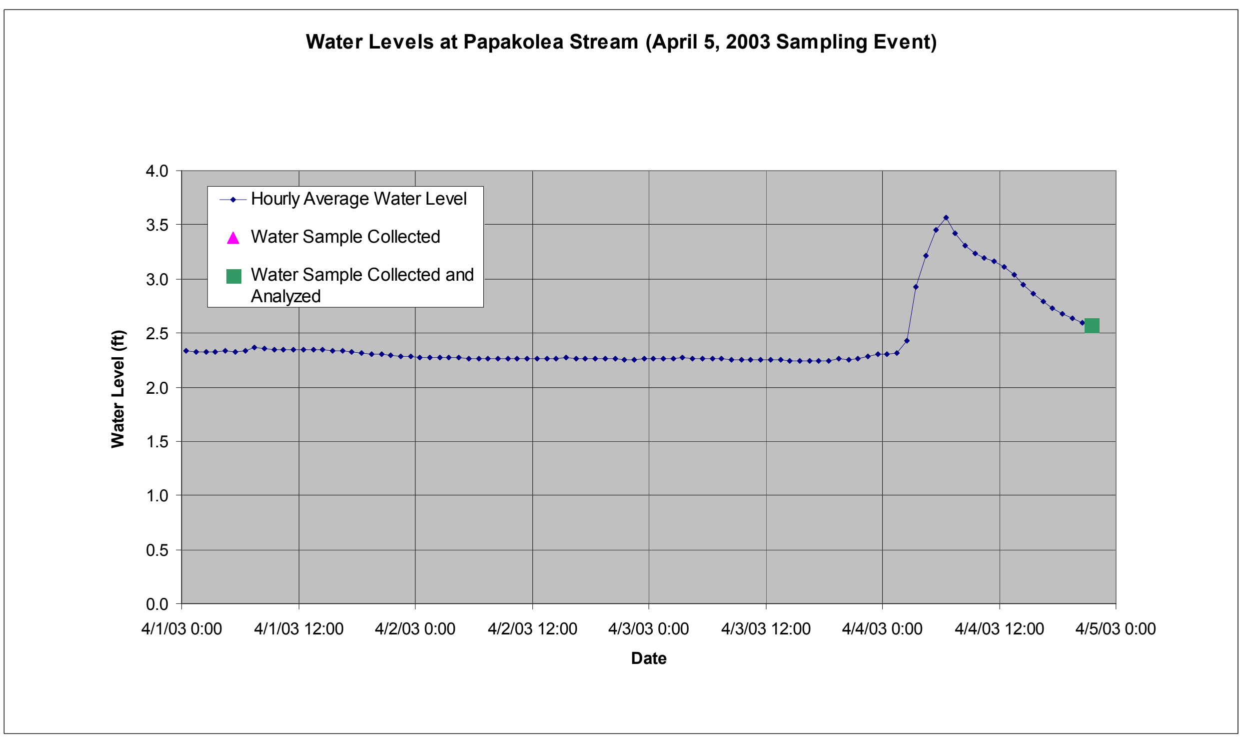


Figure C-23: Hydrograph and Samples Collected from the April 5, 2003 Event at the Huleia Stream at Halfway Bridge Location.

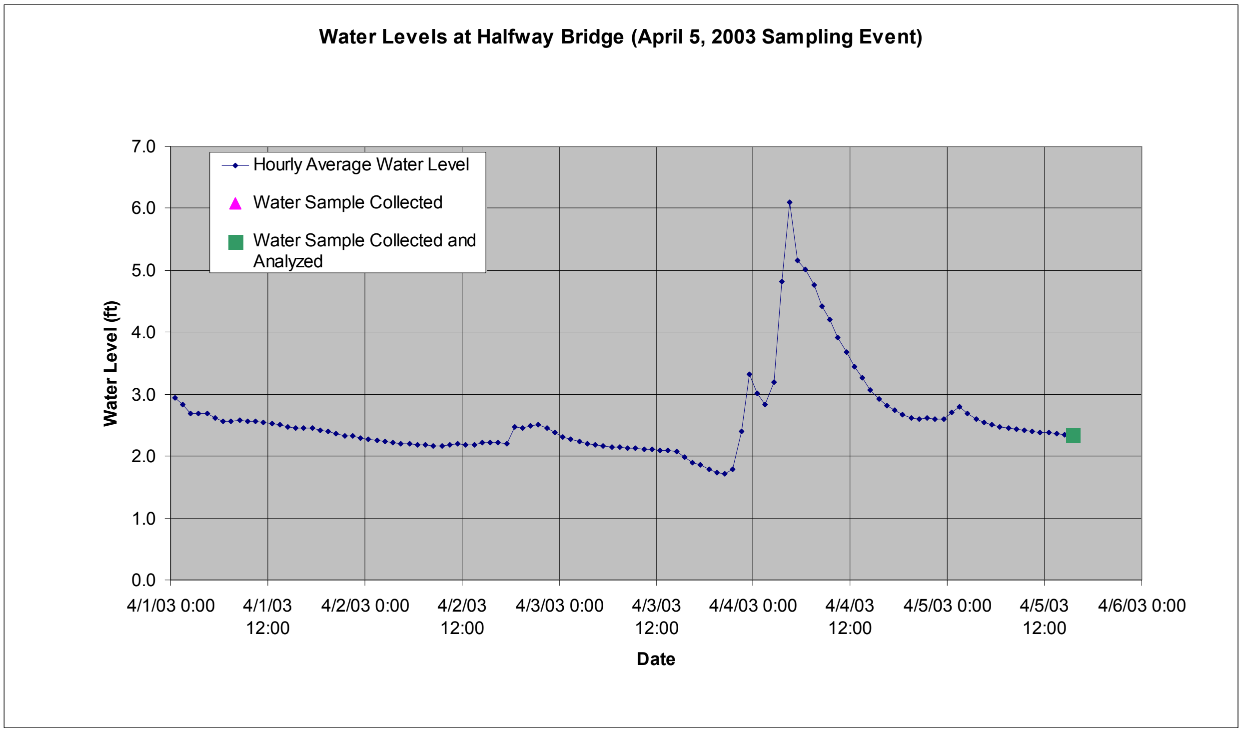


Figure C-24: Hydrograph and Samples Collected from the April 5, 2003 Event at the Kamooloa Stream Location.

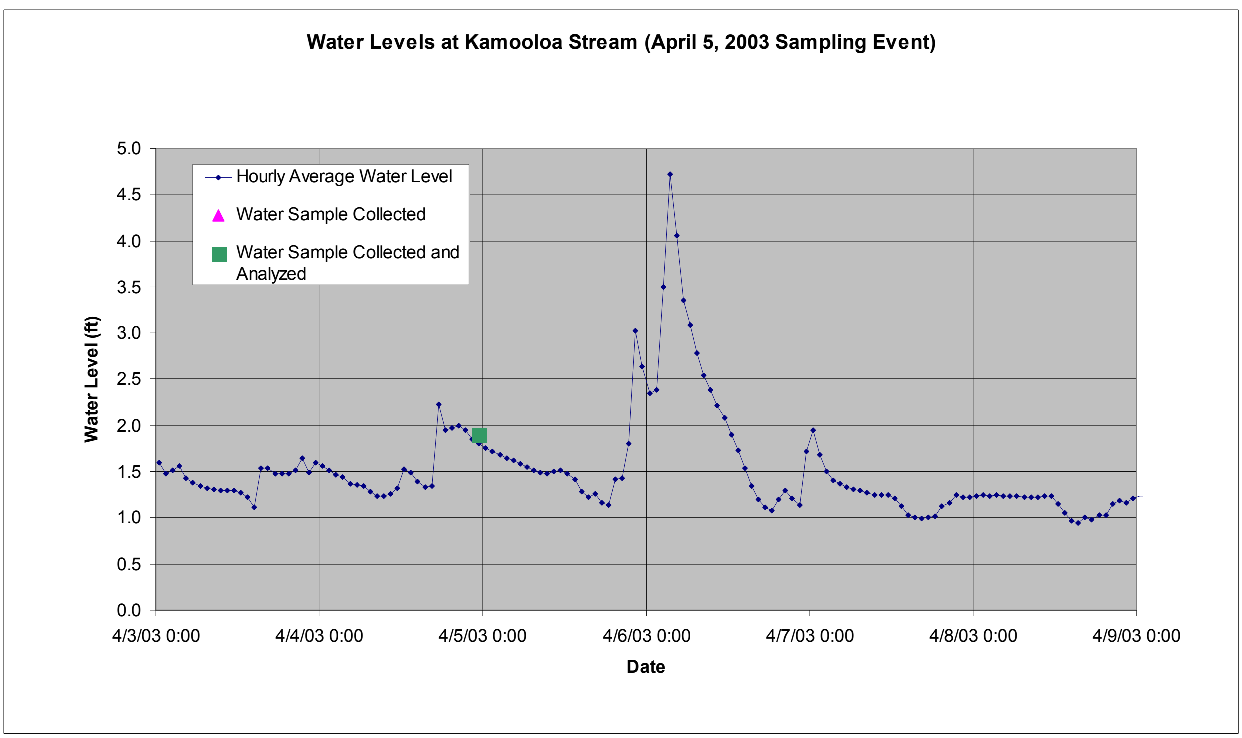


Figure C-25: Hydrograph and Samples Collected from the April 6, 2003 Event at the Lower Nawiliwili Stream Location.

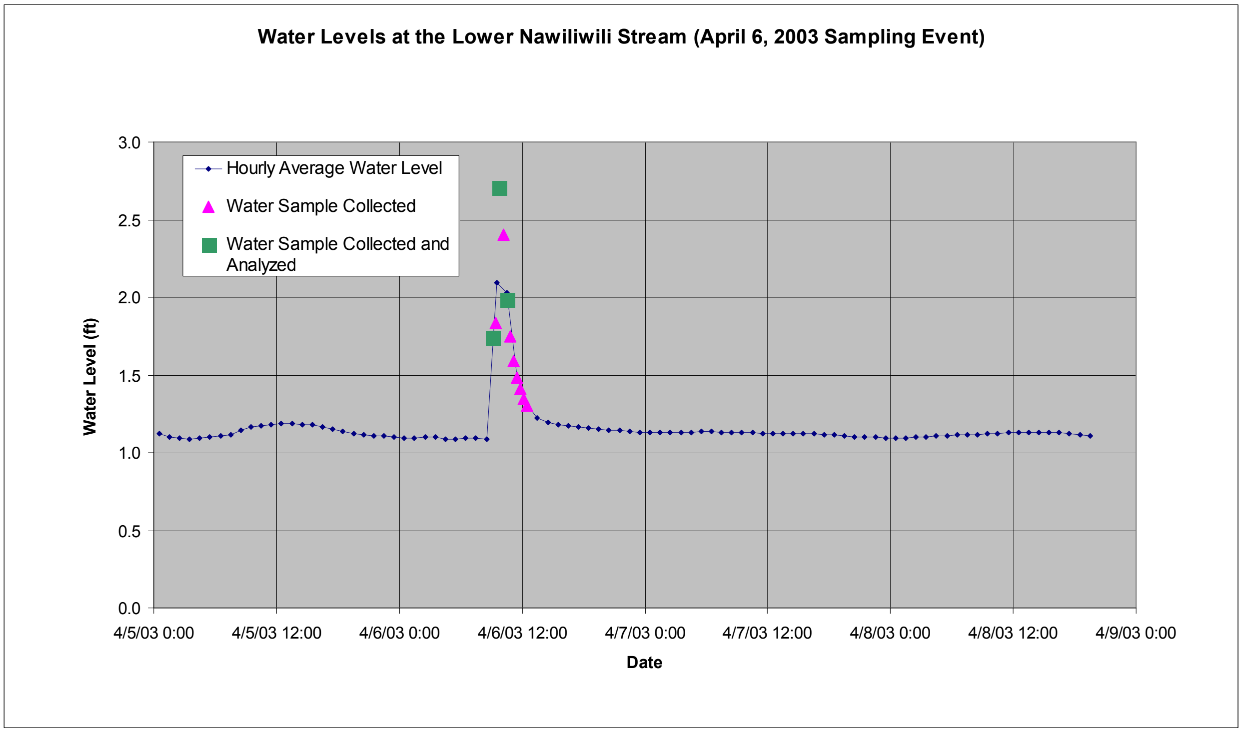


Figure C-26: Hydrograph and Samples Collected from the April 7, 2003 Event at the Huleia Stream at Halfway Bridge Location.

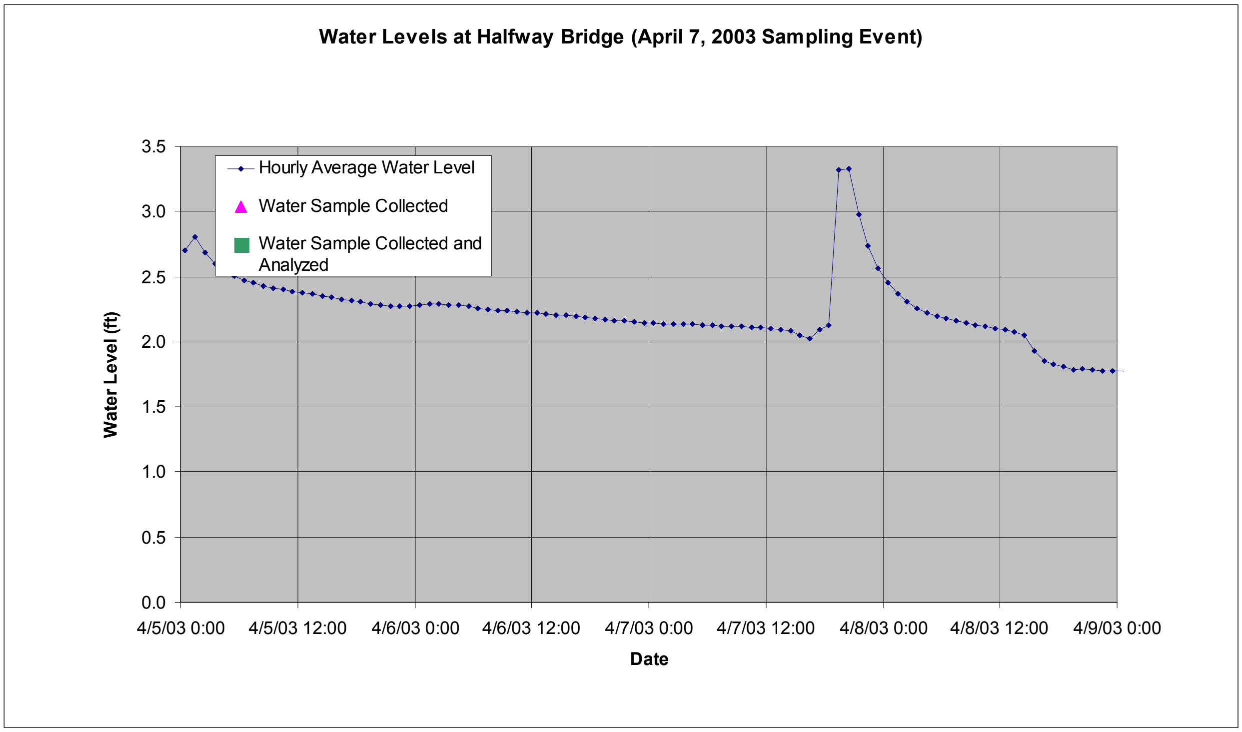
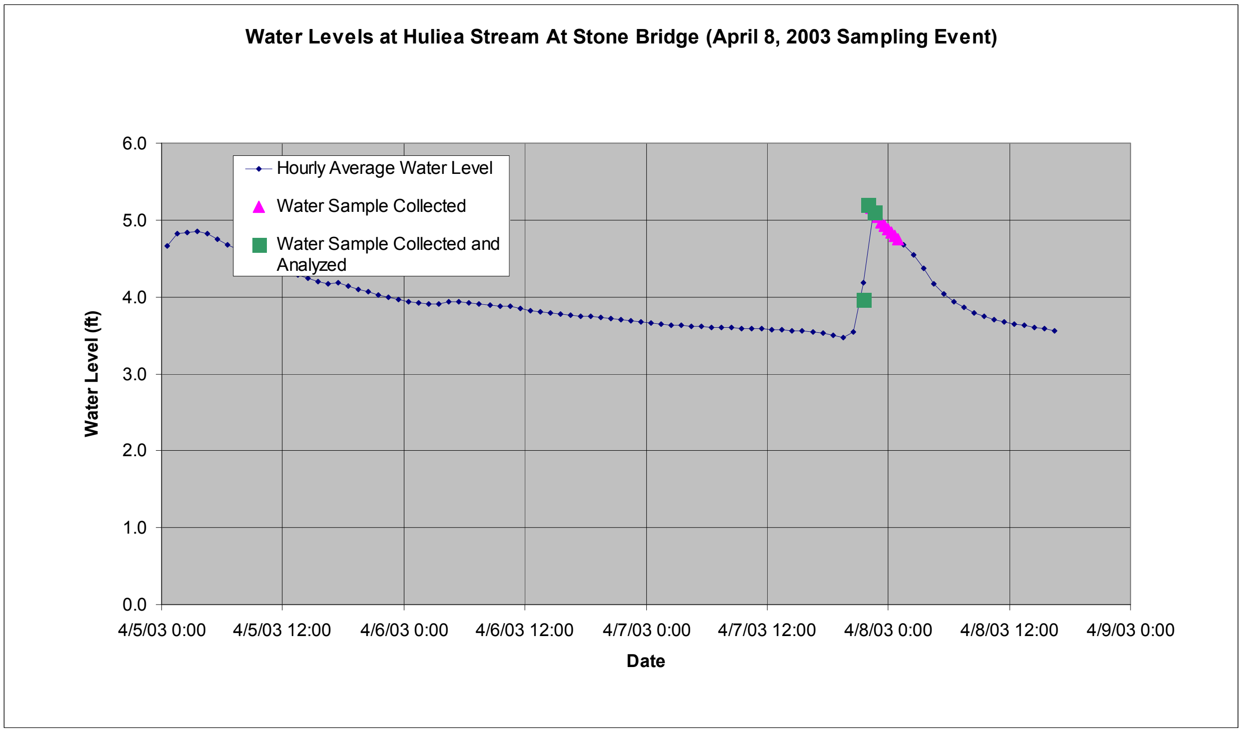


Figure C-27: Hydrograph and Samples Collected from the April 8, 2003 Event at the Huleia Stream at Stone Bridge Location.



APPENDIX D –TMDL ANALYSIS

PART A – HYDROLOGICAL ANALYSIS FIGURES

Figure D-1. Unit Storm Flow Volume vs Precipitation - USGS Gage 16068000 and the Stable Camp Precipitation Gage

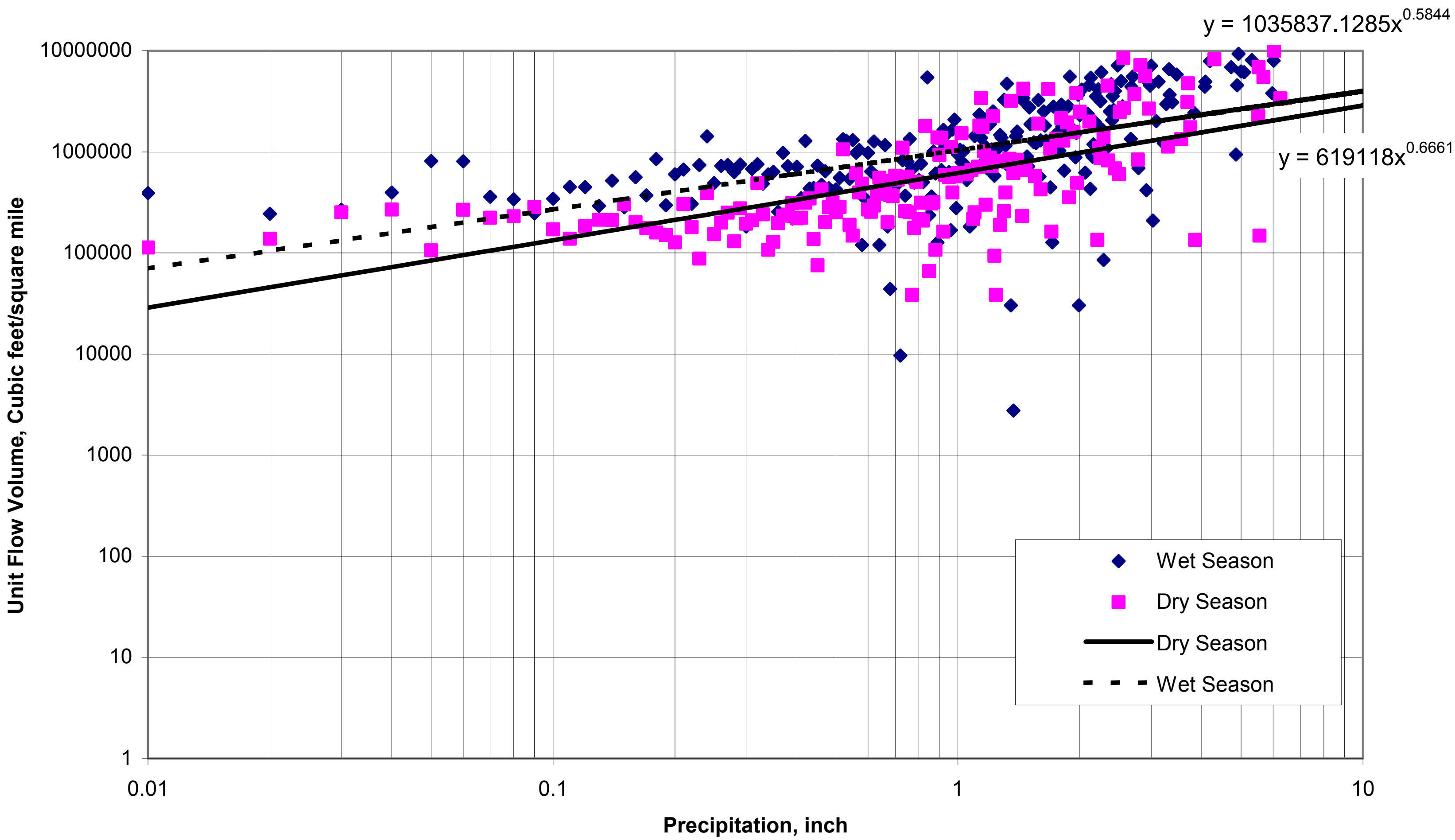


Figure D-2. Unit Storm Flow Volume vs Precipitation - USGS Gage 16097500 and the Stable Camp Precipitation Gage

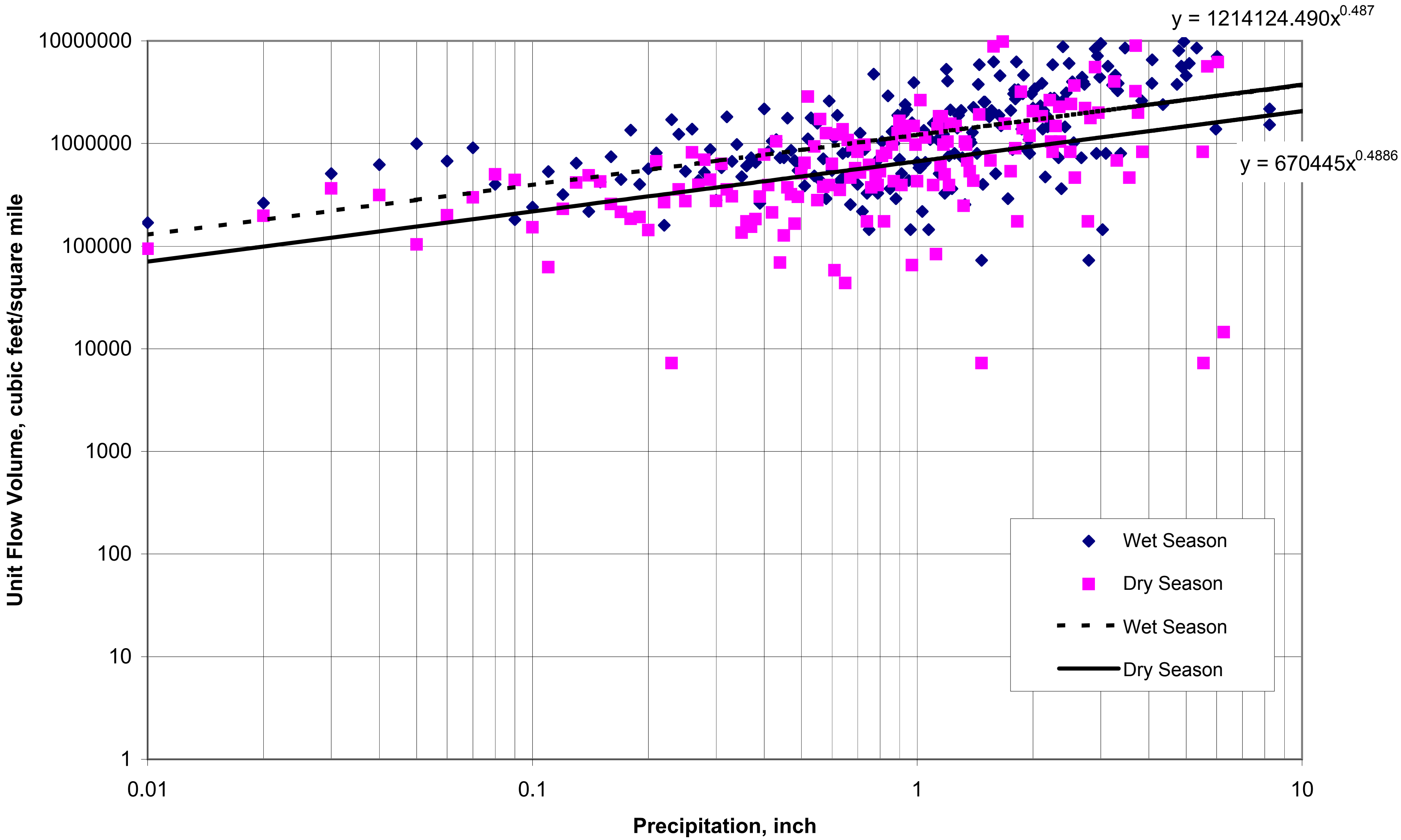


Figure D-3. Unit Storm Flow Volume vs Precipitation - USGS Gage 16071500 and the Hanahanapuni Precipitation Gage

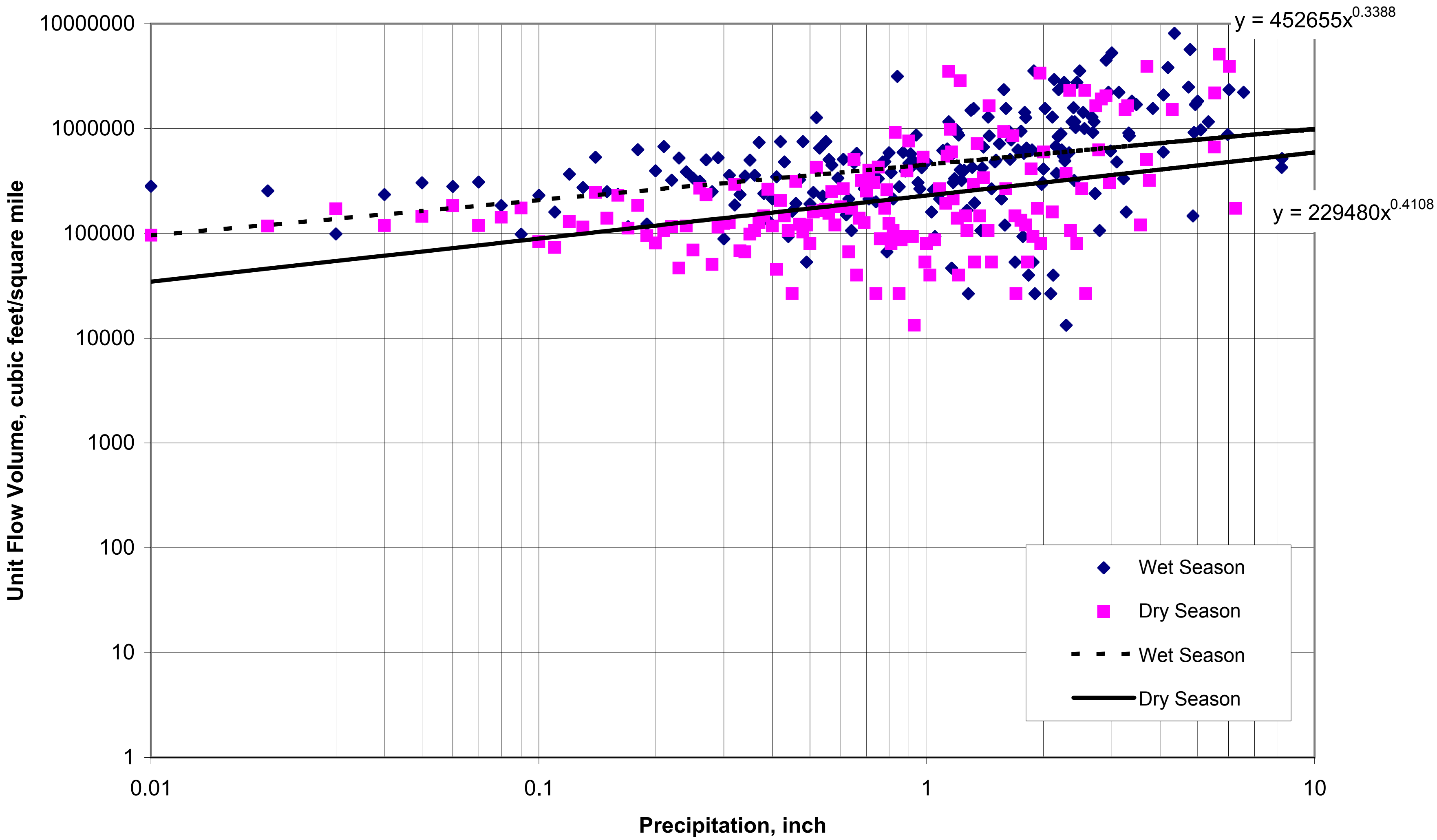


Figure D-4. Unit Storm Flow Volume vs Precipitation - USGS Gage 16114000 and the Power House Wainiha, Kailua Precipitation Gage

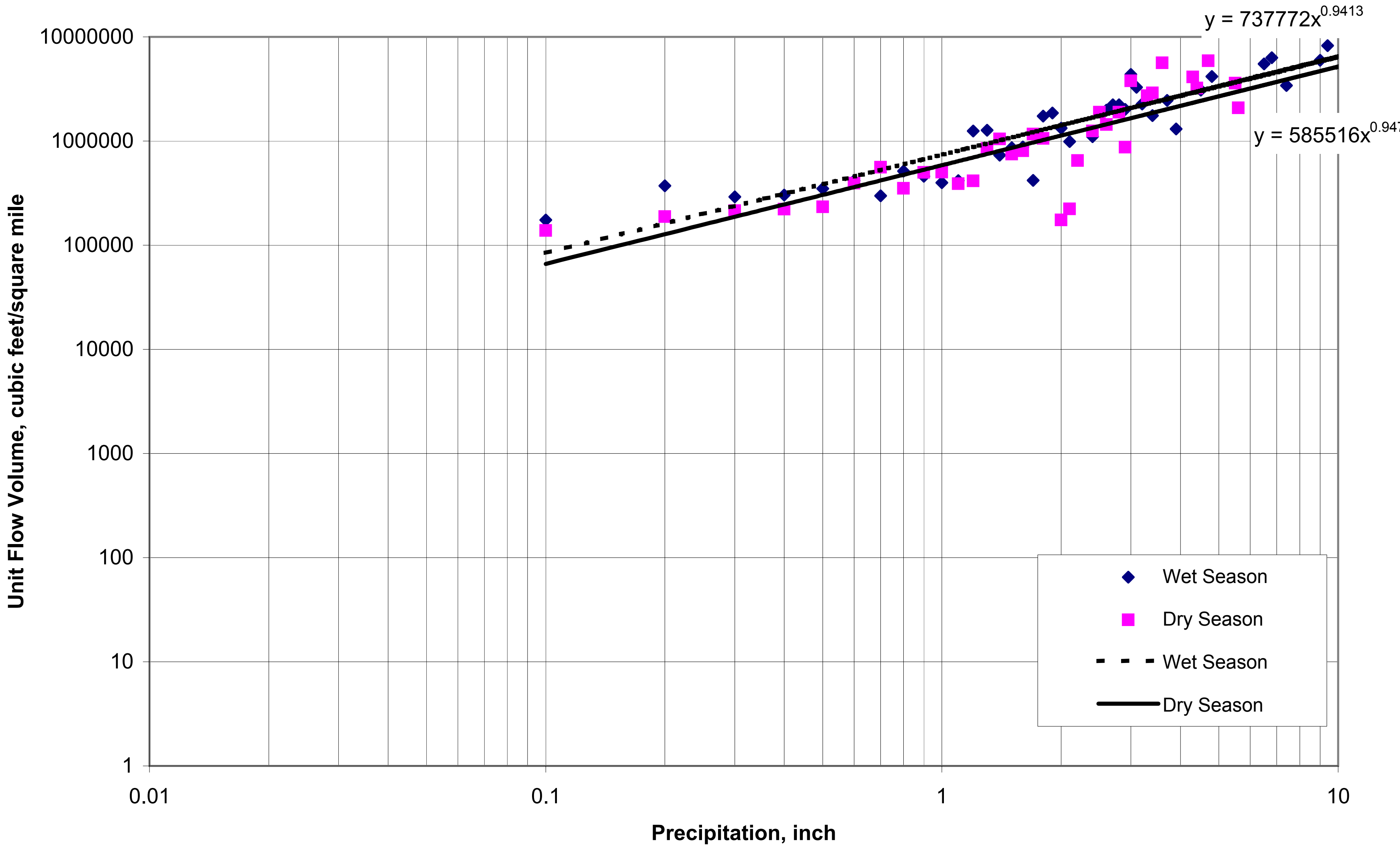


Figure D-5. Unit Storm Flow Volume vs Precipitation - USGS Gage 16229300 and the Dowsett Precipitation Gage

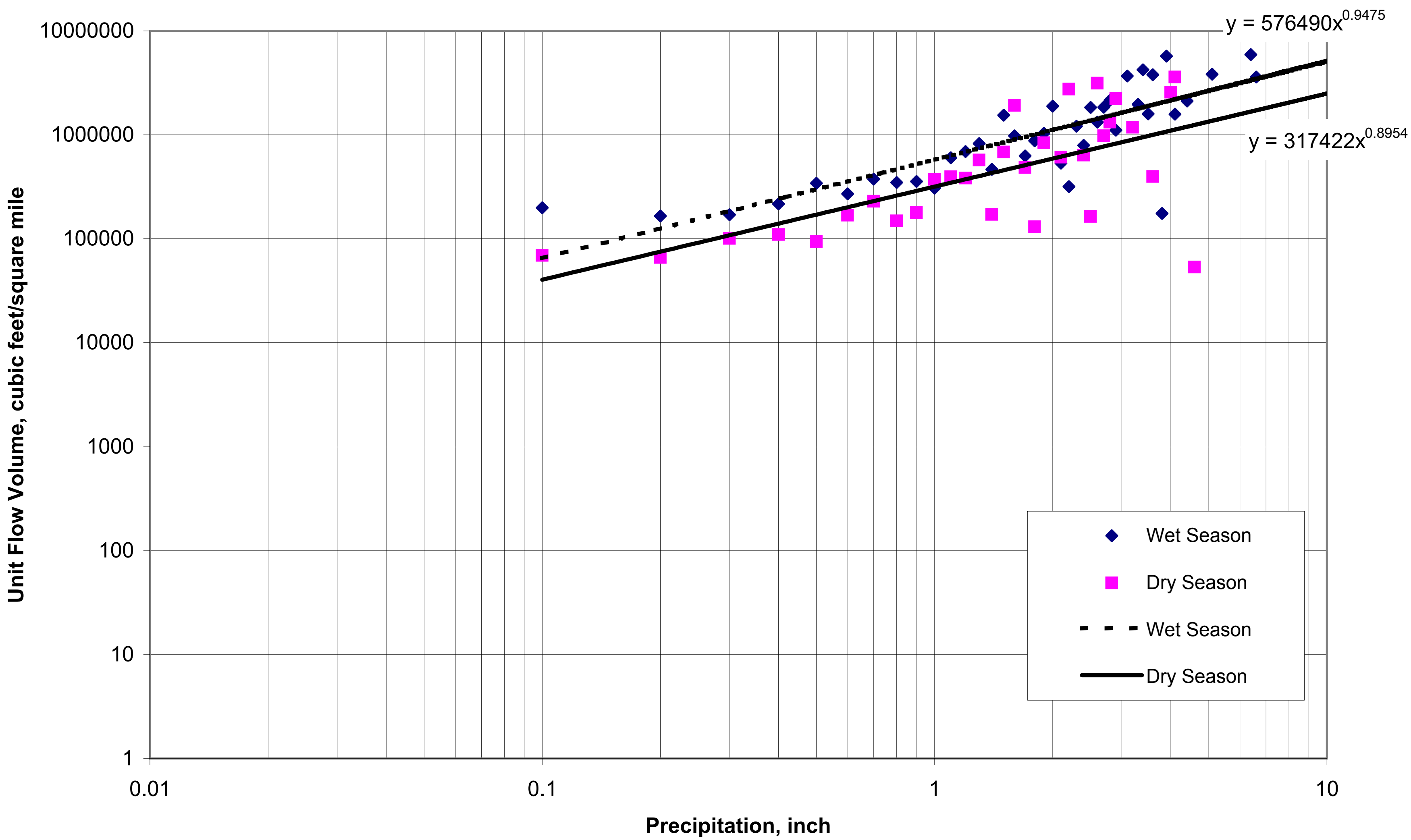


Figure D-6. Unit Storm Flow Volume vs Precipitation - USGS Gage 16244000 and the Tantalus Peak Precipitation Gage

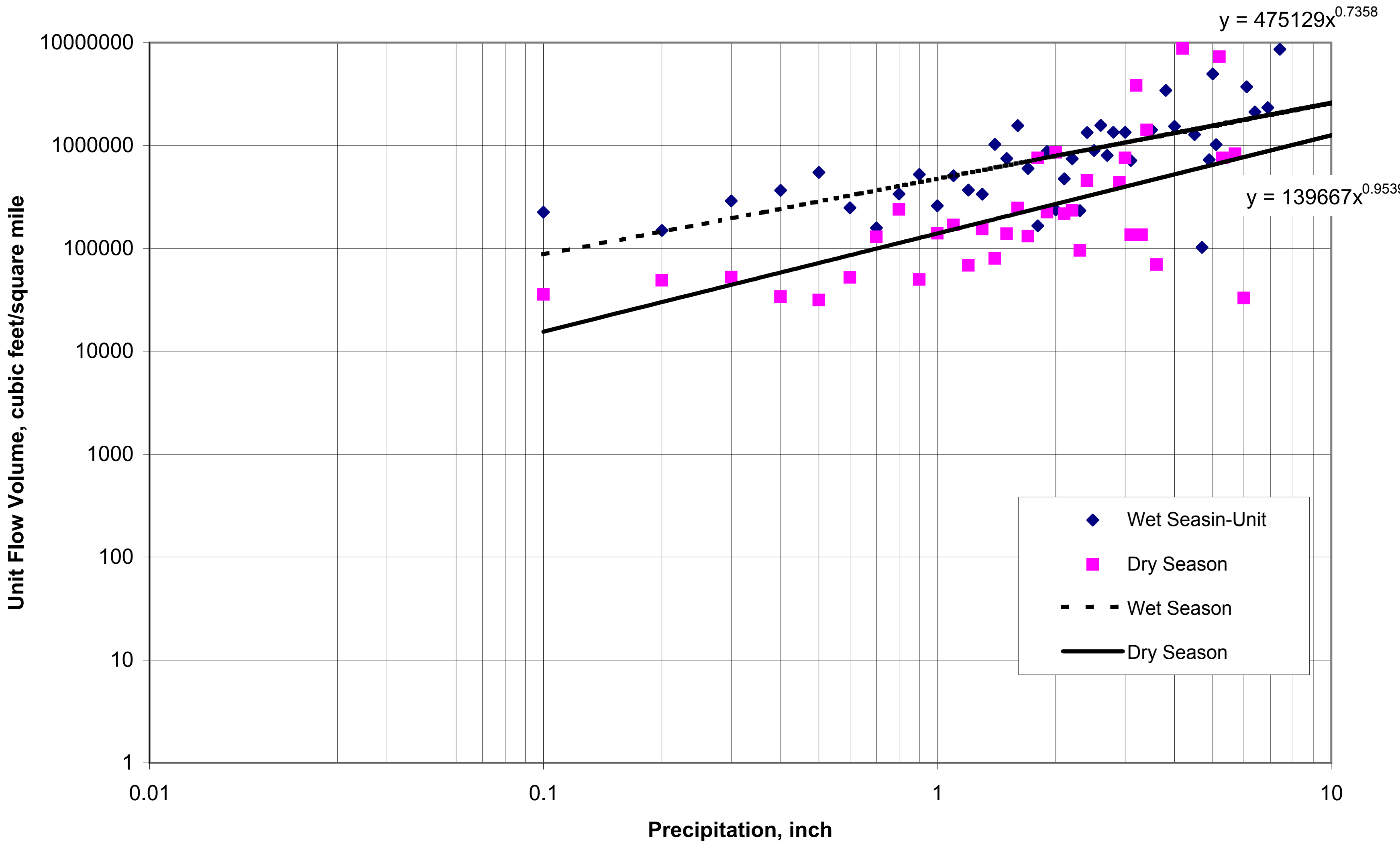
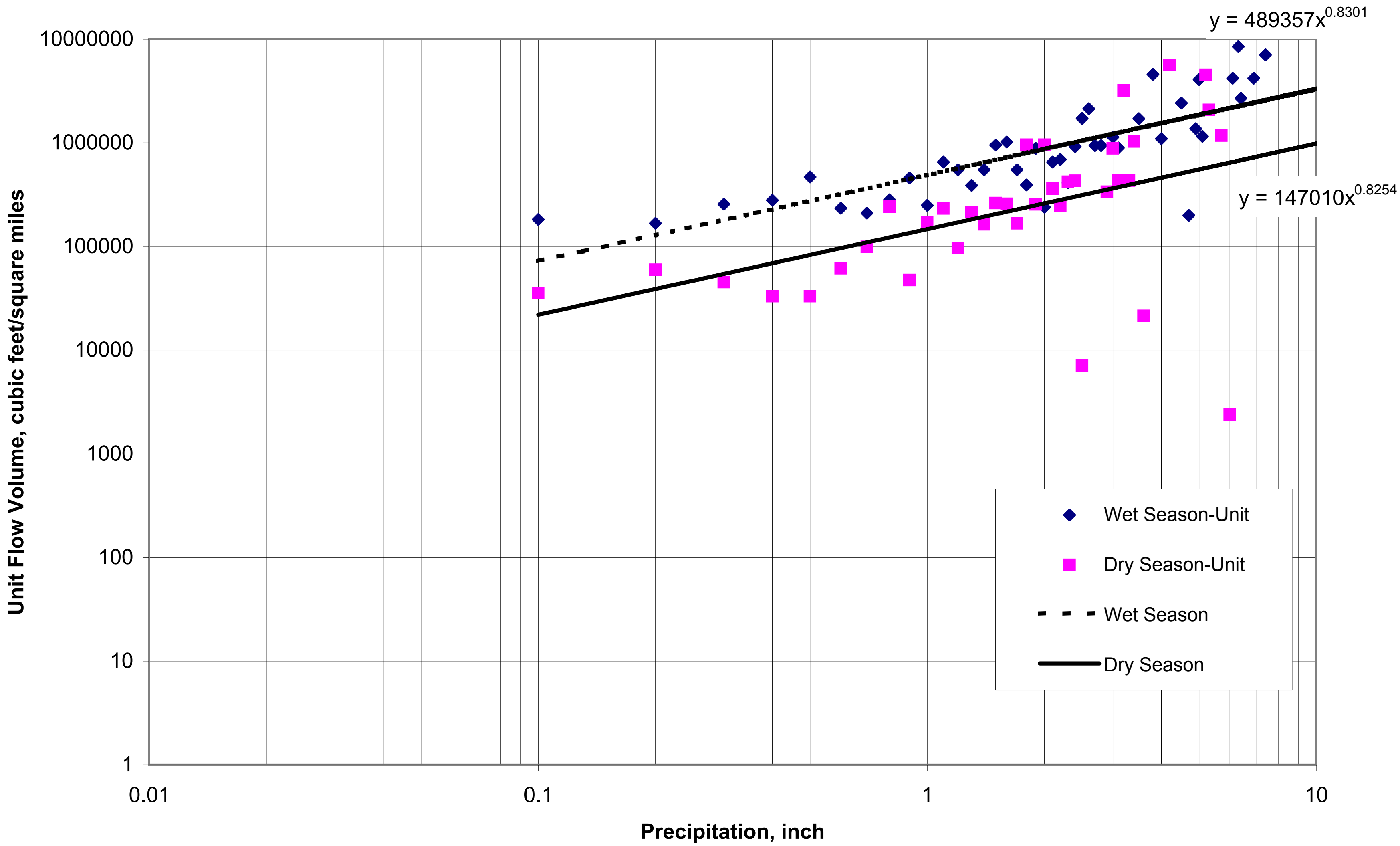


Figure D-7. Unit Storm Flow Volume vs Precipitation - USGS Gage 16247000 and the Tantalus Peak Precipitation Gage



PART B – WATER QUALITY IMPAIRMENT RATIONALE AND TMDL ANALYSIS (DATA TABLES)

Values in bold/red type (at the end of each table) indicate non-attainment of the water quality criterion and a water quality impairment for that waterbody/pollutant combination.

*Note: In all tables, abbreviation for "Samples Collected By" column:

- TT = Tetra Tech (TMDL contract with DOH Environmental Planning Office)
- DOH = DOH Clean Water Branch (CWB Monitoring and Assessment Section)
- TT + DOH Field Turb = Field Turbidity from samples collected by DOH-CWB, all other data from samples collected by Tetra Tech
- WRRC = University of Hawaii Water Resources Research Center (contract with DOH Clean Water Branch, Polluted Runoff Control Program)

Table D-1. Huleia Baseline Flow Conditions - All Data and 303(d) List Analysis

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By*
Wet Season							
Kamooloa	01/22/01	0.50	42.0	97.0	5.00	0.80	TT
Kamooloa	12/02/02	1.00	50.0	200	20.0		TT
Kamooloa	12/04/02					12.2	DOH
Kamooloa	01/13/03	0.50	50.0	149	5.00	2.02	TT + DOH Turb
Kamooloa	02/10/03	0.50	48.0	133	8.00	2.34	TT + DOH Turb
Kamooloa	03/10/03	0.50	41.0	152	5.00	5.47	TT + DOH Turb
Kamooloa	03/24/03	4.00	33.0	128	6.00	3.26	TT + DOH Turb
Kamooloa	04/19/03	13.0	23.0	136	5.00		TT
Halfway Bridge	12/02/02	0.50	141	181	8.00		TT
Halfway Bridge	12/03/02					3.48	DOH
Halfway Bridge	01/13/03	1.00	91.0	156	5.00	3.00	TT + DOH Turb
Halfway Bridge	02/10/03	0.50	78.0	141	6.00	2.85	TT + DOH Turb
Halfway Bridge	03/10/03	1.00	50.0	138	5.00	5.07	TT + DOH Turb
Halfway Bridge	03/24/03	0.50	43.0	119	6.00	2.85	TT + DOH Turb
Halfway Bridge	04/19/03	4.00	26.0	105	6.00		TT
Stone Bridge	01/22/01	0.50	96.0	152	7.00	1.90	TT + DOH Turb
Stone Bridge-10	11/28/01					21.8	WRRC
Stone Bridge-10	02/27/02					5.50	WRRC
Stone Bridge-10A	03/19/02					12.0	WRRC
Stone Bridge-10	03/20/02					9.62	WRRC
Stone Bridge-10	04/22/02					3.40	WRRC
Stone Bridge-10A	04/24/02					5.90	WRRC
Stone Bridge-10A	11/20/02					3.80	WRRC
Stone Bridge-10	11/25/02					3.55	WRRC
Stone Bridge	12/02/02	1.00	246.0	342.0	16.00	6.11	TT + DOH Turb
Stone Bridge	01/13/03	0.50	152.0	272.0	5.00	3.33	TT + DOH Turb
Stone Bridge	02/10/03	0.50	86.0	167.0	8.00	1.72	TT + DOH Turb
Stone Bridge	03/10/03	1.00	103.0	281.0	5.00	6.51	TT + DOH Turb
Stone Bridge	03/24/03	0.50	45.0	164.0	6.00	2.67	TT + DOH Turb
Stone Bridge	04/19/03	7.00	73.0	158.0	8.00		TT

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Dry Season							
Kamooloa	05/10/01					4.28	DOH
Kamooloa	07/23/01	0.50	28.0	122	5.00	4.60	TT
Kamooloa	05/05/03	2.00	31.0	140	5.00	4.80	TT
Kamooloa	06/02/03	1.00	53.0	143	5.00		TT
Kamooloa	07/06/03	10.0	42.0	128	5.00	5.30	TT
Kamooloa	07/28/03	6.00	5.00	83.0	5.00		DOH
Kamooloa	08/04/03	1.00		144	6.00	1.30	TT
Kamooloa	09/07/03	2.00	1.00		7.00		TT
Kamooloa	10/05/03	1.00	27.0	254	8.00		TT
Halfway Bridge	05/05/03	0.50	45.0	114	5.00	3.40	TT
Halfway Bridge	06/02/03	1.00	79.0	143	5.00		TT
Halfway Bridge	07/06/03	1.00	68.0	157	5.00	2.70	TT
Halfway Bridge	07/29/03	1.50	62.0	156	10.0		DOH
Halfway Bridge	08/04/03	2.00	45.0	127	7.00	3.00	TT
Halfway Bridge	09/07/03	0.50	18.0		7.00		TT
Halfway Bridge	10/05/03	0.50	15.0	201	6.00		TT
Stone Bridge	05/10/01					3.41	DOH
Stone Bridge	07/23/01	1.00	23.0	107	19.0	2.62	TT
Stone Bridge-10	10/31/01					2.60	WRRC
Stone Bridge-10	05/14/02					25.6	WRRC
Stone Bridge-10A	05/16/02					8.50	WRRC
Stone Bridge-10	06/24/02					6.20	WRRC
Stone Bridge-10A	06/26/02					5.30	WRRC
Stone Bridge-10A	07/16/02					2.30	WRRC
Stone Bridge-10	07/24/02					3.47	WRRC
Stone Bridge-10A	08/21/02					4.40	WRRC
Stone Bridge-10A	09/25/02					2.20	WRRC
Stone Bridge-10	10/16/02					2.12	WRRC
Stone Bridge	05/05/03	1.00	112	192	5.00	3.90	TT
Stone Bridge	06/02/03	1.00	74.0	267	5.00		TT
Stone Bridge	07/06/03	1.00	117	194	5.00	3.10	TT
Stone Bridge	07/29/03	1.20	98.0	236	9.00		DOH
Stone Bridge	08/04/03	1.00	84.0	184	8.00	1.50	TT
Stone Bridge	09/07/03	1.00	170		8.00		TT
Stone Bridge	10/05/03	2.00	54	154	8.00		TT
Geomean (Wet)		0.98	62.8	160	6.64	4.05	
Geomean (Dry)		1.24	**38.6**	156	6.45	**3.66**	
Wet GM Criterion		20	70	250	50	5	
Dry GM Criterion		10	30	180	30	2	
Number Above Wet Criterion		0	9	3	0	10	
Number of Wet Samples		20	20	20	20	25	
Number Above Dry Criterion		0	15	7	0	21	
Number of Dry Samples		22	22	20	23	23	

Table D-2. Huleia Baseline Flow Conditions - Station Analysis

Station Name	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
-					
Wet GM Criterion	20	70	250	50	5
Dry GM Criterion	10	30	180	30	2
Kamooloa					
Geomean (Wet)	1.18	39.8	139	6.69	3.06
Geomean (Dry)	1.82	15.9	138	5.66	**3.65**
Number Above Wet Criterion	0	0	0	0	2
Number of Wet Samples	7	7	7	7	6
Number Above Dry Criterion	0	3	1	0	4
Number of Dry Samples	8	7	7	8	5
Halfway Bridge					
Geomean (Wet)	0.89	61.8	138	5.92	3.36
Geomean (Dry)	0.87	**40.6**	147	6.24	**3.02**
Number Above Wet Criterion	0	3	0	0	1
Number of Wet Samples	6	6	6	6	5
Number Above Dry Criterion	0	5	1	0	3
Number of Dry Samples	7	7	6	7	3
Stone Bridge					
Geomean (Wet)	0.89	**101**	209	7.27	4.88
Geomean (Dry)	1.13	**80.0**	184	7.58	**3.80**
Number Above Wet Criterion	0	6	3	0	7
Number of Wet Samples	7	7	7	7	14
Number Above Dry Criterion	0	7	5	0	14
Number of Dry Samples	7	8	7	8	15

Table D-3. Huleia Stormflow Conditions - All Data and 303(d) List Analysis

*In this and subsequent Stormflow tables, Sample ID indicates which bottle in a 12 bottle sequence (single sampling event) was selected for lab analysis

Station Name/Sample ID*	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet							
Kamooloa #1	02/14/03	48.0	8.00	217	28.0	27.6	TT
Kamooloa #2	02/14/03	70.0	83.0	454	39.0	63.8	TT
Kamooloa #1	03/07/03	77.5	3.00	238	13.0	36.8	TT
Kamooloa #2	03/07/03	62.0	29.0	303	9.0	31.2	TT
Kamooloa #5	03/07/03	65.6	13.0	197	13.0	37.2	TT
Kamooloa #1	04/01/03	42.0	33.0	879	100	20.5	TT
Kamooloa #4	04/01/03	14.0	2.00	407	55.0	20.2	TT
Kamooloa #5	04/01/03	48.0	1.00	592	88.0	52.6	TT
Kamooloa #1	04/04/03	22.0	5.00	202	11.0	17.1	TT
Kamooloa #2	04/04/03	22.6	16.0	252	13.0	13.6	TT
Kamooloa #3	04/04/03	26.0	10.0	185	14.0	19.5	TT
Kamooloa #1	04/08/03	232	32.0	821	113	83.4	TT
Kamooloa #2	04/08/03	22.2	27.0	358	40.0	20.8	TT
Halfway Bridge #1	02/14/03	29.0	32.0	341	88.0	34.4	TT
Halfway Bridge #12	02/14/03	373	141	421	68.0	304	TT
Halfway Bridge #6	02/14/03	53.5	194	377	86.0	65.5	TT
Halfway Bridge #1	03/07/03	181	185	1030	78.0	122	TT
Halfway Bridge #10	03/07/03	718	75.0	675	128	568	TT
Halfway Bridge #7	03/07/03	1140	126	680	117	76.80	TT
Halfway Bridge #1	03/27/03	62.0	25.0	278	67.0	56.4	TT
Halfway Bridge #3	03/27/03	38.3	81.0	306	74.0	54.6	TT
Halfway Bridge #7	03/27/03	16.0	66.0	229	48.0	29.0	TT
Halfway Br. Grab	04/01/03	4.60	22.0	184	19.0	11.7	TT
Halfway Br. Grab	04/05/03	22.2	41.0			22.5	TT
Stone Bridge-10	11/28/01					21.8	WRRC
Stone Bridge #1	01/25/03	7.60	74.0	313	30.0	3.28	TT
Stone Bridge #12	01/25/03	8.40	75.0	357	30.0	2.80	TT
Stone Bridge #4	01/25/03	45.5	107	654	128	6.35	TT
Stone Bridge #1	03/07/03	382	140	312	14.0	22.4	TT
Stone Bridge #3	03/07/03	38.00	176	337	10.0	4.12	TT
Stone Bridge #5	03/07/03	20.60	168	339	9.0	6.18	TT
Stone Bridge Grab	03/07/03	11.0	236	518	49.0	34.9	TT
Stone Bridge #1	03/30/03	43.4	96.0	260	18.0	13.1	TT
Stone Bridge #3	03/30/03	122.0	147	344	18.0	55.6	TT
Stone Bridge #5	03/30/03	140.0	135	707	76.0	96.8	TT
Stone Bridge Grab	04/05/03	34.8	72.0			32.4	TT
Stone Bridge #1	04/08/03	50.2	59.0	527	87.0	38.3	TT
Stone Bridge #3	04/08/03	86.3	96.0	594	95.0	36.5	TT
Stone Bridge #5	04/08/03	45.0	97.0	499	73.0	41.4	TT

Station Name/Sample ID	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Dry Season							
Kamooloa	07/28/03	6.00	5.00	83.0	5.00		DOH
Halfway Bridge	07/29/03	1.50	62.0	156	10.0		DOH
Stone Bridge-10	05/14/02					25.6	WRRC
Stone Bridge-10A	05/16/02					8.5	WRRC
Stone Bridge	07/29/03	1.20	98.0	236	9.0		DOH
Storm Geomean		39.7	42.9	356	34.5	**28.9**	
Wet 10% NTE Criterion		50	180	520	100	15	
Dry 10% NTE Criterion		30	90	380	60	5.5	
Exceeding Wet Criterion		16	3	10	4	32	
Exceeding Dry Criterion		25	15	15	16	38	
Number of Samples		41	41	39	39	41	

Table D-4. Huleia Stormflow Conditions - Station Analysis

Station Name	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet 10% NTE Criterion	50	180	520	100	15
Dry 10% NTE Criterion[1]	30	90	380	60	5.5
Kamooloa					
Storm Geomean	37.8	10.4	308	25.0	**29.5**
Number Above Wet Criterion	5	0	3	1	12
Number Above Dry Criterion	8	0	5	3	13
Number of Samples	14	14	14	14	13
Halfway Bridge					
Storm Geomean	**53.1**	68.9	363	58.4	**64.9**
Number Above Wet Criterion	6	2	3	2	10
Number Above Dry Criterion	7	4	4	8	11
Number of Samples	12	12	11	11	11
Stone Bridge					
Storm Geomean	32.9	110	405	31.5	**16.9**
Number Above Wet Criterion	5	1	4	1	10
Number Above Dry Criterion	10	11	6	5	14
Number of Samples	15	15	14	14	17

Table D-5. Nawiliwili Baseline Flow Conditions - All Data and 303(d) List Analysis

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Lower Nawiliwili-1	11/28/01					8.45	WRRC
Lower Nawiliwili-1	02/27/02					10.0	WRRC
Lower Nawiliwili-1A	03/19/02					5.70	WRRC
Lower Nawiliwili-1	03/20/02					10.5	WRRC
Lower Nawiliwili-1	04/22/02					8.85	WRRC
Lower Nawiliwili-1A	04/24/02					6.50	WRRC
Lower Nawiliwili-1A	11/20/02					4.90	WRRC
Lower Nawiliwili-1	11/25/02					2.86	WRRC
Lower Nawiliwili	01/13/03	2.00	969	1510	6.00	7.20	TT + DOH Turb
Lower Nawiliwili	01/27/03	3.00	758	1200	15.0	5.43	TT + DOH Turb
Upper Nawiliwili	01/27/03	0.50	954	1210	56.0		TT
Lower Nawiliwili	02/10/03	2.00	1130	1100	14.0	6.37	TT + DOH Turb
Lower Nawiliwili	02/25/03	3.00	1080	1160	12.0	6.97	TT + DOH Turb
Upper Nawiliwili	02/25/03	0.50	1270	1310	55.0	0.93	TT + DOH Turb
Lower Nawiliwili	03/10/03	3.00	1060	1350	5.0	8.18	TT + DOH Turb
Upper Nawiliwili	03/10/03	1.00	966	1100	35.0	2.45	TT + DOH Turb
Lower Nawiliwili	03/24/03	2.00	1220	1390	11.0	7.07	TT + DOH Turb
Upper Nawiliwili	03/24/03	1.00	1260	1150	45.0	1.13	TT + DOH Turb
Lower Nawiliwili	04/19/03	22.0	1180	1420	14.0		TT
Upper Nawiliwili	04/19/03	34.0	1170	1350	50.0		TT
Dry Season							
Lower Nawiliwili-1	10/31/01					5.70	WRRC
Lower Nawiliwili-1	05/14/02					63.4	WRRC
Lower Nawiliwili-1A	05/16/02					7.00	WRRC
Lower Nawiliwili-1	06/24/02					17.5	WRRC
Lower Nawiliwili-1A	06/26/02					7.00	WRRC
Lower Nawiliwili-1A	07/16/02					8.50	WRRC
Lower Nawiliwili-1	07/24/02					10.1	WRRC
Lower Nawiliwili-1A	08/21/02					6.40	WRRC
Lower Nawiliwili-1A	09/25/02					6.70	WRRC
Lower Nawiliwili-1	10/16/02					9.37	WRRC
Lower Nawiliwili	05/05/03	3.00	1220	1400	6.00	6.40	TT
Upper Nawiliwili	05/05/03	1.00	1000	1240	55.0	1.50	TT
Lower Nawiliwili	06/02/03	3.00	1220	1170	13.0		TT
Upper Nawiliwili	06/02/03	1.00	1170	1110	49.0		TT
Lower Nawiliwili	07/06/03	2.00	1140	1330	8.00	4.00	TT
Upper Nawiliwili	07/06/03	0.50	1200	1170	51.0	0.26	TT
Lower Nawiliwili	08/04/03	3.00	1210	1370	16.0	4.80	TT
Lower Nawiliwili	09/07/03	3.00	1040		34.0		TT
Lower Nawiliwili	10/05/03	3.00	807	1670	14.0		TT

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Geomean (Wet)		2.42	**1074**	**1264**	19.4	**5.10**	
Geomean (Dry)		1.84	**1103**	**1297**	20.5	**6.03**	
Wet GM Criterion		20	70	250	50	5	
Dry GM Criterion		10	30	180	30	2	
Number Above Wet Criterion		2	12	12	2	12	
Number of Wet Samples		12	12	12	12	17	
Number Above Dry Criterion		0	9	8	4	13	
Number of Dry Samples		9	9	8	9	15	

Table D-6. Nawiliwili Baseline Flow Conditions - Station Analysis

Station Name	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
-					
Wet GM Standard	20	70	250	50	5
Dry GM Standard	10	30	180	30	2
Upper Nawiliwili					
Geomean (Wet)	1.53	**1115**	**1220**	**47.5**	**1.37**
Geomean (Dry)	0.79	**1120**	**1172**	**51.6**	**0.62**
Number Above Wet Criterion	1	5	5	2	0
Number of Wet Samples	5	5	5	5	3
Number Above Dry Criterion	0	3	3	3	0
Number of Dry Samples	3	3	3	3	2
Lower Nawiliwili					
Geomean (Wet)	3.35	**1046**	**1297**	10.2	**6.75**
Geomean (Dry)	2.80	**1095**	**1379**	13.0	**8.55**
Number Above Wet Criterion	1	7	7	0	12
Number of Wet Samples	7	7	7	7	14
Number Above Dry Criterion	0	6	5	1	13
Number of Dry Samples	6	6	5	6	13

Table D-7. Nawiliwili Stormflow Conditions - All Data and 303(d) List Analysis

Station Name/Sample ID	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Lower Nawiliwili-1	11/28/01					8.45	WRRC
Lower Nawiliwili #1	03/07/03	218	101	1120	27.0	123	TT
Lower Nawiliwili #4	03/07/03	175	820	913	36.0	107	TT
Lower Nawiliwili #6	03/07/03	70.0	760	852	27.0	54.0	TT
Lower Nawiliwili #1	03/27/03	352	437	997	181	204	TT
Lower Nawiliwili #3	03/27/03	490	438	910	178	346	TT
Lower Nawiliwili #6	03/27/03	212	260	552	93.0	106	TT
Lower Nawiliwili #1	04/01/03	1640	180	595	193	699	TT
Lower Nawiliwili #3	04/01/03	3870	195	1000	618		TT
Lower Nawiliwili #5	04/01/03	4520	140	990	747		TT
Lower Nawiliwili #1	04/04/03	175	942	1690	98.0	84.1	TT
Lower Nawiliwili #3	04/04/03	82.2	350	532	16.0	77.6	TT
Lower Nawiliwili #5	04/04/03	212	588	1090	171	154	TT
Lower Nawiliwili #1	04/08/03	353	258	1550	588	75.80	TT
Lower Nawiliwili #4	04/08/03	3630	685	6520	6000	2545	TT
Lower Nawiliwili #6	04/08/03	331	321	2270	1300	221	TT
Upper Nawiliwili #4	03/07/03	822	165	625	148.0	962	TT
Upper Nawiliwili #5	03/07/03	682	169	612	138.0	638	TT
Upper Nawiliwili #7	03/07/03	492	296	631	86.0	483	TT
Dry Season							
Lower Nawiliwili-1	05/14/02					63.4	WRRC
Lower Nawiliwili-1A	05/16/02					7.00	WRRC
Storm Geomean		**464**	**322**	**1019**	**171**	**148**	
Wet 10% NTE Criterion		50	180	520	100	15	
Dry 10% NTE Criterion		30	90	380	60	5.5	
Exceeding Wet Criterion		18	13	18	11	17	
Exceeding Dry Criterion		18	18	18	14	19	
Number of Samples		18	18	18	18	19	

Table D-8. Nawiliwili Stormflow Conditions - Station Analysis

Station Name	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet 10% NTE Criterion	50	180	520	100	15
Dry 10% NTE Criterion	30	90	380	60	5.5
Upper Nawiliwili					
Storm Geomean	**651**	**202**	**623**	**121**	**667**
Number Above Wet Criterion	3	1	3	2	3
Number Above Dry Criterion	3	3	3	3	3
Number of Samples	3	3	3	3	3
Lower Nawiliwili					
Storm Geomean	**434**	**354**	**1124**	**183**	**112**
Number Above Wet Criterion	15	12	15	9	14
Number Above Dry Criterion	15	15	15	11	16
Number of Samples	15	15	15	15	16

Table D-9. Puali Baseline Flow Conditions - All Data and 303(d) List Analysis

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Puali-8	11/28/01					4.06	WRRC
Puali-8	02/27/02					4.40	WRRC
Puali-8	03/20/02					4.09	WRRC
Puali-8	04/22/02					2.92	WRRC
Puali-8	11/25/02					10.0	WRRC
Puali-8A	03/19/02					4.10	WRRC
Puali	04/15/02	1.00	339	451	5.00	2.49	TT + DOH Turb
Puali-8A	04/24/02					3.90	WRRC
Puali	11/04/02	3.00	90.0	161	14.0	5.35	TT + DOH Turb
Puali-8A	11/20/02					3.00	WRRC
Puali	01/13/03	1.00	185	361	5.00	3.21	TT + DOH Turb
Puali	02/25/03	3.00	450	556	10.0	5.30	TT + DOH Turb
Puali	03/10/03	3.00	510	500	5.00	6.69	TT + DOH Turb
Puali	03/24/03	3.00	460	586	10.0	5.60	TT + DOH Turb
Puali	04/19/03	12.0	304	396	10.0		TT
Dry Season							
Puali-8	10/31/01					2.40	WRRC
Puali	05/07/02	5.00	734	725	36.0	8.86	TT + DOH Turb
Puali Upper	05/07/02	1.00	105.0	276	5.00	2.90	DOH
Puali-8	05/14/02					14.7	WRRC
Puali	05/20/02	1.00	244	404	9.00	3.14	TT + DOH Turb
Puali Upper	05/20/02	7.00	58.0	205	5.00	9.70	DOH
Puali	06/17/02	4.00	624	764	26.0	5.98	TT + DOH Turb
Puali Upper	06/17/02	18.0	90.0	192	9.00	29.8	DOH
Puali-8	06/24/02					3.37	WRRC
Puali	07/08/02	3.00	712	908	44.0	6.12	TT + DOH Turb
Puali Upper	07/08/02	4.00	24.0	115	5.00	8.55	DOH
Puali-8	07/24/02					10.1	WRRC
Puali-8	10/16/02					5.67	WRRC
Puali-8A	05/16/02					7.50	WRRC
Puali-8A	06/26/02					4.60	WRRC
Puali-8A	07/16/02					5.00	WRRC
Puali-8A	08/21/02					3.80	WRRC
Puali-8A	09/25/02					3.50	WRRC
Puali	05/05/03	12.0	193	288	9.00	13.0	TT
Puali	06/02/03	2.00	268	396	12.0		TT
Puali	07/06/03	4.00	67.0	239	5.00	2.90	TT
Puali	07/20/03	3.00	119	208	11.0		DOH
Puali Middle	07/20/03	2.80	340	433	4.00		DOH

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Puali	08/04/03	3.00	251	324	13.0	3.60	TT
Puali	09/07/03	4.00	143		8.00		TT
Puali	10/05/03	6.00	98.0	176	10.0		TT
Geomean (Wet)		2.67	**292**	**402**	7.80	4.35	
Geomean (Dry)		3.77	**171**	**319**	10.0	**5.90**	
Wet GM Criterion		20	70	250	50	5	
Dry GM Criterion		10	30	180	30	2	
Number Above Wet Criterion		0	7	6	0	5	
Number of Wet Samples		7	7	7	7	14	
Number Above Dry Criterion		2	15	13	2	21	
Number of Dry Samples		15	16	15	16	21	

Table D-10. Puali Baseline Flow Conditions - Station Analysis

Station Name	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)
Wet GM Criterion	20	70	250	50	5
Dry GM Criterion	10	30	180	30	2
Upper Puali					
Geomean (Wet)	N/A				
Geomean (Dry)	4.26	**85.1**	**222**	5.38	**9.20**
Number Above Wet Criterion	0	0	0	0	0
Number of Wet Samples	0	0	0	0	0
Number Above Dry Criterion	1	4	4	0	4
Number of Dry Samples	5	5	5	5	4
Lower Puali					
Geomean (Wet)	2.67	**292**	**402**	7.80	4.35
Geomean (Dry)	3.54	**234**	**382**	13.3	**5.32**
Number Above Wet Criterion	0	7	6	0	5
Number of Wet Samples	7	7	7	7	14
Number Above Dry Criterion	1	11	9	2	17
Number of Dry Samples	10	11	10	11	17

Table D-11. Puali Stormflow Conditions - All Data and 303(d) List Analysis

Station Name/Sample ID	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Puali-8	11/28/01					4.06	WRRC
Puali #1	03/07/03	306	588	925	78.0	221	TT
Puali #11	03/07/03	348	527	946	118	314	TT
Puali #12	03/07/03	277	490	901	125	280	TT
Puali #1	03/30/03	74.8	280	635	56.0	37.2	TT
Puali #3	03/30/03	85.6	403	1100	198	65.3	TT
Puali #5	03/30/03	89.5	432	877	69.0	56.6	TT
Dry Season							
Puali	05/07/02	5.00	734	725	36.0	8.86	TT + DOH Turb
Upper Puali	05/07/02	1.00	105	276	5.00	2.90	DOH
Puali-8	05/14/02					14.7	WRRC
Puali-8A	05/16/02					7.50	WRRC
Storm Geomean		**55.1**	**393**	**747**	59.6	**31.5**	
Wet 10% NTE Criterion		50	180	520	100	15	
Dry 10% NTE Criterion		30	90	380	60	5.5	
Exceeding Wet Criterion		6	7	7	3	6	
Exceeding Dry Criterion		6	8	7	5	9	
Number of Samples		8	8	8	8	10	
Lower Puali							
Storm Geomean		**97.6**	**475**	**861**	84.9	**40.0**	
Wet 10% NTE Criterion		50	180	520	100	15	
Dry 10% NTE Criterion		30	90	380	60	5.5	
Exceeding Wet Criterion		6	7	7	3	6	
Exceeding Dry Criterion		6	7	7	5	9	
Number of Samples		7	7	7	7	9	

Table D-12. Papakolea Baseline Flow Conditions - All Data and 303(d) List Analysis

Station Name	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Papakolea-9	**11/28/01**					13.2	WRRC
Papakolea-9	02/27/02					11.0	WRRC
Papakolea-9	03/20/02					18.3	WRRC
Papakolea-9	04/22/02					10.0	WRRC
Papakolea-9	11/25/02					3.7	WRRC
Papakolea-9A	03/19/02					11.0	WRRC
Papakolea-9A	04/24/02					10.0	WRRC
Papakolea-9A	11/20/02					6.0	WRRC
Papakolea	02/10/03	6.00	482	510	10.0		TT
Papakolea	03/10/03	9.00	1110	1540	5.0		TT
Dry Season							
Papakolea-9	10/31/01					6.5	WRRC
Papakolea-9	05/14/02					64.2	WRRC
Papakolea-9	06/24/02					14.1	WRRC
Papakolea-9	07/24/02					13.1	WRRC
Papakolea-9	10/16/02					17.1	WRRC
Papakolea-9A	05/16/02					17.0	WRRC
Papakolea-9A	06/26/02					7.5	WRRC
Papakolea-9A	07/16/02					7.6	WRRC
Papakolea-9A	08/21/02					8.0	WRRC
Papakolea-9A	09/25/02					5.3	WRRC
Papakolea	05/05/03	4.00	648	765	5.0	9.90	TT
Papakolea	06/02/03	8.00	493	553	8.0		TT
Papakolea	07/06/03	10.0	169	664	6.0	5.50	TT
Papakolea	08/04/03	8.00	337	570	13.0	6.70	TT
Papakolea	09/07/03	8	237		9.00		TT
Papakolea	10/05/03	9.0	340	829	12.0		TT
Geomean (Wet)		7.35	**731**	**886**	7.07	**9.47**	
Geomean (Dry)		7.46	**337**	**668**	8.34	**10.5**	
Wet GM Criterion		20	70	250	50	5	
Dry GM Criterion		10	30	180	30	2	
Number Above Wet Criterion		0	2	2	0	7	
Number of Wet Samples		2	2	2	2	8	
Number Above Dry Criterion		0	6	5	0	13	
Number of Dry Samples		5	6	5	6	13	

Note: All Papakolea data are considered to be collected at a single station.

Table D-13. Papakolea Stormflow Conditions - All Data and 303(d) List Analysis

Station Name/Sample ID	Date Sampled	Total Suspended Solids (mg/L)	Nitrate + Nitrite (µg/L N)	Total Nitrogen (µg/L N)	Total Phosphorus (µg/L P)	Turbidity (NTU)	Samples Collected By
Wet Season							
Papakolea-9	11/28/01					13.2	WRRC
Papakolea #1	02/14/03	9140	198	1140	260	2100	TT
Papakolea # 5	02/14/03	5250	395	8610	2050	2640	TT
Papakolea #6	02/14/03	2580	512	6430	1860	1160	TT
Papakolea Grab	03/07/03	27.0	1600	1890	29.0	39.4	TT
Papakolea Grab	04/01/03	6.10	1230	1620	21.0	9.07	TT
Papakolea Grab	04/04/03	39.0	1710			45.5	TT
Papakolea	04/08/03	7.00	1180	1510.0	14.0		TT
Dry Season							
Papakolea-9	05/14/02					64.2	WRRC
Papakolea-9A	05/16/02					17.0	WRRC
Storm Geomean		**178**	**769**	**2575**	**143**	**136**	
Wet 10% NTE Criterion		50	180	520	100	15	
Dry 10% NTE Criterion[1]		30	90	380	60	5.5	
Exceeding Wet Criterion		3	7	6	3	7	
Exceeding Dry Criterion		4	7	6	3	8	
Number of Samples		7	7	6	6	8	

Note: All Papakolea data are considered to be collected at a single station.

Table D-14. Enterococcus Data and TMDL Analysis

Date	Huleia	Upper Nawiliwili	Papakolea	Puali
10/31/2001	144	3600	920	840
11/28/2001	1360	2080	1480	920
2/27/2002	152	2200	1320	840
3/20/2002	164	3760	1080	960
4/22/2002	288	**11200**	1280	840
5/14/2002	**2440**	1560	**2320**	2600
6/24/2002	376	1640	536	840
7/24/2002	260	1680	800	1440
10/16/2002	148	1680	760	560
11/25/2002	360	8800	1200	560
3/19/2002	720	4400	1560	1960
4/24/2002	356	1040	360	760
5/16/2002	396	1320	568	328
6/26/2002	360	720	680	520
7/16/2002	760	32	1320	**3120**
8/21/2002	440	1440	600	920
9/25/2002	176	1680	272	280
11/20/2002	88	1560	400	520
Geometric Mean	338	1748	839	851
GM Criteria	33	33	33	33
Percent Reduction	90.2%	98.1%	96.1%	96.1%
Maximum Value	2440	11200	2320	3120
Max Criteria	89	89	89	89
Percent Reduction	96.4%	99.2%	96.2%	97.1%
Reduction Required	**90.2%**	**98.1%**	**96.1%**	**96.1%**

APPENDIX E – NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT INVENTORY AND ALLOCATION ANALYSIS

Table E-1: NPDES Permits Regulating Industrial Stormwater Discharge in the Nawiliwili Watershed (see Figure E-1 for locations)

File No	Facility TMK	Permit Issued Date	Permit Expiration Date	Owner Legal Name	Facility Legal Name	Receiving Stream(s)	Discharge Monitoring Required?[1]	Compliance Incidents[4]	Last Inspection Date[6]	Last SWPCP Date
Individual Permit (Subject to TMDLs)										
HI20842	4-3-4-01:01	3/17/06*	1/31/10	Jas. W. Glover, Ltd.	JAS Glover Rock Quarry	Kuia and Kamooloa	Yes	[5]		8/03/04
Open Notice of General Permit Coverage (NGPC) (Subject to TMDLs)										
R80C508	4-3-6-012:19 & 24	3/28/06	11/6/07 (Need to Reapply)	Polynesian Adventure Tours, Inc.	Polynesian Adventure Tours, Inc. - Lihue Baseyard	Nawiliwili	Yes			2/06
R60B235	4-4-3-01: Portion of 1	1/19/05	11/6/07 (Need to Reapply)	County of Kauai	Puhi Metals Recycling Center	Papakolea [2]	Yes			6/04 updated 3/07
R80A320	4-3-3-11:03	7/14/04	11/6/07 (Reapplied)	Kauai Commercial Company, Inc.	Kauai Commercial Company, Inc.	Puali	Yes			8/23/06
R50A540	4-3-3-03:1 & 33	1/19/05	11/6/07 (Need to Reapply)	County of Kauai	Halehaka Landfill	Puali	Yes			6/04
R90A264	4-3-3-03:35	12/6/02	Reapplied on 4/6/08[3]	Grove Farm Properties, Inc.	Lihue-Puhi Wastewater Treatment Plant	Puali (Outfall No. W-1)	Yes			10/97[3]

* Public comments and DOH responses about the issuance of this permit are reproduced in Attachment 1 at the end of this Appendix.
[1] See Current Permit Limits in Table 3-3
[2] Emergency Discharge Only
[3] Need Test Parameters & Updated SWPCP to complete application
[4] Unless otherwise noted, searches of DOH databases did not identify the occurrence or resolution of any complaints; the negative results of any inspections; or non-compliance with permit conditions. However, closer yet incomplete review of the permit files identified occasional and sometimes persistent problems meeting monitoring, planning, and filing requirements, as well as other relatively minor pollution incidents, not shown in this table.
[5] 11/2/06 & 1/1/05 Breach in berm near outfall #3 due to high water in Kuia Stream; 1/1/2005 Overflow in Quarry area near outfall #1 due to heavy rain.
[6] Unless otherwise noted, searches of DOH databases and permit files did not identify any facility inspections performed by government regulators and their contractors. However, closer review of the permit files may still reveal records of previous inspections.

File No	Facility TMK	Permit Issued Date	Permit Expiration Date	Owner Legal Name	Facility Legal Name	Receiving Stream(s)	Discharge Monitoring Required? [1]	Compliance Incidents[4]	Last Inspection Date[5]	Last SWPCP Date
Closed NGPC (Not Subject to TMDLs)										
R70A601		10/1/97	9/21/02	Dillingham Construction Pacific, Ltd.	Hawaiian Bitumuls & Paving Company	Kamooloa				
R80A479		1/11/95	10/28/97	Gray Line Hawaii, Ltd.	Gray Line Hawaii, Ltd., Kauai	Nawiliwili				
R12A280	4-3-8-04:07	10/8/97	9/21/02	The Lihue Plantation Company, Ltd.	The Lihue Plantation Company, Ltd,	Nawiliwili				
R12A496	4-3-3-11: Portion 05 (40, 40L, 41)	10/19/98	9/21/02	Grove Farm	Meadow Gold Dairies - Puhi Plant	Puali				

Table E-2: NPDES Permits Regulating Discharges of Construction Stormwater in Nawiliwili Watershed (see Figure E-1 for locations)

Facilities currently regulated under general permit coverage, or with unknown regulatory status, are shown in bold, italic type below [1]

File No	Facility TMK	NGPC Issued Date	NGPC Expiration Date[1]	NGPC Termination Date	Owner Legal Name	Facility Legal Name	Facility Disturbance Area (Acres)	Compliance Incidents[2]
Puali Watershed								
Receiving Water: Halehaka and Puali Streams								
R10A337	4-3-3-3:1	11/18/1998	9/21/2002	9/21/2002	Grove Farm Properties, Inc.	Puakea Golf Course 2nd Nine Holes		
Receiving Water: Halehaka Stream								
R10A946	4-3-3-03:1	2/2/1999	9/21/2002	10/21/2002	State of Hawaii	Kauai Intermediate School		
R10A426	4-3-3-03: Por 1	11/18/1998	9/21/2002	8/7/2003	Grove Farm Properties, Inc.	Pikake Subdivision		
R10B544	4-3-3-03:45	6/12/2003	11/6/2007	5/13/2004	Regency at Puakea, LLC	Regency at Puakea		
R10B916	4-3-3-03:48	10/11/2004	11/6/2007	9/22/2006	Regency Huleia LLC	Regency at Huleia	13.94	
R10C644	4-3-3-03:40	11/6/2006	11/6/2007	9/30/2007	Self-Help Housing Corporation of Hawaii	Puhi Self-Help Housing Project	6.70	
R10B968	4-3-8-02:16 4-3-4-07:3	9/20/2004	11/6/2007	2/16/2008	Island School	Island School Gymnasium & Halau	2.9	
Receiving Water: Puhi Stream								
R10B313	Various	9/19/2002	9/21/2002	8/31/2004	State of Hawaii	Centralized District Office and Baseyard Complex		
R10C020	4-3-3-13-54	11/12/2004	11/6/2007	8/31/2006	Island Self Storage, LLC	Island Self Storage, LLC	2.43	
R10C559	***4-3-3-12:21***	***6/15/2006***	***11/6/2007***		***Siena Holdings, LLC***	***Unlimited Baseyard***	***2.45***	
Receiving Water: Puali Stream								
R10A017	4-3-3-03:1	3/15/1993	12/31/1993	9/29/1993	Grove Farm Properties, Inc.	Lihue-Puhi WWTP Driveway		
R10A307		8/22/1995	10/28/1997	12/18/1996	County of Kauai	Halehaka Landfill Closure		
R10A301		5/4/1994	10/28/1997	12/19/1996	Grove Farm Properties, Inc	Puako Subdivision		
R10A525	4-3-3-03:1	11/18/1998	9/21/2002	9/21/2002	Grove Farm Properties, Inc.	Puakea Golf Course Core Area		

File No	Facility TMK	NGPC Issued Date	NGPC Expiration Date[1]	NGPC Termination Date	Owner Legal Name	Facility Legal Name	Facility Disturbance Area (Acres)	Compliance Incidents
R10B603	4-3-3-10:42		1/9/2007	1/9/2004	Home Depot USA	Home Depot	9.75	
R10A052	4-3-3-03:1	11/18/1998	9/21/2002	9/21/2004	Grove Farm Properties, Inc.	Puakea Golf Course 1st Nine Holes		
R10C312	4-3-3-01: 48, 50, & 51	11/30/2005	11/6/2007	8/25/2007	Costco Wholesale	Costco Wholesale	18.52	
R10A132	4-3-3-03:37	7/14/2005	11/6/2007	8/31/2007	D.R. Horton - Schuler Division	Ho'okena at Puhi (Formerly Halenani Villages Phase 1E)	4.05	
R10B926	***4-3-3-03:1***	***7/21/2004***	***11/6/2007***		***Grove Farm Properties, Inc.***	***Pikake Subdivision: Subdivision of Lot 1575-A, S-2004-12***	***58***	
R10B994	***4-3-3-03:33***	***1/11/2005***	***11/6/2007***		***Grove Farm Properties, Inc.***	***Lot 1572 Borrow Site***	***8.58***	
R10B362	***4-3-3-10: 42-47***	***1/3/2003***	***11/6/2007***		***Grove Farm Land Corp.***	***Grove Farm Village West (Portion of)***	***9.79***	
Receiving Water: Nawiliwili Stream								
R10A180	4-3-3-03: Por 1	9/14/1993	12/31/1995	12/31/1995	Grove Farm Properties, Inc	Kukui Grove Shopping Center Expansion		
R10A338	4-3-6-02:18	3/28/1994	10/28/1997	9/10/1997	County of Kauai	Antone K. Vidinha Stadium Addition		
R10A593	4-3-6-02: Por 1/S-84-56	8/11/1995	10/28/1997	1/9/1998	Okada Trucking Company, Ltd.	Molokoa Subdivision Unit III		
R10A635	4-3-8-04:1 & 7 4-3-8-14:29	4/26/1999	9/21/2002	12/13/2001	State of Hawaii	Kaumualii Highway, Kuhio Hwy. & Rice St. Improvement		
File No	**Facility TMK**	**NGPC Issued Date**	**NGPC Expiration Date[1]**	**NGPC Termination Date**	**Owner Legal Name**	**Facility Legal Name**	**Facility Disturbance Area (Acres)**	**Compliance Incidents**

R10C142	4-3-3-03, 04, 06, & 11 4-3-4-04, 05, & 06 4-3-8-05	1/2/2008	10/21/2012	4/28/2008	State of Hawaii	Kaumualii Highway Resurfacing, Lihue Mill Bridge to Puhi Road, Project No. 50DE-01-05M	9.28	
R10C396	***4-3-5-01: 27, 82, & 83 4-3-5-02: 015***	***12/7/2005***	***11/6/2007***		***Association of Apartment Owners of Marriott's Kauai Resort and Beach Club***	***Kauai Marriott Resort and Beach Club Emergency Storm Drain System Repair***	***2***	10/12/2007 DOH site visit
R10C543	***4-3-6-04:9***	***8/21/2006***	***11/6/2007***		***Lihue 56, LLC***	***Lihue 56, LLC***	***2.88***	
R10C851	***4-3-5-01:1 & 7 4-3-5-02:2, 15, & 17***	***12/20/2007***	***10/21/2012***		***Association of Apartment Owners of Marriott's Kauai Resort and Beach Club***	***Kauai Marriott Resort and Beach Club Drain Line Repair, Phase V-Drain Line AB Augmentation***	***2***	11/21/2005 sewage spill
R10C726	***4-3-8-05:22 (units 2 & 3)***	***3/31/2008***	***10/21/2012***		***Koamalu Plantation LLC***	***Koamalu Plantation***	***11***	
Receiving Water: Papakolea Stream								
R10A840	4-3-3-02:por of 1	5/18/1998	9/21/2002	10/10/2002	County of Kauai	Puhi Metals Recycling Center		

[1]DOH issues NPDES general permits on a five-year cycle, thus all coverage for all permittees expires at the end of each cycle, as indicated by the dates in this column. Thus for purposes of this inventory, facilities currently regulated under general permit coverage are:

1. those with NGPC Expiration Date 10/21/2012, and no apparent NGPC Termination Date, and
2. those with NGPC Expiration Date 11/6/2007, and no apparent NGPC Termination Date. In these cases, either the Termination Date has not yet been entered in the DOH database or the application for coverage through 10/21/2012 has not yet been submitted, approved, or entered.

[2]Unless otherwise noted, searches of DOH databases did not identify the occurrence or resolution of any complaints; the negative results of any inspections; or non-compliance with permit conditions. However, closer yet incomplete review of the permit files identified occasional and sometimes persistent problems meeting monitoring, planning, and filing requirements, as well as other relatively minor pollution incidents, not shown in this table.

Table E-3: Storm Load Calculations for NPDES Permits Regulating Industrial Stormwater Discharge in the Nawiliwili Watershed

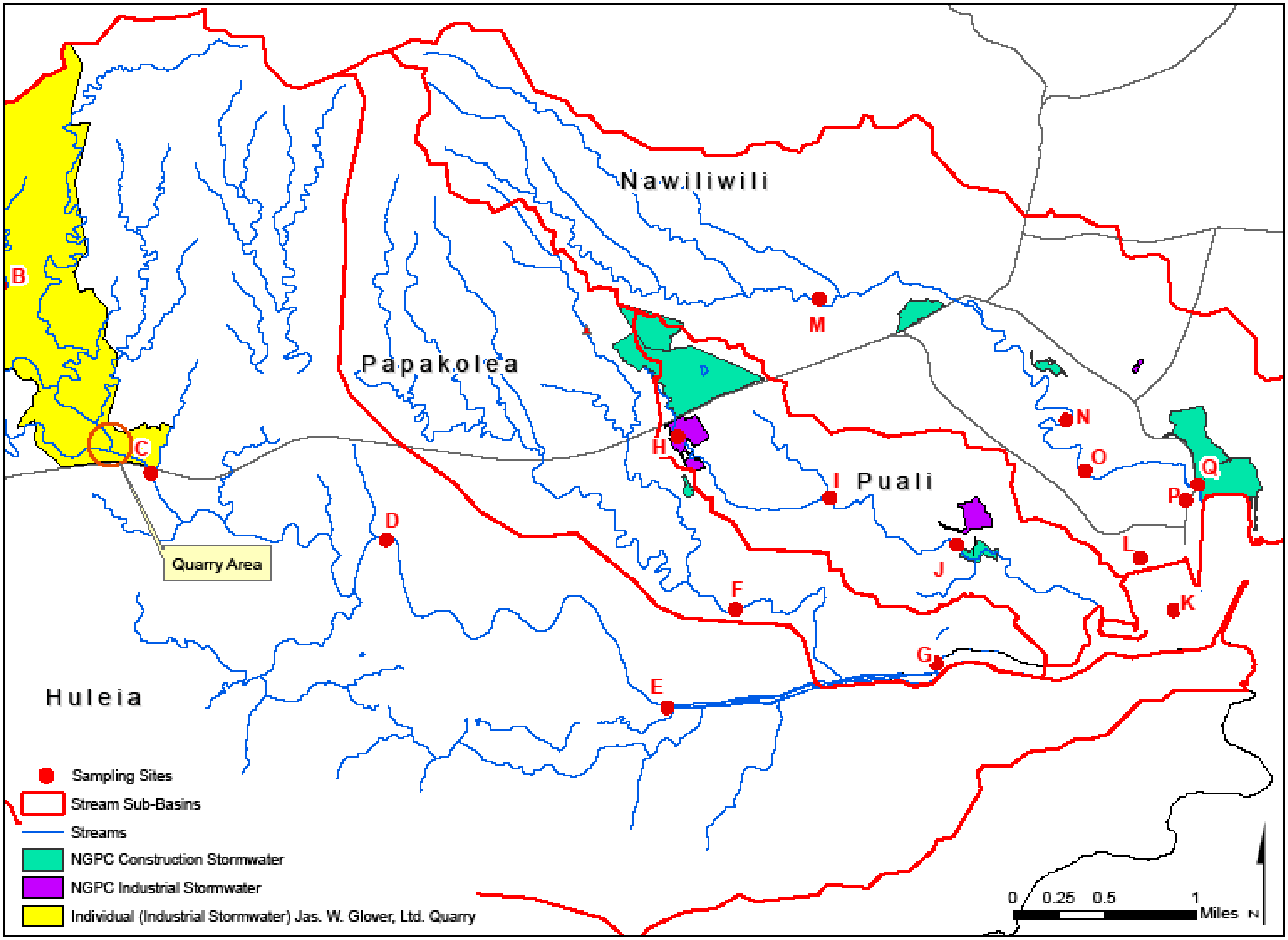
Facility Legal Name	Polynesian Adventure Tours, Inc. - Lihue Baseyard	Puhi Metals Recycling Center	Kauai Commercial Company, Inc.	Halehaka Landfill	Lihue-Puhi Wastewater Treatment Plant (WWTP)	Jas W Glover Quarry[2]	
Facility Area (Acres)	0.55	10	3.27	22	13.8	248.1	
Receiving Waters	Lower Nawiliwili Stream	Papakolea Stream[1]	Puali Stream	Puali Stream	Puali Stream (Outfall No. W-1)	Kamooloa and Kuia Streams[3]	
						To Halfway Bridge	To Stone Bridge
Agricultural Area of Receiving Waterbody						2014	4487
Urban Area of Receiving Waterbody	496.0	106.0	228.5	228.5	228.5		
1-Year Storm Event							
TMDL Target Load for Urban/Agricultural Area (lb/d)							
TSS	8286	1796	3096	3096	3096	26771	62032
Nitrate + Nitrite	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen	237	86.8	67.7	67.7	67.7	780	1445
Phosphorus	38.8	12.1	11.0	11.0	11.0	165	301
Turbidity (NTU)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits (lb/d)							
TSS	9.19	169	44.3	298	187	**3297.86**	3429.94
Nitrate + Nitrite	None	None	None	None	None	None	None
Nitrogen	0.263	8.19	0.969	6.52	4.09	96.09	**79.90**
Phosphorus	0.043	1.14	0.158	1.06	0.666	20.38	**16.63**
Turbidity (NTU)	None	None	None	None	None	None	None

Facility Legal Name	Polynesian Adventure Tours, Inc. - Lihue Baseyard	Puhi Metals Recycling Center	Kauai Commercial Company, Inc.	Halehaka Landfill	Lihue-Puhi Wastewater Treatment Plant (WWTP)	Jas W Glover Quarry[2]	
2-Year Storm Event							
TMDL Target Load for Urban/Agricultural Area (lb/d)							
TSS	9804	2166	3833	3833	3833	31384	71994
Nitrate + Nitrite	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen	280	105	83.8	83.8	83.8	914	1677
Phosphorus	45.9	14.6	13.7	13.7	13.7	194	349
Turbidity (NTU)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits (lb/d)							
TSS	10.9	204	54.9	369	231	**3866**	3981
Nitrate + Nitrite	None	None	None	None	None	None	None
Nitrogen	0.311	9.88	1.20	8.07	5.06	113	**92.7**
Phosphorus	0.051	1.38	0.196	1.32	0.825	23.9	**19.3**
Turbidity (NTU)	None	None	None	None	None	None	None
5-Year Storm Event							
TMDL Target Load for Urban/Agricultural Area (lb/d)							
TSS	11894	2694	4876	4876	4876	37792	85667
Nitrate + Nitrite	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen	340	130	107	107	107	1101	1995
Phosphorus	55.7	18.1	17.4	17.4	17.4	233	415
Turbidity (NTU)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits (lb/d)							
TSS	13.2	254	69.8	469	294	**4656**	4737
Nitrate + Nitrite	None	None	None	None	None	None	None
Nitrogen	0.377	12.3	1.525	10.3	6.44	136	**110**
Phosphorus	0.062	1.71	0.249	1.67	1.05	28.8	**23.0**
Turbidity (NTU)	None	None	None	None	None	None	None

Facility Legal Name	Polynesian Adventure Tours, Inc. - Lihue Baseyard	Puhi Metals Recycling Center	Kauai Commercial Company, Inc.	Halehaka Landfill	Lihue-Puhi Wastewater Treatment Plant (WWTP)	Jas W Glover Quarry[2]	
10-Year Storm Event							
TMDL Target Load for Urban/Agricultural Area (lb/d)							
TSS	13072	3000	5475	5475	5475	41434	93366
Nitrate + Nitrite	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen	374	145	120	120	120	1207	2174
Phosphorus	61.2	20.2	19.5	19.5	19.5	256	453
Turbidity (NTU)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits (lb/d)							
TSS	14.5	283	78.3	527	331	**5104**	5162
Nitrate + Nitrite	None	None	None	None	None	None	None
Nitrogen	0.414	13.7	1.71	11.5	7.23	149	**120**
Phosphorus	0.068	1.91	0.279	1.88	1.18	31.5	**25.0**
Turbidity (NTU)	None	None	None	None	None	None	None

Notes:
Permitted Facility Limits Based on (Facility Area/Urban or Agricultural Land Use Area) * Ag or Urban TMDL Target Loading
All waterbodies do not meet turbidity storm flow standards and therefore limits on TSS and nutrients are necessary.
[1] Emergency Discharge Only
[2] The facility is located in agricultural zoning.
[3] The quarry is located below the Kamooloa Stream station. The allocation is the bolded value and is the lesser of the allocation calculated for the Halfway Bridge and Stone Bridge endpoints.

Figure E-1 – Location of facilities regulated by NPDES permits in the Nawiliwili Bay watershed



APPENDIX E, ATTACHMENT 1 – Public Comments and DOH Responses, Reissuance of NPDES Permit for Glover Rock Quarry (2006)

NO 20842

AUG 3 0 2005/NP

P. 3

Nawiliwili Bay Watershed Council
P. O. Box 366
Lihue, HI 96766

& JLS

Clean Water Branch
Environmental Management Division
Department of Health
P. O. Box 3378
Honolulu, HI 96801-3378

Attention: Chiyome Leinaala Fukina, M.D.
Director of Health

Subject: NPDES Permit No. HI0020842
Permittee: Jas. W. Glover, Ltd.
Halfway Bridge Rock Quarry and Crusher

Aloha Dr. Fukina:

The Nawiliwili Bay Watershed Council (NBWC) requests that a public hearing on the above captioned matter be scheduled in Lihue, Kauai in the near future. Several issues and concerns need to be further addressed and the public at large would benefit from knowing more about the processes and procedures that are operating in this situation.

You are considering a five year permit extension for one of the few permitted facilities in the Nawiliwili Bay watershed, a Category I Impaired waterbody where watershed restoration activities are required. This facility was flagged as a concern in the watershed restoration plan recently developed by the University of Hawaii Water Resources Research Center.

Although there have apparently been no reported discharges from this facility since 1989 there have been numerous reports of white sediments discharging into streams in this area. It seems the current monitoring program needs significant improvement and mitigation plans need to be developed for areas of significant concern.

We have recently become aware of, but have not yet had the opportunity to review, the Storm Water Management Plan the Permittee has submitted to DOH. We would like the opportunity to review the proposed Plan and believe this plan could benefit from additional public input. We would greatly appreciate it if a copy of the Plan could be forwarded to us and that a waiver of costs be granted.

We are also aware the proposed TMDL load requirements for this permittee are about to be released by DOH. Here again, the public needs to know more about these requirements, how they are interrelated with the NPDES process and how they are going to work together to improve water quality in the Nawiliwili Bay watershed with respect to this specific site and Permittee as well as in the bigger picture

Please inform us of your decision as soon as possible. If necessary, I can be contacted at 808-346-1544 or you can call Vice Chairperson David Martin at 808-346-3047.

Sincerely,

Cheryl Lovell-Obatake

Cheryl Lovell Obatake
Chairperson

Cheryl @ 808-346-1549 9/30/05 10:46
no email access - prefer mailed - leave message w/ cost + call back #
76pgs x 5¢ = $3.80

LINDA LINGLE
GOVERNOR OF HAWAII

FILE COPY

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD / CWB

02053PJLS.06d

Mailed 2/17/06

February 15, 2006

Ms. Cheryl Lovell Obatake
Chairperson
Nawiliwili Bay Watershed Council
P.O. Box 366
Lihue, HI 96766

Dear Ms. Obatake:

Subject: Comments on Public Notice for Proposed Water Pollution Control Permit For Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher National Pollutant Discharge Elimination System (NPDES) Permit No. HI 0020842

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, received on August 30, 2005, requesting a public hearing to address your questions about the subject facility. Your comments (in italics) and the DOH's responses are as follows:

The Nawiliwili Bay Watershed Council (NBWC) requests that a public hearing on the above captioned matter be scheduled in Lihue, Kauai in the near future. Several issues and concerns need to be further addressed and the public at large would benefit from knowing more about the processes and procedures that are operating in this situation.

The public notice documents for the subject facility (i.e., the Public Notice, Public Notice Permit, and Permit Rationale) were available to the public on the CWB website and at the offices listed in the Public Notice. The permit application and Storm Water Pollution Control Plan (SWPCP) were and are also available upon request. At this time, a public hearing is not warranted.

You are considering a five year permit extension for one of the few permitted facilities in the Nawiliwili Bay watershed, a Category I Impaired waterbody where watershed restoration activities are required. This facility was flagged as a concern in the watershed restoration plan recently developed by the University of Hawaii Water Resources Research Center [WRRC].

The CWB reviewed the Final "Assessment and Protection Plan for the Nawiliwili Watershed: Phase 3 - Watershed Restoration and Protection Plan" (Plan), dated December 2004, and found reference to the facility on pages 47-48. On page 47, the Plan refers to "frequent washing of cement trucks . . . white silt resulting from washing the trucks had inundated the stream near this location." The Permittee has stated that their "standard operating procedures are that the concrete trucks are washed at the end of the working day. Wash-water generated by this activity is discharged directly from the wash station into our settling ponds." Please also see the response to your next comment.

In addition, Page 5 of the Rationale states, "[b]ased on the Discharge Monitoring Reports (DMRs) submitted by the Permittee, there has been no discharge from Outfall Serial Nos. 001, 002, 003, 004, and 005 from January 1, 1989 to present." The Permittee states "[w]e are aware of the potential effects of our operations and the sensitivity of the watershed area. Our operating practices and the design of our facilities comply with the clean water environmental management practices stipulated by the NPDES permit."

Although there have apparently been no reported discharges from this facility since 1989 there have been numerous reports of white sediments discharging into streams in this area. It seems the current monitoring program needs significant improvement and mitigation plans need to be developed for areas of significant concern.

The CWB does not have a record of any recent complaints regarding white sediment to the Kamooloa Stream, Kuia Stream, or Huleia Stream. About five to six years ago, a report of white sediment on the stone bridge in the Huleia Bridge was received by the CWB. The sediment was actually a crystal (not identified) that formed on the stone bridge. The Permittee is required to report any discharge from their facility (see Part A.4. of the Permit). Failure to report a discharge could subject the facility to administrative and/or civil penalties pursuant to Hawaii Revised Statutes, Sections 342D-30 and 31, which provide for penalties of up to $25,000 per day for each violation. Preventive maintenance and non-compliance reporting (including steps taken or planned to reduce, eliminate, and prevent the reoccurrence of the discharge) are stated in the SWPCP, dated July 28, 2004. As stated Condition No. 8 of the Standard NPDES Permit Conditions, updated as of December 31, 2002, the "Permittee shall take all reasonable steps to minimize or prevent any discharge . . . in violation of this permit or applicable law."

We have recently become aware of, but have not yet had the opportunity to review, the Storm Water Management Plan the Permittee submitted to DOH. We would like th opportunity to review the proposed Plan and believe this plan could benefit from additional public input. We would greatly appreciate it if a copy of the Plan could be forwarded to us and that a waiver of costs be granted.

A copy of the SWPCP, dated July 28, 2004, and the Bill for Collection of $3.80 are enclosed.

We are also aware the proposed TMDL load requirements for this permittee are about to be released by DOH. Here again, the public needs to know more about these requirements, how they are interrelated with the NPDES process and how they are going to work together to *improve water quality in the Nawiliwili Bay watershed with respect to this specific site and Permittee as well as in the bigger picture.*

When the Section 206 Water Quality Management Plans required by the Act are updated and adopted, the CWB will implement the Waste Load Allocations for Total Maximum Daily Loads.

If you have any further questions, please contact Ms. Joanna L. Seto of the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

DENIS R. LAU, P.E., CHIEF
Clean Water Branch

JLS:cu

Enclosures: 1. SWPCP, dated July 28, 2004
2. Bill for Collection of $3.80

c: Water Division (WTR-5), CWA Standards and Permits Office, EPA, Region 9
Mr. John Romanowski, Jas. W. Glover, Ltd. (w/o encls.) [via fax 591-9174 only]
Mr. David Pirie, Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher (w/o encls.) [via fax (808) 246-6209 only]
Mr. Gary Ueunten, DHO - Kauai (w/o encls.) [via fax (808) 241-3566 only]

PD20842

P. 37

August 25, 2005

Alec Wong
Clean Water Branch,
Environmental Management Division,
Department of Health,
919 Ala Moana Blvd. Room 301,
Honolulu, HI 96814-4920

'05 AUG 29 P1:48

Re: proposed NPDES permit for the Halfway Bridge facility (Kauai) posted for public review

I haven't had a tremendous amount of time to look this over, but I did have a few questions and concerns.

Questions, Comments & Concerns:

Question 1 : Page 3 of Permit rationale states that existing settling ponds retain storm water runoff from the quarry site for normal storm events.Do these ponds contain the runoff from the parking lot where the cement trucks are washed, because often in the morning Hule'ia has a noticeable sediment load after the trucks have been> washed which makes me question if settling ponds are in place, are they sufficient. If they are not in place, then is there a plan to implement them.

Question/Concern 2: It appears that there have been no reported discharges since 1989. Yet, there have been numerous complaints by a neighboring resident and white sediments have been witnessed (by me and others doing monitoring)on numerous occasions in this area. What will be done to insure that discharges are being reported?

Q3: I see that there is a monitoring plan in place in the event of a discharge, but what about in the interim. Well there be any monitoring in place that would call for taking random samples now and then to insure that the ponds are working? Or is that what Gary Ueunten does?

Q4: Finally, if there is a discharge, then what? It seems as if it is sampled and reported, but are there any remediation efforts?

Q5:When will the facility to treat the volume of process waters and stormwaters (mentioned on p3 of permit)be constructed (I'm glad that this will be in place by the way!)? Is this a priority?

Aloha,

Monika Mira
P.O. Box 735
Eleele, HI 96705

p-4

FILE COPY

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

Aw JS

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD / CWB

02053PJLS.06c

mailed 2/17/06

February 15, 2006

Ms. Monika Mira
P.O. Box 735
Eleele, Hawaii 96705

Dear Ms. Mira:

Subject: Comments on Public Notice for Proposed Water Pollution Control Permit For Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher National Pollutant Discharge Elimination System (NPDES) Permit No. HI 0020842

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, received on August 29, 2005, with your questions, comments and concerns about the subject facility. Your comments (in italics) and the DOH's responses are as follows:

Question 1: Page 3 of Permit rationale states that existing settling ponds retain storm water runoff from the quarry site for normal storm events. Do these ponds contain the runoff from the parking lot where the cement trucks are washed, because often in the morning Hule'ia has a noticeable sediment load after the trucks have been> [sic] washed which makes me question if settling ponds are in place, are the sufficient. If they are not in place, then is there a plan to implement them.

The Permittee has stated that their "standard operating procedures are that the concrete trucks are washed at the end of the working day. Wash-water generated by this activity is discharged directly from the wash station into our settling ponds."

Question/Concern 2: It appears that there have been no reported discharges since 1989. Yet, there have been numerous complaints by a neighboring resident and white sediments have been witnessed (by me and others doing monitoring) on numerous occasions in this area. What will be done to insure that discharges are being reported?

The CWB does not have a record of any recent complaints regarding white sediment to the Kamooloa Stream, Kuia Stream, or Huleia Stream. About five (5) to six (6) years ago, a report of white sediment on the stone bridge in the Huleia Bridge was received by the CWB. The sediment was actually a crystal (not identified) that formed on the stone bridge. The Permittee is required to report any discharge from their facility (see Part A.4. of the Permit). Failure to report a discharge could subject the facility to administrative and/or civil penalties pursuant to Hawaii

Revised Statutes, Sections 342D-30 and 31, which provide for penalties of up to $25,000 per day for each violation.

Q3: I see that there is a monitoring plan in place in the event of a discharge, but what about in the interim. Well [sic] there be any monitoring in place that would call for taking random samples now and then to insure that the ponds are working? Or is that what Gary Ueunten does?

The Permittee states that "[t]he facilities are designed to contain a 10-year, 24 hour storm event. In the interim, there is no potential for pollutants to enter receiving waters." The Permittee is not required to sample the pond water when there is no discharge to State waters.

Q4: Finally, if there is a discharge, then what? It seems as if it is sampled and reported, but are there any remediation efforts?

The Permittee is required to sample the discharge when it occurs. The quality of the stormwater and processed generated waste water entering the State waters is required to meet the daily maximum discharge limitations listed in the Permit (see Part A.2. of the Permit). Preventive maintenance and non-compliance reporting (including steps taken or planned to reduce, eliminate, and prevent the reoccurrence of the discharge) are stated in the Storm Water Pollution Control Plan, dated July 28, 2004. As stated Condition No. 8 of the Standard NPDES Permit Conditions, updated as of December 31, 2002, the "Permittee shall take all reasonable steps to minimize or prevent any discharge . . . in violation of this permit or applicable law."

Q5: When will the facility to treat the volume of process waters and stormwaters (mentioned on p3 of permit) be constructed (I'm glad that this will be in place by the way!)? Is this a priority?

The Permittee states that the "majority of the facilities already exist [and the] remainder will either be constructed ... before activities commence in that particular mining area [or once] the design requirements in the application are approved with the issuance of the permit."

If you have any further questions, please contact Ms. Joanna L. Seto of the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

DENIS R. LAU, P.E., CHIEF
Clean Water Branch

JLS:cu

c: Water Division (WTR-5), CWA Standards and Permits Office, EPA, Region 9
Mr. John Romanowski, Jas. W. Glover, Ltd. [via fax 591-9174 only]
Mr. David Pirie, Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher [via fax (808) 246-6209 only]
Mr. Gary Ueunten, DHO - Kauai [via fax (808) 241-3566 only]

TO: A. Wong, CWB
THROUGH: H. Lao, EPO
FROM: D. Penn, EPO
DATE: 08/25/2005
SUBJECT: NPDES Permit No. HI-0020842 (Halfway Bridge Rock Quarry and Crusher)
cc: J. Seto, CWB
M. Tsuji, CWB
S. Blanton, Tetra Tech EM, Inc.

Comments on proposed permit (Notice dated July 27, 2005):

1. Permit Review

In the future, we suggest that proposed permit issuance and reissuance affecting receiving waters currently under TMDL development (in this case, Huleia Stream and tributaries) or to facilities with established Waste Load Allocations (WLAs) be routed through EPO for internal review before proceeding to public notice.

2. Permit Issuance

Our review of the permit file and discussions with CWB staff indicate that the facility was not inspected by DOH during the current permit cycle. Thus we suggest that the proposed permit issuance date be postponed until a standard facility inspection is completed. The information submitted with the permit application, as well as additional information that we suggest also be included with the application (see below) will help us to more accurately compute facility Waste Load Allocations as part of the Huleia Stream TMDLs. Thus we suggest that the proposed permit issuance date be postponed until facility Waste Load Allocations are established by DOH, or that permit conditions be added to reopen the permit or activate certain new conditions after the facility Waste Load Allocations are established by DOH (see below).

3. Permit Notification

We suggest that the Notice of Proposed permit and related sections of the permit and rationale clarify that:

A. Kuia Stream and Kamooloa Stream are tributaries of Huleia Stream. Water quality in these streams is impaired by excessive turbidity [2004 303(d) List].

B. Nawiliwili Bay is the receiving water for Huleia Stream. Water quality in Nawiliwili Bay is impaired by excessive turbidity and nutrients, and certain locations within the Bay demonstrate excessive enterococci, nitrate-nitrite nitrogen, ammonium nitrogen, and chlorophyll a [2004 303(d) List].

C. Downstream segments of Huleia Stream and Estuary that flow through the Huleia National Wildlife Refuge are "Class 1" "Inland Waters."

D. TMDL development for Huleia Stream is near completion and will include the establishment of Waste Load Allocations (WLAs) for nutrients and sediments discharged under the proposed permit.

4. Effluent limitations and monitoring requirements (Permit Part A)

1. We suggest that the permit define and quantify the hydrologic characteristics (total 24 hour rainfall) of a 10 year, 24 hour rainfall event at the facility location.

The permit files indicate 9.5" (based on 1962 Rainfall Frequency Atlas) or 9.8" (no rationale provided). We suggest that more current data and more detailed rationale be used to update this definition.

2. We suggest that Flow Minimum Monitoring Frequency be hourly during all discharges and that automated recording equipment be installed, operated, and maintained to supply these data.
3. We suggest that a standard, automated rain gage station be installed, operated and maintained at the facility. Rainfall total shall be continuously recorded at 15 minute intervals and reported monthly to the State of Hawaii Climatologist in an electronic format that meets the State Climatologist's data management requirements.

   We also suggest that a prioritized list and description (e.g. station name, number, and operator; coordinates; and sampling interval, reporting interval, and data custodian) of DOH-approved substitute "closest available rain gage[s] in the same watershed" be included in the permit. Is the Halenanahu station that was formerly used in this capacity still operating?
4. We suggest that the Permittee shall orally report any discharge immediately (within one hour) after the Permittee becomes aware of the circumstances. To accomplish this, we suggest that an on-site/off-site alarm system be installed, operated, and maintained in conjunction with the automated flow monitoring equipment suggested in 2. above.
5. We suggest that the Permittee shall also keep records of and report to DOH:
   a. the hourly and event total and event mean volume of the discharge (see 2. above).
   b. the hourly rainfall in inches per hour for each hour which caused or contributed to the discharge (see 3. above).
6. We suggest that alternative effluent sampling procedures be considered and that sampling be extended beyond the first hour of discharge, since sampling during the first hour only may be both logistically difficult and scientifically non-representative of the entire discharge event. Compliance with this condition would be facilitated by the use of an on-site/off-site alarm system (see 4. above) and automated effluent sampling. Applicant's previous assumption (11/29/99) that autosampling is not possible due to the lack of electrical power at the facility is not supported by current sampling technology (battery-operated).
10. We suggest that the reporting period shall be monthly.
11. We suggest that annual wet and dry season sampling of the sedimentation ponds be added to the Other Monitoring Requirements, and that this sampling also include BOD, DO, ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, and total phosphorous (all from unfiltered samples), temperature, conductivity, salinity, pH, turbidity, and total suspended solids (see **6.1.** below).
12. We suggest that within one year after Waste Load Allocations (WLAs) for the facility are established by DOH, the permittee shall revise its Stormwater Pollution Control Plan (SWCP) and Effluent Monitoring Program (EMP) to explain how the permittee will implement the WLAs. Implementation of these revisions shall begin within two years after the Waste Load Allocations (WLAs) for the facility are established by DOH.

13. We also suggest that SWCP guidelines and review/approval process be specified in the permit, and that the SWCP be required to include improved characterization and quantification of the contributing area and pollutant sources associated with each permitted outfall, and the structural specifications for each permitted outfall. The 2004 SWCP is inconsistent in this regard. We suggest that a table be presented showing, for each contributing area, the size, grade, land cover, industrial activities, retention capacity, discharge capacity, and 10 yr/24 hr storm characteristics (rainfall depth, runoff volume, peak discharge).
14. We suggest that Section 4-1 of the SWCP, which states "No stormwater discharge sampling data is available" be revised to include the complete record of sampling data that is available in the permit files and other permittee records.

5. Other Requirements (Permit Part C)

1. We suggest that the Permittee shall submit **and implement** (emphasis added) an updated Effluent Monitoring Program, and that within one year after Waste Load Allocations (WLAs) for the facility are established by DOH, the permittee shall revise its Effluent Monitoring Program (EMP) to explain how the permittee will implement the WLAs. Implementation of these revisions shall begin within two years after the Waste Load Allocations (WLAs) for the facility are established by DOH.

   We also suggest that EMP guidelines and review/approval process be specified in the permit.

2. We suggest that the timeline for Schedule of Maintenance submittal be changed from at least 14 days to at least 30 days prior to the requested maintenance.

3. We suggest that the current sampling guidance, which seems to mandate a 72-hour waiting period between sampling the first 0.1' rainfall event and subsequent sampling rainfall event, be revised to allow for more frequent monitoring during storm conditions.

6. Description of the Present Discharge (Permit Rationale)

1. We suggest that new test results from the sampling of the sedimentation ponds for all permitted outfalls be submitted for this reapplication, and that this sampling also include BOD, DO, ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, and total phosphorous (all from unfiltered samples), temperature, conductivity, salinity, pH, turbidity, and total suspended solids (see **4.**12. above).

7. Proposed Determinations (Permit Rationale)

2. Specific Criteria
   The "dry" and "wet" criteria listed at Chapter 11-54-05.2(b)(1) are divided on the basis of time of year, not magnitude of rainfall event as implied by the current rationale text. However, in TMDL development EPO does use wet season criteria alone as numeric targets for stormflows. Thus, EPO suggests deleting "Therefore" from the sentence "Therefore, it is appropriate to apply the 'wet

'criteria to the facility," and that replacement language justifying the application of the "wet" criteria only be developed in partnership with EPO.

Historic DMR data and sedimentation pond data, along with the total lack of nutrient, conductivity, and salinity data for facility discharge, do not strongly support the conclusions that "even these [2% of the time standards] are not likely to be violated" and "The discharge from the facility would only be expected to cause a violation of the water quality criteria for total suspended solids, pH, and turbidity."

Although "Not to be exceeded more than 2% the time" can be expressed as equivalent to seven days per year, we suggest that for the purpose of applying water quality criteria to stormwater discharges, it can also be expressed as "the criteria not to be exceeded when stream discharge is equivalent to Q02 discharge derived from the appropriate frequency distribution curve." To assist with the determination of appropriate water quality criteria for the proposed permit, we suggest that stream and facility discharge conditions associated with a 10 year, 24 hour rainfall event at the facility location be calculated and compared with calculated Q02 discharges immediately upstream from the facility outfalls.

3. Toxic Pollutants Criteria

Although there is no reference to toxic pollutants in the application, we suggest that the next inspection of the facility and its operations and documentation include validating or invalidating the assumption that toxic pollutants are not potential pollutants requiring monitoring at this facility.

LINDA LINGLE
GOVERNOR OF HAWAII

FILE COPY

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

AW JS

In reply, please refer to:
EMD / CWB

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

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routed 2/17/06

February 15, 2006

To: Dave Penn, Ph.D.
Environmental Planning Office (EPO)

Through: Kelvin Sunada, Office Manager
EPO

Denis R. Lau, P.E., Chief
Clean Water Branch (CWB)

From: Alec Wong
Engineering Section Supervisor
CWB

Subject: Comments on Public Notice for Proposed Water Pollution Control Permit For Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher National Pollutant Discharge Elimination System (NPDES) Permit No. HI 0020842

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your e-mailed memo, dated August 25, 2005, regarding the subject facility. Your comments (in italics) and the CWB's responses (below) are as follows:

1. Permit Review

In the future, we suggest that proposed permit issuance and reissuance affecting receiving waters currently under TMDL development (in this case, Huleia Stream and tributaries) or to facilities with established Waste Load Allocations (WLAs) be routed through EPO for internal review before proceeding to public notice.

The CWB acknowledges the suggestion.

2. Permit Issuance

Our review of the permit file and discussions with CWB staff indicate that the facility was not inspected by DOH during the current permit cycle. Thus we suggest that the proposed permit issuance date be postponed until a standard facility inspection is completed. The information submitted with the permit application, as well as additional information that we suggest also be included with the application (see below) will help us to more accurately compute facility Waste

Load Allocations as part of the Huleia Stream TMDLs. Thus we suggest that the proposed permit issuance date be postponed until facility Waste Load Allocations are established by DOH, or that permit conditions be added to reopen the permit or activate certain new conditions after the facility Waste Load Allocations are established by DOH (see below).

The permit issuance date will not be postponed until Waste Load Allocations (WLAs) are established. There is an issuance schedule submitted to the Environmental Protection Agency (EPA) in accordance with grant negotiations and requirements.

The CWB will require the submittal of an implementation and monitoring plan for the WLA. The implementation plan shall identify specific Permittee activities targeted to reducing WLA-identified pollutant discharges in the watershed as necessary to comply with the WLA. The monitoring plan shall specify the water quality monitoring and activity tracking necessary to demonstrate efforts to comply with the WLAs assigned to the Permittee. The Permittee shall submit these plans to DOH within one (1) year of the effective date of this permit.

3. Permit Notification

We suggest that the Notice of Proposed permit and related sections of the permit and rationale clarify that:

- *A. Kuia Stream and Kamooloa Stream are tributaries of Huleia Stream. Water quality in these streams is impaired by excessive turbidity [2004 303(d) List].*
- *B. Nawiliwili Bay is the receiving water for Huleia Stream. Water quality in Nawiliwili Bay is impaired by excessive turbidity and nutrients, and certain locations within the Bay demonstrate excessive enterococci, nitrate-nitrite nitrogen, ammonium nitrogen, and chlorophyll a [2004 303(d) List].*
- *C. Downstream segments of Huleia Stream and Estuary that flow through the Huleia National Wildlife Refuge are "Class 1" "Inland Waters."*
- *D. TMDL development for Huleia Stream is near completion and will include the establishment of Waste Load Allocations (WLAs) for nutrients and sediments discharged under the proposed permit.*

The Rationale will be revised to include the above-mentioned items.

4. Effluent limitations and monitoring requirements (Permit Part A)

1. We suggest that the permit define and quantify the hydrologic characteristics (total 24 hour rainfall) of a 10 year, 24 hour rainfall event at the facility location. The permit files indicate 9.5" (based on 1962 Rainfall Frequency Atlas) or 9.8" (no rationale provided). We suggest that more current data and more detailed rationale be used to update this definition.

Please contact the Weather Bureau directly to determine whether the Halenanahu station is still operating.

4. *We suggest that the Permittee shall orally report any discharge immediately (within one hour) after the Permittee becomes aware of the circumstances. To accomplish this, we suggest that an on-site/off-site alarm system be installed, operated, and maintained in conjunction with the automated flow monitoring equipment suggested in 2. above.*

   The Permittee is required to take samples "for the first 15 minutes of the discharge" (Part A.6. of the Permit), and therefore will be focused on the task at hand. Part A.4. of the Permit will continue to state that the "Permittee shall orally report any discharge within one (1) week from the time the Permittee becomes aware of the circumstances." Furthermore, the Permittee is required to report any noncompliance in accordance with Part B.2. of the Permit.

5. *We suggest that the Permittee shall also keep records of and report to DOH:*
   a. *the hourly and event total and event mean volume of the discharge (see 2. above).*
   b. *the hourly rainfall in inches per hour for each hour which caused or contributed to the discharge (see 3. above).*

   The following language will be included in Part A.5.d. of the permit "[c]haracteristics (timing, duration, intensity, total rainfall) of the storm event(s);"

6. *We suggest that alternative effluent sampling procedures be considered and that sampling be extended beyond the first hour of discharge, since sampling during the first hour only may be both logistically difficult and scientifically non-representative of the entire discharge event. Compliance with this condition would be facilitated by the use of an on-site/off-site alarm system (see 4. above) and automated effluent sampling. Applicant's previous assumption (11/29/99) that autosampling is not possible due to the lack of electrical power at the facility is not supported by current sampling technology (battery-operated).*

   The Sample Type for Total Suspended Solids and Turbidity in Part A.2. of the Permit has been revised from "Grab" to "Composite" and also includes the following note: "The Permittee shall collect samples for analysis from a discharge resulting from a representative storm. A representative storm means a rainfall that accumulates more than 0.1 inch of rain and occurs at least seventy-two hours after the previous measurable (greater than 0.1 inch) rainfall event.

The 1962 Rainfall Frequency Atlas has not been updated. This document continues to be the basis for the 9.5 inches quantity of rainfall for the 10 year, 24-hour rainfall event used by the facility in its storage calculations.

In accordance with 40 CFR §436.21(c), "[t]he term '10-year 24-hour precipitation event' shall mean the maximum 24-hour precipitation event with a probable reoccurrence interval of once in 10 years. This information is available in 'Weather Bureau Technical Paper No. 40,' May 1961 and 'NOAA Atlas 2,' 1973 for the 11 Western States, and may be obtained from the National Climatic Center of the Environmental Data Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce."

2. *We suggest that Flow Minimum Monitoring Frequency be hourly during all discharges and that automated recording equipment be installed, operated, and maintained to supply these data.*

As stated on Page 5 of the Rationale, "[b]ased on the Discharge Monitoring Reports (DMRs) submitted by the Permittee, there has been no discharge from Outfall Serial Nos. 001, 002, 003, 004, and 005 from January 1, 1989 to present." Therefore, the requirement to install automated recording equipment for once per discharge sampling is not warranted. The monitoring frequency shall continue to be once per discharge (Part A.2. of the Permit).

3. *We suggest that a standard, automated rain gage station be installed, operated and maintained at the facility. Rainfall total shall be continuously recorded at 15 minute intervals and reported monthly to the State of Hawaii Climatologist in an electronic format that meets the State Climatologist's data management requirements.*
We also suggest that a prioritized list and description (e.g. station name, number, and operator; coordinates; and sampling interval, reporting interval, and data custodian) of DOH-approved substitute "closest available rain gage[s] in the same watershed" be included in the permit. Is the Halenanahu station that was formerly used in this capacity still operating?

The requirement for a standard rain gage station to be installed, operated and maintained at the facility will be included in the permit. The CWB will include your suggestion to install an automated rain gage in the Rationale. The station name, number, and operator; coordinates; and sampling interval, reporting interval, and data custodian DOH-approved substitute "closest available rain gage[s] in the same watershed" will also be included in the permit (Part A.3. of the Permit).

The Permittee shall collect samples for analysis during the first 15 minutes of the discharge and at 15-minute intervals thereafter for the duration of the discharge. If the discharge lasts for over an hour, the Permittee may cease sample collection.

For this permit, if the duration of discharge is less than 30 minutes, the sample collected during the first 15 minutes of discharge shall be analyzed as a composite sample. If the duration of discharge is greater than 30 minutes, the Permittee shall analyze two (2) or more sample aliquots as a composite sample.

The composite sample shall be flow proportional; either the time interval between each aliquot or the volume of each aliquot shall be proportional to the total storm water discharge flow since the collection of the previous aliquot. Composite samples represent the average characteristics of the storm water discharge during the compositing period."

10.[sic] *We suggest that the reporting period shall be monthly.*

Monthly reporting is required of facilities with continuous or frequent discharges. This facility did not have a discharge during the last entire permit period, therefore the reporting period shall continue to be quarterly.

11. We suggest that annual wet and dry season sampling of the sedimentation ponds be added to the Other Monitoring Requirements, and that this sampling also include BOD, DO, ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, and total phosphorous (all from unfiltered samples), temperature, conductivity, salinity, pH, turbidity, and total suspended solids (see ***6.1.*** *below).*

The permit requires monitoring of the discharge from overflows from the containment facility. There is no history of continuous or frequent discharges from the facility, therefore it is not justified to require monitoring of the sedimentation ponds.

12. We suggest that within one year after Waste Load Allocations (WLAs) for the facility are established by DOH, the permittee shall revise its Stormwater Pollution Control Plan (SWCP) and Effluent Monitoring Program (EMP) to explain how the permittee will implement the WLAs. Implementation of these revisions shall begin within two years after the Waste Load Allocations (WLAs) for the facility are established by DOH.

The CWB will include the following "The DOH shall notify the Permittee as Waste Load Allocations (WLAs) are adopted by DOH that identify the Permittee as a source. The Permittee shall develop implementation and monitoring plans for a minimum of one (1) additional WLA per year within one (1) year of the notification date." (Part A.11.c. of the Permit).

13. *We also suggest that SWCP guidelines and review/approval process be specified in the permit, and that the SWCP be required to include improved characterization and quantification of the contributing area and pollutant sources associated with each permitted outfall, and the structural specifications for each permitted outfall. The 2004 SWCP is inconsistent in this regard. We suggest that a table be presented showing, for each contributing area, the size, grade, land cover, industrial activities, retention capacity, discharge capacity, and 10 yr/24 hr storm characteristics (rainfall depth, runoff volume, peak discharge).*

    The requirements for the contents of the Storm Water Pollution Control Plan (SWPCP) may be found in 40 CFR 122.26(c) and HAR, Chapter 11-55, Appendix B, Section 6 and/or 7. The EPA Summary Guidance for Developing Pollution Prevention Plans and Best Management Practices for Storm Water Management For Industrial Activities (EPA 833-R-92-002, October 1992) provides a step-by-step process to develop the SWPCP. Most of the contents of the suggested table may already be found on pages 3-1 to 3-2; Figures #2, 3, 4, 5, 6, 7, and 8; and Tables #2A-B, #3A-D, and #4 of the SWPCP.

14. *We suggest that Section 4-1 of the SWCP, which states "No stormwater discharge sampling data is available" be revised to include the complete record of sampling data that is available in the permit files and other permittee records.*

    There has been no discharge from the facility in the last permit period. Discharges prior to the last permit period were addressed at the time of the discharge.

5. ***Other Requirements (Permit Part C)***

1. *We suggest that the Permittee shall submit* ***and implement*** *(emphasis added) an updated Effluent Monitoring Program, and that within one year after Waste Load Allocations (WLAs) for the facility are established by DOH, the permittee shall revise its Effluent Monitoring Program (EMP) to explain how the permittee will implement the WLAs. Implementation of these revisions shall begin within two years after the Waste Load Allocations (WLAs) for the facility are established by DOH.*

    We also suggest that EMP guidelines and review/approval process be specified in the permit.

    The Permittee is required to "submit an updated Effluent Monitoring Program to the Director for approval within 60 days after the effective date of this permit." The CWB will include the requirement "to implement" the EMP over the coming calendar year.

Please see EPO Comment No. 4.12 for CWB response for WLAs.

2. *We suggest that the timeline for Schedule of Maintenance submittal be changed from at least 14 days to at least 30 days prior to the requested maintenance.*

   The standard timeline in NPDES permits for submittal of the Schedule of Maintenance is 14 days prior to any maintenance of facilities.

3. *We suggest that the current sampling guidance, which seems to mandate a 72-hour waiting period between sampling the first 0.1' rainfall event and subsequent sampling rainfall event, be revised to allow for more frequent monitoring during storm conditions.*

   The sampling guidance follows Federal regulations in 40 CFR §122.21(g)(7)(ii) which states "[f]or storm water discharges, all samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inch and at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event," therefore no change will be made.

6. ***Description of the Present Discharge (Permit Rationale)***
   1. *We suggest that new test results from the sampling of the sedimentation ponds for all permitted outfalls be submitted for this reapplication, and that this sampling also include BOD, DO, ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, and total phosphorous (all from unfiltered samples), temperature, conductivity, salinity, pH, turbidity, and total suspended solids (see **4**.12. above).*

   Please see CWB response for WLAs at EPO Comment No. 4.11.

7. ***Proposed Determinations (Permit Rationale)***
   2. *Specific Criteria*
   The "dry" and "wet" criteria listed at Chapter 11-54-05.2(b)(1) are divided on the basis of time of year, not magnitude of rainfall event as implied by the current rationale text. However, in TMDL development EPO does use wet season criteria alone as numeric targets for stormflows. Thus, EPO suggests deleting "Therefore" from the sentence "Therefore, it is appropriate to apply the 'wet 'criteria to the facility," and that replacement language justifying the application of the "wet" criteria only be developed in partnership with EPO.

   Historic DMR data and sedimentation pond data, along with the total lack of nutrient, conductivity, and salinity data for facility discharge, do not strongly support the conclusions that "even these [2% of the time standards] are not likely to be violated" and "The discharge from the facility would only be expected to cause a violation of the water quality criteria for total suspended solids, pH, and turbidity."

Although "Not to be exceeded more than 2% the time" can be expressed as equivalent to seven days per year, we suggest that for the purpose of applying water quality criteria to stormwater discharges, it can also be expressed as "the criteria not to be exceeded when stream discharge is equivalent to Q02 discharge derived from the appropriate frequency distribution curve." To assist with the determination of appropriate water quality criteria for the proposed permit, we suggest that stream and facility discharge conditions associated with a 10 year, 24 hour rainfall event at the facility location be calculated and compared with calculated Q02 discharges immediately upstream from the facility outfalls.

The Permittee is required to "design, construct and maintain a facility to contain or treat the volumne of process generated waste waters and stormwaters which would result from a 10 year, 24-hour rainfall event" (Part A.1. of the Permit). Therefore, discharges from the facility would predominantly occur during the wet season and no change will be made to the rationale.

The "not to be exceeded more than 2% the time" language is as stated in HAR, Chapter 11-54, Section 11-54-5.2(b)(1). The permit will not include language which is under development within the DOH.

3. *Toxic Pollutants Criteria*
Although there is no reference to toxic pollutants in the application, we suggest that the next inspection of the facility and its operations and documentation include validating or invalidating the assumption that toxic pollutants are not potential pollutants requiring monitoring at this facility.

There has been no discharge from the facility in the last permit period. As stated in the 40 CFR, toxic pollutants need only be analyzed if they are identified as potential pollutants requiring monitoring in the SWPCP.

If you have any questions, please contact Ms. Joanna L. Seto of the Engineering Section, CWB, at 586-4309.

JLS:cu

c: Water Division (WTR-5), CWA Standards and Permits Office, EPA, Region 9
Mr. John Romanowski, Jas. W. Glover, Ltd. [via fax 591-9174 only]
Mr. David Pirie, Jas. W. Glover, Ltd. - Halfway Bridge Rock Quarry and Crusher [via fax (808) 246-6209 only]
Mr. Gary Ueunten, DHO - Kauai [via fax (808) 241-3566 only]

APPENDIX F –WASTEWATER DISPOSAL SYSTEM INVENTORY

Within the Nawiliwili Bay watershed, areas served by various wastewater disposal systems include the sewered parcels of Lihue-Puhi town, parcels with records of known cesspools and septic tanks (collectively termed IWS for Individual Wastewater Systems), five active Large Capacity Cesspools (LCC), and parcels assumed to use unrecorded IWS (primarily cesspools) based on land use and zoning designations, building values, and development patterns (see Inventory table below). Where sewered parcels also have a cesspool card, it is possible that these parcels never connected with the sewer collection system, or that the cesspools were closed but the records were not updated after sewer construction and connection (the same can hold true for most other cessspool card records). The exact locations of the cesspools within the parcels are not readily available.

Five LCCs were recently closed, and the five remaining open LCCs at Kauai High School are scheduled to be closed by Sept. 2009 (see "Large Capacity Cesspool Closure" below). Although their exact location within the parcels is ambigious, their closure may positively impact water quality, depending upon their proximity to streams and other site-specific factors.

The State of Hawaii Department of Health Wastewater Branch (DOH-WWB) maintains a database that includes information about cesspool and septic tank plan (IWS) approvals and construction inspections. Planned IWS are not always constructed, and planned systems may be operating without final approval or inspection. Thus our identification of "IWS with Final Approval" may be a conservative estimate the total number of operating IWS potentially known to DOH. Data below is current as of 2006, and may not reflect newer construction projects.

Table F-1: Wastewater Disposal System Inventory for Nawiliwili Bay Watershed

	Sub-Basins				
	Huleia	Nawiliwili	Papakolea	Puali	Total
Records of known disposal systems	**5**	**1,294**	**37**	**166**	**1,502**
Sewer Only	0	791	0	0	791
Unsewered	**5**	**503**	**37**	**166**	**711**
Sewered with Cesspool Card (closed cesspool?)	0	180	0	0	180
Large Capacity Cesspool (may overlap with cesspool card)	0	5	0	0	5
IWS with Final Approval or Inspection (may overlap with cesspool card)	3	53	7	35	98
Cesspool Card Parcels (closed?)	2	261	30	130	423
Estimated number of unrecorded disposal systems (cesspools)*	**8**	**475**	**36**	**793**	**1,222**
Parcel w/ bldg value >$25,000	8	386	25	486	905
Parcels w/known housing developments	0	89	11	217	317
Parcels w/bldg value <$25,000	64	263	13	80	420
Total estimated disposal systems (Records + unrecorded)	13	1,769	73	959	2,724
Total evaluations	77	2,032	86		3,144

- Parcels with a Building Value Greater than $25,000 appear to have structures on them due to their layout, zoning, dwelling unit data, and building value. For the purposes of this report, parcels with these attributes were assumed to have a bathroom and a cesspool for disposal, as they are beyond sewer service areas. Google Earth Satellite photos, personal information, and newspaper accounts of home sales were used to verify these structures.
- Many parcels within known housing development project areas that have full land use and zoning approvals were apparently developed (based on physical evidence, real estate ads, and best professional judgement), but with no cesspool /sewer information or building value found. It is likely that these new developments occurred after 2006, or the data has not yet been input to the DOH Wastewater Inventory. These parcels are assumed to have cesspools, as they are beyond sewer service areas.
- Parcels with low to no building value, no obvious road access, no satellite photo evidence and no personal verification were assumed to have no buildings and no cesspools.

Large Capacity Cesspool Closure

"A large capacity cesspool is one that discharges sanitary waste with human waste and serves: (1) a multiple dwelling; OR (2) a non-residential location with the capacity to serve 20 or more persons per day. Single-family homes connected to their own individual cesspool are not subject to the federal UIC regulations. The number of persons served by a residential cesspool and the quantity of flow received by a cesspool are not specific considerations in the federal definition of a large capacity cesspool. However, if the flow to the cesspool is greater than 1000 gallons per day (gpd), it is also subject to the State of Hawaii's Underground Injection Control (UIC) rules regardless of the number of persons served per day, which are implemented by the Safe Drinking Water Branch, UIC program.[1]"

Table F-2: Large Capacity Cesspool Inventory for Nawiliwili Bay Watershed

TMK	Owner	Major Owner	Tax Acres	Owner	Owner/Use	Treatment	Closed Date		Are They Closed?
							Original EPA Required	Revised	
State and Kauai County Government									
433005008	County of Kauai	County of Kauai	4.38	Puhi Park	County of Kauai	Septic Tank	4/5/05	9/30/06	Closed 1/24/08
436002003	State of Hawaii	State of Hawaii	2.68	Lihue County Park	County of Kauai	Septic Tank	4/5/05	9/30/06	Closed 1/24/08
438005013	State of Hawaii	State of Hawaii	2.47	Dept of Water	Micro Lab	Septic Tank	4/5/05	9/30/06	Closed 1/24/08
432004005	Gomes, Mary A Trust	other	1.47		Nawiliwili Park		4/5/05	9/30/06	Closed 1/24/08
438005017	State of Hawaii	State of Hawaii	1.54				4/5/05	9/30/06	Closed 1/24/08

[1] EPA Region 9 Underground Injection Control http://www.epa.gov/region09/water/groundwater/uic-hicesspools.html Contact: Kate Rao (rao.kate@epa.gov) (415) 972-3533

State of Hawaii Dept. of Education									
432005010	State of Hawaii	State of Hawaii	9.06	Kauai High School	Dept. of Accounting	Septic Tank	4/5/05	9/30/09	No
432005011	State of Hawaii	State of Hawaii	8.71	Kauai HS	Guidance Center	Septic Tank	4/5/05	9/30/09	No
433003007	State of Hawaii	State of Hawaii	8.12	Kauai HS	-	Septic Tank	4/5/05	9/30/09	No
433003009	State of Hawaii	State of Hawaii	1.76	Kauai HS	-	Septic Tank	4/5/05	9/30/09	No
433003015	State of Hawaii	State of Hawaii	3.09	Kauai HS	-	Septic Tank	4/5/05	9/30/09	No

All Large Capacity Cesspools in Hawaii were required to be closed by April 5, 2005 by order of the EPA Region 9 Consent Agreement and per 40 C.F.R. § 144.88. None of the LCCs in the Nawiliwili Bay Watershed (see table above) were closed by the initial regulatory date. The State of Hawaii and the County of Kauai fulfilled their Consent Agreement and Final Order for UIC AO 2005-0006 by January 24, 2008, closing five large capacity cesspools. However, the five remaining LCCs on the Kauai High School property are still in operation. They are scheduled to be closed on September 30, 2009 by the State of Hawaii Department of Education according to Consent Agreement UIC-AO-2006-001, with the following requirements:

- Respondent shall close the large capacity cesspools referred to in paragraph 8 in accordance with 40 C.F.R. § 144.89(a) no later than September 30, 2009.
- If the alternative treatment technology is a septic tank system, an effluent filter is required prior to disposal into the leach field or seepage pit. Respondent shall apply for and obtain state underground injection control permits for all systems requiring such permitting. Any alternative wastewater treatment system must be approved by the Hawaii Department of Health prior to any construction. Respondent shall consult with the Hawaii Department of Health Wastewater Branch during planning and design to ensure the adequacy of all alternative wastewater systems.
- Within 6 months of signature of the Final Order, Respondent shall provide EPA with a detailed schedule for closure of each large capacity cesspool listed in Table 1, identifying each large capacity cesspool by facility and TMK number. This schedule will identify the alternative treatment technology chosen, design completion date, construction initiation date for each of the alternative wastewater systems, date that an Engineer's Report will be submitted to EPA and Hawaii Department of Health for each of the facilities, and date that each large capacity cesspool will be closed.

Proximity of Large Capacity Cesspools to Streams and Sampling Locations

The five LCCs closed by January 24, 2008 were all in operation during water quality sampling by Tetra Tech and the University of Hawaii Water Resources Research Center (WRRC), and thus may have affected impairment and loading caluclations in ways that may no no longer apply.

- Puhi Park (4:3:3:005:008) is located within 115 feet of Halehaka Stream, but it is likely that the actual park bath rooms are closer to the road, which is within 1500-2000 ft. of the main branch of Puali Stream.
- Nawiliwili Park (4:3:2:004:005) is within 155 ft of Nawiliwili Stream. Three WRRC sampling sites in nearby waterbodies (Kalapaki Beach, Marriot Culvert, and Big Trees) are within 500 ft of Nawiliwili Park. The WRRC Jetty site is within 1500-2000 ft. of the park.

- Lihue County Park (4:3:6:002:003), Kauai Department of Water Micobiology Lab (4:3:8:005:013) and a State of Hawaii facility (4:3:8:005:017) are all within 1000 ft. of the main branch of Nawiliwili Stream. If these sites are/were leaking to Nawiliwili Stream, they may have impacted the follwing downstream sampling sites : TetraTech Lower Nawiliwili Stream, and WRRC Nawiliwili, Kalapaki Beach, Marriot Culvert, and Pines Trees.

Each of the five LCCs still open is associated with Kauai High School, and each parcel involved lies within 500 ft of the main branch of Nawiliwili Stream; within 1000 ft of the WRRC water quality sampling sites at Big Trees, Kalapaki Beach and Marriot Culvert; and within 1500-2500 ft of Nawiliwili Bay and the WRRC Paplinahoa and Seaflite Jetty water quality sampling sites.

Figure F-1: Distribution of Wastewater Disposal Systems in the Nawiliwili Bay Watershed

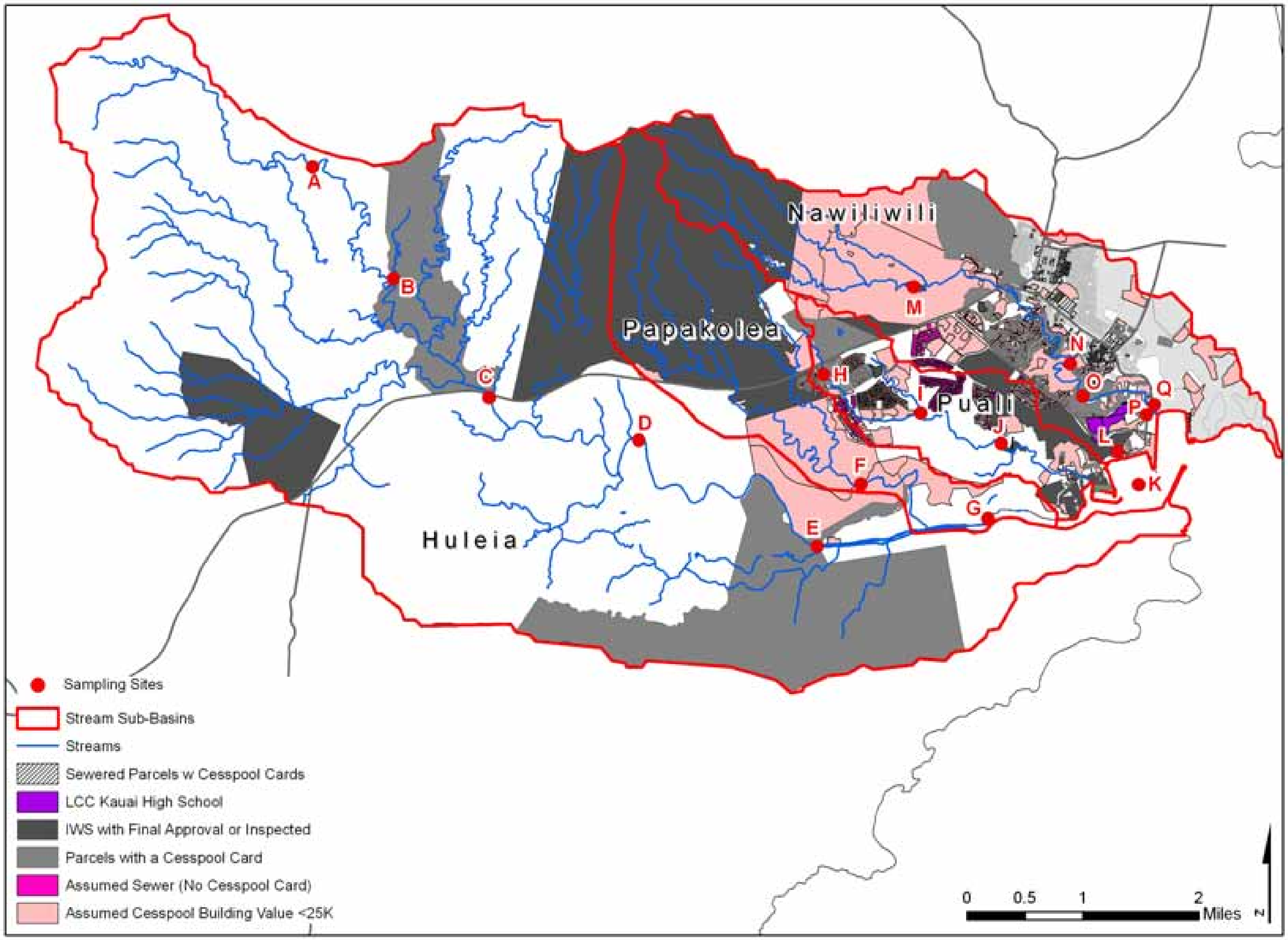
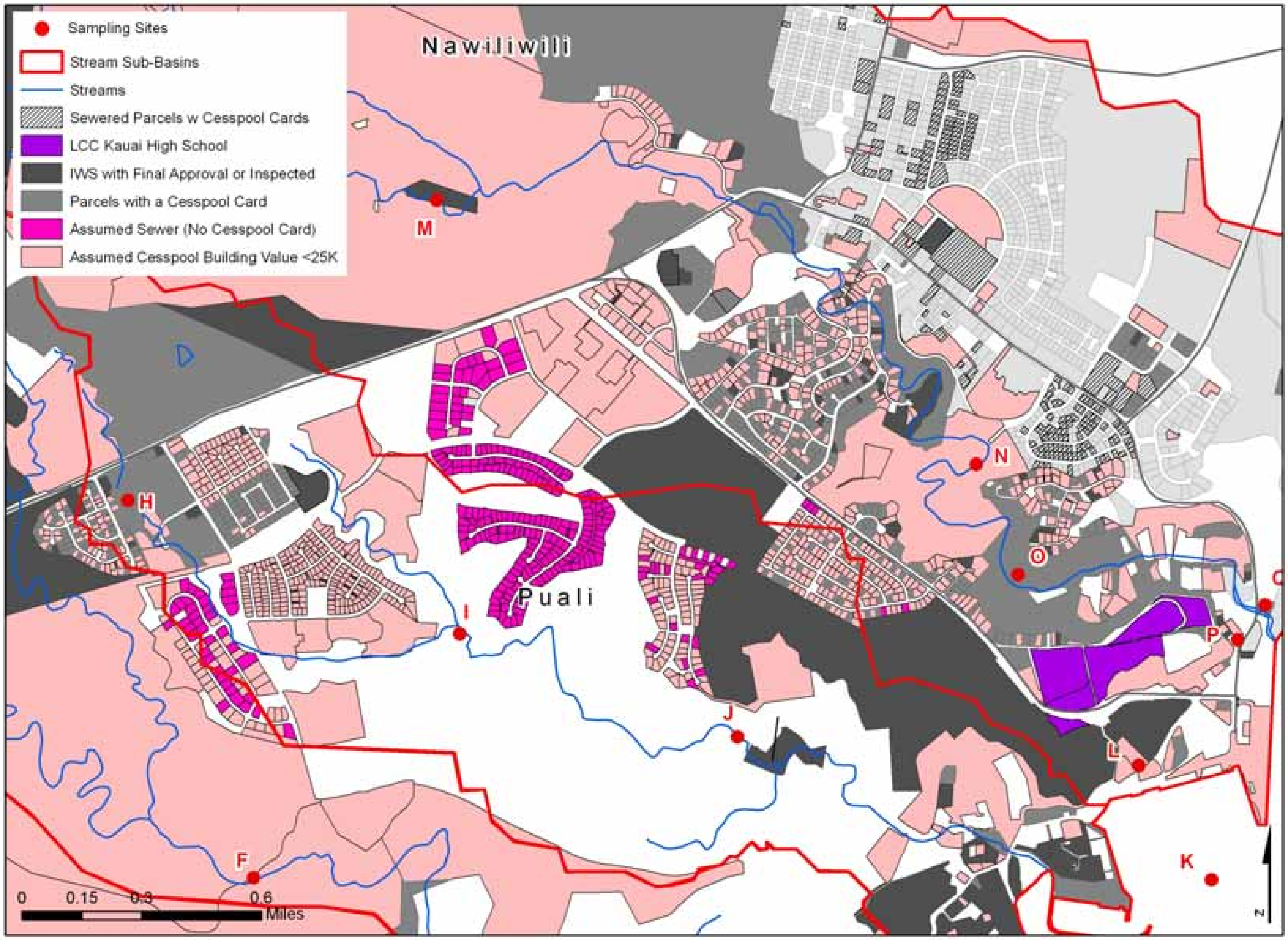


Figure F-2: Distribution of Wastewater Disposal Systems in the Lower Puali and Nawiliwili Sub-Basins



APPENDIX G – WASTEWATER SPILL INVENTORY

Date/Time Began	Overflow Location	Receiving Waterbody	Days Posted/Closed	Posting Location	Type of Overflow	Quantity	Cause of Overflow
07/16/00	Lihue Plantation, Lihue	Nawiliwili Stream			Scrubber water, Cane Washwater	48,000	Pumping station shut down required to repair major piping leak at cane washing operations, a discharge occurred from the mill water recycling system. 48,000 gallons of water from the power house scrubber was discharged to Nawiliwili Stream.
10/27 to 10/28/00	Lihue Plantation, Lihue	Nawiliwili Stream			Non-contact Cooling Water, Cane Washwater	400,000	Mechanical difficulties with variable speed pump, initially determined to be packing leakage (during intermittent flow), followed by pump failure at approximately 2300 hrs.
09/05/00	Haleko Road, Lihue Plantation	Nawiliwili Stream			Non-contact Cooling Water	150,000	Release of non-contact cooling water from the waste water retention facilities at Lihue Plantation's Haleko Road site, discharge was limited to one-pass non-contact cooling water used by the power plant for bearing and compressor heat transfer.
09/25/00	Pier Dock #2, Nawiliwili Harbor	Nawiliwili Harbor		N/A		1	Bilge slop release due to operator error.
01/06/02	Lihue WWTP	Nawiliwili Stream, Kalapaki Bay	5	Beach	Chlorinated Effluent	250,000	Primary effluent and back up pumps failed to start, causing overflow from manhole, secondary/chlorinated effluent spilled to ground, through golf course, ditch and entered Nawiliwili Stream, which leads to Kalapaki Bay.
07/17/03	Hardy and Kuhio Highway (Collection System)	Ground		N/A	Raw Sewage	800	Private lateral blocked by roots and grease caused discharge from clean out which flowed across the parking lot, down the driveway, and into the storm drain.

Date/Time Began	Overflow Location	Receiving Waterbody	Days Posted/Closed	Posting Location	Type of Overflow	Quantity	Cause of Overflow
05/20/04	Kauai Marriott, Nawiliwili (Collection System)	Nawiliwili Stream	7	Beach	Raw Sewage	23,000	Blockage in gravity line from the Kauai Marriott Hotel to the Kauai County PS was forcing raw sewage up through the ground. It appeared that the effluent might be coming from a buried manhole.
01/01/05	Kauai Marriott, Nawiliwili (Collection System)	Nawiliwili Stream	12	Beach	Raw Sewage	132,000	Due to heavy rains over the weekend. A sink hole caused a tree to fall, breaking a sewer line.
02/02/05	3610 Rice Street	Ocean		N/A	Raw Sewage	0	Force main break due to pre-existing sinkhole fronting Kauai Marriot Resort & Beach Club and getting bigger.
7/16 to 7/17/04	MH adjacent to Marriott Hotel	Storm drain, Kalapaki Bay	4	Beach	Raw Sewage	2,000	Pump failures at the County's Marriott Pump Station during the night of 7/16/04. Pump #1 failure was due to pump going into an "incomplete sequence" which shutdown the pump.
8/9-13/07	Kauai Marriott (Pali Kai Cottage on the adjacent cliffs)	Nawiliwili Harbor	4	Shoreline	Raw Sewage		Minor leak due to a break in the line from Pali Kai Cottage. Estimated spill was from 1 to 5 gallons a minute and had been on-going for a couple of weeks.

Source: Scott Miyashiro, Hawaii Department of Health-Clean Water Branch

APPENDIX H– ESTUARY WATER QUALITY SCREENING RESULTS

Nawiliwili Bay is listed for turbidity and nutrient impairment from breakwater to shore and for nitrate+nitrite nitrogen (N+N), ammonium, turbidity, and chlorophyll-a at the offshore embayment station. Water quality was measured at the Nawiliwili offshore embayment sampling site at various depths during about 100 different sampling episodes between 1990 and 1997. The geometric mean of the Total Nitrogen (TN) concentration and chlorophyll-a concentration exceeded Hawaii water quality criteria. During the winter of 2003, water quality samples were collected at the Nawiliwili Harbor station after three storm events. Geometric mean water quality criteria were exceeded for turbidity and TN. This Appendix presents the modeling approach used to evaluate the contribution of stream sources to the nitrogen impairment of the estuary.

One of the keys to assessing turbidity impairment in Nawiliwili Bay is to establish a cause-and-effect relationship between turbidity and mass-conserving constituents such as TSS and organic matter content. Organic matter and algae concentrations are elevated further by biological and eutrophication processes caused by excessive nutrient loading. Because site-specific data are not available to analyze the relationship of turbidity and TSS and algae, the turbidity response of Nawiliwili Bay to the stream load reduction was not assessed. Total phosphorous was not evaluated because it is generally not identified for load reductions in Section 4.3.

1. Approach and Model Inputs

The bay is protected by a 2,050 feet long rubble-mound breakwater. The breakwater protects the inner bay from impact of tidal and wind waves. Nawiliwili Bay acts like a lake in that there are long residence times and low flow velocities because of the breakwater embankment. This condition allows the upland stream loads to impact the bay water quality directly. A simplified Water Quality Analysis Simulation program (WASP) was developed to evaluate the response of Nawiliwili Bay to nitrogen load reductions in Huleia, Papakolea, Puali, and Nawiliwili Streams. WASP is a dynamic compartment model that can be used to analyze a variety of water quality problems in rivers, lakes, and estuaries. The inputs include model segmentation, transport coefficient, boundary concentration, point and diffusive pollutant load, kinetic parameters, constants, flow and load time functions, and initial conditions. Water residence time was primarily controlled by inflows from the inland streams; therefore, tidal-driven circulation was not considered.

Purpose and Limitations. The purpose of the model is to evaluate the water quality response of Nawiliwili Bay and Huleia Estuary to stream load reductions, specifically TN reduction, identified in Section 4.3. The model is not calibrated with baseline water quality data and may not represent site-specific conditions. The assessment of Nawiliwili Bay and estuary water quality is based on limited water quality data and minimal temporal and spatial resolutions within the water body. A complete hydrodynamic analysis that incorporates tidal circulation and comprehensive water quality sampling and modeling is beyond the scope of this TMDL decision process; therefore, this assessment is only intended for screening purposes.

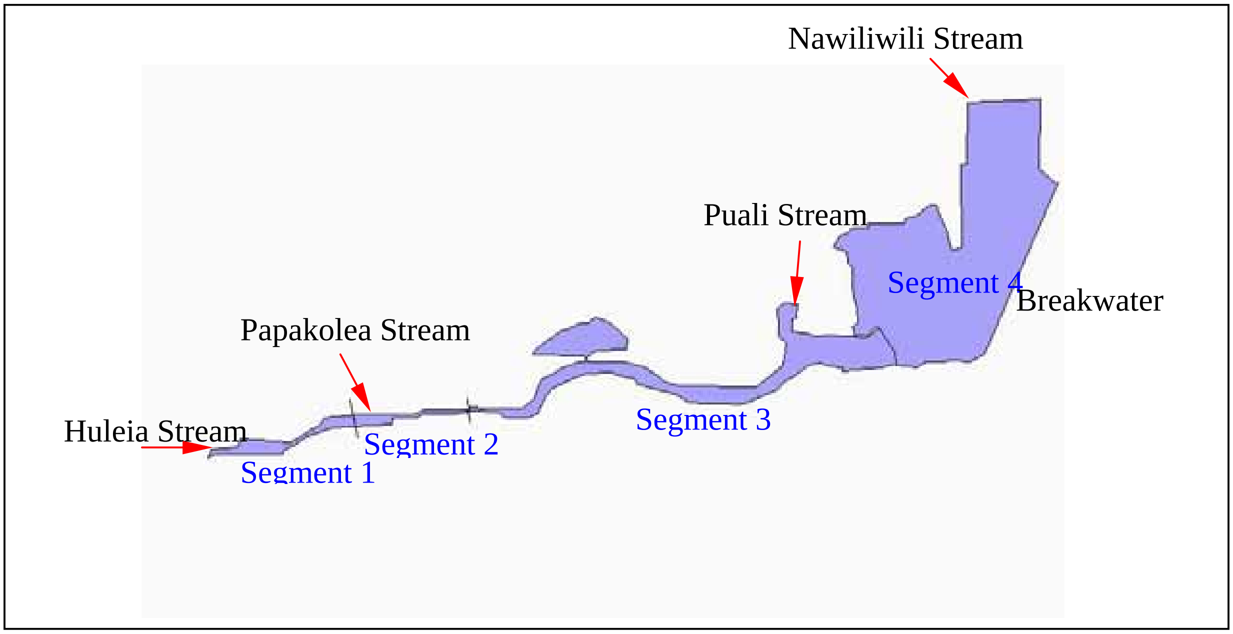
Model Inputs. Huleia Estuary and Nawiliwili Bay were divided into four segments that receive flow and loads from four streams. The segments are shown in Figure J-1, with the geometric and hydraulic parameters given in the Table I-1 below

Table H-1: WASP Segment Geometry

Segment Number	Segment Name	Length (m)	Width (m)	Depth (m)	Volume (m^3)	Travel Time[1] (days)	Velocity[1] (m/s)
1	Huleia Estuary Segment 1	700	40	1	28,000	0.12	0.0666
2	Huleia Estuary Segment 2	738	40	1.1	32,472	0.11	0.0750
3	Huleia Estuary Segment 3	2463	120	2.1	620,676	2.15	0.0133
4	Nawiliwili Bay Segment 4	1,112	764	6.1	5,182,364.8	16.21	0.0008

Notes:
cm Cubic meters
lb/d Pounds per day
m Meter
m/s Meters per second
[1] Based on base flow rate. During storm this number goes higher.

Figure H-1: WASP Model Huleia Estuary and Nawiliwili Bay Segments



Given that the assessment only requires screening-level analysis and detailed water quality data are not readily available, the simplified estuary modeling incorporated the following assumptions:

1. Initial chemical concentrations are set to water quality criteria.
2. The diffuse loads from the land directly connected to the bay are not evaluated.
3. Tidal effects are not incorporated due to the poor estuary mixing and long residence time.
4. All nutrient loads to the bay are considered dissolved.
5. Each segment of the four segments is well mixed.
6. Organic nitrogen is approximated by subtracting N+N from TN. N+N:TN ratio is determined based on sampling data.
7. TP and TSS are not simulated due the low level of TP loading and the lack of data to support TSS analysis.
8. The water temperature is the same as air temperature.

Huleia Estuary and Nawiliwili Bay receive loads from Huleia, Papakolea, Puali, and Nawiliwili Streams. Two primary inputs to the WASP model are daily flow rates and loads from these four streams. The existing flow rates are estimated by adding base flows as presented in 3.3 and storm flows. The storm flows are calculated using the regression equations included in Figure 3-6, drainage areas for each stream, and average daily precipitation. The existing loads from these four streams were calculated by adding base flow loads (Table 3-6) and storm loads (calculated by multiplying the storm volume and derived storm flow concentration, Table 3-7). The total loads from each stream are summarized below in Table H-2. Nawiliwili Stream provides a predominant load to the estuary, although its drainage area is much smaller than Huleia Stream. The highly urbanized runoff in Nawiliwili Stream may contribute to elevated nutrient concentration in the stream water, and subsequently, in the bay. Significant loading is also estimated from the Huleia and Papakolea Streams.

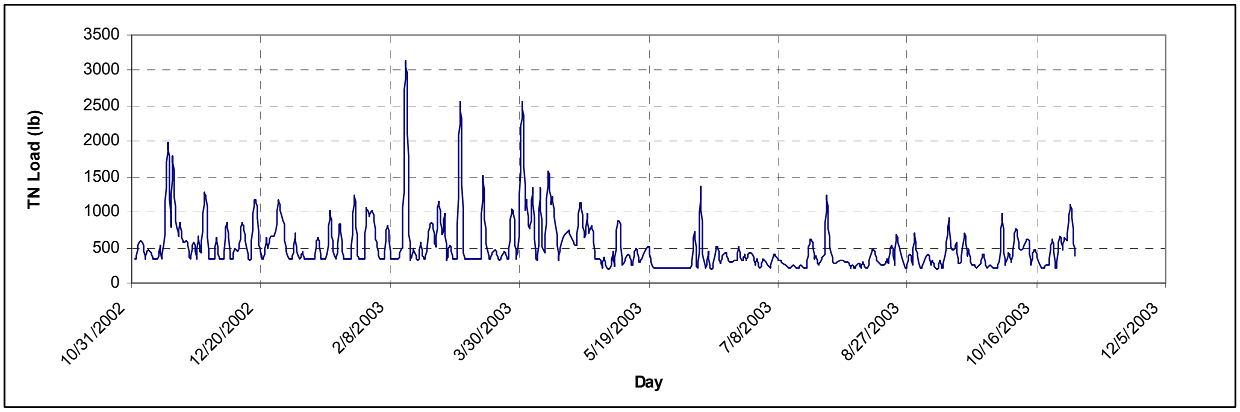
Table H-2: Existing Annual Loads to Nawiliwili Bay

Stream	TSS (lb)		TP (lb)		TN (lb)	
	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Huleia Stream	2,105,119	1,183,723	2,653	1,501	46,524	27,866
Nawiliwili Stream	5,529,687	3,029,420	2,392	1,354	31,183	20,040
Papakolea Stream	3,094,198	1,716,806	1,061	585	33,215	17,025
Puali Stream	508,869	278,845	364	204	3,662	1,816
Total Annual Load to Bay	11,237,873	6,208,794	6,470	3,643	114,584	66,748

Notes:
TN Total nitrogen
TP Total phosphorus
TSS Total suspended solids

The following figure (H-2) shows approximate variation in total daily TN loads for 2003. It indicates higher TN loading in the wet season than in the dry season, primarily due to the greater frequency and magnitude of storm events. The months of March and April deliver the highest loads of the year. A similar trend is observed for TSS and TP.

Figure H-2: Total Daily TN Load to Nawiliwili Bay from Streams



2. Model Results

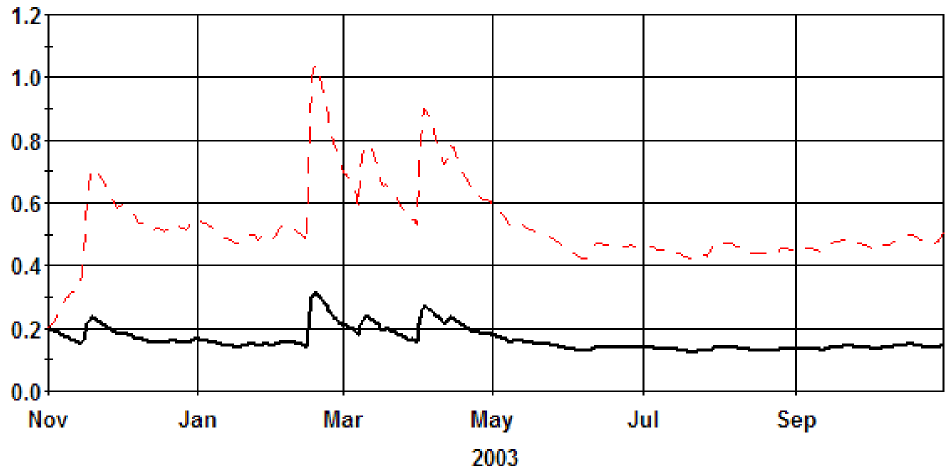
Results of the WASP model suggest that TN concentrations in the bay are generally higher in winter and exceed the embayment 0.3 mg/L geomean water quality criterion throughout the year. In summer, TN decreases as the streams provide less flow and loading than in winter. The model indicates that load reductions in four streams would lower the TN concentration in the bay, and a 70 percent reduction in TN loading from the four streams would allow the estuary to meet water quality the water quality criterion of 0.2 mg/L.

Table H-3: Geometric Mean of TN Concentration in Nawiliwili Bay

Scenarios	Wet (mg/L)	Dry (mg/L)
Exiting Concentration	0.57	0.47
After 70 Reduction	0.18	0.14

The simulated TN concentrations in the Nawiliwili Bay before and after the load reductions are presented below (Figure H-3) suggesting that TN concentration in the bay follows a similar seasonal loading trend. However, the response is not as acute as in the estuary due to dilution effects in the larger embayment.

Figure H-2: Simulated Total Nitrogen Concentration in Nawiliwili Bay



Dashed Red Line – Response to existing load
Solid Black Line – Response after 70 % reduction in upland streams

Discussion.

Nawiliwili Bay receives pollutant loads from four streams that result in the elevated turbidity and nitrogen levels. Turbidity is a measure of water clarity that refers to the intensity of light scattered or absorbed by suspended matter, dissolved organic compounds, and plankton in the water sample. Turbidity is measured using the dimensionless NTU, which is a measure of optical properties rather than mass-based concentration. It is thus difficult to evaluate turbidity as mass load in the estuary model. Quantifying the relationship between pollutant mass loads and turbidity is a necessary first step towards completing the TMDL. Therefore, one of the keys in assessing turbidity impairment in Nawiliwili Bay is to establish a cause-and-effect relationship between turbidity and mass-conserving constituents such as TSS and organic matter content. Organic matter and algae concentrations are elevated further by biological and eutrophication processes caused by excessive nutrient loading. Because the site-specific data are not available to analyze the relationship of turbidity and TSS and algae, the turbidity response of Nawiliwili bay to the stream load reduction was not assessed. Total phosphorous was not evaluated because it is generally not identified for load reductions in Section 4.3.

APPENDIX I – DOCUMENTATION OF PUBLIC PARTICIPATION PROCESS

- Classified Ad and Affidavit of Publication-Notice of Public Information Meeting – The Garden Island Newspaper, July 30, 2008
- Classified Ad and Affidavit of Publication -Notice of Public Information Meeting – Honolulu Star-Bulletin, July 30, 2008
- List of Addresses Receiving Direct Notice of Public Information Meeting
- Nawiliwili TMDL Public Information Meeting Sign-In Sheet
- Nawiliwili TMDL Fact Sheet
- Alexander & Baldwin Comment & DOH Response to Comment
- Bushnell, Andrew Comment & DOH Response to Comment
- Grove Farm Company, Inc. Comment & DOH Response to Comment
- Hawaii Farm Bureau Federation Comment & DOH Response to Comment
- Jas W. Glover, Ltd. Comment & Response to Comment
- Kauai Marriott Resort and Kauai Lagoons, LLC Comment & DOH Response to Comment

STATE OF HAWAII
COUNTY OF KAUAI
AFFIDAVIT OF PUBLICATION

THE GARDEN ISLAND

BARBARA MATSUNAGA
DOH-ENVIRONMENTAL PLANNING OFF
919 ALA MOANA BLVD ROOM 312
HONOLULU HI 96814

REFERENCE: 114534
703671 (TMDLs) NAWILIWILI BAY WATERSHED

Diean Kamauoha, being duly sworn, deposes and says, that she is an employee of "The Garden Island," a newspaper published in Lihue, County of Kauai, State of Hawaii; that the NOTICE in the above entitled matter of which the annexed is a true and correct copy, was published 1 time(s) in "The Garden Island" aforesaid and that this affiant is not a party to or in any way interested in the above entitled matter.

Diean Kamauoha

Subscribed and sworn to before me this 11th day of August, 2008.

Carmencita P. Centeno

CARMENCITA P. CENTENO
Notary Public, Fifth Judicial Circuit
State of Hawaii
My Commission Expires: July 25, ~~2008~~ 2012

PUBLISHED ON: 07/30/2008

FILED ON: 07/30/08

NOTICE OF PUBLIC COMMENT PERIOD AND PUBLIC INFORMATION MEETING - TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR NAWILIWILI BAY WATERSHED, ISLAND OF KAUAI, HAWAII

The proposed decision will affect water pollution control permits and provide guidance for other planning and regulatory approvals (e.g. land use and environmental management) within the Nawiliwili Bay watershed.

Under §303(d) and §303(e) of the Federal Clean Water Act, 33 U.S.C. §1313(d) and §1313(e), and 40 CFR §130.7 and §130.5, the State of Hawaii Department of Health (DOH) requests public comments on proposed total maximum daily loads (TMDLs) of total suspended solids, nitrate+nitrite nitrogen, total nitrogen, total phosphorus, and enterococcus (bacterial indicator) in four major streams (Huleia, Papakolea, Puali, and Nawiliwili) of the Nawiliwili Bay Watershed, Kauai. The proposed decision divides each of these twenty TMDLs (each TMDL addresses a single waterbody-pollutant combination) into load allocations (LAs) for various sources of polluted runoff and diffuse pollution (nonpoint sources), and wasteload allocations (WLAs) for point sources of these pollutants (point sources are facilities regulated by National Pollutant Discharge Elimination System, or NPDES, permits). The WLAs proposed involve stormwater discharges from six NPDES-permitted industrial facilities within the Nawiliwili Bay watershed – the Jas. Glover Rock Quarry (operating under individual permit coverage); Polynesian Adventure Tours, Inc. Lihue Baseyard; Puhi Metals Recycling Center; Kauai Commercial Company, Inc.; Halehaka Landfill; and Lihue-Puhi Wastewater Treatment Plant (each operating under general permit coverage).

The proposed TMDLs, LAs, and WLAs are presented in a draft decision document entitled "Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii." This draft document is available for public inspection Monday through Friday between 7:45 am and 4:30 pm in the Environmental Planning Office (EPO), DOH, 919 Ala Moana Boulevard, Room 312, Honolulu, Hawaii 96814; the Kauai District Health Office, DOH, 3040 Umi Street Lihue, Hawaii 96766; and the East Kauai Soil and Water Conservation District, 4334 Rice Street, Rm. #104, Lihue, Hawaii 96766. For a copy of the draft document, please phone the EPO at (808) 586-4337, fax the EPO at (808) 586-4370, send e-mail to barbara.matsunaga@doh.hawaii.gov, visit our web site at http://www.hawaii.gov/health/epo, or mail a request to the EPO postal address below.

In order to be considered in the decision making process, all comments on the proposed decision must be received in writing (fax and e-mail acceptable) no later than 4:30 PM on Tuesday, September 02, 2008, except that comments postmarked or shipped by this deadline will also be accepted. Send comments to the Program Manager, Environmental Planning Office, State of Hawaii Department of Health, 919 Ala Moana Boulevard, Room 312, Honolulu, HI 96814; kelvin.sunada@doh.hawaii.gov; or fax to (808) 586-4370. Public comments and the DOH response will be used to revise the draft decision document, as necessary, for final EPA approval of the proposed TMDLs.

A public information meeting on the proposed TMDLs is scheduled for Wednesday, August 13, 2008, from 6:30 – 8:30 PM in the Niumalu Park Pavilion, Niumalu Road, Lihue, Hawaii 96766. The purpose of the meeting is to explain why the TMDLs are being established, the methods used to calculate the allocations, and the results of these calculations, and to discuss the relationships between these TMDLs, efforts to improve water quality in the Nawiliwili Bay watershed, and the State's water quality management planning process in general.

If you require special assistance or auxiliary aids or services to participate in the meeting (i.e. sign language interpreter, wheelchair accessibility, or parking designated for the disabled), please contact EPO (at the numbers/addresses shown above) no later than August 08, 2008 so that arrangements can be made.

Chiyome L. Fukino, M.D.
Director of Health

(July 30, 2008)

IN THE MATTER OF

Public Notice

AFFIDAVIT OF PUBLICATION

STATE OF HAWAII } SS.

City and County of Honolulu

Rose Mae Rosales being duly sworn, deposes and says that she is a clerk, duly authorized to execute this affidiavit of MidWeek Printing, Inc. publisher of MidWeek and the Honolulu Star-Bulletin, that said newspapers are newspapers of general circulation in the State of Hawaii, and that the attached notice is true notice as was published in the aforementioned newspapers as follows:

Honolulu Star-Bulletin 1 times on:

07/30/2008

Midweek Wed. 0 times on:

Midweek Fri. 0 times on:

______ times on:

And that affiant is not a party to or in any way interested in the above entitled matter.

Subscribed to and sworn before me this 30th day

of July A.D. 20 08

Notary Public of the First Judicial Circuit
State of Hawaii

My commission expires: October 07, 2010

Ad # 0000055733

NOTICE OF PUBLIC COMMENT PERIOD AND PUBLIC INFORMATION MEETING
- TOTAL MAXIMUM DAILY LOADS (TMDLs)
FOR NAWILIWILI BAY WATERSHED, ISLAND OF KAUAI, HAWAII

The proposed decision will affect water pollution control permits and provide guidance for other planning and regulatory approvals (e.g. land use and environmental management) within the Nawiliwili Bay watershed.

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Chiyome L. Fukino, M.D.
Director of Health
(SB55733 7/30/08)

PATRICIA K. REESE
NOTARY PUBLIC
Comm. No. 86-467
STATE OF HAWAII

LN: ______

Addressees receiving personalized notice letters about the ‘availability of the draft rationale for a proposed water quality decision concerning “Total Maximum Daily Loads for Nawiliwili Bay Watershed" (with the public notice enclosed)

Ms. Maile Romanowski, President Jas. W. Glover, Ltd. P.O. Box 579 Honolulu, Hawaii 96809	Mr. Stephen G. Holaday, President Kauai Commercial Company, Inc. 822 Bishop Street Honolulu, Hawaii 96813
Mr. Glenn Kawamura Polynesian Adventure Tours, Inc. 1049 Kikiowaena Place Honolulu, Hawaii 96819	Mr. Donn R. Campion 15280 Bohlman Road Saratoga, California 95070
Mr. Alvin Kyono, Kauai Branch Manager State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife 3060 Elwa Street, Rm. 306 Lihue, Hawaii 96766	Mr. Steven Kyono, Kauai District Engineer State of Hawaii Department of Transportation Highways Division 1720 Haleukana Street Lihue, Hawaii 96766
Mr. Ted Inouye, Chair East Kauai Soil and Water Conservation District P.O. Box 278 Hanamaulu, Hawaii 96715	Mr. Warren Haruki, CEO Grove Farm Company, Inc. & Grove Farm Properties, Inc. P.O. Box 662069 Lihue, Hawaii 96766-7069
Kauai Aquatic Life and Wildlife Advisory Committee, State of Hawaii Department of Land and Natural Resources c/o Mr. Jeffrey Bryant 9825 Uuku Road Waimea, Hawaii 96796	Kauai Aquatic Life and Wildlife Advisory Committee, State of Hawaii Department of Land and Natural Resources c/o Mr. Edson Martin 6022G Olohena Road Kapaa, Kauai 96746
Ms. Liz Cervantes, Manager Kauai Marriott Resort & Beach Club 3610 Rice Street Lihue, Hawaii 96766	Mr. Ian Costa, Director County of Kauai, Planning Department 4444 Rice Street, Suite 473 Lihue, Hawaii 96766
Mr. Donald Fujimoto, Director County of Kauai, Department of Public Works 4444 Rice Street, Suite 275 Lihue, Hawaii 96766	Mr. Gilbert Kea, President Garden Island Resource Conservation and Development, Inc. c/o Laurie Ho, NRCS RC&D Coordinator 3083 Akahi Street, Suite 204 Lihue, Hawaii 96766-1102
Kauai Watershed Alliance c/o Mr. Trae Menard, Program Director The Nature Conservancy Kaua‘i Program 4180 Rice Street, Suite 102 B Lihu‘e, Hawai‘i 96766	Mr. Kalani Fronda, Kauai Land Manager Kamehameha Schools P.O. Box 3466 Honolulu, Hawaii 96801
To Whom It May Concern Lihue Land Company, Inc. P.O. Box 662069 Lihue, Hawaii 96766-7069	Mr. Robert Schleck, Director Nuhou Corporation P.O. Box 1631 Lihue, Hawaii 96766

Mr. Gavin Hubbard, Director Okada Trucking Company, Ltd. 818 Moowaa Street Honolulu, Hawaii 96817	Mr. Robin C.A. Rice, President Wm. Hyde Rice, Ltd. P.O. Box 1391 Lihue, Hawaii 96766
Mr. Mike Hawkes, Refuge Manager Huleia National Wildlife Refuge U.S. Fish and Wildlife Service P.O. Box 1128 Kilauea, Hawaii 96754	

Dept of Health TMDL
Nawiliwili

Aug 13, 2008

Name	Contact
Monika Mira	surfkalapaki@gmail.com
Sara Bowen	Sara.bowen@hi.racdnet.net
Roy Oyama	West Kauai Soil + Kauai Farm B[illegible]
Steven Kyono	HDOT-HIGHWAYS DIV. 241-3000
Raymond McCormick	HDOT - HIGHWAYS DIV. 241 3000
LEX RIGGLE	4334 RICE ST., LIHUE 96766 245-9014 ext.
Laurie Ho	3083 Akahi St, Ste. 204, Lihue 96766 246-009[illegible]
Gary Ueunten	DOH CWB Kauai 241-3323
TESSIE KINNAMAN	P.O. Box 464 Koloa, HI 96756
Cheryl Lovell-Obatake	P.O. Box 366 Lihue, HI 96766 kuhiau@hotm[illegible]
Ken Shinsato	Aqua Engineers 3560 Koloa Rd Kalaheo 967[illegible]
Mike Mitchell	michael_mitchell@fws.gov 828-1413
Sean O'Keefe	sokeefe@hcsugar.com
Janet Ashman	ashman.janet@gmail.com
Carl Berg	cberg@pixi.com
JEFF POULLATH	2110 Kaneka St. Apt. 112 LIHUE, HI 96766 808/[illegible]
DAVID PIRIE	JAS. W. GLOVER LTD. 245-3609
Guy Moriguchi	PO. BOX 945, Koloa Hi 96756 332-[illegible]
MAHELANI SILVA	P.O. BOX 927 LIHUE HI 96766 NALEOHAWAIIAN@AOL.COM 808-635-973[illegible]
Pomaikai Kane	PO Box 3502 Lihue pkaneautoplus@yahoo 6512792

<u>Nawiliwili Bay TMDL Update (August 13, 2008)</u>

What is the TMDL Process [State of Hawaii Department of Health (DOH)]?

- identify activities that help reduce pollutant loads, improve water quality, and increase our ability to support legally-protected uses (such as recreation, aesthetic enjoyment, ecosystem protection, and native breeding).
- these activities may be favored to receive funding from DOH [Clean Water Act Section 319(h) grants] and may also qualify for funding from other sources.
- the process starts with identifying places where water quality is "limited" or "impaired."

Why is Nawiliwili Bay part of this process?

Early assessment of Nawiliwili Bay, visual inspections of streams (1996), and later information identified several areas where water quality is "limited" or "impaired" at Huleia, Papakolea, Puali, and Nawiliwili Streams. The limitations/impairments include:

- Excessive sediment (indicated by total suspended solids and/or turbidity) in all 4 streams
- Excessive nitrogen (as nitrate + nitrite and/or total nitrogen) in all 4 streams
- Excessive phosphorus in Papakolea and Nawiliwili streams
- Excessive levels of indicator bacteria (enterococcus) in all 4 streams

The complete statewide list of impaired waters and supporting information can be viewed online at www.hawaii.gov/health/environmental/env-planning/wqm/303dpcfinal.pdf or requested from DOH (see contact information on the other side of this flyer).

What happens next?

- To satisfy federal Clean Water Act requirements, the U.S. Environmental Protection Agency (EPA), DOH, TetraTech, Inc., AECOS, Inc., Jack D. Smith, and the Research Corporation of the University of Hawaii conduct a federally-funded water quality planning process for four major streams that flow into Nawiliwili Bay.
- Based on calculations of existing pollutant loads and their relationship with State water quality standards, we suggest how pollutants, pollutant source areas, and stream environments could be managed to achieve necessary water quality improvements.
- We submit Total Maximum Daily Loads (TMDLs), which establish the maximum rate at which these waters can receive certain pollutants (in this case, bacterial indicators and sediments) without exceeding the State's water quality standards, for EPA approval after the public review process is completed.
- DOH will continue working with the watershed community to plan actions for reducing pollutant loads, improving water quality, and supporting protected uses in specific problem areas.
- A community prescription for watershed health can already be found in the "Assessment and Protection Plan for the Nawiliwili Watershed ", which is a "Watershed-Based Plan" that includes the nine components specified by EPA guidance for such plans. (www.epa.gov/fedrgstr/EPA-WATER/2003/October/Day-23/w26755.htm).
- The actions identified in the TMDL decision and the Watershed Based Plan may be prioritized to receive funding from the Department of Health [Clean Water Act Section 319(h) grants] and may also qualify for funding from other sources.

Where do we get more information about this project? **other side>**

Nawiliwili Bay TMDL Update (August 13, 2008)

Who is responsible for this project?

- The Total Maximum Daily Load (TMDL) Program is a cooperative effort of the U.S. Environmental Protection Agency (EPA) and the State of Hawaii Department of Health (DOH).
- The program is coordinated by the DOH Environmental Planning Office with technical assistance from the DOH Clean Water Branch and the DOH State Laboratories Division.
- Community interests help us identify water pollution problems and create water quality solutions in the Nawiliwili Bay watershed.

Department of Health Contact Information

State of Hawaii Department of Health (Chiyome Leinaala Fukino, M.D., Director)
Environmental Health Administration (Laurence K. Lau, Deputy Director)

Environmental Planning Office (Kelvin H. Sunada, Program Manager)
919 Ala Moana Boulevard, Third Floor
Honolulu, HI 96814
PHONE (808) 586-4337 **271-3141+ 64337 TOLL-FREE FROM KAUAI**
FAX (808) 586-4370 **271-3141+ 64370 TOLL-FREE FROM KAUAI**

David Penn, Total Maximum Daily Load Coordinator david.penn@doh.hawaii.gov
Alexandre Remnek, Environmental Engineer alexandre.remnek@doh.hawaii.gov
Linda Koch, Assessment Coordinator linda.koch@doh.hawaii.gov
Renee Kinchla, RCUH Water Quality Assessment Specialist renee.kinchla@doh.hawaii.gov

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Where do we get more information about TMDLs?

National TMDL program information **www.epa.gov/owow/tmdl**
The DOH Environmental Planning Office website at **www.hawaii.gov/health/epo** includes:

- TMDL technical reports and implementation plans
- stream biological assessment reports
- Statewide Clean Water Act §303(d) list of Impaired Waters
- Various Water Quality Standards information and water quality reports

The DOH Clean Water Branch website at
www.hawaii.gov/health/environmental/water/cleanwater/index.html includes:

- Monitoring and Analysis Program information (including Current Warnings, Advisories, and Closures)
- Water Pollution Control Permit information (NPDES and Water Quality Certification)
- Polluted Runoff Control Program information [Clean Water Act Section 319(h) grants]

What about enforcement?
Federal, state, and local law do not explicitly require nonpoint source TMDL implementation and nonpoint source TMDLs are not enforced as such by federal, state, and local authorities. EPA and DOH enforce ambient water quality standards, water pollution control permit conditions, and water pollution control permitting requirements.

What is the TMDL Process [State of Hawaii Department of Health (DOH)]? **other side>**

ALEXANDER & BALDWIN, INC.

September 2, 2008

State of Hawaii Department of Health
Environmental Planning Office
Attention: Mr. Kelvin Sunada
919 Ala Moana Boulevard, Room 312
Honolulu, HI 96814

Subject: **Total Maximum Daily Loads for Nawiliwili Bay Watershed**

Dear Mr. Sunada:

Alexander and Baldwin, Inc. (A&B) is pleased to provide comments regarding the draft report entitled *Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii.* An A&B subsidiary, Kauai Commercial Company, Incorporated (KCC), is located within the watershed and discharges stormwater associated with industrial activity into a tributary of Puali Stream; as such, KCC is potentially impacted by Waste Load Allocations (WLAs) presented in the draft document.

While A&B recognizes that the water quality data presented in the draft TMDL document indicates the need for load reductions to achieve current water quality standards, we believe that some revisions to the document are needed to improve the reliability of load reduction estimates.

Linkage Methodology

Of major concern to A&B is the linkage methodology used in the draft TMDL document to establish a relationship between the pollutant indicators, numeric targets, and estimated loadings. While we acknowledge that long-term and continuous stream flow and precipitation data were not available for the streams within the decision area, and that a creative means of addressing this data gap was needed, we have serious questions regarding the scientific validity of the "regional monitoring" approach used.

The regional monitoring approach, which uses stream flows in "similar" gaged streams to estimate stream flows in the ungaged streams of interest, essentially assumes that a watershed on Kauai (or indeed even on Oahu) with similar land use characteristics to a watershed of interest will generate the same stream flow response (in terms of flow per square mile of watershed) to a given rainfall event. This assumption ignores potentially significant differences in the hydrogeology of watersheds even on the same island. Clearly, the watershed hydrogeology will markedly effect both the base flow in the

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streams (which figures prominently in the linkage analysis) and the stream flow responses to rainfall events. For example, the southern Lihue Basin (which encompasses the Nawiliwili Bay Watershed), characterized by a thick lens of fresh groundwater in a large region of low permeability, is known to differ geologically from other areas of the Hawaiian Islands to the extent that application of the conventional models explaining modes of occurrence of groundwater in Hawaii has not been successful in this region. Groundwater discharge through streams and springs constitutes the main path for natural outflow from the aquifer in this area, which may contribute to higher base flows as compared to streams (particularly on Oahu) with differing hydrogeology.

Rainfall distribution across the watershed is another variable that is a driving factor in estimating stream flows. Although rainfall was one factor that was considered in selecting "similar" gaged streams for use in estimating flows in the ungaged streams of interest, in many cases rain gages used in this evaluation were not even located within the same watershed as the streams being gaged. In addition, data from a single rain gage could not be used to compare the rainfall distribution across the watershed, which is at least as important a variable as the rainfall at any single location within the watershed (or outside of the watershed). Importantly, all of the rain gages used to characterize rainfall and the corresponding stream flow within the Nawiliwili Bay Watershed (Lihue, Lihue Airport, and Omao) appear to be located *outside* of the watershed area, and at lower elevations where rainfall is less than half of that received in the upper reaches of the watershed.

Additional concerns regarding the linkage methodology include the lack of detailed information regarding land use distribution in the "similar" streams that were used to develop flow estimates for the streams of interest, and the impact of stream diversions and impoundments on the accuracy of stream flow estimates. Figure 1-4 of the draft document shows a complex system of ditches, flumes, and reservoirs potentially impacting flows in each of the major streams of the Nawiliwili Bay Watershed. Conversely, only one of the seven "similar" streams is listed as having a diversion above its stream flow gage. Depending upon how these systems are operated, significant variations in flow relative to a given rainfall event may occur. The assumption in the gage analysis that no diversion or impoundment of the streams is occurring would therefore seem to be a serious weakness.

The linkage methodology is perhaps the most important portion of the TMDL document because it establishes, based upon the stream flows in the affected streams, the capacity of the water body to assimilate pollutant loads while still meeting water quality criteria. If stream flows are underestimated, then TMDL's, WLA's and LA's will be similarly underestimated, and the reduction in pollutant loads necessary to achieve numerical water quality standards will be overestimated. Of course the reverse is true if stream flows are overestimated. Due to their critical importance to the calculation of the TMDLs, we strongly urge that actual watershed-specific stream flow and rainfall data be collected, or that other scientifically defensible data be used in preparing this and future TMDL documents.

TMDLs Based on "Base Flow"

The draft document presents TMDLs, WLA's, and LA's for base flows and for various storm event flows in the four major streams of the Nawiliwili Bay Watershed. It is unclear, however, whether water quality data used determine load reductions for the base flow scenario was actually collected during base flow conditions. The validity of calculating TMDLs for streams under "base flow" conditions (as opposed to average flow, median flow, or some other flow condition) is questionable and should be revisited, given that "base flow" by definition does not include any flow (or pollutants) originating from stormwater runoff.

In this case, since TMDLs, WLAs, and LA's have all been calculated based upon the stream's assimilative capacity during base flow conditions (i.e., the flow resulting primarily from groundwater rather than rainfall, as determined through the hydrologic analysis described in Section 3.3 of the draft document), estimated load reductions will be skewed high if so-called "base flow" water quality data is actually collected during flow conditions other than base flow. That is, pollutant inputs into the stream during true base flow conditions are limited to those pollutants present in groundwater and pollutant levels during base flow will therefore be lower than pollutant levels present when there is runoff. Pollutant loads will of course increase as rainfall (and runoff) increases. Existing loads for the "base flow" scenario that are calculated using water quality data that was collected during runoff events will be greater than the true "base flow" existing loads, and will result in higher estimated load reductions than are actually required.

Since TMDLs are calculated for base flow conditions, the analysis would appear to assume that water quality data for the "base flow" scenario was collected during base flow conditions, as determined by rainfall data from three reference rain gages. As described above, these reference rain gages are not located within the Nawiliwili Bay Watershed and are not necessarily reflective of rainfall within the watershed, particularly at upper elevations (where annual rainfall is substantially higher than that at the rain gage locations). As such, low rainfall data presented in Table 2-4 is not necessarily indicative of base flow conditions in the streams. Any precipitation occurring in the upper watershed, potentially introducing pollutants into the stream from runoff in these areas, would not be reflected in rain gage data collected at these lower elevation stations. Moreover, at least some amount of precipitation was measured even at the reference rain gages during almost all of the base flow events, and in some cases rainfall for events characterized as "base flow" actually exceeded 80th or even 90th percentile values.

In order for the document to accurately reflect the true load reductions that are necessary to achieve compliance with the water quality standards, it may be appropriate to estimate TMDLs, WLA's, and LA's for flow conditions in the streams that are similar to the "baseline flow" (as opposed to "base flow"; these terms appear to be used interchangeably in the document) conditions during which "non-storm" water quality data was collected. This would of course require the collection of site-specific stream flow data, as recommended above. Alternatively, a comment could be inserted into the TMDL document clarifying that calculated load reductions are likely overestimated as a result of differences between base flow and actual stream flow during the collection of water quality data.

Impact of Draft TMDL on NPDES Permittees
The draft document indicates that there are currently six facilities within the Nawiliwili Bay Watershed holding National Pollutant Discharge Elimination System (NPDES) permits that regulate stormwater discharges associated with their industrial activities. WLA's for each of these facilities corresponding to various storm events are provided in Table 3-9, while a "de minimis" WLA for all facilities under base flow conditions is specified in Table 3-10.

According to the draft document, "any TMDL Waste Load Allocations (WLAs) are immediately effective to be applied in NPDES permits", and "NPDES permits issued by the DOH shall include limitations needed to implement the WLAs in TMDLs, and the DOH shall enforce these limits". This would seem to suggest that the numerical WLAs will somehow be translated into enforceable numerical permit limits. However, Environmental Planning Office (EPO) staff present at the August 13 public hearing stated that the WLAs would be implemented through a condition in the General Permit Authorizing Discharges of Stormwater Associated with Industrial Activity (HAR Chapter 11-55, Appendix B) requiring permittees to submit an implementation and monitoring plan upon approval of the TMDL. It is unclear in the draft document exactly how the numerical WLA's will be translated into NPDES permit requirements. Consistent with EPA guidance (*Establishing TMDL WLAs for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs; November 2002*), the TMDL document should specify how the numerical Waste Load Allocations will be implemented (i.e., whether by numerical permit limits or by site-specific Best Management Practices, such as those typically described in a facility's Stormwater Pollution Control Plan).

As noted above, WLA's are presented in Table 3-9 for various storm events, including 1-, 2-, 5- and 10-year storms. If these WLA's are to be translated into numerical NPDES permit limits, then the draft document should describe how this might be accomplished, given that the permit limit would change based on the size of the rainfall event. It would also be helpful if the size of the storm event (in inches of rainfall) corresponding to each WLA was presented in the draft document. This would allow permittees to determine the amount of runoff that would be discharged from their individual facilities during each storm event, to estimate the corresponding maximum pollutant concentration in the discharge that would comply with the WLA, and to assess whether achieving the proposed WLA may be problematic.

Permittees need to understand the impact that the TMDL will have on their NPDES permits in order to determine the extent, if any, to which they will be impacted and to be able to provide appropriate comment on the draft document.

Other Miscellaneous Comments

- Page v: There appear to be typographical errors in Table ES-1 regarding baseline flow WLAs and LAs for Nitrate + Nitrite and Total Nitrogen (wet season) in Puali Stream and Papakolea Stream. For these entries, the sums of the WLA, LA, and MOS do not add up to the TMDL. In each case, the WLA and LA are entered as "0.0" (indicating a non-zero value less than 0.1) but the difference between the sum and the TMDL is greater than what could be attributed to rounding error. Different LA values are shown in Table 3-10.
- Page 3-5: Regulatory effluent limits for stormwater from NPDES permitted facilities are listed in Table 3-3 of the draft. The permit limits provided in Table 3-3 for the Kauai Commercial Company (KCC) facility are incorrect. Currently, the NPDES permit for the KCC facility requires monitoring and reporting only for Total Suspended Solids, Nitrate/Nitrite, Total Nitrogen, and Total Phosphorous in the discharge; the permit does not specify any limits for these pollutants.
- Page 3-8: There appear to be discrepancies between stream gage descriptions provided in Table 3-4 of the draft document and corresponding stream gage information contained in the 1990 Hawaii Stream Assessment (HSA). Specifically, the drainage areas provided for gage numbers 16097500, 16244000, and 16247000 do not match those in the HSA. The latter two drainage areas (and the corresponding USGS descriptions) may be simply be transposed in Table 3-4, as the tributary areas in Table 3-5 are reversed and do match those in the HSA. For gage number 16097500, the HSA indicates a drainage area of 1.9 square miles as compared to 1.19 square miles given in Tables 3-4 and 3-5 and used in the unit base flow calculations. The drainage areas should be confirmed and corrections made, if necessary, to the hydrologic analysis which uses these drainage areas.

A&B appreciates the opportunity to provide comments on the draft TMDL, and would welcome the opportunity to discuss any of our comments with DOH-EPO staff.

Sincerely,

Sean M. O'Keefe
Director, Environmental Affairs
Alexander & Baldwin, Inc.

cc: G.S. Holaday, HC&S
G. Wilbourn, KCC
D. Heafey, HC&S
M. Ching, A&B
J. Ashman, HARC

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-0417

September 18, 2008

Sean M. O'Keefe,
Director, Environmental Affairs
Alexander & Baldwin, Inc.
P.O. Box 266
Puunene, Hawaii 96784

Dear Mr. O'Keefe:

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for providing Alexander & Baldwin, Inc. (A&B) comments on the draft TMDL, dated September 2, 2008. We appreciate your detailed attention to the draft document. While we share the belief that collecting additional data and revising the document would increase the level of certainty in load reduction estimates, we also believe that the results presented are sufficient to meet Clean Water Act requirements and obtain U.S. Environmental Protection Agency (EPA) approval of the proposed TMDL decision. We consider this decision as a starting point for implementation activities that can be adapted as new information becomes available, including, if warranted, future revision of the TMDL decision. Department of Health (DOH) capacity for TMDL development is limited by available resources and information, and we welcome any support that can be provided for boosting TMDL program capacity and increasing data availability.

Other Miscellaneous Comments

We appreciate your effort to identify miscellaneous errors on pages v, 3-5, and 3-8. In Table ES-1 of the final document, we corrected baseline flow LAs for Nitrate + Nitrite and Total Nitrogen (wet season) in Puali Stream and Papakolea Stream, which are now consistent with the LA values shown in Table 3-10. We re-inspected the Kauai Commercial Company NPDES permit file and confirmed that the permit does not specify any discharge limits for Total Suspended Solids, Nitrate/Nitrite, Total Nitrogen, and Total Phosphorous, as well as for temperature. We corrected Table 3-3 accordingly, and added comments showing that the permit does include effluent limits for metals and petroleum hydrocarbons. Also, we noted that the flow chart showing the general route taken by storm water at the facility indicates that "Some runoff from undeveloped land to the south of the facility may enter from off-site," and thus requested that the DOH Clean Water Branch (CWB) field verify this condition during a future facility inspection and address this condition quantitatively in WLA implementation and the next NPDES permit reissuance.

With regard to apparent discrepancies on page 3-8, please note that the 1990 Hawaii Stream Assessment is not an authoritative reference for U.S. Geological Survey (USGS) stream gauge descriptions. Water-Data Site Information for Hawaii obtained directly from USGS (http://waterdata.usgs.gov/hi/nwis/si) confirm that the drainage area for gauge number 16097500 is 1.19 square miles, and that "Palolo Stream" and "Pukele Stream" entries for "USGS Description" were inadvertently transposed in Table 3-4. In the final document, we corrected Table 3-4 accordingly. Based on our inspection of the corresponding baseflow hydrographs and seasonal relationships between stream flow volume and precipitation (see Appendix D, Part A) we determined that no corrections are necessary to the hydrologic analysis which uses these drainage areas.

Impact of Draft TMDLs on NPDES Permittees
In response to the concern that "Permittees need to understand the impact that the TMDL will have on their NPDES permits…," we expanded the explanation of the Waste Load Allocation (WLA) implementation process in section 5.0 of the final document (Implementation Framework). One reason that "It is unclear in the draft document exactly how the numerical WLA's will be translated into NPDES permit requirements" is that is also unclear within DOH, pending further review, exactly how this will occur. One thing that is clear is that WLA implementation requirements for general permit coverage don't take effect within a current permit cycle, they only take effect upon the initiation of a new permit cycle as triggered by applicant action (filing Notice of Intent or claiming automatic coverage) or DOH action (issuing Notice of General Permit Coverage).

In the November 2002 EPA memorandum you referenced (http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf), we don't find any statement or implication that "the TMDL document should specify how the numerical Waste Load Allocations will be implemented." In fact, the memorandum implies (near the top of page 5) that this is a post-TMDL decision - "EPA expects that the NPDES permitting authority will review the information provided by the TMDL … and determine whether the effluent limit is appropriately expressed using a BMP approach … or a numeric limit." Consistent with this expectation, the manner in which DOH addresses the numerical limitations will be determined on a permit-specific basis, while providing a mechanism for permittees to play an active role in specifying how WLAs will be implemented. In the final document, we also added the following description of this mechanism to Section 3.5.2. (Waste Load Allocation) and discussed it in Section 5.3. (Other Implementation Considerations and Priorities):

> Under condition 6.(a) of NPDES General Permits Authorizing Discharges of Storm Water Associated with Industrial Activities [Hawaii Administrative Rule

> §11-55 Appendix B, Storm Water Pollution Control Plan Requirements], "**the permittee shall develop and implement a storm water pollution control plan** to minimize the discharge of pollutants in storm water runoff and to maintain compliance with conditions of this general permit" (p. 55-B-7, emphasis added), and the storm water pollution control plan shall include nine enumerated components, including (emphasis added below):
>
> > (9) If the industrial facility discharges storm water to a state water for which a total maximum daily load has been approved by the EPA, the permittee shall develop and submit an implementation and monitoring plan with the notice of intent or within ninety days after the issuance date of the notice of general permit coverage or by the date the permittee claimed automatic coverage as specified in section 11-55-34.09(e)(2). **The permittee shall incorporate the total maximum daily load into the facility's storm water pollution control plan within sixty days of the date of submittal of the plan and implement necessary steps to meet the plan.**

Please note that WLA implementation requirements for general permit coverage don't take effect within a current permit cycle, they only take effect upon the initiation of a new permit cycle as triggered by applicant action (filing Notice of Intent or claiming automatic coverage) or DOH action (issuing Notice of General Permit Coverage). Please contact the DOH Clean Water Branch to verify the operative steps and timelines for this process.

As implied by A&B comment ("If these WLAs [for various storm events] are to be translated into numerical NPDES permit requirements, the draft document should describe how this might be accomplished, given that the permit limit would change based on the size of the rainfall event"), translating the WLAs into numerical NPDES permit requirements might be accomplished by establishing a sliding scale or frequency distribution of permit limits as a function of rainfall event size. We added language to this effect in Section 3.5.2. (Waste Load Allocation) and Section 5.3. (Other Implementation Considerations and Priorities).

Linkage Methodology and **TMDLs Based on "Base Flow"**

Along with A&B, two other parties expressed concern about the linkage methodology, base flow estimation, and load analysis used in the TMDL development process. In order to better address these concerns, we would appreciate the inclusion of references to any specific scientific authorities upon which the A&B comments may be based. Although these comments raise legitimate questions about the assumptions, data, and methodology employed, we believe that DOH used the best available information, adequate data, and reasonable methodology to produce a scientifically valid and defensible TMDL decision. While there is always room for improvement, any concerns about the assumptions, data, and methodology are more matters of degree than disqualification, and can only be resolved by additional long-term data collection in the watershed, which was not and is not feasible given the available information, schedule, scope of work, and budget for developing this particular TMDL.

While there may be "potentially significant differences in the hydrogeology of watersheds even on the same island," the level of information needed to better determine actual differences and account for their significance in the regional hydrologic analysis is beyond the scope and capacity of the current TMDL development process. Common scientific knowledge and recent U.S. Geological Survey (USGS) studies do illustrate fundamental hydrogeologic differences between Kauai and other islands in Hawaii, but we are not aware of more detailed work to differentiate Kauai watersheds from each other in ways that would influence the regional hydrologic analysis. Although the discretization of the USGS southern Lihue basin model is adequate for studying ground-water withdrawal effects at the regional scale[*] this model may be too coarse for studying streamflow effects at a more localized scale needed to achieve greater levels of certainty in stream flow estimates. It would therefore be difficult to properly integrate a compatible groundwater model with a watershed model given the scope and level of funding for Nawiliwili TMDL development. We also note that basic rainfall-runoff estimates used in the USGS simulation are based on a methodology similar to that used in the Nawiliwili TMDL analysis, namely assuming that runoff-to-rainfall ratios in ungauged areas are the same as in adjacent gauged basins in similar climatologic settings.

Our ability to characterize and consider the spatial variability of rainfall distribution within and across the watershed, and its corresponding influence as "a driving factor is estimating stream flows," is limited by the scope of available rainfall and streamflow data and by the data requirements for completing the regional hydrologic analysis (comparability of data attributes among stations and periods of record). We addressed your additional concern "regarding land use distribution in the 'similar' streams that were used to develop flow estimates for the streams of interest" by revising the land use and land cover information in Table 3-5 (Baseflow Estimation for the Selected USGS Flow Gauges). For agricultural and conservation land, the areal flow estimates are based primarily on comparison with Kauai watersheds, using flow gauges servicing areas dominated by Koloa volcanic series formations and sedimentary deposits similar to those found in the Nawiliwili Bay watershed. The applicability of the selected Oahu stream flow gauges to the Nawiliwili Bay watershed is based on their representation of an urban land use component (between 7% and 30% of the contributing area) mixed with forested and open/agricultural lands, along with their fulfillment of all the remaining gauge selection criteria, save for Nawiliwili-like substrates and soils.

Determining "the impact of stream diversions and impoundments on the accuracy of stream flow estimates" requires specific information about the structure and operation of the irrigation systems that divert, impound, and release streamflows and other surface runoff. While collecting more continuous, long-term, watershed-specific streamflow and rainfall data would help improve the pollutant loading calculations, without additional quantification of the stream diversions, reservoir impoundments, and flow augmentation (releases) in these legacy irrigation ditch systems, any hydrologic model attempting to use new basic hydrologic data would remain

[*] Izuka, S.K. and D.S. Oki. 2002. Numerical simulation of ground-water withdrawals in the southern Lihue Basin, Kauai, Hawaii: U.S. Geological Survey Water-Resources Investigations Report 01-4200.

difficult to calibrate. Much of this flow diversion, impoundment, and augmentation information would need to come from records generated primarily by private parties who either no longer collect this information or do not routinely provide it to DOH or to readily-accessible depositories such as the water use reports submitted to and maintained by the State of Hawaii Commission on Water Resource Management.

Regional hydrologic analysis is a relatively simplistic approach for estimating stream flows that is nonetheless based upon sound data and analysis, and is commonly and appropriately used in limited data situations. Given the data limitations and the complexity of the hydrologic network, DOH believes that estimating average baseline flows and one, two, five and ten year storm flows based on a comparative analysis of similar watersheds was the best linkage option available. For TMDL purposes, estimated stream flows are multiplied by both water quality criteria and measured water quality (concentrations) to calculate maximum allowable loadings (TMDL, or assimilative capacity) and actual loadings. The difference between these actual loadings and the TMDL loadings are the loading reductions required to attain the water quality criteria.

The relationship between TMDL loadings and actual loadings is a function of the relationship between water quality criteria and the geometric means of measured concentrations. Thus even if we improved flow estimates using a more analytically robust and data-intensive hydrologic methodology, it would not change the percent loading reductions required to meet water quality standards, and would therefore not be expected to unduly influence the implementation strategy and tactics for addressing water quality impairments in the watershed. In addition, the potential impacts of any errors are mitigated, as intended by program regulations and guidance, by the TMDL Margins of Safety, which account for lack of knowledge, uncertainty, and errors concerning the relationship between load and wasteload allocations and water quality.

Therefore, DOH doesn't intend to delay TMDL development and forestall TMDL implementation in order to collect additional watershed-specific streamflow and rainfall data. However, parties responsible for TMDL implementation and water quality standards attainment may opt to collect this and any other data that better informs the implementation process.

As you suggest, throughout the document "baseline flow conditions" and "base flow" conditions" are used interchangeably. However, our use of these terms doesn't adhere to the proposed absolutist definition "does not include any flow (or pollutants) originating from stormwater runoff." In many hydrologic applications, "base flow" is defined as a specific portion of the flow frequency distribution, such as Q90, or the flow regime that occurs 90% of the time. In our application, the distinction between stormflow and baseline flow conditions is similarly a matter of degree, as in the proposed relativist definition "flow resulting primarily from groundwater rather than rainfall." This distinction is used for purposes of applying limited data collected under a range of untargeted and targeted streamflow conditions, and should clarify that water quality data used to calculate loads, based on geometric mean water quality criteria, for the baseline flow scenario was actually collected under untargeted streamflow conditions that may include, but are not dominated by, flow resulting from rainfall.

We thank A&B for its ongoing participation in DOH water pollution control and water quality management efforts, and look forward to ongoing cooperative efforts to improve the TMDL process. If you have any questions about this letter, please contact David Penn, TMDL Coordinator at 586-4337 or at david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

DOH-EPO
RECEIVED

'08 AUG 21 A11:37

6510 Olohena Road
Kapa`a, HI 96746

August 20, 2008

Program Manager,
Environmental Planning Office
State of Hawai`i Department of Health
919 Ala Moana Blvd., Room 312
Honolulu, HI, 96814

Dear Sir,

I am responding to an article that appeared in *The Garden Island* newspaper here on Kaua`i, "Input Sought on Nawiliwili Pollution" [August 15, 2008].

I am a long-time user of Kalapaki Bay and the Nawiliwili area as a canoe paddler and canoe surfer. I have noticed a steady deterioration in the quality of the water over the past four decades—since I am not taking water samples, I am referring primarily to turbidity, especially within Kalapaki Bay. In fact the turbidity of the water has increased dramatically within Kalapaki over the last several years, until this summer, when it has improved quite noticeably—and this despite the fact that it has been a relatively wet summer, with a good deal of stream run-off. All of this is based on my personal observation and the observations of several of my paddling friends who agree that the water appears cleaner now than it was a year ago.

May I suggest an explanation for the recently improved water quality: it is the reduction in the number of cruise ships that are visiting Nawiliwili. I am not opposed to cruise ships using the harbor. That is what harbors are for. However, I believe that if the cruise ships are required to alter, only slightly, their operations within the harbor we can have both cruise ships and better water quality.

On several occasions while paddling across the mouth of the harbor, just inside the breakwater, we have encountered cruise ships leaving the harbor. They travel very slowly, with engines operating at very low speed until they arrive at the harbor mouth, but still within the breakwater. Then, once they have made their final turn and are aimed out to sea, they gun their engines and huge quantities of silt are churned up from the bottom of the harbor. We have not carefully followed the path of this turbid water—no doubt filled with a large variety of pollutants from a whole variety of sources-- but it is my belief that a good deal of this muddy water is carried into Kalapaki Bay, and with large ships leaving the harbor on an almost daily basis, the bay never had an opportunity to clean itself. Now that there are fewer ships leaving the bay, a good deal of recovery is apparent.

I wrote a letter to *The Garden Island* about this problem, perhaps a year ago, when three cruise ships were visiting Nawiliwili on a regular basis and others more sporadically. Nothing seems to have come from that letter. Now that the ships are arriving in smaller numbers, and the bay has cleaned itself considerably, the cause-and-effect relationship between the cruise ships' actions and the pollution of the bay seems more apparent.

If it is within the power of the Department of Health to mitigate these effects, may I suggest that large ships (not just cruise ships) be required to clear the harbor entirely—perhaps traveling several hundred yards beyond the breakwater—before "gunning" their engines, so that the silt will not be carried back into the harbor and especially into Kalapaki Bay. These ships should also be asked/required to use minimal power at all times while operating within the harbor area.

I would appreciate it if you would acknowledge receipt of this letter, and if you are not the appropriate authority to deal with this issue, to forward my comments to the proper authority, and let me know who I can contact to follow up.

Sincerely yours,

Andrew F. Bushnell

Andrew F. Bushnell

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-0418

September 18, 2008

Mr. Andrew F. Bushnell
6510 Olohena Road
Kapaa, Hawaii 96746

Dear Mr. Bushnell:

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for your observations and suggestions about the relationship between cruise ship actions and pollution of Nawiliwili Bay (letter dated August 20, 2008). In response, we added information concerning vessel engine speed and sediment resuspension to section 1.1 (Problem Definition) of the final TMDL document, and forwarded your letter to State agencies that deal with this issue:

> State Department of Health, Environmental Health Administration (Laurence K. Lau, Deputy Director);
> State Department of Transportation, Harbors Division (Davis Yogi, Harbors Administrator);
> State Department of Land and Natural Resources, Division of Aquatic Resources (Dan Polhemus, Administrator);
> State Department of Business, Economic Development, and Tourism, Research and Economic Analysis Division (Pearl Imada Iboshi, Administrator);

You may also wish to contact the U.S. Department of Homeland Security, U.S. Coast Guard District 14.

The Department's currently proposed total maximum daily load (TMDL) decision focuses on water quality problems and solutions for inland waters (four major streams), not marine waters. Please note that under Hawaii Revised Statutes §342D-I(2) and (3), the Department may engage in monitoring and studying of direct or indirect environmental effects of commercial passenger vessels operating in the marine waters of the state, and in researching ways to reduce effects of those vessels on marine waters and other coastal resources. Although the Department does not systematically monitor, study, or research these effects at present, if and when we develop TMDLs for marine waters in Nawiliwili Bay proper, cruise ships and all other marine vessel traffic in the Bay will be more closely scrutinized by the Environmental Planning Office as potential causes of water quality problems.

If you have any questions about this letter, agency contact information, or the Department's TMDL program, please contact David Penn, TMDL Coordinator at 586-4337 or at david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

August 28, 2008

David C. Penn, Ph. D.
Total Maximum Daily Load Coordinator
State of Hawaii Department of Health
Environmental Health Administration
919 Ala Moana Blvd., Room 312
Honolulu, Hawaii 96814

Re: Total Maximum Daily Loads for Nawiliwili Bay Watershed

Dear David:

The following should address your questions and requests following our August 13th meeting at the Grove Farm office.

Klussman Reservoir:

This reservoir, which was formerly used for agriculture irrigation, is no longer in service. The ditch that previously fed into this reservoir has been diverted for other purposes, and this site is kept as an emergency holding facility in the event that the Lihue-Puhi Wastewater Treatment Plant produces anything less than R1 effluent.

In such a situation, the effluent will be directed to the Klussman Reservoir and treated and settled.

Storm Drainage System at the Lihue-Puhi Wastewater Treatment Plant:

As confirmed by Aqua Engineers (operators of the plant) there is no effluent from the plant, nor does storm run-off from areas surrounding the plant's boundaries flow through the plant's storm drainage system. The original plans do not indicate the flow of the storm run-off upon leaving Grove Farm Properties land.

Layout of Irrigation Ditches and Other Water Sources:

We have located maps and drawings detailing our irrigation ditches and water sources from past agricultural activities. Some of these maps are very old and fragile, and we would like to keep them on our premise. You are more than welcome to view these maps at our Grove Farm offices.

3-1850 Kaumualii Highway P.O. Box 662069 Lihue, HI 96766-7069
P 808.245.3678 F 808.246.9470
www.grovefarm.com

I-2254

We understand that the integrity of our waterways is integral in being responsible stewards of our lands. Practices in place include ensuring that our wastewater facility and systems are properly maintained, and that alternate plans are in place in the event of an unforeseen emergency.

We continue to diligently maintain all water sources, including the cleaning and restoration of streams, ditches and reservoirs that lay on Grove Farm lands. Also, Grove Farm takes on an active role in the abatement of feral animals which includes annual contracts with the USDA APHIS for feral animal mitigation.

Another area of focus is through our native Hawaiian plant restoration program whereby 2,500 native plants are being cultivated at Iliahi. The program is two-fold in that it propagates native and in some cases rare plants that can be used to restore our lands, as well as provides an education program that continues to target elementary school students.

We would like to continue to maintain this open dialogue with you. Please do not hesitate to contact myself or my staff at anytime.

Sincerely,

Michael H. Tresler
Senior Vice President
Grove Farm Company, Inc.

3-1850 Kaumualii Highway P.O. Box 662069 Lihue, HI 96766-7069
P 808.245.3678 F 808.246.9470
www.grovefarm.com

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-0419

September 18, 2008

Mr. Michael H. Tresler, Senior Vice President
Grove Farm Company, Inc.
P.O. Box 662069
Lihue, Hawaii 06766-7069

Dear Mr. Tresler:

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for the information provided in your letter dated August 28, 2008. We added the information concerning the status of Klussmann Reservoir to section 1.2.3. (Stream Systems) of the final TMDL document, and requested that the Department of Health Wastewater Branch include field verification of all inlets and outlets to Klussman Reservoir in a future field inspection of the Lihue-Puhi Wastewater Treatment Plant (WWTP). With regard to the storm drainage system at the WWTP, we notified the Department of Health Clean Water Branch (CWB) of the apparent exceedances of NPDES permit effluent limits indicated on the Discharge Monitoring Report provided to us by Aqua Engineers at our recent meeting (August 13, 2008), and noted this information in section 1.2.3 (Stream Systems) of the final TMDL document; requested that CWB include in a future field inspection of the WWTP drainage system (1) field verification that storm water runoff from areas surrounding the plant's boundaries does not flow through the WWTP's storm drainage system and (2) field verification of the pathways and receiving waters for storm water runoff leaving the facility; and requested that these matters be addressed in detail in the next NPDES permit reissuance. We have yet to receive the copy of the WWTP facility drainage plan that was to be provided by Aqua Engineers and Grove Farm.

We thank Grove Farm for maintaining a dialogue with us about DOH water pollution control and water quality management efforts, and gratefully accept your invitation to view maps and drawings detailing irrigation ditches and water sources at the Grove Farm Offices. We asked the State of Hawaii Commission on Water Resource Management to collaborate with us in this effort, and hope to schedule an appointment to begin the viewing later this month. In order to better promote TMDL implementation throughout the watershed, we would also like to learn more about the objectives and results of Grove Farm's feral animal management efforts with Hawaii Wildlife Services (U.S. Department of Agriculture Animal Plant and Health Inspection Service), particularly with regard to location and number of animals removed and program cost per unit effort.

If you have any questions about this letter, please contact David Penn, TMDL Coordinator at 586-4337 or at david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

Hawaii Farm Bureau
FEDERATION

September 2, 2008

State of Hawaii Department of Health
Environmental Planning Office
Attention: Mr. Kelvin Sunada
919 Ala Moana Boulevard, Room 312
Honolulu, HI 96814

Subject: **Total Maximum Daily Loads for Nawiliwili Bay Watershed**

Dear Mr. Sunada:

Hawaii Farm Bureau Federation (HFBF) is a non-profit organization of farming families united for the purpose of helping to ensure the future of agriculture, thereby promoting the well-being of farming and the State's economy. Hawaii's farmers have a long history of efforts to preserve the land and water resources upon which we depend for our livelihood. We therefore support the objective of restoring and protecting water quality throughout the state. At the same time, we must ensure that regulatory programs are designed and implemented based upon reliable data and sound science so that farmers can continue to farm. Toward that end, HFBF is pleased to offer the following comments on the draft Total Maximum Daily Loads (TMDL) report for the Nawiliwili Bay Watershed.

The draft TMDL document for the Nawiliwili Bay Watershed proposes significant reductions in sediment and nutrient loadings to each of the four major streams within the watershed. The proposed Load Allocations (LAs) have the potential to impact a variety of non-point sources of runoff, including agriculture. It is therefore important to HFBF and its member farmers that these Load Allocations be grounded in a sound analysis of existing and target water quality, pollutant sources, and existing pollutant loading.

Of concern to HFBF is the "linkage methodology" and hydrologic analysis described in Sections 3.2 and 3.3 of the draft document. Due to the lack of robust stream flow and precipitation data that are needed to estimate load allocations, and the inability to calibrate the hydrologic watershed model to collected flow data, an innovative regional monitoring approach was used. In essence, this approach assumes watersheds with similar rainfall and land usage will have similar stream flows without regard for other factors, such as the hydrogeology of the watershed. HFBF believes strongly that this approach is overly simplistic, and may contribute to significant errors in estimates of stream flow in the targeted watersheds. Such errors will of course result in corresponding errors in the estimation of pollutant loadings in the stream, of pollutant loads that the stream can assimilate while continuing to meet water quality standards, and of the load reductions necessary to achieve acceptable water quality.

HFBF strongly encourages that the Environmental Planning Office (EPO) consider validating the regional monitoring approach through the collection of stream flow and precipitation data from the targeted watersheds prior to basing Load Allocations and implementation plans on such broad extrapolations from other watersheds. We further encourage that EPO enlist the assistance of the USGS, UH-WRRC, DLNR/CWRM, or other organization with similar experience in quantifying and evaluating flows in Hawaii streams to review and vet this approach. Given the critical importance of stream flow estimations to the TMDL development process, it is imperative that they be based upon sound data and analysis.

HFBF thanks you for the opportunity to provide comments on the draft TMDL, and looks forward to receiving your response.

Sincerely,

Janet Ashman

Janet Ashman
Co-Chair, Environmental Stewardship Committee
Hawaii Farm Bureau Federation

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-0420

September 18, 2008

Janet Ashman
Co-Chair, Environmental Stewardship Committee
Hawaii Farm Bureau Federation
P.O. Box 88
Puunene, Hawaii 96784

Dear Ms. Ashman,

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for providing Hawaii Farm Bureau Federation comments on the draft TMDL, dated September 2, 2008. While we acknowledge the potential for the technical approach used to contribute to uncertainty and error in estimated stream flow and corresponding load calculations, we believe that the results presented are sufficient to meet Clean Water Act requirements and obtain U.S. Environmental Protection Agency (EPA) approval of the proposed TMDL decision. We consider this TMDL decision as a starting point for implementation activities that can be adapted as new information becomes available, including, if warranted, future revision of the TMDL decision. Department of Health (DOH) capacity for TMDL development is limited by available resources and information, and we welcome any support that can be provided for boosting TMDL program capacity and increasing data availability.

Although regional hydrologic analysis may be a simplistic approach for estimating stream flows, it is nonetheless based upon sound data and analysis, and is commonly and appropriately used in limited data situations. For TMDL purposes, estimated stream flows are multiplied by both water quality criteria and measured water quality (concentrations) to calculate maximum allowable loadings (TMDL) and actual loadings. The difference between these actual loadings and the TMDL loadings are the loading reductions required to attain the water quality criteria. The relationship between TMDL loadings and actual loadings is a function of the relationship between water quality criteria and the geometric means of measured concentrations. Thus even if we improved flow estimates using a more analytically robust and data-intensive hydrologic methodology, it would not change the percent loading reductions required to meet water quality standards, and would therefore not be expected to unduly influence the general nonpoint source implementation strategy and tactics for agriculturalists to address water quality impairments in the watershed. In addition, the potential impacts of any errors are mitigated, as intended by program regulations and guidance, by the TMDL Margins of Safety, which account for lack of knowledge, uncertainty, and errors concerning the relationship between load and wasteload allocations and water quality.

Additional long-term data collection in the watershed was not and is not feasible given the available information, schedule, scope of work, and budget for developing this particular TMDL. DOH doesn't intend to delay TMDL development and implementation by first validating the results of the hydrologic analysis. However, parties responsible for TMDL implementation and water quality standards attainment may opt to collect precipitation, stream flow, stream diversion, and water use data that better informs the implementation process. In general, greater cooperation and collaboration with the agricultural community in measuring and recording data on stream diversions, cropping systems, livestock stocking rates, input application rates (irrigation water, fertilizers, pesticides) and other management practices would help DOH to develop TMDLs that better meet Farm Bureau expectations. We encourage the Hawaii Farm Bureau Federation to work with DOH and with its membership to facilitate the collection of such data.

DOH regularly consults with and sometimes employs organizations like the U.S. Geological Survey (USGS), University of Hawaii Water Resources Research Center (UH-WRRC), and the State of Hawaii Department of Land and Natural Resources, Commission on Water Resource Management (DLNR-CWRM) to help quantify and evaluate flows in Hawaii streams, and is an active participant in ongoing intergovernmental efforts to better "Know the Flow." Note that UH-WRRC, in producing the DOH-funded "Assessment and Protection Plan for the Nawiliwili Watershed" (see El-Kadi et al. 2003 in the TMDL References, Section 8.0) also used a simplified analytical approach for estimating streamflows based on assumptions about land use and flow routing that are similar to those used for TMDL development. USGS groundwater studies for the region (Izuka, S.K. and D.S. Oki. 2002. Numerical simulation of ground-water withdrawals in the southern Lihue Basin, Kauai, Hawaii: U.S. Geological Survey Water-Resources Investigations Report 01-4200) calculated basic rainfall-runoff estimates with a methodology similar to that used in Nawiliwili TMDL development, namely runoff-to-rainfall ratios in ungaged areas were assumed to be the same as in adjacent gaged basins in similar climatologic settings. We believe that DOH used the best available information, adequate data, and reasonable methodology for TMDL decision purposes. While there is always room for improvement, any concerns about the data and methodology are more matters of degree than disqualification.

We thank the Hawaii Farm Bureau Federation for its ongoing participation in DOH water pollution control and water quality management efforts, and look forward to ongoing cooperative efforts to improve the TMDL process. In the future, we hope that this participation and cooperation will include more information from local Farm Bureau chapters about specific problems and potential solutions within the watersheds of concern. If you have any questions about this letter, please contact David Penn, TMDL Coordinator at 586-4337 or at david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

Jas. W. Glover Ltd.'s Comments Regarding:

Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii

Draft for Public Review

By the

State of Hawaii Department of Health
Environmental Health Administration
Environmental Planning Office

July 2008

Introduction

Jas. W. Glover Ltd. is a woman owned, Native Hawaiian owned, small manufacturing and mining business. We carry out aggregate quarrying operations on the Island of Kauai under a license agreement with a major land-owning company – Grove Farm Co. Ltd. One of the operations is a basalt quarry at Halfway Bridge which is in the Huleia stream watershed area. Huleia stream is one of the four major streams of the Nawiliwili Bay watershed which have proposed TMDL's.

Summary

The proposed TMDL document is quite large (221 pages) and scientifically detailed. We have attempted to gain an understanding of the document and it's implication on our Halfway Bridge facility and it's NPDES permit via reviewing the document and with discussions with Department of Health (DOH) staff. Our interpretations are stated below and it is our understanding that these were confirmed in discussions with DOH staff. If these interpretations stated in this comment document are incorrect, we request that we be given further opportunity to participate before the finalization of the plan and the implementation process.

There are some inaccuracies in the TMDL document in relation to our facility and it's NPDES permit. Although these do not appear to affect the Waste Load Allocations (WLA's), we believe they should be corrected in the final version of the TMDL document before it is finalized.

Our current understanding (from our interpretation of this document, our permit, and discussions with DOH staff) is that that once the TDML's are finalized, the DOH will advise us of the WLA's allocated to our facility and the effect on our NPDES permit. Per the permit, we need to submit a plan for implementation and monitoring of the WLA's. We request the opportunity to participate in the finalization of the implementation and monitoring plans as it relates to our facility. We also request that should there be other implementation plans that impact our operations, we be given the opportunity to participate before they are finalized.

Specific Comments

Extracts of the document are presented in italics with our comments directly afterwards in standard case.

Section 3 - Load Analysis

3.1.3 Point Sources

"The discharge is from a rock quarry and plant, located just downstream of the confluence of Kuia Stream and Kamooloa Stream, where operations include mining, crushing, and screening of rock and gravel."

Our NPDES permit has seven outfalls, two are downstream of the confluence of Kuia Stream and Kamooloa Stream, two discharge into Kamooloa Stream and three discharge into Kuia Stream.

"The facility also withdraws water for its operations from Kamooloa Stream."

The facility does not withdraw water for its operations from Kamooloa Stream, but from an irrigation system.

"The site has three outfalls: (1) from a holding pond; (2) from a settling pond; and (3) from an irrigation drainage tunnel."

Our NPDES permit has seven outfalls from different parts of the operations. See above.

"Waste Load Allocations to be incorporated in future permit cycles is presented in Section 4 below."

Section 4 does not specify our WLA's – section 3.5.2 does – specifically table 3-9.

Further investigation of quarry operations and their potential impacts on surface waters, are an important part of the TMDL implementation framework for point sources (see Section 7).

The implementation framework is not defined in the TMDL document. Discussions with EPO staff indicated that the implementation would become the responsibility of other branches of the DOH. We request that we are given the opportunity to participate in the development of any implementation plans that may impact us.

3.5.2 Waste Load Allocations

Our interpretation (which was confirmed via discussions between our David Pirie with DOH, EPO Environmental Engineer, Alexandre Remnek on 8/26/08) is that the proposed WLA's for Jas. W. Glover Ltd.'s quarry at Halfway Bridge are specified in table 3-9 on page 3-18. There are no other requirements of this TMDL that would impact our facility or the NPDES permit. We request that if there are changes to the WLA's specified in table 3-9, or other specific requirements, that we be given the opportunity to participate in the development of them.

Section 5 - Implementation Framework

There is nothing specific in this section as to how the WLA's will be implemented. Refer to our comments in the summary section above. We request that we are given the opportunity to participate in the development of any implementation plans that may impact us.

Conclusion

Although there are a few inconsistencies (noted above), the TMDL process appears to have followed a sound scientific process in developing the WLA's that will be allocated to our facility. Our major concern is that the implementation plans in the TDML document are not clearly defined, and we request that we be able to participate in the development of implementation and monitoring requirements applicable to our facility, as these requirements will contribute to the cost of our operations and subsequently the cost of our products to the community.

David Pirie
Materials Superintendent
Jas. W. Glover Ltd.

September 2, 2008

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-0421

September 18, 2008

David Pirie, Materials Superintendent
Jas. W. Glover, Ltd.
P.O. Box 662069
Lihue, Hawaii 06766-7069

Dear Mr. Pirie:

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for Jas W. Glover, Ltd. (Glover) comments dated September 2, 2008. In Section 3.1.3of the final TMDL document, we corrected the inaccuracies you noted in relation the Glover facility and its NPDES permit to more accurately reflect the number, location, and function of facility outfalls and water sources, and fixed the inconsistent references to other sections of the text. As discussed in your telephone conversations with our staff, it is now our understanding that the facility withdraws its water from a tunnel/ditch system whose source and contributing area remain uncertain, and that water from this system that is not withdrawn at the diversion point flows into Kamooloa Stream. As we continue to verify the structure and mechanics of this system in cooperation with Grove Farm and the State of Hawaii Commission on Water Resource Management, we will keep you informed of our findings.

In response to the major concern "that the implementation plans in the TMDL document are not clearly defined," and your request that "we be able to participate in the development of implementation of monitoring requirements applicable to our facility," we expanded the explanation of the implementation process in section 5.0 of the final document (Implementation Framework). The manner in which DOH addresses the development of implementation and monitoring requirements will be determined on a permit-specific basis, while providing a mechanism for permittees to play an active role in specifying how Waste Load Allocations (WLAs) will be implemented. In the final document, we added a description of this mechanism to Section 3.5.2. (Waste Load Allocation) and discussed it in Section 5.3. (Other Implementation Considerations and Priorities). Please contact the Department of Health Clean Water Branch to verify the operative steps and timelines for this process with regard to your current NPDES permit.

The WLAs assigned to Glover in the final document are the same as those in the draft document (no "changes to the WLA's specified in table 3-9, or other specific requirements"). With regard to your request to be given the opportunity to participate, before they are finalized, in "other implementation plans that impact our operations," we are not aware of any other NPDES permits authorizing discharges to Huleia Stream (Appendix E). Although we currently don't have a process for directly notifying existing permit holders of new NPDES permit applications potentially affecting the existing permit's receiving waters, the DOH Clean Water Branch website (http://hawaii.gov/health/environmental/water/cleanwater/pubntcs/index.html) includes a weekly update all permit applications received within the last four weeks (general and individual permits) and notices of proposed individual permits that are available for public review. For both point source and nonpoint source implementation planning, we expect that those conducting the planning process will, by referring to the TMDL decision document, identify Jas. W. Glover, Ltd. as a party to include in this process.

If you have any questions about this letter, please contact David Penn, TMDL Coordinator at 586-4337 or david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

KAUAI
RESORT
Marriott

September 2, 2008

VIA EMAIL AND US MAIL

Environmental Planning Office
State of Hawaii Department of Health
919 Ala Moana Boulevard Room 312
Honolulu, HI 96814

Attention: Mr. Kelvin Sunada, Program Manager

Re: *EPO-0353, Total Maximum Daily Loads (TMDLs) for Nutrients, Sediment, and Bacterial Indicator in Four Major Streams of the Nawiliwili Bay Watershed, Kauai, Hawaii*

Dear Sirs:

We appreciate the opportunity to comment on the proposed TMDL decision for Nutrients, Sediment, and Bacterial Indicator in the Nawiliwili Bay Watershed, Draft for Public Review dated July, 2008 (TMDL document). The Kauai Marriott Resort and Beach Club (Kauai Marriott) and the Kauai Lagoons, LLC (Kauai Lagoons) strongly support efforts to protect the environment of Kauai and achieve the best water quality possible. Both resorts have adopted stormwater management plans aimed at improving the water quality discharging from our respective properties.

We have significant concerns with regard to the technical issues related to development of the TMDL and as to the timing and implications associated with the development of appropriate treatment controls to improve water quality in the Nawiliwili Bay watershed. The technical issues that we see with the report include:

- Stream Monitoring Locations;
- Sample Collection and Analysis;
- Source Assessment;
- Flow Determinations;
- Load Analysis;
- Implementation Framework; and
- Other Implementation Considerations and Priorities.

With regard to timing, the comments made by the Department of Health (DOH) panel during the public informational meeting held on August 13, 2008 at the Niumalu Park Pavilion indicated that a reason for submittal of this proposed TMDL at this time, with limited opportunity for public involvement, was to submit this report before the end of the EPA fiscal year. In addition, some of the comments made by the panel appeared to downplay the importance of the TMDL document in EPA's

TMDL decision making process. We are concerned that the comments made by the panel at the informational meeting may have given the wrong impression to members of the public about the potential impacts of an EPA approved TMDL. We are also concerned that the proposed TMDL document, which will be submitted to EPA for approval, does not provide adequate analysis of current loading issues in Nawiliwili Bay.

The County of Kauai has a small population of approximately 63,000 people with a median yearly income of $45,000 (http://quickfacts.census.gov/qfd/states/15/15007.html). There are limited industrial, commercial and municipal watershed stakeholders in the Nawiliwili Bay area and few identified point sources of pollutants. In our opinion, implementation of a TMDL using information from the TMDL document may result in an undue burden to the community surrounding Nawiliwili Bay. Therefore, we strongly advocate that a thorough review of the TMDL document with significant public involvement be conducted prior to its submittal to the EPA.

Achieving the best water quality possible requires good data, good science and realistic implementation measures. We recommend that potential pollutant issues in the Nawiliwili Bay watershed be identified with the best science and data available. We also recommend that the implementation of management measures to address this or other TMDLs incorporate a realistic timeline for implementation that is developed with significant input from the residents of Kauai and Nawiliwili Bay watershed stakeholders.

The Kauai Marriott and Kauai Lagoons strive to be an integral part of the Kauai community by hiring and purchasing locally as much as possible; by becoming involved with community issues; and supporting the Kauai and Hawaii cultural community. We look forward to working with DOH and the community in the Nawiliwili Bay watershed to preserve and protect water quality and the natural Hawaiian environment.

We request that the comments, observations, and requested corrections in the attached comment letter be incorporated into the Draft TMDL document prior to submission to the EPA. We also request opportunity for additional public comment after any modifications to the Draft TMDL document are made, prior to submittal to the EPA.

We would appreciate an opportunity to discuss all items with the Environmental Planning Office at your earliest convenience.

Technical Comments

The TMDL decision rationale is supported by an investigation of land-uses, water quality, and pollutant transport mechanisms of the four major stream systems that flow into Nawiliwili Bay. These data are then used to determine the load reductions required to meet water quality criteria. Our comments on the TMDL document are summarized below. All section, page number and table references are related to the TMDL document.

Stream Monitoring Locations

The TMDL document contains conflicting descriptions of the stream monitoring locations used to collect water samples. Figures 1-3 and 1-4 indicate sample stations M, N, and O in the Nawiliwili

Stream are locations Upper Nawiliwili, Middle Nawiliwili, and Lower Nawiliwili, respectively. However, Table 2-1 indicates location O as Upper Nawiliwili, location P as Lower Nawiliwili, and location N as Nawiliwili Bay. Since water samples collected from these sites are used to assess concentrations of nutrients, bacteria and sediment that determine load allocations and load reductions associated with the TMDL analysis, we respectfully recommend the monitoring locations and associated data be verified with respect to geographic location.

Sample Collection and Analysis

The storm events sample collection description (Section 2.1.3.1) states:

> *"An ISCO 6712 automated sampler was used to collect a series of 12 samples during each storm event, assumed to be four hours long based on a regional rainfall analysis. The first sample was collected following a 0.5-foot increase in the water level of the stream, as measured by an automated differential pressure transducer. The 11 subsequent samples were collected at 20-minute intervals (equally-spaced across the four-hour design event). Any deviations from this sampling scheme are presented in Appendix B.*

Section 2.1.3.1 also indicates that storm samples from the first flush, peak flow and receding side of the hydrograph were analyzed based on the storm hydrograph.

The TMDL document does not contain any references to deviations from the proposed sampling protocol in Appendix B or elsewhere. The TMDL document is unclear as to how or if the selected samples were composited, what portion of the hydrograph the presented nutrient concentration for each storm event represent and whether the sampled storm is representative of the four-hour design event. Additionally, Section 2.2 notes that all field turbidity data was rejected due to instrument calibration problems in the field and nutrient data from some sites (WRRC sampling efforts) were not comparable to data from other sources and therefore not used in the TMDL analysis.

We are concerned that a more robust data collection and analysis program may be required in order to more fully understand the nature and variability of nutrient and sediment loading in the Nawiliwili Bay watershed prior to the TMDL implementation. We request additional information be presented to indicate the representativeness of the sample results for each sampling event.

Source Assessment

Nutrient and bacterial loading in the watershed appears to be a function of nonpoint sources. Section 3.1.1 of the TMDL document identifies wastewater, fertilizers, wildlife, septic systems, cesspools, sewage and natural processes as sources for nitrogen and enterococcus in surface waters. Given that groundwater provides a significant source of base flow for the Nawiliwili watershed through spring outlets, an important aspect of pollutant loading analysis is the identification of background nutrient concentrations associated with groundwater. Section 3.1.1 and Table 3-2 indicate that the groundwater nitrogen concentrations in the Nawiliwili Bay watershed are often higher (in some cases up to two orders of magnitude greater) than water quality criteria. The relative contribution of groundwater sources to overall loading in the Nawiliwili Bay watershed is an important factor in assessing various best management practices (BMPs) approaches and feasibility to achieve pollutant reductions through BMP implementation. Additional data is required to assess the input of groundwater-related pollutants to streams in the Nawiliwili Bay watershed.

Flow Determinations

We acknowledge that long term and continuous monitoring data are not available for the Nawiliwili Bay watershed and therefore regional monitoring data were used for the linkage methodology. In order to estimate flows in the Nawiliwili Bay watershed, the TMDL linkage methodology utilized four stream flow gauges on the island of Kauai (all four located outside the Nawiliwili Bay watershed) and three stream flow gauges on the island of Oahu to develop the statistical relationship between precipitation and stream flow. However, we are concerned that the flow volume estimates made using these seven stream flow gauges may not represent conditions within the Nawiliwili Bay watershed. The TMDL document identifies "*annual precipitation totals, land use within the tributary area, topography, and conformance with the assumption of no stream diversions*" as criteria important to the selection of similar streams used for the stream flow comparisons. However, Section 3.3.1 notes:

> *"Although Nawiliwili Bay watershed is one of the areas on Kauai most impacted by urbanization, the four selected gauges on Kauai did not include any tributary areas that were urbanized."*

Given the importance of land use and urbanization in determining runoff rate and volumes, it is unclear of the applicability of the selected stream flow gauges to the Nawiliwili Bay watershed.

In the second step of the hydrologic analysis, precipitation gauges were selected to pair with the stream flow gauges. However, differences in local precipitation are significant on Kauai, potentially making the rainfall/flow relationship difficult to predict. Section 3.3.3.2 notes:

> *"Since not all rain gauges were located in the same watershed as the flow gauge, there was not always a direct correlation between recorded rainfall and recorded flow."*

As seen from Table 1 below (data summarized from Table 2-4 in the TMDL document) local precipitation differences between rain gauge locations on the island of Kauai were highly variable on days when wet weather stream sampling was conducted.

Table 1. Precipitation data in the Nawiliwili watershed.

	24-hour Precipitation (assumed to be inches)			Difference Between Highest and Lowest Rainfall
Date	Lihue	Omao	Lihue Airport	
02/14/03	0.69	0.81	2.41	1.72
03/07/03	0.05	0.01	0.77	0.76
04/04/03	0.20	0.68	0.14	0.48

In addition, the TMDL document does not provide any geographic linkage between the precipitation and stream flow gauges used for the Oahu sites in the TMDL analysis. Accordingly, the use of potentially disparate precipitation and stream flow data to estimate flow volumes within the Nawiliwili Bay watershed is inappropriate. Additional data is required to verify stream flows within the Nawiliwili Bay watershed and more accurately calculate the TMDL load capacity and current load estimation for each constituent prior to TMDL implementation.

Load Analysis

In order to assign pollutant load allocations to segments of the four streams in the Nawiliwili Bay watershed, estimated relationships between pollutant loading and land use were used from literature sources. This is despite the fact that no strong correlations between land use and pollutant loading were found using data collected within the Nawiliwili Bay watershed. While we understand the process described in Section 4.1 of the TMDL document that assigns load allocations to areas in the Nawiliwili Bay watershed based on estimated pollutant loading of areas with similar land uses, it is unclear as to how land use will apply to the load reductions assigned to specific watershed areas. Additional clarification is necessary. We recommend additional sampling be conducted in order to more fully understand pollutant sources in the Nawiliwili watershed and any potential correlations between land use and pollutant loading.

Implementation Framework

We agree that water quality impairments in the Nawiliwili Bay watershed can and should be addressed. Based on the limited data presented in the TMDL document, the overall loads appear to be related to nonpoint sources associated with both natural and anthropogenic activities. The nutrient and bacterial loads are likely related to "background" groundwater nutrient loads and wastewater and/or sewage sources. Sediment loads are likely a result of natural erosional processes and various other agricultural or human activities.

In order to cost-effectively address these issues, an integrated implementation strategy needs to be developed. The TMDL document identifies the Assessment and Protection Plan for the Nawiliwili Watershed: Phase 3-Restoration and Protection Plan (Restoration Plan) as the implementation framework to address water quality issues and improve water quality to meet State and Federal water quality standards. Although, the Restoration Plan was developed to improve water quality through a variety of strategies, it was not intended to serve as the implementation plan for achieving load reductions in the TMDL. Page 64 of the Restoration Plan states:

> *"Activities in the TMDL implementation plan for load reductions should merge with some of the restoration activities that have been identified in this report."*

We recommend an integrated implementation framework and load reduction strategy be developed for inclusion in the TMDL that incorporates modified aspects of the Restoration Plan. As an example, the TMDL document specifically identifies catch basin insert BMPs as an initial focal point for stormwater management. Although catch basin inserts may be effective in reducing some sediment loads, these BMPs have sometimes been shown to increase nutrient loads as they capture and hold decomposing organic material. Also, the Restoration Plan identifies a constructed wetland BMP be placed on the Kauai Marriott property in order to treat runoff from upstream areas. The drainage ditches from the Kauai Marriott and Kauai Lagoons that discharge to Nawiliwili Stream are considered dry ditches by the U.S. Army Corps of Engineers. We question the overall benefit to the

Nawiliwili Stream of placing a wetland BMP on the Kauai Marriott property. Therefore we recommend a feasibility analysis be performed for this specific BMP project to assess both the feasibility of implementation as well as any potential water quality benefits the project may provide prior to its inclusion into the TMDL document implementation framework.

Both the Restoration Plan and TMDL document identify the conversion of cesspools and septic tanks to conventional sanitary sewer collection and construction and upgrades to existing individual wastewater system as key BMPs to reduce nutrient and bacterial loading. Implementation activities should focus on inventory and inspection of sanitary sewer collection systems and individual wastewater systems; repairing and upgrading failing and sub-standard systems (as indicated by inspection results); and completing watershed sanitary surveys and wastewater source tracking to complement information obtained from system inventory/inspection and ambient receiving water monitoring. Other source control BMPs such as controlling non-native/invasive species and soil erosion reduction should also be encouraged.

Other communities have adopted phased iterative approaches to TMDL implementation plans that combine wide-spread source control measures with some limited capital improvement projects and a comprehensive monitoring strategy in early implementation phases to determine the effectiveness of pollutant reduction strategies. Subsequent BMP implementation efforts are then guided by the results of the effectiveness assessment of early phases, thereby maximizing load reductions and allowing a cost-effective allocation of resources. We recommend a similar approach be incorporated into the TMDL document.

Other Implementation Considerations and Priorities

Based on the limited data presented in the TMDL document, we agree that "nonpoint sources are the overwhelming concern throughout watershed" and many known sources can be immediately targeted for direct action. Specifically, improvements to the cesspool and septic systems may dramatically impact water quality throughout the watershed. As an example of the potential impact that these types of improvements may have, Appendix F of the TMDL document states:

> *"The five LCCs [Large Capacity Cesspools] closed by January 24, 2008 were all in operation during water quality sampling by Tetra Tech and the University of Hawaii Water Resources Research Center (WRCC), and thus may have affected impairment and loading calculations in ways that may no no* [sic] *longer apply."*

Based on this statement, it is assumed that nutrient and bacterial concentrations in the watershed have been reduced as a result of these closures. The data collected in 2003 used to develop the TMDL may therefore overestimate the current nutrient and bacterial loads. Accordingly, the loading calculations and subsequent load reduction goals should be revised based on current conditions. We recommend additional water sample data be collected to revise the loading estimates in the Nawiliwili Bay watershed prior to TMDL implementation.

In addition, we do not agree with the following statement in Section 5.3:

> *"the Kauai Lagoons/Marriott complex form a distinct source area for part the Nawiliwili stream estuary (via the Marriot Culvert previously sampled by UH-*

WRRC) and the adjacent Kalapaki Beach."

There are numerous upstream areas of the Kauai Marriott and Kauai Lagoons that contribute runoff to the Marriott Culvert that include the Lihue Wastewater Treatment Plant (WWTP) and portions of the city of Lihue. Sewage effluent from the Lihue WWTP is disposed via injection wells and surface application and may be a component of nonpoint source loading. We recommend that the language in this section be modified to reflect that additional sources within this sub drainage exist.

A final implementation consideration should be the incorporation of a phased TMDL implementation schedule. There are many examples of other TMDLs that include a schedule for incremental increases in yearly load reduction goals over a period of 10 to 20 years that ultimately lead to the overall TMDL load reduction objectives. The yearly load reduction increases are often commensurate with the BMP implementation feasibility to achieve pollutant load reductions. We recommend that a phased load reduction schedule be incorporated into the TMDL and a periodic review of the overall TMDL load reduction goals be conducted using best available data.

Summary

The Kauai Marriott and Kauai Lagoons strongly support efforts to improve water quality in the Nawiliwili Bay watershed and appreciate the opportunity to comment on the proposed TMDL decision document. We are concerned however with many aspects of the TMDL decision process and suggest that more data is required to understand the sources of impairment and pollutant loading in the Nawiliwili Bay watershed. In addition, we suggest the TMDL incorporate a phased load reduction schedule that allows for incremental increases in yearly load reduction goals that lead to the overall TMDL load reduction objectives. The TMDL implementation schedule should also include periodic review of the TMDL load reduction objectives based on the best available data. Finally, we suggest the development of a phased and integrated BMP implementation approach to water quality improvement that coordinates with the TMDL implementation schedule in order to cost-effectively target known sources. The BMP implementation approach should include a concurrent coordinated effectiveness assessment process to assess BMP effectiveness and identify future opportunities for load reductions.

In conclusion of the comments presented herein, we request that the comments, observations, and requested corrections be incorporated into the Draft TMDL document prior to submission to the EPA. We also request an opportunity for an additional public comment period after any modifications to the Draft TMDL document are made, prior to submittal to the EPA. We would appreciate an opportunity to discuss all items with the Environmental Planning Office at your earliest convenience.

Sincerely,

Kauai Marriott Beach Club and Resort

Bill Countryman
General Manager

Kauai Lagoons, LLC

Steve Busch
General Manager

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:

EPO-0422

September 18, 2008

Bill Countryman, General Manager
Kauai Marriott Resort
3610 Rice Street
Lihue, Hawaii 96766

Steve Busch, General Manager
Kauai Lagoons, LLC
3351 Hoolaulea Way, Suite 201
Lihue, Hawaii 96766

Dear Sirs:

SUBJECT: Total Maximum Daily Loads for Major Streams of the Nawiliwili Bay Watershed

Thank you for providing comments on the draft TMDL (dated September 2, 2008) and expressing your support for efforts to improve water quality in the Nawiliwili Bay watershed. We appreciate your detailed attention to the draft document, and are encouraged to learn that both Kauai Marriott and Kauai Lagoons (the resorts) have adopted resort stormwater management plans. As these plans can be used to inform future monitoring, assessment, and rehabilitation of the greater Nawiliwili Bay watershed and other resort facilities statewide, we encourage the resorts to share them with others, and to use them as a basis for pursuing Clean Water Act §319 grant funds through the Department of Health (DOH) Polluted Runoff Control Program.

We believe that DOH used the best available information, adequate data, and reasonable methodology to produce a scientifically valid, thoroughly reviewed, and defensible TMDL decision with significant public involvement that provides adequate analysis of current loading issues in four major streams of the Nawiliwili Bay Watershed. Although the achievement of water quality standards in these streams would beneficially impact downstream estuarine and marine receiving waters, this TMDL decision does not address the load capacity and required load and wasteload allocations for the Nawiliwili Bay and estuaries - this will be addressed in a future TMDL. Thus providing "adequate analysis of current loading issues in Nawiliwili Bay" is presently of marginal concern to the current TMDL decision..

We agree that collecting additional data and revising the document would increase the level of certainty in loading calculations. However, we believe that the results presented are sufficient to meet Clean Water Act requirements and obtain EPA approval of the proposed TMDL decision.

While there is always room for improvement, any concerns about the assumptions, data, and methodology used in this TMDL are more matters of degree than disqualification. Ultimately, these concerns can only be resolved by additional long-term data collection in the watershed, which was not and is not feasible given the available information, schedule, scope of work, and budget for developing this particular TMDL. DOH capacity for TMDL development is limited by available resources and information, and we welcome any support that can be provided for boosting TMDL program capacity and increasing data availability.

We consider this TMDL decision as a starting point for implementation activities that can be adapted as new information becomes available, including, if warranted, future revision of the TMDL decision. DOH expects that TMDL implementation (including a realistic timeline and any future revision) will be community-driven, not DOH-imposed. Thus, the community shares responsibility for determining the extent to which TMDL implementation may or may not result in undue burden.

As requested, the comments, observations, and corrections you submitted were incorporated into the final TMDL document submitted to EPA, both as changes to the main text (as indicated below) and by otherwise addressing them in this response (included in Appendix I -Public Comments and Response to Public Comments). These and other modifications made to the draft TMDL document did not involve fundamental changes in the TMDL methodology or results, and do not alter the proposed DOH decision in ways that would require us to provide additional public notice and public comment opportunity prior to submission to EPA. We understand that Kauai Marriott representatives met with the DOH Environmental Health Administration (EHA) Deputy Director on September 10, 2008, to discuss TMDL decision timelines, TMDL implementation process and costs, and the role of Kauai County in this process. Please let us know if you still wish to discuss these and other items with the EHA Environmental Planning Office, as initially requested in your September 2 letter.

Your suggestions (**Summary** in September 2 comment letter) that “the TMDL incorporate a phased load reduction schedule,” including “periodic review of the TMDL load reduction objectives” that coordinates with “the development of a phased and integrated BMP implementation approach [including “a concurrent effectiveness assessment process”] … in order to cost-effectively target known sources” are now reflected in Section 5.0 (Implementation Framework) of the final document. We revised this section to clarify that the TMDL decision document and the Restoration Plan are intended to inform and guide the manner in which communities choose to achieve nonpoint source pollutant load reductions. The TMDL decision document is not a “TMDL Implementation Plan” in the sense expressed by your excerpt from p. 64 of the Restoration Plan (**Implementation Framework** in September 2 comment letter), and DOH does not anticipate writing a distinct “TMDL Implementation Plan” for the Nawiliwili Bay Watershed any time in the near future.

TMDL implementation within the Nawiliwili Watershed is primarily a nonpoint source management concern. Thus it is up to local parties responsible for nonpoint source management, TMDL implementation, and water quality standards attainment (such as the resorts), not DOH, to lead efforts to actually schedule phased load reductions, develop a phased and integrated BMP implementation approach, assess BMP effectiveness, and review load reduction objectives and opportunities. While your recommendation that "an integrated implementation framework and load reduction strategy be developed for inclusion in the TMDL that incorporates modified aspects of the Restoration Plan" (**Implementation Framework** in September 2 comment letter) is not within the scope of the current TMDL decision document, it can certainly be part of the framework and strategy adopted by the watershed community, and supported by DOH, as part of an ongoing TMDL process.

Timing and implications associated with the development of appropriate treatment controls to improve water quality in the Nawiliwili Bay watershed

Although the opportunities formally provided by DOH for public involvement in the proposed TMDL may seem limited, they are frequently a function of the extent to which a watershed community helps create these opportunities throughout the process. Despite the fact that the TMDL program has statewide responsibilities and no neighbor island staffing, we met individually, and sometimes repeatedly, with individual watershed partners (including on-site discussions with Kauai Marriott management about the TMDL process and Marriott water systems) and participated in several public events (such as Kauai Earth Day, Soil and Water Conservation District meetings, and Nawiliwili Watershed Council and University of Hawaii forums), resulting in many significant public contributions to the TMDL decision. As discussed in Section 7.0 of the draft document (Public Participation), "TMDL development in the Nawiliwili watershed is an outcome of many years of public participation in initiating and sustaining environmental protection programs." This also included Marriott assistance in completing Phase 1 of the DOH-funded Assessment and Protection Plan for the Nawiliwili Bay Watershed and Marriott attendance at meetings conducted to discuss restoration activities for inclusion in the Phase 3 Restoration Plan.

The public comment period for the proposed TMDL is the same as that regularly provided for all proposed DOH TMDL decisions, and we believe that DOH has met all federal requirements and fulfilled all EPA Region 9 review criteria for TMDL public participation (document provision of public notice and public comment opportunity and explain how public comments were considered in the final TMDL). The consideration of public comments did not lead to fundamental changes in the TMDL methodology or results, therefore we believe that conducting a second comment period (as requested) would unduly delay the overall TMDL process and would not lead to significant improvements in the TMDL decision.

We regret any comments made by the DOH panel during the public informational meeting held on August 13, 2008 that may have appeared to downplay the importance of the TMDL document in EPA's TMDL decision making process or given the wrong impression to members of the public about the potential impacts of an EPA-approved TMDL. The TMDL document (which now includes public comments and responses to public comments in Appendix I) and DOH's submittal letter are the basis for EPA approval, and are evaluated by EPA using the checklist found in Appendix A. The actual impacts of an EPA-approved TMDL that we intended to highlight at the meeting are the associated modifications of NPDES permit conditions (to implement Waste Load Allocations) and the increased opportunities to obtain Clean Water Act §319 grant funds (to implement nonpoint source Load Allocations).

Commonly-feared potential impacts of an EPA-approved TMDL are mostly beyond DOH control, such as government and private action (including legislation, approval and permitting conditions, lease conditions, and third-party lawsuits) to require the implementation of nonpoint source Load Allocations. DOH enforcement actions against nonpoint sources that cause or contribute to non-attainment of the water quality standards are generally complaint-driven, are not systematically pursued in conjunction with TMDL approval, and tend to focus on repeat and egregious offenders.

Technical issues – Stream Monitoring Locations and **Sample Collection and Analysis**
Based on your comments, we verified the monitoring locations and associated data with respect to the geographic location and made the necessary corrections to Table 2-1.

Deviations from the sampling scheme were inadvertently omitted from Appendix B, and are now summarized there based on the project Data Quality Evaluation approved by EPA, which also confirmed the representativeness of the sampling results. The storm samples selected for chemical analysis were not composited. Each sample selected was analyzed discretely, as indicated in Table C-4 where the record of each storm sample includes a sample ID number (#) denoting its position in the standard 12-bottle event sampling sequence (#1= first of 12 bottles). In general, the bottles selected for discrete analysis from a given event correspond, in sequence, with the first flush, peak, and recession curve displayed by the hydrograph, as illustrated by figures added to Appendix C in the final TMDL document. These figures also indicate whether the sampled storm is representative of the four-hour design event. In this regard, please note that the storm event sampling objective was to collect data from three storms at each location, covering a broad range of stormflow conditions at each location, including but not limited to the four-hour design event used as the initial setting.

With regard to field turbidity, a number of results were reported as negative values due to calibration error and/or equipment malfunction, and no data were recovered for certain events and locations. Although this resulted in the rejection of field turbidity data, the remaining laboratory turbidity dataset achieved project data quality objectives. Furthermore, turbidity data were not used for loading calculations, they were only used to assess non-attainment of the water quality criteria for turbidity. DOH assumes that implementing TMDLs for nutrients and TSS will result in the attainment of the turbidity criteria - therefore, this deviation did not adversely impact the TMDL analysis and decision.

Although a more robust data collection and analysis program would definitely be required in order to more fully understand the nature and variability of nutrient and sediment loading in the Nawiliwili Bay watershed, DOH believes that TMDL implementation should be a vehicle for this fuller understanding, not a hostage to it.

Technical issues – Source Assessment
Although additional data may be required to assess the input of groundwater-related pollutants in greater detail, the overall effects of this input are adequately (although not discretely) captured in the stream water quality data and addressed in the TMDL load allocations, and provide sufficient information for the current phase of TMDL implementation. The magnitude of these source contributions (loading) will be difficult to assess on a watershed basis. Even if more information about the magnitude and extent of groundwater source contributions were available, additional information about the sources, transport, and fate of pollutants on their way to groundwater would be needed to identify the appropriate source controls. Nonetheless, additional information obtained during TMDL implementation (such as that to be obtained from the DOH Source Water Assessment Program) could be used to focus management measures on any large groundwater sources identified.

As part of the source assessment process, we collected single samples of emergent groundwater at Makaaiai Spring and Waiaka Spring in September 2003 (see Table C-3, page C-11). The Makaaiai Spring sample had a TSS concentration greater than the value of the wet season 10% NTE criterion (probably due to local stream conditions), Total Nitrogen and Total Phosphorus concentrations just below the value of the wet season geometric mean criterion, and a Nitrate+Nitrite Nitrogen concentration well below the dry season geometric mean criterion. The Waiaka Spring sample had TSS, Nitrate+Nitrite Nitrogen, and Total Phosphorus concentrations well below the value of the dry season geometric mean criterion, and a Total Nitrogen concentration over two times greater than the value of the wet season 2% NTE criterion. Despite these apparently high groundwater concentrations, their contribution to overall water quality impairment is a function of mixing between their total flow (and loading) and the total flow and load carried in the receiving stream waters.

Nonetheless, an initial assessment of potential sources could be conducted by comparing the geometric mean pollutant concentrations measured under baseline flow and storm flow conditions. For example, Total Nitrogen concentrations are similar for Nawiliwili Stream baseline flow and storm flow conditions, while the concentrations under storm flow conditions in Puali and Papakolea streams are significantly higher than under baseline flow conditions. This suggests that cesspool and point sources may be a more significant contributor to nitrogen loadings in Nawiliwili, and storm runoff may be a more significant contributor of nitrogen for Puali and Papakolea.

Technical issues – Flow Determinations
Along with the resorts, two other parties expressed concern about the flow determinations used in the TMDL development process. To address these concerns, we added additional information to the final TMDL document to better illustrate how the results of the regional hydrologic analysis (the linkage methodology used to estimate streamflow) are applied to represent conditions within the Nawiliwili Bay watershed. We clarified the applicability of the selected stream flow gauges to the Nawiliwili Bay watershed by revising information in Table 3-5 (Baseflow Estimation for the Selected USGS Flow Gauges). Also, in response to a comment from the resorts, we revised section 3.3.1 to clarify that because Lihue-Puhi town is one of the

most heavily urbanized areas on Kauai, no stream flow gauges on Kauai could be located that both represented this urban land use component and fulfilled the remaining gauge selection criteria. The applicability of the selected Oahu stream flow gauges to the Nawiliwili Bay watershed is based on their representation of this urban land use component (between 7% and 30% of the gauge contributing area) mixed with forested and open/agricultural lands, along with their fulfillment of all the remaining gauge selection criteria, save for Nawiliwili-like substrates and soils.

We agree that differences in local precipitation are significant and highly variable on Kauai and throughout the main Hawaiian islands, making rainfall/flow relationships more difficult to predict. This both supports and argues against the use of a simplistic approach to hydrologic analysis, depending upon available data and resources. Our ability to characterize and consider the spatial variability of rainfall distribution within and across the watershed, and its corresponding influence on flow, is limited by the scope of available rainfall and streamflow data and by the data requirements for completing the regional hydrologic analysis (comparability of data attributes among stations and periods of record).

Based on your comment, we revised Table 3-4 to provide geographic linkage between the precipitation and stream flow gauges used for the Oahu sites in the TMDL analysis. We also added to Appendix D of the final TMDL document a complete set of the graphs showing the seasonal relationship between stream flow volume and precipitation (as in Figure 3-6 of the draft for public review) for each pair of flow and precipitation gauges used in the analysis. Together, this confirms that similar, rather than disparate, precipitation and stream flow data were used to estimate flow volumes. Therefore, DOH doesn't intend to delay TMDL development and implementation by first obtaining additional data to verify streams flows and recalculate TMDL load capacity and current load estimation. However, parties responsible for TMDL implementation and water quality standards attainment may opt to collect this and any other additional data that better informs the TMDL implementation process.

Technical issues – Load Analysis

Along with the resorts, two other parties expressed concern about the load analysis used in the TMDL development process. The load analysis assumes that correlations between pollutant loading and land use developed from extensive regional and nationwide studies are an acceptable substitute for local data, especially given the extreme time, effort, and funding required to produce similarly reliable results for Hawaii. No strong correlations between land use and pollutant loading were found using data collected from within the Nawiliwili Bay watershed because the sampling designs for water quality assessment and TMDL development were not intended to provide land-use specific loading data for such analysis.

Land use-based pollutant load allocations (estimates of relative loading contributions) are presented in the TMDL as a guideline for consideration in implementing the load reductions assigned to specific watershed areas. With these guidelines in place, DOH believes that it is best to move forward with implementation efforts to address water quality issues in the watershed.

Therefore, DOH doesn't intend to delay TMDL development and implementation by first conducting additional sampling to more fully understand pollutant sources in the Nawiliwili watershed and any potential correlations between land use and pollutant loading. However, parties responsible for TMDL implementation and water quality standards attainment may opt to conduct this and any other sampling that better informs the TMDL implementation process.

Implementation Framework
States are generally not required to prepare TMDL implementation plans, but are expected to support TMDL implementation through point and nonpoint source control programs and other relevant watershed management processes. The implementation framework and reasonable assurances discussed in Sections 5.0 and 6.0 of the TDML document identify how various aspects of TMDL implementation will be or could be conducted and supported, and refer to the Restoration Plan as an important foundation for implementation efforts. Further specification of implementation plans, projects, and activities - whether they are completed individually and independently or collaboratively and inter-dependently - is beyond the scope of the TMDL decision document.

Thank you for noting the potential for catch basin inserts to increase nutrient loads as they capture and hold decomposing organic material. The extent to which this potential is realized may be a function of insert maintenance effectiveness. Site-specific information addressing insert performance may be available in the records of a DOH-sponsored Polluted Runoff Control project completed in the Nawiliwili Bay watershed by Pacific Island Sustainable Community Ecosystems (PISCES).

With regard to your concerns about constructing a wetland BMP on Kauai Marriott property for treating runoff from areas upstream, at this stage in the process DOH's role is mainly to identify a wide range of implementation alternatives, not to conduct feasibility analyses for select alternatives. Constructed wetlands are a proven technology for nutrient and sediment load reduction. Feasibility analysis is common for any such engineering project, and would likely be based on technology-specific effectiveness data and site-specific performance factors. We expect that Kauai Marriott, its watershed partners, and/or local authorities seeking to impose this or other BMPs on private landowners would drive this type of detailed, site-specific implementation planning, not DOH.

Our available information suggests that "drainage ditches from the Kauai Marriott and Kauai Lagoons" discharge to the estuarine portion of Nawiliwili Stream, thus their contributing areas are not part of the current TMDL decision area (which is connected to freshwater portions of the stream only). We suggest that future assessments of this sub-basin consult resort stormwater management plans and more detailed ground truth to verify this assumption. Despite U.S. Army Corps of Engineers considerations, determinations of State jurisdiction over these watercourses under the Clean Water Act are the sole purview of DOH and the State Judiciary, and our available information suggests that at least one of them (the Marriott Culvert) meets the regulatory definition of "Streams" in Hawaii Administrative Rule §11-54-1.

Regardless of how we define these watercourses, they collect and convey polluted runoff and diffuse pollution to the estuarine portion of Nawiliwili Stream and to marine waters in Nawiliwili Bay. Therefore any pollutant load reductions achieved in these watercourses will help to address associated water quality impairments in the estuary and embayment receiving waters, and may also improve support for native aquatic life uses throughout the Nawiliwili stream system.

DOH agrees that other source control BMPs such as controlling non-native/invasive species and soil erosion reduction should also be encouraged. In addition, DOH also concurs that phased approaches to TMDL implementation plans are appropriate given funding and capacity limitations and that local monitoring data provides useful insight to BMP performance. However the effectiveness of pollutant reduction strategies can also be estimated based on data collected from similar efforts elsewhere. Local BMP effectiveness data are beneficial in determining the overall extent of BMP impacts and success of the implementation program, and DOH encourages the collection of such data. However, the lack of local data should not hinder a wide range of implementation efforts given the extensive databases and worldwide experience gained regarding effective BMP selection, installation, operation, maintenance, and evaluation.

Other Implementation Concerns and Priorities

Although the data and calculations used for TMDL development may not reflect any subsequent effects of Large Capacity Cesspool closures on current ambient water quality (pollutant concentrations) and pollutant loading, these closures do not affect the loading capacities (based on water quality standards) which are the core of the TMDL decision and are independent of observed water quality data. The large magnitude and extent of water sample data that would be required to pinpoint any load reductions directly and exclusively attributable to these closures does not warrant delaying TMDL implementation, and revising loading calculations and load reduction goals "based on current conditions" (information less than five years old) may not necessarily result in significant changes to the overall implementation framework and load reduction strategy.

DOH currently allows information that is six years old to be used in assessing water quality impairments for Clean Water Act §303(d) listing purposes, and routinely considers this to comprise the bulk of the best information available for decisionmaking purposes. DOH cannot monitor and assess everything, everywhere, all the time, and if suggestions to collect new data and revise calculations "based on current conditions" were taken to their ultimate conclusions, the decisionmaking process would be paralyzed in attempting to accommodate constantly-changing "current conditions." Nonetheless, documenting actual reductions in nutrient and bacterial concentrations resulting from wastewater disposal management measures is potentially a worthy objective for a TMDL implementation monitoring strategy, one to be decided by the watershed community as a whole, rather than by DOH alone.

As requested, we modified the language in Section 5.3 to identify additional sources that contribute runoff to the Marriott Culvert and to more diffuse surface and sub-surface loading within the related sub-drainages. We reviewed Lihue WWTP information filed with the DOH Waste Water Branch, including reports of near-shore sampling efforts undertaken by Marine

Research Consultants in 1998 which suggested that injection well effluent would not adversely affect offshore marine habitat and biota. Pump injection tests and effluent flow data from the WWTP indicate that the current injection well set-up can satisfactorily dispose of all effluent that isn't reused for golf course irrigation.

We thank Kauai Marriott and Kauai Lagoons for your interest and participation in DOH water pollution control and water quality management efforts, and look forward to ongoing cooperative efforts to improve the TMDL process. If you have any questions about this letter, please contact David Penn, TMDL Coordinator at 586-4337 or at david.penn@doh.hawaii.gov.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office