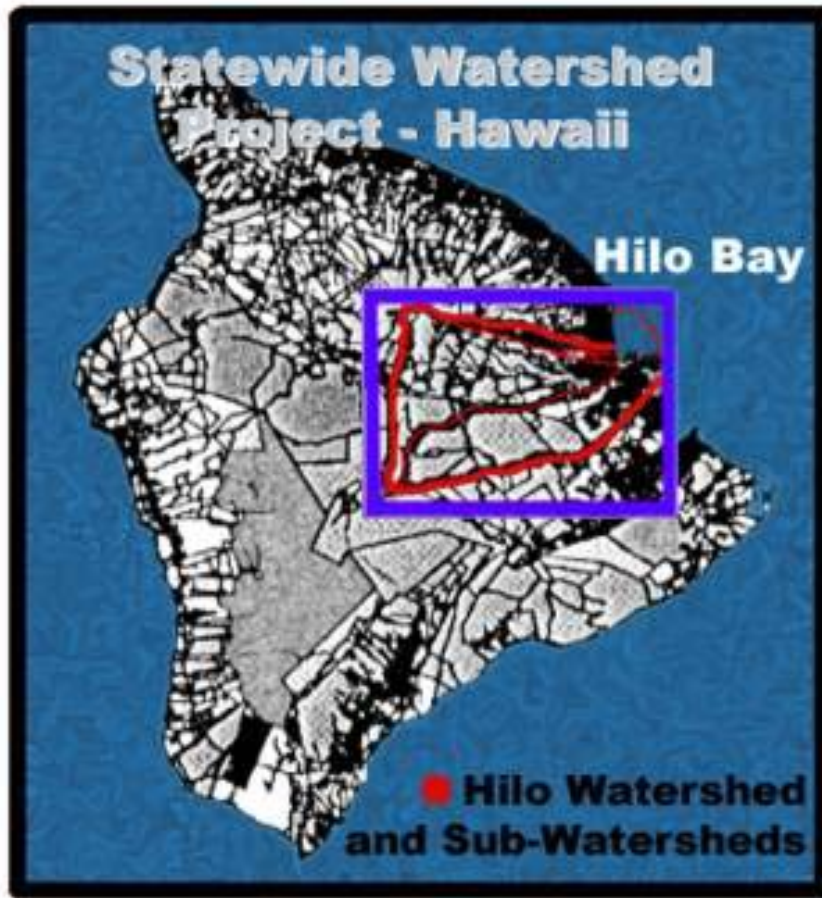


# Hilo Bay Watershed Project

## Public Input



## Final Report

Prepared By  
Hilo Bay Watershed Advisory Group

Submitted To  
Peter Rappa, Principal Investigator  
UH Environmental Center Honolulu, Hawaii

Through  
Trisha Macomber, Hilo Watershed Project Coordinator  
UH Agriculture Complex Hilo, Hawaii

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### Supplemental Information

- Information prepared by Thomas Young
  - Background information on Hilo Bay Watershed
  - Honolii and Wailuku River Water Quality Monitoring Data from the State of Hawaii Department of Health Clean Water Branch
  - Thomas Young’s conclusions on background turbidity in the Honolii and Wailuku Rivers
- Total Daily Maximum Load Fact Sheet prepared by David Penn

## Executive Summary

Hilo Bay and its tributaries do not comply with all State water quality standards and was therefore put on the U.S. Environmental Protection Agency (EPA) 303(d) list of impaired waterbodies. As the enforcement agency for the State of Hawaii, the State Department of Health (DOH) subsequently received EPA grant funds and contracted with the University of Hawaii at Manoa to complete the initial step of the EPA program to bring waters into compliance with standards. The initial step requires collecting background information and input from the community on what residents believe to be the problems associated with Hilo Bay water quality.

The analysis of the public input led to the following conclusions:

1. There are many unknowns regarding the Hilo Bay watershed's problems and potential solutions.
2. A formal, professional needs assessment/problem analysis should be conducted.
3. All the stakeholders (the community, landowners, and County, State, and Federal agencies) should be involved in the process including a formal, professional needs assessment
4. The Hilo Bay WAG/Public Input process has been of significant value:
  - a. There is a better understanding of what we -the stakeholders- do know and, mostly, *do not* know about the Hilo Bay watershed
  - b. It is clear we need to work together at all levels to identify and prioritize the Hilo Bay watershed's problems and solutions.

The first phase of any future project should focus on leadership, coordination, cooperation, systematic information gathering and analysis, and community education.

The Hilo Bay Watershed Project Public Input Final Report (Final Report) documents the public input, describes the public input process and analysis, and states the conclusions, including the watershed restoration priorities. This Final Report is a key component to the Hilo Bay Watershed Background File that provides the critical information needed for the subsequent steps, including developing a watershed restoration/management plan, obtaining funds for restoration projects, and updating policies and guidelines related to watershed management.

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## I. Overview

The U.S. Environmental Protection Agency (EPA) in accordance with the Clean Water Act, mandated that all states review water quality data for water bodies throughout the state to determine if those waters were in compliance with state water quality standards. Waterbodies that exceeded state water quality standards were labeled “impaired” or “limited” and thus qualified for the EPA Total Maximum Daily Load (TMDL) Process. TMDLs establish the maximum rate at which impaired waterbodies can receive certain pollutants without exceeding the State’s water quality standards. This process includes calculating existing pollutant loads, determining relationships between these loads and State water quality standards, and suggesting how pollutants, pollutant source areas, and stream environments could be managed to achieve necessary water quality improvements. The TMDL Process identifies activities that may help reduce pollutant loads, improve water quality, and increase a waterbody's ability to support its legally-protected uses (such as public recreation and protecting the breeding stock of native animals).<sup>1,2</sup>

The State of Hawaii Department of Health (DOH) placed several Hilo waterbodies (Waiakea, Alenaio, Wailoa, Wailuku, Honolii) on the 1998 State of Hawaii list of impaired waters under §303(d) of the federal Clean Water Act after inspection in 1996. Excessive turbidity (usually caused by sediment) is listed as a cause of poor water quality in Honolii, Wailuku, and Wailoa, and excessive nutrients (nitrogen and phosphorous) in Honolii, Wailoa, Alenaio, and Waiakea. DOH water quality monitoring data for the Honolii and Wailuku rivers can be found in *Supplemental Information* in the Appendix. Excessive pathogens, as indicated by measured enterococci levels, are listed as an additional cause of poor water quality in Wailoa. These waterbodies all feed Hilo Bay, which has been on the list of impaired waters for decades.<sup>1</sup> The current 303(d) list for the County of Hawaii is shown in *Table 1<sup>3</sup>. 2004 303(d) List for Hawaii* (see Appendix). Hilo Bay was listed due to non-compliance with State water quality standards and because it has potential for effective remediation.

<p style="text-align: center;"><b>Unifying Clean Water Programs Within Watersheds</b></p> <p>"...current federal and state environmental programs and policies are fragmented and do not adequately emphasize restoration based on management of large interconnected aquatic ecosystems. The diverse responsibility of all layers of government affecting aquatic resources needs to be better coordinated if large-scale restoration is to be accomplished efficiently and effectively. Because aquatic ecosystems are interconnected and interactive, effective restoration efforts should usually be conducted on a large enough scale to include all significant components of the watershed."</p> <p>Source/quoted from: Restoration of Aquatic Ecosystems, National Research Service, National Academy of Sciences, 1992 <a href="http://www.cleanwater.gov/action/c3b.html">http://www.cleanwater.gov/action/c3b.html</a></p>
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An EPA funded Statewide Watershed Project was initiated in 2002 to improve water quality in the impaired watersheds and bring them into compliance with State water quality standards. The DOH applied for and received EPA grant funds to participate in this

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<sup>1</sup> Source: Fact Sheet by Dave Penn, State of Hawaii Department of Health, Total Daily Maximum Load Coordinator; May 2004 (see Appendix)

<sup>2</sup> Federal, State, and local law do not require TMDL implementation and TMDLs are not enforced by federal, State, and local authorities. Ambient water quality standards, permit conditions, and permit requirements are enforced by the DOH and the EPA. Source: Fact Sheet by Dave Penn, State of Hawaii Department of Health, Total Daily Maximum Load Coordinator; May 2004 (see Appendix)

<sup>3</sup> Source: *2004 List of Impaired Waters in Hawaii Prepared Under Clean Water Act 303(d) Public Comment Draft* prepared by Linda Koch, June Harrigan-Lum and Katina Henderson for Hawaii State Department of Health, Environmental Planning Office, February 27, 2004

program. Once the impaired waters were identified, the next step in the EPA program was to record public input to be used in the development of a program to restore the impaired waters. The DOH contracted with the University of Hawaii at Manoa to gather community input for the seven most troubled State watersheds regarding what the communities believed to be the water quality problems, the causes and effects of the problems, and potential solutions. This community input will now be used in the development of an EPA watershed restoration plan to restore the health of the watershed and effectively reduce non-point source pollution (NPS) inputs.

This illustrates the shift in water resources management in recent years from eliminating obvious point sources of pollution to a watershed-based approach that emphasizes pollution prevention, economic sustainability, and overall environmental improvement. Watershed management, according to the EPA, is "a coordinating framework for environmental management that focuses on public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas."

Three key concepts of the watershed approach are:

1. Partnerships with stakeholders affected by resource management decisions
2. A geographic focus for management activities
3. Management techniques based on strong science and data.<sup>4</sup>

The purpose of this report is to:

- Describe and document the public input process
- Provide the information that is essential to the development of a watershed restoration/management plan for Hilo Bay
- Define the Hilo Bay watershed restoration priorities.

The EPA watershed restoration plans mostly focus on implementing projects that will bring impaired waters into compliance with water quality standards in a relatively short time frame. A watershed management plan however includes water quality and restoration as a component, but focuses on developing and implementing a long-term strategy for a sustainable, balanced watershed. That is, a *watershed restoration plan* could be an important component of a *watershed management plan*, but nevertheless could be designed and implemented with or without being part of a watershed management plan.

## II. Background

A watershed is a basin defined primarily by topography, and includes the area where groundwater and runoff from rainfall ultimately drain. The Hilo Bay watershed is extensive, stretching from the summits of Mauna Kea and Mauna Loa to Hilo Bay. The Hilo Bay Watershed includes all the land and water (both ground and surface water) within the watershed and consists of the following sub-watersheds: Alenaio, Honolii, Malii, Paukaa, Pukihae, Wailoa, Wailuku, Wainaku. The Hilo Bay watershed and seven of the sub-watersheds along with various monitoring stations are shown in Figure 1. This basin carries nutrients as well as natural and man-made pollutants to Hilo Bay. Pollutants can also be carried by ocean waters entering the bay (e.g., cruise ships). Current land uses are shown in Figure 2.

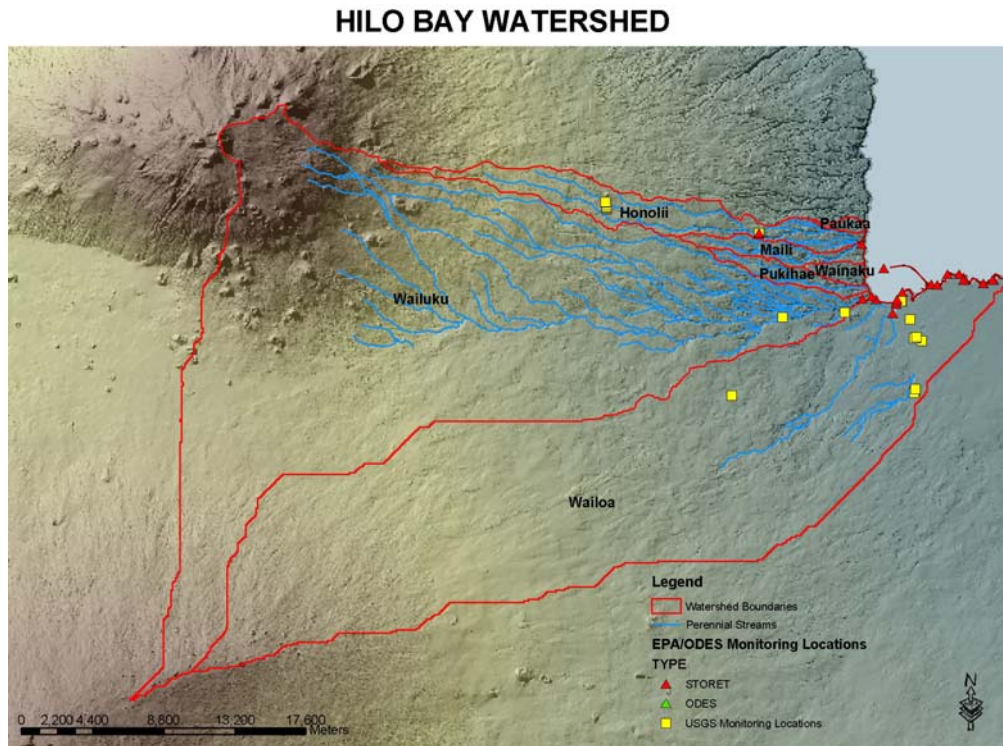
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<sup>4</sup> Source/quoted from: *MSU's Virtual Watershed Program: An Internet-based Academic Credit or Professional Certificate Program in Watershed Management* at (Internet) [www.iwr.msu.edu/vu/watershed/brochure.html](http://www.iwr.msu.edu/vu/watershed/brochure.html))

The land and waters throughout the Hilo Bay watershed have undergone dramatic changes throughout history, some natural, some man made. Where scientific documents are not available, historical publications can provide information as to the conditions of the watershed at the earliest recording to the present. Several quotes and anecdotal comments are provided in the *Supplemental Information* in the Appendix for a view of conditions prior to scientific investigation.<sup>5</sup>

The northern part of the watershed, formed by Mauna Kea has a well-defined channel system on the middle and lower slopes. Recent lava flows from Mauna Loa have obliterated natural drainageways, causing floodwaters to flow over wide areas. Large amounts of runoff water enter lava tubes and rock fractures in the area but some return to the surface as springs that flood the developed areas.<sup>6</sup>

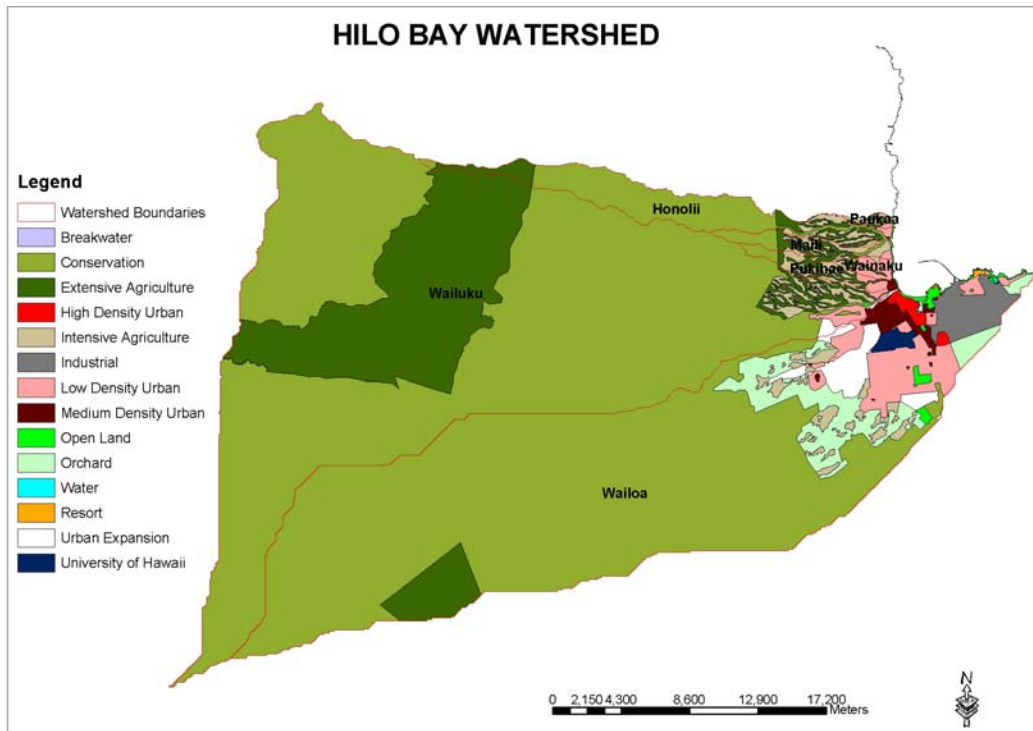
The island of Hawaii, lying in the path of the northeast tradewinds, has an orographic rainfall pattern typical of the larger islands in the Hawaiian chain. The moisture-laden trades are cooled as they rise up the mountain slopes and lose part of their moisture as rain. The prevalence of the trades throughout much of the year accounts for the high annual rainfall of 75 to more than 300 inches on the windward, northeast



**Figure 1. Hilo Bay Watershed, Sub-watersheds and Monitoring Locations**

<sup>5</sup> Source: Information provided by Thomas Young, Member of the Hilo Bay Watershed Advisory Group; May 2004; see Supplemental Information in Appendix

<sup>6</sup> Source: Watershed Work Plan Wailuku-Alenaio Watershed; Hawaii County, Hawaii 1976; Soil Conservation Service Forest Service; page 3



**Figure 2. Land Uses Within Hilo Bay Watershed**

side of the island. Orographic rainfall increases with elevation, reaching a maximum intensity from 2,000 to 3,000 feet elevation and then diminishing, so that upper slopes are semi-arid.<sup>7</sup>

Looking at the watershed holistically encourages a more integrated approach to addressing the water quality problems in a manner that will result in restoring and protecting the bay. The ultimate measure of the health of the Hilo Bay watershed will be the improvement of the water quality in Hilo Bay and its tributaries, with emphasis on a permanent reduction in turbidity, nutrients, and bacteria, to levels that comply with State standards. It should be noted that studies to date show turbidity and bacteria have a positive correlation, that is, when both occur in source water, pathogen removal coincides with

<sup>7</sup> Source: See footnote 5; page 17

#### **TURBIDITY DEFINED**

Turbidity is a principal physical characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. It is caused by suspended matter or impurities that interfere with the clarity of the water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble colored organic compounds, and plankton and other microscopic organisms.

Typical sources of turbidity in drinking water include waste discharges, runoff from watersheds, algae or aquatic weeds, humic acids/ organic compounds from decay of plants, leaves, high iron concentrations which give waters a rust-red coloration, air bubbles and particles from treatment processes

Once considered as a mostly aesthetic characteristic of drinking water, significant evidence exists that controlling turbidity is a competent safeguard against pathogens in drinking water.

turbidity/particle removal.<sup>8</sup> Thus turbidity is a special concern to community well-being.

The Hilo Bay Watershed Project Public Input Final Report (Final Report) documents the public input, describes the public input process and input analysis, records the conclusions, and defines the watershed restoration/ management priorities. This Final Report is a key component of the Hilo Bay Watershed Background File that incorporates the results of the public input process and Watershed Advisory Group meetings from July 1, 2003 through February 25, 2004. The Background File provides the critical information needed for developing a Hilo Bay watershed restoration/management plan, for obtaining State and Federal funding for restoration projects, and for updating policies and guidelines related to watershed management.

### **III. Hilo Bay Watershed Advisory Group**

The Hilo Bay Watershed Advisory Group (WAG) consists of a group of volunteers established to represent the local community in addressing watershed/water quality issues, including improving water quality throughout the Hilo Bay watershed. The WAG was formed during the public input process described above. There have been as many as 20 members with approximately ten people representing the core members. Since February 25, 2004, the WAG has been working with the University of Hawaii and Department of Health to apply for funding for the next stage of the EPA program: developing a restoration/management plan for the Hilo Bay watershed.

### **IV. Public Input Process**

Views of those living, working, and recreating in the Hilo Bay watershed were collected through public meetings and surveys. This effort was initiated in July 2003 when representatives from the Statewide Watershed Project held the first two of six public input meetings and gathered opinions about Hilo Bay water quality. Two more public input meetings were held on January 6, 2004 followed by the final two meetings on January 21, 2004. There was a total of approximately 100 participants in the six public meetings. In addition to the public meetings, surveys were distributed and some residents responded via email to a questionnaire in the local newspaper. Eleven completed surveys and ten write-in responses were submitted separately.

Questions asked of the public included:

1. What is your biggest concern about the condition of the waters (streams, groundwater, bay) in the Hilo Bay watershed?
2. What do you feel is the primary cause of the condition of Hilo Bay?
3. What do you think can or should be done to correct this problem?

All of the community input, including that from the six public meetings, responses to surveys, questionnaires, and interviews, was recorded. The issues and solutions identified through this process are listed in *Table 2. Hilo Bay Watershed Issues and Solutions Uncategorized Raw Data* (see Appendix). This information was sorted, condensed and then grouped into several different categories as shown in *Table 3. Public Issues Categorized* and *Table 4. Hilo Bay Watershed Solutions Categorized* (see Appendix). It should be noted that these causes need further validation before concluding if, and to what

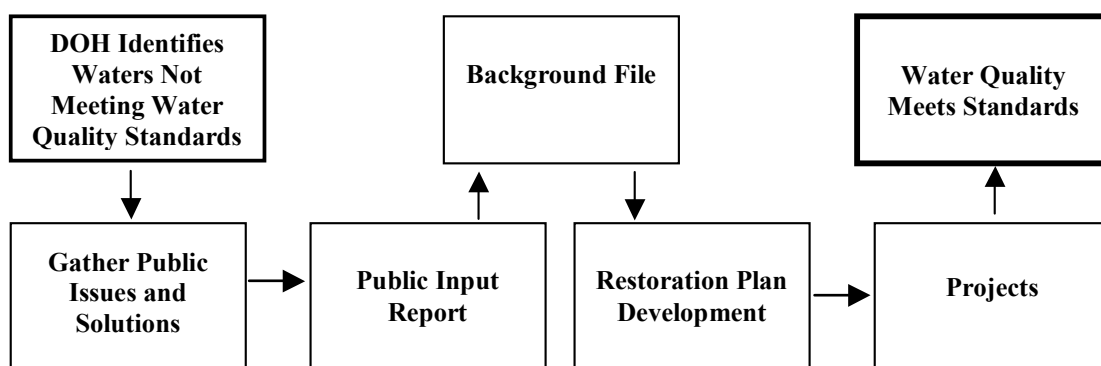
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<sup>8</sup> Source: Fox, 1995. [http://www.epa.gov/safewater/mdbp/pdf/turbidity/chap\\_07.pdf](http://www.epa.gov/safewater/mdbp/pdf/turbidity/chap_07.pdf)

extent they really are problems, which is why a formal, professional needs assessment is one of the WAG's key recommendations

This information along with other background information is being entered into a statewide database. The intent is that local input be used to guide Federal and State legislation and regulations in the watershed, and help prioritize restoration efforts and potential Federal restoration funds to improve Hilo Bay Watershed groundwater, streams and bay water quality. This effort will hopefully lead to EPA and other funding to develop and implement a restoration or management plan that addresses the identified watershed problems. This process is depicted in Figure 3.

**Figure 3. EPA Public Input and Restoration Plan Process**



## V. Public Input Analysis

A number of methods to prioritize and capture each detailed public issue were tried, however the WAG members felt they could not scientifically analyze the information in a detailed manner. Therefore a subcommittee was formed to evaluate the input. This subcommittee developed a diagram of the input using the Problem Tree method described below and in *Diagram 1. Problem Tree Example* (see Appendix). The purpose of the diagramming exercise was to validate the list, clarify the issues and their interrelationships, and to match the potential solutions with causes and/or effects, as appropriate.

The three subcommittee members (Peter Heffron, Janet Taylor, and Mary James) reviewed each of the issues in *Table 5. Hilo Bay Public Input Synthesis*. This table is a condensed version of the items on tables 3 and 4 whereby the issues have been consolidated and duplicate issues combined. Each issue was put on a separate 'Post It' note and then stuck on a large piece of poster paper, with 'causes' being located above the problem statement and 'effects' located below the problem statement. The problem statement, as identified by DOH is 'Hilo Bay water quality does not meet standards.' The outcome of the Problem Tree

**THE PROBLEM TREE...**

This tool assists in analyzing an existing situation by identifying the major problems and their main causal relationships. The output is a graphical arrangement of problems differentiated according to 'causes' and 'effects,' joined by a core, or focal, problem. This technique helps understand the context and interrelationship of problems, and the potential impacts when targeting projects and programs toward specific issues.

Source: [www.mit.edu/afs/athena/org/u/urbanupgrading/upgrading/issues-tools/tools/problem-tree.html](http://www.mit.edu/afs/athena/org/u/urbanupgrading/upgrading/issues-tools/tools/problem-tree.html) (Internet)

analysis for the issues is illustrated in *Diagram 2. Problems-Causes-Effects of the Public Input Report* (see Appendix) and was presented to and approved by the WAG on February 11, 2004.

This grouping resulted in the following causal categories:

- A. Watershed Management (or lack there of) that includes causes such as inadequate policies, communications, and information.
- B. Human-Made/Influenced that includes causes such as cesspools, illegal dumping, deforestation.
- C. Natural that includes causes such as rainfall, geology, topography.

Per the public and WAG input, the primary causes of poor water quality in the Hilo Bay watershed are *water pollution and resource degradation*,<sup>9</sup> which are in turn caused by excessive *turbidity/sedimentation, pathogens, chemicals, and solid waste that affect the watershed's air, soils, surface waters, aquifers, and Hilo Bay itself*. These latter causes are influenced by the implementation of federal, State, and County laws, policies, plans, zoning; and the actions of households, businesses, government, and other entities that positively or negatively impact the watershed.

Proposed solutions were then synthesized using a similar process resulting in the creation of *Diagram 3. Solutions* (see Appendix). This was also approved by the WAG.

The WAG concluded that the watershed management-related issues were the highest priority since members believe a comprehensive strategy and management plan, including background information, needs to be in place in order for there to be a clear understanding of the issues/problems and what should be done to solve them.

## V. Conclusions

Figure 4 combines and simplifies Diagrams 2 and 3. It illustrates the relationship of Hilo Bay watershed problems, solutions and the health of the Hilo Bay watershed as well as the WAG's priorities with respect to addressing the issues. Hilo Bay health (water quality) is influenced by both problems and solutions, which are in turn influenced by three primary activities: watershed management, human activities, and natural factors.

Some steps that can be taken to address these three priorities are:

- Priority 1, Watershed Management: Develop a Watershed Management/Restoration Plan that includes a review of current policies, data and communications that effect watershed conditions.
- Priority 2, Human Activities: Undertake a data retrieval/monitoring plan to better define human induced/influenced impacts caused by activities such as cesspool usage, illegal dumping, deforestation and improper land clearing and land management activities. Develop an information and education campaign based upon gaps in community awareness and understanding of watershed dynamics and management.

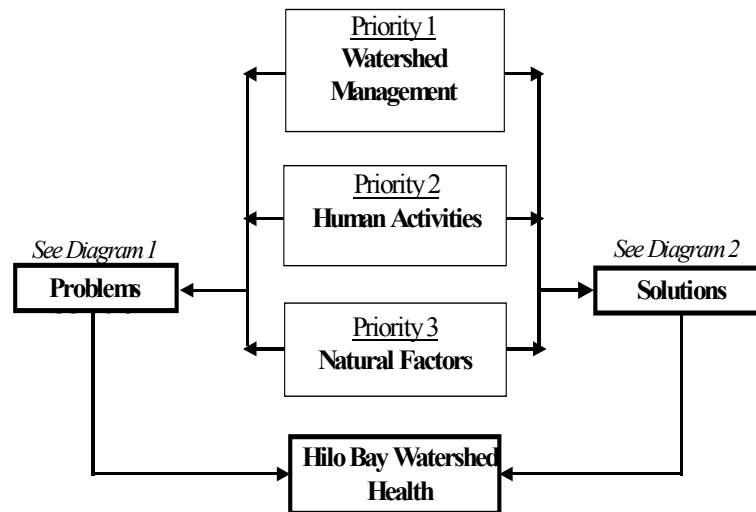
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<sup>9</sup> Per the Hawaii Watershed Project Scope of Work (Attachment to contract between the Hawaii Department of Health and the University of Hawaii/Manoa: "The respective Watershed Background Files shall identify *the causes of water pollution and resource degradation in the watershed*, identify actions stakeholders can take in order to correct the problems, and list milestones that could be used to measure the progress of restoration actions." p 1.

- Priority 3, Natural Factors: Determine background/natural water quality impacts caused by climate, geology, topography and ecosystem characteristics.

The conclusions of this process were presented to and approved by the WAG in its scheduled meeting on February 25, 2004 and are:

1. There are many unknowns regarding the Hilo Bay watershed's problems and potential solutions.
2. A formal, professional needs assessment/problem analysis should be conducted.
3. All the stakeholders (the community, landowners, and County, State, and federal agencies) should be involved.
4. The Hilo Bay WAG/Public Input process has been of significant value:
  - a. There is a better understanding of what we - the stakeholders- do know and, mostly, *do not* know about the Hilo Bay watershed
  - b. It is clear we need to work together at all levels to identify and prioritize the Hilo Bay watershed's problems and solutions.
5. The first phase of any future project should focus on leadership, coordination, cooperation, systematic information gathering and analysis, and community education.



**Figure 4. Factors Influencing Hilo Bay Watershed Health and Their Prioritization<sup>10</sup>**

<sup>10</sup> Watershed Management includes but is not limited to: policies, procedures, coordination and partnerships, monitoring, information, funding, and communication including outreach, education cultural considerations, and community involvement.

# **Table 1**

**Table 1. 2004 of Impaired Waters in Hawaii**

Source: Public Comment Draft 2004 List of Impaired Waters in Hawaii; February 27, 2004; Hawaii State Department of Health  
Pages 25 through 27

**TABLE 5: 2004 303(d) List for Hawaii**

- \* Newly listed waters are highlighted in the table, as are any changes to the parameters for previously listed waters.
- \* The “Standard” column explains whether waters listed based on numeric assessments were found to violate numeric water quality standards under wet and/or dry conditions. Estuaries do not have separate wet/dry standards and thus state “overall” values.
- \* For the purposes of this report, listed waterbodies were sorted by island, then into the streams category (salinity chronically below 0.5 ppt) or the coastal category (above 0.5 ppt). The waterbodies were then sorted alphabetically.

HAWAII

STREAMS						
Listed Waterbody	Geographic Scope of Listing	Pollutant(s)	Basis for Listing	Station ID	Standard	Priority
Aamakao Stream	Aamakao Stream	turbidity	numeric assessment	8-1-12	dry	L
Alenaio Stream	Alenaio Stream (Wailoa tributary)	nutrients	visual assessment	8-2-61.01.1		(TMDL in process)
Hakalau Stream	Hakalau Stream	nutrients turbidity	visual assessment	8-2-32		M
Honolii Stream	Honolii Stream	nutrients turbidity	visual assessment numeric assessment	8-2-56	dry dry	M
Kaieie Stream	Kaieie Stream	nutrients	visual assessment	8-2-49		M
Kapeha Stream	Kapeha Stream	turbidity	numeric assessment	8-2-37	dry	L
Kolekole Stream	Kolekole Stream	nutrients turbidity	visual assessment numeric assessment	8-2-33	dry wet, dry	M
Lalakea Stream	Lalakea Stream	turbidity	numeric assessment	8-1-45	dry	L
Niulii Stream	Niulii Stream	turbidity	numeric assessment	8-1-13	dry	L
Waiakea Stream	Waiakea Stream (Wailoa tributary)	nutrients	visual assessment	8-2-61		(TMDL in process)
Waikama Stream	Waikama Stream	turbidity	numeric assessment	8-1-14	wet, dry	L
Wailoa Stream River	Wailoa Stream River	nutrients turbidity	visual assessment	8-2-61		M

**HAWAII (continued)**

<b>STREAMS</b>						
<b>Listed Waterbody</b>	<b>Geographic Scope of Listing</b>	<b>Pollutant(s)</b>	<b>Basis for Listing</b>	<b>Station ID</b>	<b>Standard</b>	<b>Priority</b>
Wailoa/Waipio Stream	Wailoa/Waipio Stream	nitrite/nitrate	numeric assessment	8-1-44	dry	L
Wailuku Stream	Wailuku Stream	nutrients	visual assessment	8-2-60	wet, dry	L
Wainaia Stream	Wainaia Stream	turbidity	numeric assessment	8-1-09	wet	L

<b>COASTAL</b>						
<b>Listed Waterbody</b>	<b>Geographic Scope of Listing</b>	<b>Pollutant(s)</b>	<b>Basis for Listing</b>	<b>Station ID</b>	<b>Standard</b>	<b>Priority</b>
Hapuna Beach	Hapuna Beach station	chlorophyll a turbidity	numeric assessment	001200	wet wet	L
Hilo Bay	Bay inshore of Breakwater and near shore waters from Wainaku to Paukaa	nutrients turbidity	visual assessment, prior listing			M
Hilo Bay	Boat Landing station	chlorophyll a	numeric assessment	001106	wet/dry	M
Hilo Bay	Canoe Beach station	enterococci turbidity	numeric assessment	001138	wet wet/dry	M
Hilo Bay	Exit of Ice Pond station	Total P enterococci	numeric assessment	001102	wet/dry wet	M
Hilo Bay	Lighthouse station	chlorophyll a turbidity enterococci	numeric assessment	001107	wet/dry wet wet	M
Hilo Bay	Offshore station	chlorophyll a turbidity nitrite/nitrate ammonium	numeric assessment	001141	wet/dry dry wet/dry wet/dry	M
Hilo Bay	Honolii Cove station	enterococci turbidity	numeric assessment	001110	wet/dry wet/dry	M

HAWAII continued:

COASTAL (continued)						
Listed Waterbody	Geographic Scope of Listing	Pollutant(s)	Basis for Listing	Station ID	Standard	Priority
Lelewi Beach Park	Lelewi Beach Park station	Total P enterococci	numeric assessment	001121	Dry wet/dry	M
Kailua Bay	Kailua Pier A-1 station	Total P	numeric assessment	001205	wet	L
Kawaihae Harbor/ Pelekane Bay	Kawaihae Harbor/ Pelekane Bay	turbidity				L
Kawaihae Harbor/ Pelekane Bay	Spencer Park Beach station	turbidity chlorophyll a	numeric assessment	001225	wet wet	L
Kealakekua Bay	Kealakekua Bay off curio stand -station	turbidity	numeric assessment	001211	dry	L
Kolekole Beach	Kolekole Gulch station	enterococci turbidity	numeric assessment	001118	wet/dry wet/dry	L
Magic Sands Beach	Magic Sands Beach station	chlorophyll a turbidity	numeric assessment	001215	wet/dry dry	L
Pacific Ocean	Vacationland Station	turbidity	numeric assessment	1142	dry	L
Pualaa Beach Park	Pualaa Beach Park station	enterococci	numeric assessment	001143	dry	L
Puhi Bay	Puhi Bay #3 station	turbidity chlorophyll a	numeric assessment	001130	dry wet/dry	L
Richardson Ocean Center	Richardson Ocean Center station	chlorophyll a turbidity	numeric assessment	001136	wet/dry dry	L
Wailoa River	Wailoa River Boat Ramp station	enterococci	numeric assessment	001132	wet/dry	M

# **Table 2**

**Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)**

<b>ISSUE IDENTIFICATION</b>
<b>Morning Session 1/6/04</b>
1. Breakwall holding in sediment and pollution
2. Cruise ships – no laws regulating or monitoring ships
3. Sewage from septic systems and cesspools is getting into the watershed
4. Cattle polluting the water
5. Pigs, housing developments, etc. causing erosion
6. Illegal dumping
7. Overflow of Alenaio Canal
8. Old drainage project, (Kanoelehua) going into Wailoa River without adequate exit
9. Existing laws need to be enforced
<b>Evening Session 1/6/04</b>
10. Concerned with flooding effects on soccer fields
11. Channelization (mauka) causes some problems but solves others
12. Concerns about urbanization-pavement, stormwater, flooding, loss of vegetation from clearing lots
<b>Morning Session 1/21/04</b>
1. Cesspool failure. Can we build a fail-proof cesspool? Existing structures have been grandfathered in.
2. Fishponds, freshwater ponds are being overgrown with mangrove and other grasses.
3. More sediment in Wailuku River during heavy rainfalls from higher elevation. <i>“Mud comes down Wailuku River with heavy mauka rainfall but not makai rainfall.”</i>
4. There seems to be a whale/sedimentation interaction. Needs to be investigated.
5. Feral pigs contribute to erosion.
6. More communication is needed within the community. Identify relevant people within the community.
7. More publicity on watershed issues is needed.
8. Studies comparing pesticide/herbicide usage in various groups (is needed). Pesticide and herbicide usage studies are needed for land use planning.
9. Homeowners and government workers need education on pesticide use or regulation.
10. Government has no plan for erosion or sedimentation (control).
11. Golf courses add chemicals and excess nutrients to the watershed including groundwater.
12. Cruise ships are polluting the bay.
13. Breakwater impairs circulation.
14. More coordination is needed with other groups including State, County, community associations
15. There are existing hot spots in the bay that need to be addresses (old artillery bombs, kane waste products).
16. There is a lot of trash on the beaches. There should be a clean up program such as “Adopt-a-Beach” and should put garbage cans on the beaches.
<b>Evening Session 1/21/04</b>
17. Pathogens from untreated sewage (cesspools).
18. Attitude about trash and litter.
19. (Need to) distinguish watershed (problems); there is a lack of water quality monitoring at different elevations.
20. Impact of land cover types; loss of undeveloped land.
21. (There is a) lack of land use plans that are sensitive to reforestation.
22. (There is a) lack of monitoring feral animals and plant species.
23. (There is a) lack of understanding of how the system works.
24. Flood hazards increase with paving.
25. A study is needed (that includes) computational fluid dynamics (to understand how to) improve the bay flow.
26. High density development in flood zones (Komohana, Puainako).
27. Bay not swimmable?
28. Need more bayside amenities – for recreation.
29. Tap water is not clean.

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

30. Leptosporosis in streams and water.
31. Need to address problem of nutrients in Hilo Bay.
32. State and County need to maintain storm drains.
33. The bay is for recreation (but) is not inviting.
34. The breakwall is not allowing circulation.
35. Plantations are out of business and new landowners may not be practicing erosion control.
36. Arsenic is in Wailoa ponds and the bay.
37. Dredging in the 90s dredged up arsenic.
38. Which entity is responsible for land use planning?
39. Endangered species in upper forest.
40. Sediments coming from the upper (area).
41. Pollutants coming from urban (sources).
<b>Morning Session 7/1/03</b>
1. Turbidity in Bay can't see bottom
2. Disposal of oil in storm drains etc. how can we ensure oil is recycled and not dumped? Better publicity for safe disposal options?
3. Nutrients and pathogens from cesspools in coastal areas
4. Bay circulation is degraded by breakwater, it doesn't flush as efficiently
5. High waves over breakwater causes re-suspension of sediments in the bay
6. Is there a list of airborne pollutants/emissions from industry etc? Some of that must be re-deposited/rained out in watershed.
7. Increase of cruise ship traffic increases trash and sewage in bay
8. Coal ash disposal in watershed
9. Reasonable standards needed for water quality to make sure we don't put
10. farmers (e.g. Hamakua) out of business
11. Hilo's location just downstream of the high rainfall zone and its position in the landscape make it particularly vulnerable to runoff and sediment inputs.
12. In the Waianuenue area rain/runoff go into septic tanks, causing them to overflow
13. Oil on streets runs off into streams. Also problems with discarded batteries (cadmium), and termite chemicals which get into the watershed.
14. Fishermen discarding offal into bay may be attracting sharks.
15. We need to adequately address Hilo flooding problems
16. Fuel storage tanks located in Tsunami inundation area. Seems like an invitation to disaster. Do these leak into groundwater?
17. Hilo dump is unlined. What is it leaching into the groundwater/watershed?
18. Is the quality and condition of stream corridors affected by agricultural practices?
19. We need good baseline data on marine organisms. How do we know whether populations are increasing or decreasing when we don't have good baseline data?
20. Anchialine ponds are degraded in many areas. Could condition of ponds be an indicator of degradation of water quality in groundwater feeding ponds?
21. River water quality is an issue
22. How do we increase fish populations? Lots of other parts of marine community seem to be in pretty good shape, but fish definitely not as abundant as they used to be
23. Leptospirosis is a problem do we need better rat control to reduce lepto?
24. Water effluent above King's landing goes into the bay. Although it is outside the watershed it can get into the bay.
25. The conservation land and reserves marked on the maps are not all reserves. Some are used economically, eg: to graze livestock. Sub zones should be marked on the map to differentiate these areas.
26. There may be persistent organic pesticides in the sediment runoff

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

27. Hilo bay also had problems with heavy metals, Nitrates, Nitrites as well as turbidity. Why weren't those listed?
28. Wailoa pond was not declared a superfund clean-up site because the arsenic from the old canic (sp?) plant is stable in the clay soil. It sticks to clay and stays stable unless the sediment is stirred up.
29. DOH takes samples to monitor water quality in the bay all the time.
<b>Evening Session 7/1/03</b>
30. What are the remaining impacts of severe floods on the bay
31. How do stream modifications such as channelization affect the streams ecosystem
32. Nene street sewer line needs to be completed. (Homes near bay)
33. What is the impact of yard waste that is dumped in streams and along the banks of streams and canals, effect
34. stream flow. There is increased flooding due to blockages from yard waste in the streams.
35. Soaps and shampoos being used at beach parks
36. Sun-screen could pollute the waters
37. Helping the natural recovery cycle of the watershed
38. The impacts of sewage, storm drains and runoff
39. The breakwater is altering water movement and patterns. How can we improve and increase the circulation
40. of water in the bay.
41. Trash is disposed in streams
42. Are local regulatory bodies and agencies upgrading their best management practices
43. Is mercury a problem in fish and shellfish (crabs)
44. Is the arsenic sediment in Wailoa pond getting into the food chain
45. The impact of pollution on fish and invertebrates in the streams. Are they over stressed?
46. Is this project interfaced with county government
47. What are the impacts of stream channel engineering and what future projects are there
48. Are Federal agencies listening to local experts and residents
49. The flood zone designations are wrong and need to be redrawn
50. Unknown and unrecorded streams and episodic streams are flood hazards
51. What are the impacts of Waieka stream diversion work, on the land below the diversion
52. How is watershed defined considering the porous substrate and water following various paths underground, and springs popping up during storms. In other words pollutants from other areas could cross the natural surface boundaries.
53. Cruise ship impacts on the bay
54. Dumping in lava tubes including, Kaumana cave, effect water quality
55. Resident habitual disposal practices need to be changed
56. County needs to do refuge pick-up
57. Bottles are disposed from cars because of "open vessel" laws and habitual practices

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

<b>Write-ins</b>
1. Cultural issues may not have been taken into consideration, particularly when discussing flood control.
2. Breakwater is cause of dirty water in bay.
3. Bay should be used more for recreation.
4. Runoff is ruining our bay.
5. Improve Bay Front soccer fields.
6. Flooding and runoff
7. Need access to the bay for recreational use.
8. Roy Takemoto, County Planning: a. Sedimentation from non point sources b. Cesspool leachate from unsewered coastal areas c. Flood control – structural and non structural measures to reduce downstream impacts d. Data needs to clearly identify the water quality problems: - <u>Receiving water</u> : (1) identify receiving waters within the scope of the project-just Hilo Bay, or other segments of near-shore waters such as Keaukaha and Honolii. (2) characteristics of the receiving waters –extent of mixing to flush pollutants (protected vs. open coastal); benthic conditions (e.g., coral, rocky, etc.) as indicators of sensitivity to pollutants or extent of past impacts requiring restoration. (3) Users-water contact uses more sensitive to certain pollutants than say fishing. (4) Drainage basins-identify drainage basins based on receiving waters of concern - <u>Water quality data</u> : identify pollutants in order to understand potential sources - <u>Pathways</u> -hydrologic models to understand extent of rainfall runoff that flows into the receiving waters from streams vs. groundwater, pathways of groundwater flow. - <u>Land uses within drainage basins of concern</u> -land uses classified by potential pollutant generation (see Write-in Solutions #8 for list of data available from Planning Department)
9. David Kimo Frankel: DOH study shows Waiakea Pond is contaminated with arsenic at exceedingly high levels. Has seen toddlers walking in the pond and fishermen catching fish there.
10. Deborah Ward (see correspondence 1/20/04 for details): Concerned about water resources on Mauna Kea: hazardous materials released from observatory/telescope-related activities; observatory sewage systems
11. Professor called in with proposed research project: The objective of the project is to understand the system on the Hamakua side of Wailuku River. There are a lot of sub basin tributaries. Proposal is to run paired catchment studies, i.e., find small watersheds of equal area and geology, for example one forested and one in pasture. Study runoff and water sediment and pollutants from the two different land types. There are many possible pairs.
12. Ululani Sherlock regarding Puna Community Trails Council. (punatrail.htm) (see document)
<b>Surveys</b>
1. It would be nice to know where (and who) the most beneficial place is to give concerns to. Water education should be a larger priority!!!! Keep asking for community help, there are a lot of people concerned about this issue. Assume the people care. No one knows where to go!
2. The issue that concerns me about the watershed is we don't know that much about it, (i.e., land cover, nutrient, sediment, pesticide, pathogen sources) so how can we develop a restoration plan. More information about the watershed is needed before planning can take place (research dollars).
3. There seems to be a major disconnect with agencies that manage at least half of the watershed area you are working on. There are many working watershed groups working throughout the State and I have not seen them mentioned at all. Plans are great, but funding is always a major problem and should be addressed more actively. The plan does nothing without monies to make it happen. DHHL rep – good point on needing contact with community associations that would have reached far more people connected with the area of concern. Should have contacted agencies connected with watersheds to speed up process of identifying problems or at least validating communities concerns, eg. pesticide use – agencies may have stats on these kind of issues
4. I heard that the Army buried a lot of toxic waste along Flume Road after WWII. If it's true, maybe Super Fund

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

could be tapped to clean it up.
<b>SOLUTIONS</b>
<b>Morning Session 1/6/04</b>
1. Open section of breakwall.
2. Require monitoring and regulating cruise ships
3. Build ponds using bioremediation to clean wastewater (cattle).
4. Composing toilets
5. Straighten canal so discharge straight to the ocean.
6. Use curtain system and recycle water (drainage going into Wauloa River)
7. Better enforcement of existing laws.
<b>Evening Session 1/6/04</b>
8. Coordinate efforts (flooding effects on soccer fields).
9. Use lava tubes as conduits (flooding effects on soccer fields).
10. Regarding urbanization: Use zoning and land use planning. Need to involve Stae and County. Purchase watershed land for catchment basins, more vegetation cover.
<b>Morning Session 1/21/04</b>
1. WAG should use seed money to start a financial self-perpetuating project to provide funds to implement improvement projects.
2. Education programs and community awareness is needed.
3. Should consider individual household treatment systems.
4. (The watershed program/project should be) published on the T.V. show <i>Living in Paradise</i>
5. Restrict uses in watersheds.
6. Start an "Adopt-a-Beach" program.
7. Put garbage cans on beaches.
8. Open up more access to hunters and implement an education program.
9. Have regular contact with groups in the watershed.
<b>Evening Session 1/21/04</b>
1. Poke holes in the breakwater
2. Put more trash cans in the downtown area (beaches).
3. Develop an Adopt-a-Beach program.
4. <i>Use the media shock value to arouse the public (action) with such issues as "stool, leptosporosis, and arsenic"</i>
5. Hook up more houses to the sewer system.
6. Get County to follow their own agreement regarding sewer hookups.
7. Get data and background data (water quality, pathogens, etc.).
8. Bring in NRCS ??? wateshed protection plans under PL 566.
9. Get the Corps of Engineers involved.
10. (Make a) scale model of Hilo Bay (so that you can) change parameters to measure effects.
11. Educate the children (Stream Day).
12. (Need) more community programs (Get the Drift & Bag It)
13. Continue WAG and other community ( <i>action groups</i> ).
14. Continue dialogue and discussion in public form: radio, T.V., letters.
15. In the forest and lands bring land owners together (urban areas, County & Planning, State & private landowners in upper)
16. Involve NRCS in developing conservation practices.
<b>Morning Session 7/1/03</b>
1. Have separated trash, etcetera pickup by garbage company, to facilitate recycling
2. Expansion of sewer system to Nene St to eliminate sewage release to Bay
3. Make breaks in breakwater to improve circulation in Bay
4. A project to divert Kaumana runoff from Wailuku river to reduce erosion would run \$6 million.

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

5. Make sediment runoff control
6. Get EPA grants to fund cleanup projects
7. Increase runoff-holding ponds to reduce sediment/water discharge to Bay
8. Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump
9. We need BMPs to dispose of wastes
10. Cover crops, tree crops, NRCS recommendations to filter sediments, nutrients
11. Build check dams to enhance percolation of runoff
12. Build check dams to enhance percolation of runoff
13. Native forest protection
14. Increase shoreline cleanup activities and to get community participation
15. Use community-planning approach to guide development
16. Make sure that Planning Department incorporates watershed awareness
<b>Evening Session 7/1/03</b>
17. Improve water circulation in Hilo Bay (break water removal, alteration?)
18. Enforcement of dumping regulations
19. Community education on dumping impacts
20. Provide alternatives to dumping
21. Get county involved (Peter B, waste water & Pat Engelhart)
22. Project should interface with DOE teachers and Environmental programs
23. Make disposal of toxic wastes easier
24. Have community service days and involved charter schools
25. Have collection containers for bottles
26. Assess and measure materials entering watershed
27. Need assessment of fecal coliform sources
28. Need assessment of fecal coliform sources
29. Impacts of homeless people and squatters on beaches
30. Tell residents on Wailuku rivers where their sewage goes
31. DOH lacks the manpower to test leakage from private residences
32. Get a sewer system for lower Kaumana
33. Reverse leptospirosis contamination if possible
34. Learn if leptospirosis increasing, the vectors are increasing, and is it an acceptable risk
35. What are the effects of soil fumigants
<b>Write-ins</b>
1. WAG members should be aware of cultural issues before decision-making. Have a Hawaiian cultural leader on WAG.
2. Make hole in breakwater to facilitate flushing.
3. Bay should be turned into a beautiful beach, can use for jet skiing.
4. Divert runoff to Kona by a cheapie culvert system.
5. Develop a grant proposal.
6. Both State and County should clean storm drains regularly.
7. Remove fence on Bay Front. Install more facilities: tables, trash bins, etc.
8. Roy Takemoto: They are willing to participate in whatever they can assist with. Data available from Planning Department (GIS): (a) perennial streams; (b) drainage basins; (c) tax parcel maps (area, TMK, owner, etc.); (d) roads; (e) USGS raster map; (f) aerial photos; (g) DLNR, DOH aquifer classifications; (h) zoning, General Plan, State Land Use designations; (i) others.

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

9. David Kimo Frankel: Clean up Waiakea Pond.
10. Professor called in with proposed research project: The objective of the project is to understand the system on the Hamakua side of Wailuku River. There are a lot of sub basin tributaries. Proposal is to run paired catchment studies, i.e., find small watersheds of equal area and geology, for example one forested and one in pasture. Study runoff and water sediment and pollutants from the two different land types. There are many possible pairs.
<b>Surveys</b>
1. Legislation for Clean Water regulations.
2. Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to do the same. Get radio stations/ advertising agencies involved as well.
3. Manage invasive species; learn about ecosystem linkages to different elevations/climates and the role of soil and biota in affecting water flow ( <i>throughfall</i> , erosion, uptake). Bring in ahupua'a concept as a PR campaign.
4. Should make more fish farms which makes more fish and organization in Hilo Bay; put up more trash boxes
5. Put more trash (cans) near rivers; educate children.
6. Need monitoring programs to develop target areas in watershed (where's the problem). Land cover in watershed.
7. (1)Get accurate info on number, distribution of cesspool, sewer, septic. The head of the Hilo wastewater treatment plant told me he doesn't know how many houses were hooked up to the sewer. (2)Re-examine plans to put a hole in the breakwater to improve circulation. (3) We need more quality data for groundwater, streams and ocean. (4) Incentive for erosion control on construction sites. (5) Incentives to include adequate previous area in new development and avoid paving. (6) Investigate vegetative barrier to filter runoff before it reaches bay and streams. (7) There is very little stream flow data for doing flood planning.
8. Get monies to do the projects.
9. Learn to use pesticides and herbicides effectively. Dispose of toxic waste (oil from cars, coolant, etc.) safely.

## SURVEYS

Surveys included a list of potential concerns for participants to check off if he/she felt it was a concern of his/hers. This table summarizes the results. Each letter under 'Person' represents one participant's input, that is, there were eleven people that completed this survey.

Issue	Person											Tot
	a	b	c*	d	e	f	g**	h*	i	j	k	
(a) excess sediment	1	1	1							1	1	5
(b) excess nutrients			1				1	1			1	4
(c) erosion		1	1					1	1			4
(d) overuse of pesticide/fertilizers			1	1			1				1	4
(e) stream/native species habitat degradation			1		1		1	1	1			5
(f) algae/aquatic plant overgrowth			1				1	1				3
(g) contamination of groundwater	1	1	1	1			1	1				6
(h) debris/garbage (in-stream or illegal dumping)	1		1		1							3
(i) excessive or illegal diversion			1									1
(j) cesspool failures			1					1				2
(k) excessive agriculture runoff	1		1				1					3
(l) urban runoff	1		1	1			1	1				5
(m) improper use of storm drains			1									1
(n) other			1					As***				1

\* - "c", "g", "i", "j", and "k" made comments on the issues (see Survey Section above)

\*\* - "g" marked areas of interest

\*\*\* - "As" means arsenic

Table 2. Hilo Bay Watershed Issues and Solutions (Uncategorized Raw Data)

July 1, 2003 Expectations

Morning Session:

1. An Informational meeting and to touch base with members
2. Finding something useful to do
3. Just want to listen
4. Want clean water for swimming
5. Getting a start in assigning land values
6. Expressing Soil & Water Conservation District concerns, over 400 cooperators, and understanding what needs to be done
7. Saving anchialine ponds
8. Interested in canoe paddling and Sierra Club involvement
9. Want a community effort to improve water quality
10. Because of ocean overuse and pollution there is a need for cleaning up Hilo Bay beaches
11. Leleiwi drains into beach area
12. An active community participation, involvement
13. Improved water quality in Hilo Bay
14. Want it noted that Richardson's Beach is over used, fish depletion, etc.
15. Want to know what has been done in Hilo Bay area
16. Want to clean up bay
17. Want to provide information to the group
18. Want to know the reasons for what's happening in the water
19. Pollution concerns. The County is behind in addressing this area
20. Want to see more use out of Bay
21. Swimmers are concerned with water quality, interested in helping out
22. Want to help

Evening Session 7/1/03:

1. Identify problem areas
2. Address sewage from beach parks and facilities that gets into the ocean.
3. Satisfying curiosity
4. Want to know about the water quality effects on fish life in the Lileiwi area
5. Hearing views of others
6. To understand the projects scope
7. Want students involved with water testing (environmental studies)
8. Understanding increases and decreases of e-Coli at Onekaakaa park

MSJ: complete3meetings+surveyinput 012704: 1/27/04

# **Table 3**

**Table 3. Hilo Bay Issues Categorized**

Category <sup>1</sup>	Subcategory <sup>1</sup>	Issue Identification
		<b>Morning Session 1/6/04</b>
WQ	Sed,pol	1. Breakwall holding in sediment and pollution
WQ L&P	Path, chem.	2. Cruise ships – no laws regulating or monitoring ships
WQ	Path	3. Sewage from septic systems and cesspools is getting into the watershed
WQ	Path	4. Cattle polluting the water
WQ	sed	5. Pigs, housing developments, etc. causing erosion
WQ	chem	6. Illegal dumping
WV	flood	7. Overflow of Alenaio Canal
WV	flood	8. Old drainage project, (Kanoelehua) going into Wailoa River without adequate exit
L&P	enf	9. Existing laws need to be enforced
		<b>Evening Session 1/6/04</b>
WV Rec	Flood	10. Concerned with flooding effects on soccer fields
WV	Flood	11. Channelization (mauka) causes some problems but solves others
WV WQ	Flood ero	12. Concerns about urbanization-pavement, stormwater, flooding, loss of vegetation from clearing lots
		<b>Morning Session 1/21/04</b>
WQ	Path	1. Cesspool failure. Can we build a fail-proof cesspool? Existing structures have been grandfathered in.
Bio	overgrw	2. Fishponds, freshwater ponds are being overgrown with mangrove and other grasses.
WQ	sed	3. More sediment in Wailuku River during heavy rainfalls from higher elevation. <i>“Mud comes down Wailuku River with heavy mauka rainfall but not makai rainfall.”</i>
WQ	sed	4. There seems to be a whale/sedimentation interaction. Needs to be investigated.
WQ	ero	5. Feral pigs contribute to erosion.
Com	com	6. More communication is needed within the community. Identify relevant people within the community.
Com	Com, edu	7. More publicity on watershed issues is needed.
Inf	Stud	8. Studies comparing pesticide/herbicide usage in various groups (is needed). Pesticide and herbicide usage studies are needed for land use planning.
Com	Edu	9. Homeowners and government workers need education on pesticide use or

<sup>1</sup> **Categories**

WV = water volume (**flood**ing, runoff, etc)

WQ = water quality (**sed**iment, **ero**sion, **path**ogens, pesticides, herbicides, fertilizers, **chem**icals, metals, toxics, drinking water, groundwater, trash, **poll**utants, **circ**ulation, etc.)

L&P = laws & policies (making and **enf**orcing L&P such as zoning, land use planning, BMPs, cruise ships, etc)

Bio = biota (endangered/ native species of plants/ animals, fishery, habitat, overgrowth, etc.)

Com = communication (outreach, **edu**cation, coordination, culture, community involvement, obtaining funds, etc.)

Rec = recreation (swimming, surfing, soccer, etc.)

Inf = information (data, studies, etc.)

Table 3. Hilo Bay Issues Categorized

		regulation.
<b>L&amp;P<sup>2</sup></b>		10. Government has no plan for erosion or sedimentation (control).
<b>WQ</b>	Nutr, chem.	11. Golf courses add chemicals and excess nutrients to the watershed including groundwater.
<b>WQ</b>	Path, chem.	12. Cruise ships are polluting the bay.
<b>WQ</b>	cir	13. Breakwater impairs circulation.
<b>Com</b>	Coord	14. More coordination is needed with other groups including State, County, community associations
<b>WQ</b>	Chem.	15. There are existing hot spots in the bay that need to be addresses (old artillery bombs, kane waste products).
<b>WQ</b>	trash	16. There is a lot of trash on the beaches. There should be a clean up program such as “Adopt-a-Beach” and should put garbage cans on the beaches.
		<b>Evening Session 1/21/04</b>
<b>WQ</b>	path	17. Pathogens from untreated sewage (cesspools).
<b>WQ</b>	Trash	18. Attitude about trash and litter.
<b>Inf</b>	WQ data	19. (Need to) distinguish watershed (problems); there is a lack of water quality monitoring at different elevations.
<b>WQ</b>	Ero,	20. Impact of land cover types; loss of undeveloped land.
<b>L&amp;P</b>		21. (There is a) lack of land use plans that are sensitive to reforestation.
<b>Inf</b>	Monitor	22. (There is a) lack of monitoring feral animals and plant species.
<b>Inf</b>		23. (There is a) lack of understanding of how the system works.
<b>WV</b>	flood	24. Flood hazards increase with paving.
<b>Inf</b>	Study	25. A study is needed (that includes) computational fluid dynamics (to understand how to) improve the bay flow.
<b>WV L&amp;P</b>	Flood	26. High density development in flood zones (Komohana, Puainako).
<b>Rec</b>		27. Bay not swimmable?
<b>Rec</b>		28. Need more bayside amenities – for recreation.
<b>WQ</b>	Drk Wtr	29. Tap water is not clean.
<b>WQ</b>	Path	30. Leptosporosis in streams and water.
<b>WQ</b>	Nutr	31. Need to address problem of nutrients in Hilo Bay.
<b>L&amp;P</b>	Maint.	32. State and County need to maintain storm drains.
<b>Rec</b>		33. The bay is for recreation (but) is not inviting.
<b>WQ</b>	Circ	34. The breakwall is not allowing circulation.
<b>WQ Com</b>	Ero Edu	35. Plantations are out of business and new landowners may not be practicing erosion control.

<sup>2</sup> **Catagories**

**WV** = water volume (**flood**ing, runoff, etc)

**WQ** = water quality (**sed**iment, **ero**sion, **path**ogens, pesticides, herbicides, fertilizers, **chem**icals, metals, toxics, **dr**inking **w**ater, groundwater, trash, **poll**utants, **circ**ulation, etc.)

**L&P** = laws & policies (making and **en**forcing L&P such as zoning, land use planning, BMPs, cruise ships, etc)

**Bio** = biota (endangered/ native species of plants/ animals, fishery, habitat, overgrowth, etc.)

**Com** = communication (outreach, **edu**cation, coordination, culture, community involvement, obtaining funds, etc.)

**Rec** = recreation (swimming, surfing, soccer, etc.)

**Inf** = information (data, studies, etc.)

Table 3. Hilo Bay Issues Categorized

<b>WQ<sup>3</sup></b>	Chem.	36. Arsenic is in Wailoa ponds and the bay.
<b>WQ</b>	Chem.	37. Dredging in the 90s dredged up arsenic.
<b>L&amp;P</b>	Enfor	38. Which entity is responsible for land use planning?
<b>Bio</b>		39. Endangered species in upper forest.
<b>WQ</b>	Sed	40. Sediments coming from the upper (area).
<b>WQ</b>		41. Pollutants coming from urban (sources).
		<b>Write-ins</b>
<b>Com</b>	Cultural	1. Cultural issues may not have been taken into consideration, particularly when discussing flood control.
<b>WQ</b>	Circ	2. Breakwater is cause of dirty water in bay.
<b>Rec</b>		3. Bay should be used more for recreation.
<b>WQ</b>	runoff	4. Runoff is ruining our bay.
<b>Rec</b>	soccer	5. Improve Bay Front soccer fields.
<b>WV</b>	Flood	6. Flooding and runoff
<b>WQ</b>	runoff	
<b>Rec</b>		7. Need access to the bay for recreational use.

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<sup>3</sup> **Categories**

**WV** = water volume (**flood**ing, runoff, etc)

**WQ** = water quality (**sed**iment, **ero**sion, **path**ogens, pesticides, herbicides, fertilizers, **chem**icals, metals, toxics, **dr**inking **w**ater, groundwater, trash, **poll**utants, **circ**ulation, etc.)

**L&P** = laws & policies (making and **en**forcing L&P such as zoning, land use planning, BMPs, cruise ships, etc)

**Bio** = biota (endangered/ native species of plants/ animals, fishery, habitat, overgrowth, etc.)

**Com** = communication (outreach, **edu**cation, coordination, culture, community involvement, obtaining funds, etc.)

**Rec** = recreation (swimming, surfing, soccer, etc.)

**Inf** = information (data, studies, etc.)

Table 3. Hilo Bay Issues Categorized

<p><b>WQ<sup>4</sup></b></p> <p><b>WV</b></p> <p><b>Inf</b></p> <p><b>L&amp;P</b></p>	<p>Sed, path,</p> <p>Flood Data, studies</p> <p>Land use</p>	<p>8. Roy Takemoto, County Planning:</p> <p>a. Sedimentation from non point sources</p> <p>b. Cesspool leachate from unsewered coastal areas</p> <p>c. Flood control – structural and non structural measures to reduce downstream impacts</p> <p>d. Data needs to clearly identify the water quality problems:</p> <p>-<u>Receiving water</u>:</p> <p>(1) identify receiving waters within the scope of the project-just Hilo Bay, or other segments of near-shore waters such as Keaukaha and Honolii.</p> <p>(2) characteristics of the receiving waters –extent of mixing to flush pollutants (protected vs. open coastal); benthic conditions (e.g., coral, rocky, etc.) as indicators of sensitivity to pollutants or extent of past impacts requiring restoration.</p> <p>(3) Users-water contact uses more sensitive to certain pollutants than say fishing.</p> <p>(4) Drainage basins-identify drainage basins based on receiving waters of concern</p> <p>-<u>Water quality data</u>: identify pollutants in order to understand potential sources</p> <p>-<u>Pathways</u>-hydrologic models to understand extent of rainfall runoff that flows into the receiving waters from streams vs. groundwater, pathways of groundwater flow.</p> <p>-<u>Land uses within drainage basins of concern</u>-land uses classified by potential pollutant generation (see Write-in Solutions #8 for list of data available from Planning Department)</p>
<p><b>WQ</b></p>	<p>Metals</p>	<p>9. David Kimo Frankel: DOH study shows Waiakea Pond is contaminated with arsenic at exceedingly high levels. Has seen toddlers walking in the pond and fishermen catching fish there.</p>
<p><b>WQ</b></p>	<p>DW</p>	<p>10. Deborah Ward (see correspondence 1/20/04 for details): Concerned about water resources on Mauna Kea: hazardous materials released from observatory/telescope-related activities; observatory sewage systems</p>
<p><b>Inf</b></p>	<p>study</p>	<p>11. Professor called in with proposed research project: The objective of the project is to understand the system on the Hamakua side of Wailuku River.</p>

<sup>4</sup> **Categories**

**WV** = water volume (flooding, runoff, etc)

**WQ** = water quality (**sediment**, **erosion**, **pathogens**, pesticides, herbicides, fertilizers, chemicals, metals, toxics, drinking water, groundwater, trash, **pollutants**, **circulation**, etc.)

**L&P** = laws & policies (making and **enforcing** L&P such as zoning, land use planning, BMPs, cruise ships, etc)

**Bio** = biota (endangered/ native species of plants/ animals, fishery, habitat, overgrowth, etc.)

**Com** = communication (outreach, education, coordination, culture, community involvement, obtaining funds, etc.)

**Rec** = recreation (swimming, surfing, soccer, etc.)

**Inf** = information (data, studies, etc.)

Table 3. Hilo Bay Issues Categorized

		There are a lot of sub basin tributaries. Proposal is to run paired catchment studies, i.e., find small watersheds of equal area and geology, for example one forested and one in pasture. Study runoff and water sediment and pollutants from the two different land types. There are many possible pairs.
<b>Com</b> <sup>5</sup>	Cultural	12. Ululani Sherlock regarding Puna Community Trails Council. (punatrail.htm) (see document)
		<b>Surveys</b>
<b>Com</b>	Com, edu	13. It would be nice to know where (and who) the most beneficial place is to give concerns to. Water education should be a larger priority!!!! Keep asking for community help, there are a lot of people concerned about this issue. Assume the people care. No one knows where to go!
<b>Inf</b>	Lack of	14. The issue that concerns me about the watershed is we don't know that much about it, (i.e., land cover, nutrient, sediment, pesticide, pathogen sources) so how can we develop a restoration plan. More information about the watershed is needed before planning can take place (research dollars).
<b>Com</b>	Coord, edu	15. There seems to be a major disconnect with agencies that manage at least half of the watershed area you are working on. There are many working watershed groups working throughout the State and I have not seen them mentioned at all. Plans are great, but funding is always a major problem and should be addressed more actively. The plan does nothing without monies to make it happen. DHHL rep – good point on needing contact with community associations that would have reached far more people connected with the area of concern. Should have contacted agencies connected with watersheds to speed up process of identifying problems or at least validating communities concerns, eg. pesticide use – agencies may have stats on these kind of issues
<b>WQ</b>	chem	16. I heard that the Army buried a lot of toxic waste along Flume Road after WWII. If it's true, maybe Super Fund could be tapped to clean it up.

<sup>5</sup> **Catagories**

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# **Table 4**

**Table 4. Hilo Bay Watershed Solutions Categorized<sup>1</sup>**

<b>Morning Session 1/6/04</b>	
<b>WQ</b>	1. Open section of breakwall.
<b>L&amp;P</b>	2. Require monitoring and regulating cruise ships
<b>WQ</b>	3. Build ponds using bioremediation to clean wastewater (cattle).
<b>WQ</b>	4. Composing toilets
<b>WQ</b> <b>WV</b>	5. Straighten canal so discharge straight to the ocean.
<b>WQ</b>	6. Use curtain system and recycle water (drainage going into Wailoa River)
<b>L&amp;P</b>	7. Better enforcement of existing laws.
<b>Evening Session 1/6/04</b>	
<b>Com</b> <b>WV</b>	8. Coordinate efforts (flooding effects on soccer fields).
<b>WV</b>	9. Use lava tubes as conduits (flooding effects on soccer fields).
<b>WV</b> <b>WQ</b> <b>L&amp;P</b>	10. Regarding urbanization: Use zoning and land use planning. Need to involve State and County. Purchase watershed land for catchment basins, more vegetation cover.
<b>Morning Session 1/21/04</b>	
<b>Com</b>	1. WAG should use seed money to start a financial self-perpetuating project to provide funds to implement improvement projects.
<b>Com</b>	2. Education programs and community awareness is needed.
<b>WQ</b>	3. Should consider individual household treatment systems.
<b>Com</b>	4. (The watershed program/project should be) published on the T.V. show <i>Living in Paradise</i>
<b>Com</b> <b>L&amp;P</b>	5. Restrict uses in watersheds.
<b>Com</b>	6. Start an "Adopt-a-Beach" program.
<b>WQ</b>	7. Put garbage cans on beaches.
<b>Com</b> <b>L&amp;P</b>	8. Open up more access to hunters and implement an education program.
<b>Com</b>	9. Have regular contact with groups in the watershed.
<b>Evening Session 1/21/04</b>	
<b>WQ</b>	1. Poke holes in the breakwater
<b>WQ</b>	2. Put more trash cans in the downtown area (beaches).
<b>Com</b>	3. Develop an Adopt-a-Beach program.

<sup>1</sup> **Categories**

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Table 4. Hilo Bay Watershed Solutions Categorized<sup>1</sup>

<b>Com</b> <sup>2</sup>	4. Use the media shock value to arouse the public (action) with such issues as “stool, leptosporosis, and arsenic”
<b>WQ</b>	5. Hook up more houses to the sewer system.
<b>Com L&amp;P</b>	6. Get County to follow their own agreement regarding sewer hookups.
<b>Inf</b>	7. Get data and background data (water quality, pathogens, etc.).
<b>Inf L&amp;P</b>	8. Bring in NRCS ??? watershed protection plans under PL 566.
<b>Com</b>	9. Get the Corps of Engineers involved.
<b>Inf</b>	10. (Make a) scale model of Hilo Bay (so that you can) change parameters to measure effects.
<b>Com</b>	11. Educate the children (Stream Day).
<b>Com</b>	12. (Need) more community programs (Get the Drift & Bag It)
<b>Com</b>	13. Continue WAG and other community (action groups).
<b>Com</b>	14. Continue dialogue and discussion in public form: radio, T.V., letters.
<b>Com</b>	15. In the forest and lands bring land owners together (urban areas, County & Planning, State & private landowners in upper)
<b>Com</b>	16. Involve NRCS in developing conservation practices.
<b>Morning Session 7/1/03</b>	
<b>WQ</b>	1. Have separated trash, etcetera pickup by garbage company, to facilitate recycling
<b>WQ</b>	2. Expansion of sewer system to Nene St to eliminate sewage release to Bay
<b>WQ</b>	3. Make breaks in breakwater to improve circulation in Bay
<b>WQ WV</b>	4. A project to divert Kaumana runoff from Wailuku river to reduce erosion would run \$6 million.
<b>WQ WV</b>	5. Make sediment runoff control
<b>Com</b>	6. Get EPA grants to fund cleanup projects
<b>WQ</b>	7. Increase runoff-holding ponds to reduce sediment/water discharge to Bay
<b>WQ</b>	8. Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump
<b>WQ</b>	9. We need BMPs to dispose of wastes
<b>WQ</b>	10. Cover crops, tree crops, NRCS recommendations to filter sediments, nutrients
<b>WQ WV</b>	11. Build check dams to enhance percolation of runoff
<b>Bio</b>	12. Native forest protection
<b>Com</b>	13. Increase shoreline cleanup activities and to get community participation
<b>Com L&amp;P</b>	14. Use community-planning approach to guide development
<b>Com</b>	15. Make sure that Planning Department incorporates watershed awareness

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Table 4. Hilo Bay Watershed Solutions Categorized<sup>1</sup>

<sup>3</sup>	<b>Evening Session 7/1/03</b>
<b>WQ</b>	16. Improve water circulation in Hilo Bay (break water removal, alteration?)
<b>WQ L&amp;P</b>	17. Enforcement of dumping regulations
<b>Com</b>	18. Community education on dumping impacts
<b>Com WQ</b>	19. Provide alternatives to dumping
<b>Com</b>	20. Get county involved (Peter B, waste water & Pat Engelhart)
<b>Com</b>	21. Project should interface with DOE teachers and Environmental programs
<b>WQ</b>	22. Make disposal of toxic wastes easier
<b>Com WQ</b>	23. Have community service days and involved charter schools
<b>WQ Com</b>	24. Have collection containers for bottles
<b>Inf</b>	25. Assess and measure materials entering watershed
<b>Inf</b>	26. Need assessment of fecal coliform sources
<b>Inf</b>	27. Impacts of homeless people and squatters on beaches
<b>Com</b>	28. Tell residents on Wailuku rivers where their sewage goes
<b>WQ Com</b>	29. DOH lacks the manpower to test leakage from private residences
<b>WQ</b>	30. Get a sewer system for lower Kaumana
<b>WQ</b>	31. Reverse leptospirosis contamination if possible
<b>Inf</b>	32. Learn if leptospirosis increasing, the vectors are increasing, and is it an acceptable risk
<b>Inf WQ</b>	33. What are the effects of soil fumigants
	<b>Write-ins</b>
<b>Com</b>	1. WAG members should be aware of cultural issues before decision-making. Have a Hawaiian cultural leader on WAG.
<b>WQ</b>	2. Make hole in breakwater to facilitate flushing.
<b>Rec</b>	3. Bay should be turned into a beautiful beach, can use for jet skiing.
<b>WV</b>	4. Divert runoff to Kona by a cheapie culvert system.
<b>Com</b>	5. Develop a grant proposal.
<b>WQ L&amp;P</b>	6. Both State and County should clean storm drains regularly.
<b>Com WQ</b>	7. Remove fence on Bay Front. Install more facilities: tables, trash bins, etc.
<b>Inf</b>	8. Roy Takemoto of County Planning Department: They are willing to participate in whatever they can assist with. Data available from (GIS): (a) perennial streams; (b) drainage basins; (c) tax parcel maps

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Table 4. Hilo Bay Watershed Solutions Categorized<sup>1</sup>

	(area, TMK, owner, etc.); (d) roads; (e) USGS raster map; (f) aerial photos; (g) DLNR, DOH aquifer classifications; (h) zoning, General Plan, State Land Use designations; (i) others.
<b>WQ<sup>4</sup></b>	9. David Kimo Frankel: Clean up Waiakea Pond.
<b>Inf</b>	10. Professor called in with proposed research project: The objective of the project is to understand the system on the Hamakua side of Wailuku River. There are a lot of sub basin tributaries. Proposal is to run paired catchment studies, i.e., find small watersheds of equal area and geology, for example one forested and one in pasture. Study runoff and water sediment and pollutants from the two different land types. There are many possible pairs.
	<b>Surveys</b>
<b>L&amp;P</b>	11. Legislation for Clean Water regulations.
<b>WQ Com</b>	12. Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to do the same. Get radio stations/ advertising agencies involved as well.
<b>Bio Inf Com</b>	13. Manage invasive species; learn about ecosystem linkages to different elevations/climates and the role of soil and biota in affecting water flow ( <i>throughfall</i> , erosion, uptake). Bring in ahupua'a concept as a PR campaign.
<b>Bio WQ</b>	14. Should make more fish farms which makes more fish and organization in Hilo Bay; put up more trash boxes
<b>WQ Com</b>	15. Put more trash (cans) near rivers; educate children.
<b>Inf</b>	16. Need monitoring programs to develop target areas in watershed (where's the problem). Land cover in watershed.
<b>Inf  WQ Inf L&amp;P L&amp;P Inf Inf</b>	17. (1)Get accurate info on number, distribution of cesspool, sewer, septic. The head of the Hilo wastewater treatment plant told me he doesn't know how many houses were hooked up to the sewer. (2)Re-examine plans to put a hole in the breakwater to improve circulation. (3) We need more quality data for groundwater, streams and ocean. (4) Incentive for erosion control on construction sites. (5) Incentives to include adequate previous area in new development and avoid paving. (6) Investigate vegetative barrier to filter runoff before it reaches bay and streams. (7) There is very little stream flow data for doing flood planning.
<b>Com</b>	18. Get monies to do the projects.
<b>Com WQ</b>	19. Learn to use pesticides and herbicides effectively. Dispose of toxic waste (oil from cars, coolant, etc.) safely.

List of Solutions 012804

**Categories**

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# Table 5

**Table 5. Hilo Bay Watershed Public Input Synthesis**

**SUB-PROBLEM: TURBIDITY**

CAUSES	EFFECTS	SOLUTIONS
Rain/ runoff: <ul style="list-style-type: none"> <li>• rainfall volume</li> <li>• steep slopes (landscape)</li> </ul>	Flooding, erosion, etc	<ul style="list-style-type: none"> <li>• Channelization</li> <li>• A project to divert Kaumana runoff from Wailuku river to reduce erosion would run \$6 million.</li> <li>• Use curtain system and recycle water (drainage going into Wailoa River)</li> <li>• Cover crops, tree crops, NRCS recommendations to filter sediments, nutrients</li> <li>• Straighten canal so discharge straight to the ocean.</li> <li>• Make sediment runoff control</li> <li>• Increase runoff-holding ponds to reduce sediment/water discharge to Bay</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
<p>Land use:</p> <ul style="list-style-type: none"> <li>• poor planning/ zoning</li> <li>• urbanization/ construction</li> <li>• grazing/ farming</li> <li>• consider reforestation; reserve areas</li> <li>• wildlife (pigs)</li> <li>• illegal clearing</li> <li>• poor enforcement of grubbing and grading laws</li> <li>• ignorance of Soil Conservation practices by owners, developers, and earth moving contractors</li> </ul>	<p>Erosion, etc</p>	<ul style="list-style-type: none"> <li>• upgrade and monitor BMPs</li> <li>• Use/design landscapes to reduce erosion; maintain existing vegetation and trees</li> <li>• Offer incentives for erosion control on construction sites</li> <li>• Offer incentives to include adequate previous area (in fill?) in new development and avoid paving</li> <li>• Revise/develop/enforce LUP/zoning/ erosion control plan</li> <li>• Sustainability planning</li> <li>• Set up a penalty system for repeat offenders/violators of grubbing and grading laws</li> <li>• Request SWCD/County to complete the revision of the Hawaii County Grubbing and Grading Ordinance</li> <li>• Regarding urbanization: Use zoning and land use planning. Need to involve State and County. Purchase watershed land for catchment basins, more vegetation cover.</li> <li>• Correct reserve maps; use sub zones to differentiate specific use areas</li> <li>• WQ standards</li> <li>• Use community-planning approach to guide development</li> <li>• Protect native forests and manage invasive species (Note: <b>from Solutions list</b>)</li> <li>• Learn about ecosystem linkages to different elevations/climates, and the role of soil and biota in affecting water flow (throughfall, erosion, uptake).</li> </ul>
<p>Breakwater</p>	<p>Poor circulation traps pollution</p>	<ul style="list-style-type: none"> <li>• Remove, poke holes in, or modify BW</li> <li>• Re-examine plans to put a hole in the breakwater to improve circulation.</li> </ul>
	<p>Impact biota &amp; habitat</p>	
<p><b>PATHOGENS</b></p>		

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
Residential: <ul style="list-style-type: none"> <li>• cesspools, septic tanks,</li> <li>• treatment plant spills</li> <li>• plantation camps discharging raw sewage directly into waterways</li> </ul>	Illness/ disease Non potable surface & groundwater	<ul style="list-style-type: none"> <li>• Consider individual household treatment systems like composting toilets; Monitor waters; develop and enforce regulations; post areas where problems</li> <li>• Hook up more houses to the sewer system (eg. Kaumana and Nene St sewer line); get County to follow their own agreement regarding sewer hookups</li> </ul>
Industry/commercial <ul style="list-style-type: none"> <li>• cruise ships</li> <li>• observatories (see submittal)</li> </ul>	Illness/ disease Non potable surface & groundwater	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Regulations/ enforcement</li> <li>• Require monitoring and regulating cruise ships</li> </ul>
Animals: <ul style="list-style-type: none"> <li>• livestock</li> <li>• wildlife (pigs, rodents, etc)</li> <li>• domestic animals</li> </ul>	Illness/ disease Non potable surface & groundwater	<ul style="list-style-type: none"> <li>• Better rodent control (lepto)</li> <li>• Monitoring</li> <li>• Regulations/ enforcement</li> <li>• Build ponds using bioremediation to clean wastewater (cattle).</li> </ul>
Storm water runoff (6)		
<b>CHEMICALS</b>		
<u>Heavy metals including mercury, arsenic (sediment) (Caneck)</u> Illegal dumping Air pollution Arsenic: Caneck production; resuspended in the bay Dredging Urban & ag runoff Unlined dumps		<ul style="list-style-type: none"> <li>• Educate public on impacts of dumping</li> <li>• Provide alternatives to dumping</li> <li>• Enforcement of dumping regulations</li> <li>• Clean up Waiakea? (Wailoa) Pond</li> <li>• Develop/revise and impose BMPs for waste disposal</li> <li>• Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to do the same. Get radio stations/ advertising agencies involved as well.</li> </ul> <p>Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump</p>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
<p><u>Hazardous materials/ toxic waste:</u>                      Illegal dumping including lava tubes, caves)                      Landfill                      Air pollution                      Military waste (eg. artillery shells in bay, along Flume Rd)                      Urban &amp; ag runoff                      Observatories                      Unlined dump                      Cruise ships</p>	<p>Pollution of waterways and coastal receiving waters</p>	<ul style="list-style-type: none"> <li>• Educate public on impacts of dumping</li> <li>• Provide alternatives to dumping</li> <li>• Enforcement of dumping regulations</li> <li>• Dispose of toxic waste (oil from cars, coolant, etc.) safely.</li> <li>• Require monitoring and regulating cruise ships</li> <li>• Make disposal of toxic wastes easier;</li> <li>• Develop/revise and impose BMPs for waste disposal</li> <li>• Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to so the same. Get radio stations/ advertising agencies involved as well.</li> <li>• Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump</li> </ul>
<p><u>Oil</u>                      Illegal dumping                      Urban runoff                      Unlined dump</p>	<p>Pollution of waterways and coastal receiving waters</p>	<ul style="list-style-type: none"> <li>• Educate public on impacts of dumping</li> <li>• Provide alternatives to dumping</li> <li>• Enforcement of dumping regulations</li> <li>• Dispose of toxic waste (oil from cars, coolant, etc.) safely</li> <li>• Develop/revise and impose BMPs for waste disposal</li> <li>• Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to so the same. Get radio stations/ advertising agencies involved as well.</li> </ul>
<p>Energy byproduct (coal ash)</p>		
<p><u>Fuel:</u>                      Potential source in disaster (eg tsunami, etc)</p>	<p>Pollution of waterways and coastal receiving waters</p>	

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
<p><u>Pesticides/ herbicides</u>                      Illegal dumping                      Urban &amp; ag runoff                      Unlined dumps</p>	<p>Pollution of waterways and coastal receiving waters</p>	<ul style="list-style-type: none"> <li>• Educate public on impacts of dumping</li> <li>• Provide alternatives to dumping</li> <li>• Enforcement of dumping regulations</li> <li>• Learn to use pesticides and herbicides effectively</li> <li>• Develop/revise and impose BMPs for waste disposal</li> <li>• Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to do the same. Get radio stations/ advertising agencies involved as well.</li> <li>• Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump</li> </ul>
<p><u>Nutrients</u>                      Over-fertilizing (domestic, ag, golf courses)                      Urban runoff                      Unlined dumps</p>	<p>Pollution of waterways and coastal receiving waters</p>	<ul style="list-style-type: none"> <li>• Develop/revise and impose BMPs for waste disposal</li> <li>• Try to reduce some of the agents that add to these problems within their own household. Educate others of the problem and encourage them to do the same. Get radio stations/ advertising agencies involved as well.</li> <li>• Hilo area groundwater is very high quality and high flow, provides natural dilution of groundwater contaminants like leachate from dump</li> </ul>
<p><u>Soaps/ sunscreen</u>                      Unlined dumps                      Beaches</p>	<p>Pollution of waterways and coastal receiving waters</p>	
<p>Cane waste</p>	<p>Pollution of waterways and coastal receiving waters</p>	
<p>Air pollution</p>	<p>Pollution of waterways and coastal receiving waters</p>	
<p><b>SOLID WASTE</b></p>		
<p>Littering, attitudes</p>	<p>Trash</p>	<ul style="list-style-type: none"> <li>• clean up and adopt-a-beach programs, add more trash containers near waterways; educate children.</li> <li>• County needs to do refuge pick up</li> <li>• Have separated trash, etcetera pickup by garbage company to facilitate recycling</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
Cruise ships		<ul style="list-style-type: none"> <li>Require monitoring and regulating cruise ships</li> </ul>
Fisherman discard offal	May attract sharks	
Litter/debris clogs storm drains/ channels	Flooding	<ul style="list-style-type: none"> <li>Needs regular storm drain cleaning</li> </ul>
“open vessel law” & bad habits	Bottle disposed from cars, etc	<ul style="list-style-type: none"> <li>Poor habits need to be changed; offer recycle rebates on containers</li> <li>Have collection containers for bottles</li> </ul>
<b>FLOODING</b>		
	Soccer fields damaged/ unplayable	<ul style="list-style-type: none"> <li>Improve fields</li> </ul>
Channelization/stream channel engineering	Flooding	<ul style="list-style-type: none"> <li>Better land use planning</li> <li>Use lava tubes as conduits (flooding effects on soccer fields)</li> </ul>
Urbanization; high density development in flood zones (Kaumana, Puainako)	Flooding	<ul style="list-style-type: none"> <li>Improve/ revise current land use planning</li> <li>Make sure that Planning Department incorporates watershed awareness</li> </ul>
Incorrect flood zone designations	Flooding	<ul style="list-style-type: none"> <li>Redraw flood zone designations</li> <li>Use community-planning approach to guide development</li> </ul>
Unknown, unrecorded & episodic streams	Flooding	<ul style="list-style-type: none"> <li></li> </ul>
?Impacts of Waieka Stream diversion on land below		<ul style="list-style-type: none"> <li></li> </ul>
Flooding	Impacts bay	<ul style="list-style-type: none"> <li>Build check dams to enhance percolation of runoff</li> <li>Divert runoff to Kona by a cheapie culvert system.</li> </ul>
Blockage from yard waste dumped in waterways	flooding	<ul style="list-style-type: none"> <li>County/State maintain and clean storm drains regularly</li> </ul>
		<ul style="list-style-type: none"> <li>Cultural issues need to be considered, especially flood control</li> </ul>
		<ul style="list-style-type: none"> <li>Need structural and non structural measures to reduce downstream flooding</li> </ul>
<b>RECREATION</b>		
Flooded Soccer fields	Can't play soccer	<ul style="list-style-type: none"> <li>improve fields; coordinate efforts</li> </ul>
Pathogens, pollution, sediment impose swimming concerns	Bay not inviting for contact recreation;	<ul style="list-style-type: none"> <li>. Install more facilities: tables, trash bins, etc.</li> </ul>
Access to bay limited (including fence)	Limits recreation potential	<ul style="list-style-type: none"> <li>Remove fence on Bay Front ; increase access</li> </ul>
Increase recreation (bay front?)		<ul style="list-style-type: none"> <li>need more amenities (picnic tables, garbage cans, etc.); make more inviting</li> <li>turn Bay into a beautiful beach (can use for jet skiing)</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
		<ul style="list-style-type: none"> <li>• Open up more access to hunters and implement an education program</li> </ul>
<b>BIOTA</b>		
Invasive species	Ponds overgrown with mangrove and grasses	<ul style="list-style-type: none"> <li>•</li> </ul>
	?Endangered species in upper forests	<ul style="list-style-type: none"> <li>•</li> </ul>
Pollution	May overstress fish & invertebrates	<ul style="list-style-type: none"> <li>•</li> </ul>
Richardson Beach is overused and over-fished		<ul style="list-style-type: none"> <li>•</li> </ul>
		<ul style="list-style-type: none"> <li>• help the natural recovery cycle of watrshd</li> </ul>
Stream modification	How does it impact stream ecosystem	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>COMMUNICATION</b>		
Didn't see recognition of many groups working on wtrshd issues in State	Disconnect w/groups & agencies working on watrshd	<ul style="list-style-type: none"> <li>•</li> </ul>
No funding	Plans not effective without funding	<ul style="list-style-type: none"> <li>• actively address funding; get monies to do the projects.</li> <li>• The WAG should use seed money to start a self-perpetuating project to provide funds to implement watershed improvement projects</li> <li>• Get EPA grants to fund cleanup projects</li> <li>• Develop a grant proposal.</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
Poor communication	Lack of community involvement and understanding	<ul style="list-style-type: none"> <li>• contact/coordinate w/community assoctns connected to wtrshdissues to reach more people</li> <li>• Have regular contact with community groups and other entities that affect and are affected by the watershed (include urban/rural areas, private landowners, Federal, State, County/planning, businesses, etc.).</li> <li>• Tell residents on Wailuku rivers where their sewage goes</li> <li>• Establish watershed education, community awareness, and action programs for children and adults. Examples: An annual "Stream Day, " and "Get the Drift" and "Bag It."</li> <li>• (Publicize the watershed project on the T.V. show, "Living in Paradise"</li> <li>• Have community service days and involved charter schools</li> <li>• Use the media to help stimulate public involvement in the project with such announcements as, "These things are in our streams, rivers, and bays: "excrement, leptosporosis, and arsenic.</li> <li>• Continue WAG and other community (action groups).</li> <li>• Continue dialogue about the watershed in public form via radio, T.V., letters to the editor, etc.</li> <li>• Increase shoreline cleanup activities and to get community participation</li> <li>• Project should interface with DOE teachers and Environmental programs</li> </ul>
Need coordination w/ County & State, etc		<ul style="list-style-type: none"> <li>• coordinate with County, State, etc</li> <li>• Involve NRCS in developing conservation practices.</li> <li>• Get county involved (Peter B, waste water &amp; Pat Engelhart)</li> </ul>
Not considering culture		<ul style="list-style-type: none"> <li>• cultural issues need to be considered</li> <li>• Promote the Ancient Hawaiian Ahupua'a watershed concept as a way to generate participation in the project.</li> <li>• Be aware of cultural issues before decision-making; have a Hawaiian cultural leader on WAG.</li> </ul>
		<ul style="list-style-type: none"> <li>• review Puna Community Trails Council document</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
Are federal agencies listening to local experts & residents?		<ul style="list-style-type: none"> <li>• Improve communication w/ relevant people</li> <li>• Involve the Corps of Engineers in the project. [ ? ]</li> </ul>
Lack of monitoring of feral pigs & plant species		<ul style="list-style-type: none"> <li>•</li> </ul>
Lack of information and lack of understanding of how the system works	<ul style="list-style-type: none"> <li>• don't understand bay flow &amp; how to improve</li> <li>• don't understand impacts from pesticides, herbicides, etc usage</li> </ul>	<ul style="list-style-type: none"> <li>• do computational fluid dynamics study</li> <li>• Make a scale model of Hilo Bay so that you can change parameters to measure effects.</li> <li>• do study comparing different usages (grazing, urbanization, etc); apply results to land use planning</li> <li>• Learn if leptospirosis increasing, the vectors are increasing, and is it an acceptable risk</li> <li>• Professor called in with proposed research project: The objective of the project is to understand the system on the Hamakua side of Wailuku River. There are a lot of sub basin tributaries. Proposal is to run paired catchment studies, i.e., find small watersheds of equal area and geology, for example one forested and one in pasture. Study runoff and water sediment and pollutants from the two different land types. There are many possible pairs.</li> <li>• We need more quality data for groundwater, streams and ocean.</li> </ul>
Lack WQ monitoring data at different elevations		<ul style="list-style-type: none"> <li>•</li> </ul>
Lack of data and information	<p>Lack understanding of Wailuku wtrshd; impacts from different land uses</p> <p>Can't identify or understand WQ problems</p>	<ul style="list-style-type: none"> <li>• do research as proposed in 31</li> <li>• obtain receiving water &amp; WQ data &amp; do modeling (see 28)</li> <li>• get students involved in WQ testing</li> <li>• Get data and background data (water quality, pathogens, etc.)</li> <li>• Need assessment of fecal coliform sources</li> <li>• Need monitoring programs to develop target areas in watershed (where's the problem). Land cover in watershed.</li> <li>• Assess and measure materials entering watershed</li> <li>• Impacts of homeless people and squatters on beaches</li> </ul>
Don't know much about wtrshd (see 32)	Can't develop restoration plan	<ul style="list-style-type: none"> <li>• get more information (research dollars)</li> </ul>
DOH lacks the manpower to test leakage from private residences		<ul style="list-style-type: none"> <li>• Get accurate info on number, distribution of cesspool, sewer, septic. County Wastewater Department not sure how many houses are hooked up to the sewer.</li> </ul>
		<ul style="list-style-type: none"> <li>• review DOH WQ monitoring data</li> </ul>

Table 5. Hilo Bay Watershed Public Input Synthesis

CAUSES	EFFECTS	SOLUTIONS
		<ul style="list-style-type: none"> <li>• contact agencies with watrshd information to expedite validating concerns</li> <li>• Contact Roy Takemoto of County Planning Department. They are willing to participate in whatever they can assist with. Data available from (GIS): (a) perennial streams; (b) drainage basins; (c) tax parcel maps (area, TMK, owner, etc.); (d) roads; (e) USGS raster map; (f) aerial photos; (g) DLNR, DOH aquifer classifications; (h) zoning, General Plan, State Land Use designations; (i) others.</li> </ul>
		<ul style="list-style-type: none"> <li>• Bring in NRCS ? watershed protection plans under PL 566.</li> </ul>
	Don't know what the effects are of soil fumigants	<ul style="list-style-type: none"> <li>• Research existing literature on soil fumigants and groundwater contamination in Hawaii</li> </ul>
Loss of vegetation	Flooding	<ul style="list-style-type: none"> <li>• Investigate vegetative barrier to filter runoff before it reaches bay and streams.</li> <li>• There is very little stream flow data for doing flood planning.</li> </ul>
Subzones (eg. Grazing) are not differentiated on Forest Reserve & Conservation maps		<ul style="list-style-type: none"> <li>• Use subzones to differentiate these areas and put on map</li> </ul>
	Don't understand increase/decrease of E. coli at Onekaakaa Park	
Need baseline data on marine organisms		<ul style="list-style-type: none"> <li>•</li> </ul>

**General Solutions**

<b>Com L&amp;P</b>	Restrict uses in watersheds.
<b>L&amp;P</b>	Better enforcement of existing laws.
<b>L&amp;P</b>	Legislation for Clean Water regulations.

Notes:

1. Assume all these elements/pollutants effect the watershed where the watershed includes surface and groundwater (see 21).
2. We need documentation to know to what extent these are problems.
3. Where the "effect" is blank, assume result is general water pollution including runoff.
4. Urbanization includes pavement, loss of vegetation, etc.
5. Communication includes outreach, education coordination, culture, community involvement, obtaining funds, etc)
6. Storm water runoff is a contributing factor to most pollutants.

File: mj: causes effects solutions table 2 6 04

# Diagram 1

## Diagram 1. The Problem Tree Method<sup>1</sup>

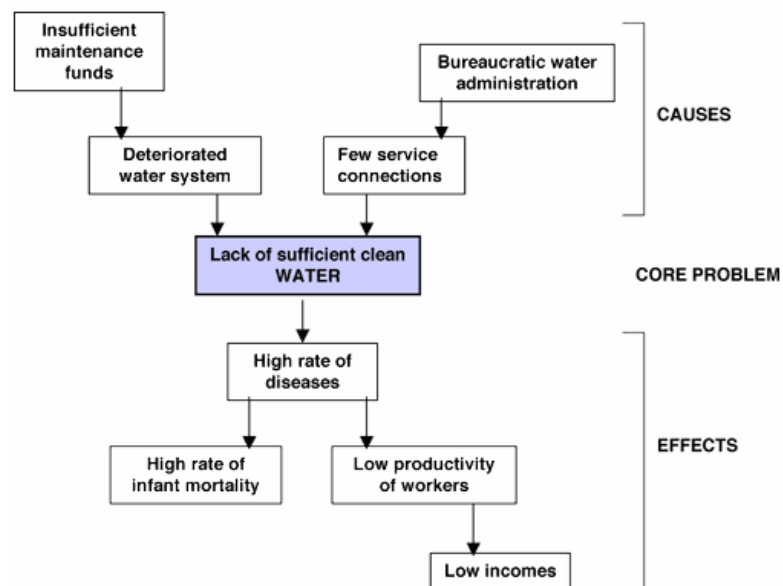
The “Problem Tree” analytical tool assists in analyzing an existing situation by identifying the major problems and their main causal relationships. The output is a graphical arrangement of problems differentiated according to ‘causes’ and ‘effects,’ joined by a core, or focal, problem. This technique helps understand the context and interrelationship of problems, and the potential impacts when targeting projects and programs toward specific issues.

Use of cards - one problem per card - makes the tool useful for group participation in a workshop setting. The outcome represents the collective thinking of the participants.

The ‘problem tree’ is often followed by an ‘objectives tree.’ The problems are converted through simple rewording into specific objectives, and the chart then shows a ‘means-ends’ relationship. For example, ‘lack of sufficient water’ becomes ‘improve water supply.’ These objectives then provide a basis for project and program definition.

Because the ‘problem tree’ is never static and seldom - if ever - the same for different groups and at different times, it is more a device to broaden thinking than as a definitive project determinant. For example, ‘lack of sufficient water’ could either be a ‘cause’ or an ‘effect,’ depending on the situation and participating group, and the project objectives and tasks would be different for each.

Diagram 1. Example Problem Tree



### Steps:

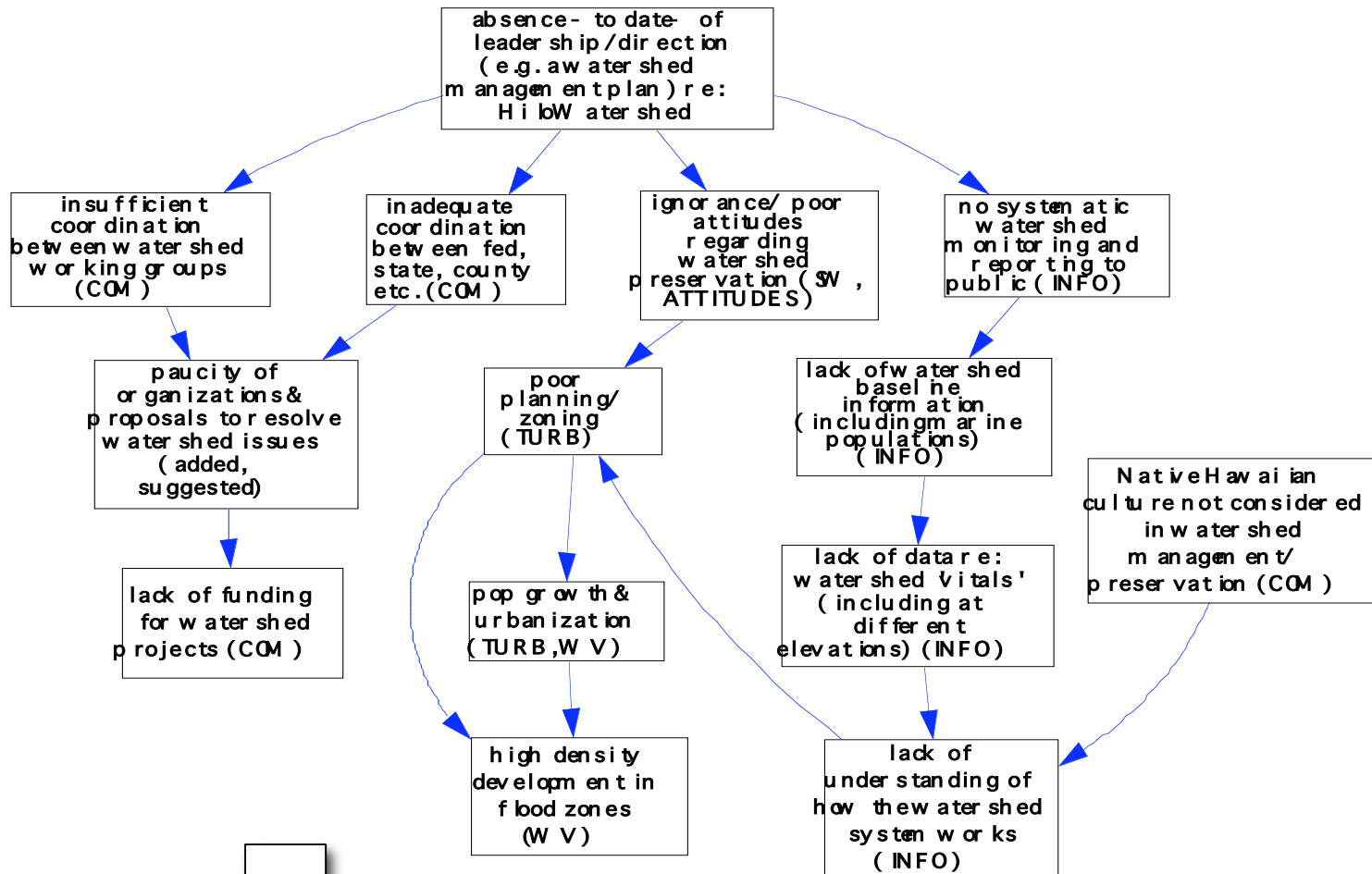
1. List all the problems that come to mind. Problems need to be carefully identified: they should be existing problems, not possible, imagined or future ones. The problem is an existing negative situation, it is not the absence of a solution.
2. Identify a core problem (this may involve considerable trial and error before settling on one).
3. Determine which problems are “Causes” and which are “Effects.”
4. Arrange in hierarchy both Causes and Effects, i.e., how do the causes relate to each other - which leads to the other, etc.

<sup>1</sup> Source: <http://www.mit.edu/afs/athena/org/u/urbanupgrading/upgrading/issues-tools/tools/problem-tree.html>

# Diagram 2

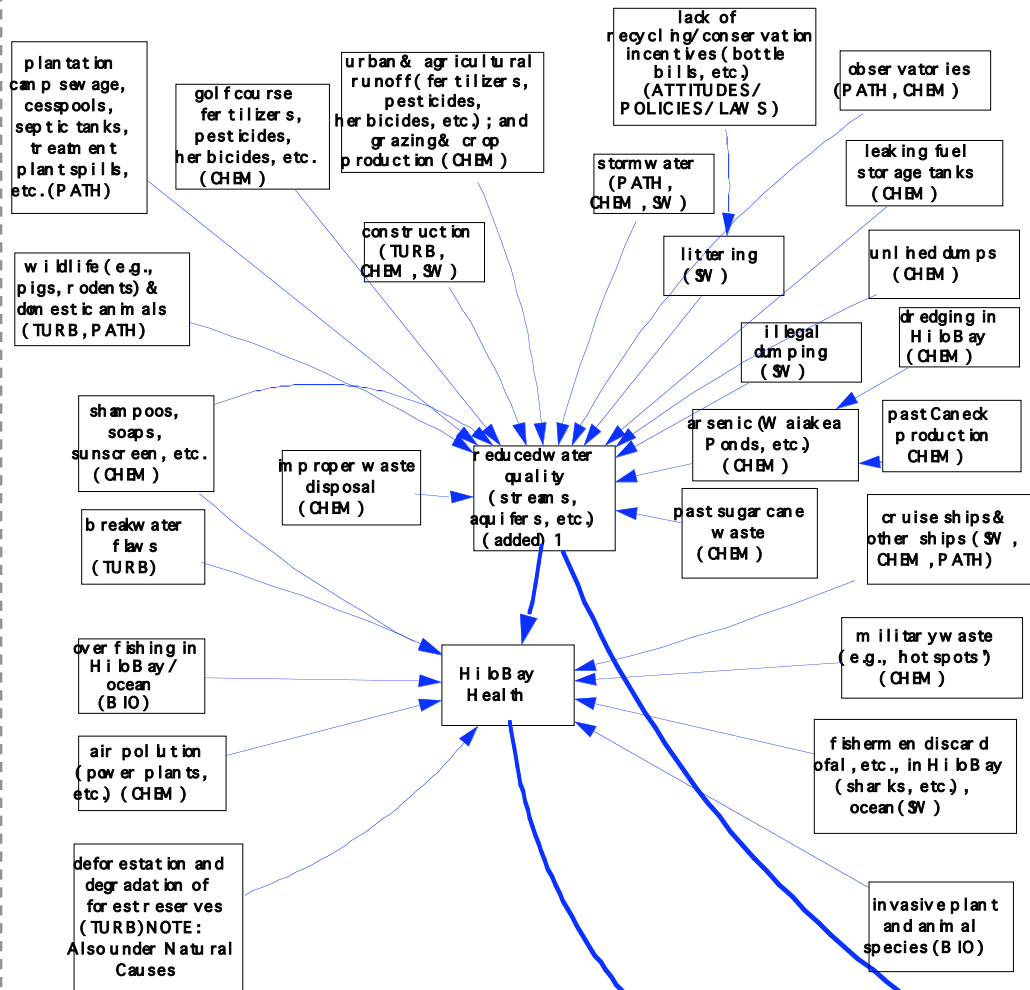
## Diagram 2. Hilo Watershed Problems-Causes-Effects of the Public Input Report

A . C A U S E S W A T E R S H E D M A N A G E M E N T ( P O L I C Y , C O M M U N I C A T I O N S ,  
M O N I T O R I N G / I N F O R M A T I O N , E T C . )

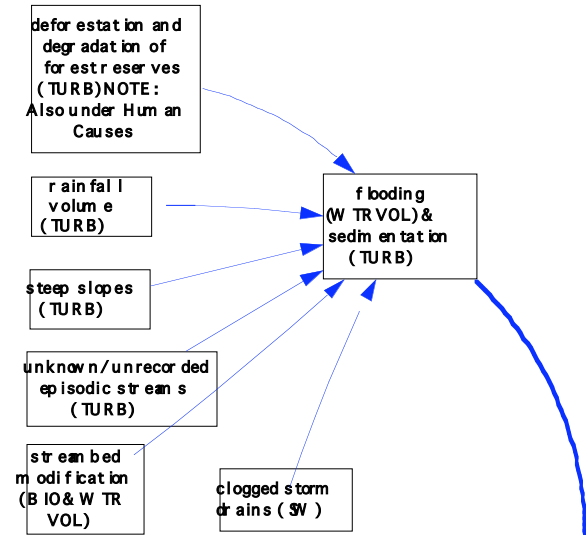


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# B.C A U S E S :HUMAN MADE/INFLUENCED



# C .CAUSES :NATURAL (RAINFALL, GEOLOGY, TOPOGRAPHY, ETC.)



# D .P R O B L E M (EPA/DOH DEFINED)

PROBLEM :  
W A T E R S H E D  
W A T E R  
Q U A L I T Y  
N O T T O  
S T A N D A R D

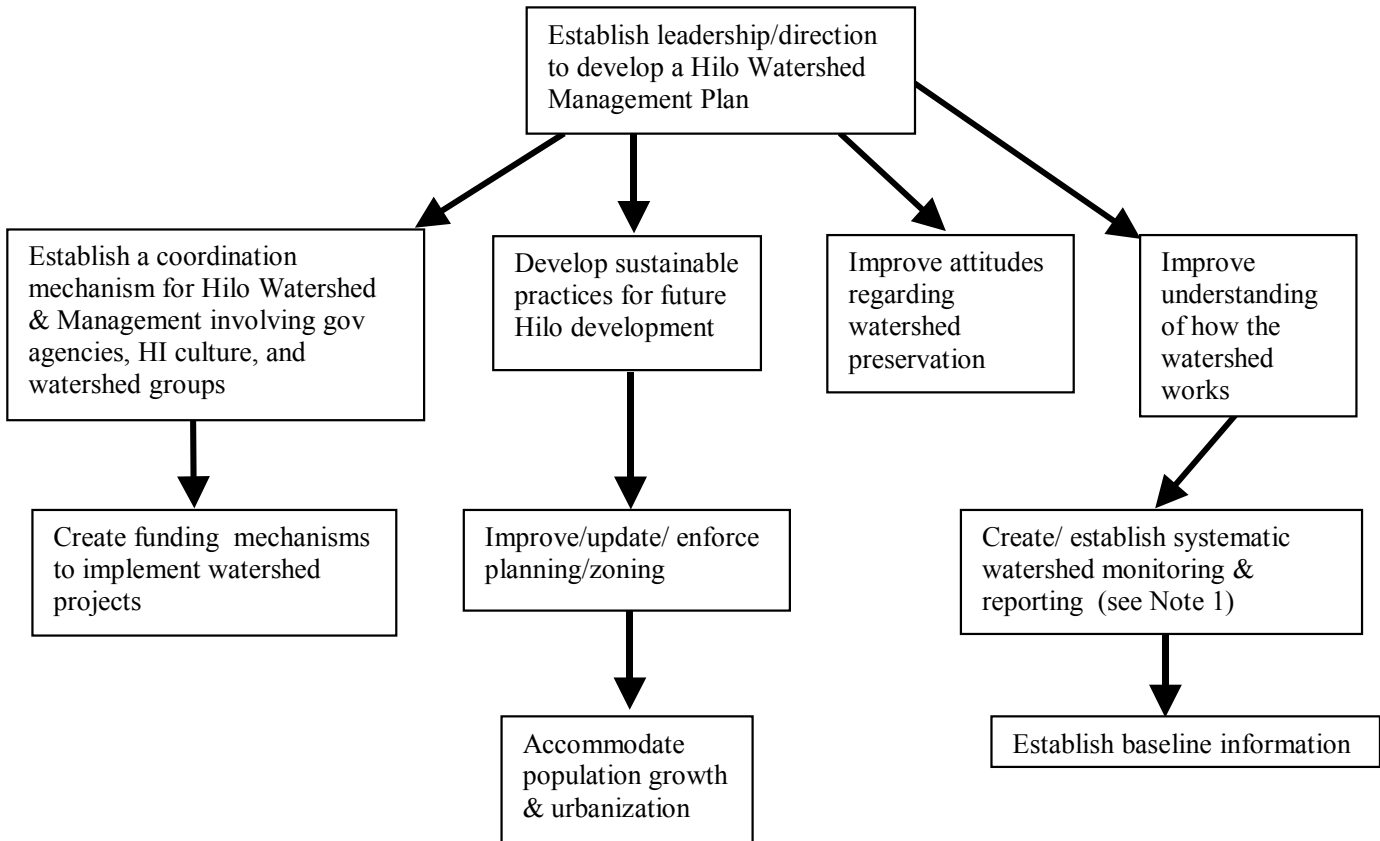
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# Diagram 3

## Diagram 3. Solutions Tree

### A. Solutions to Watershed Management Plan<sup>1</sup>



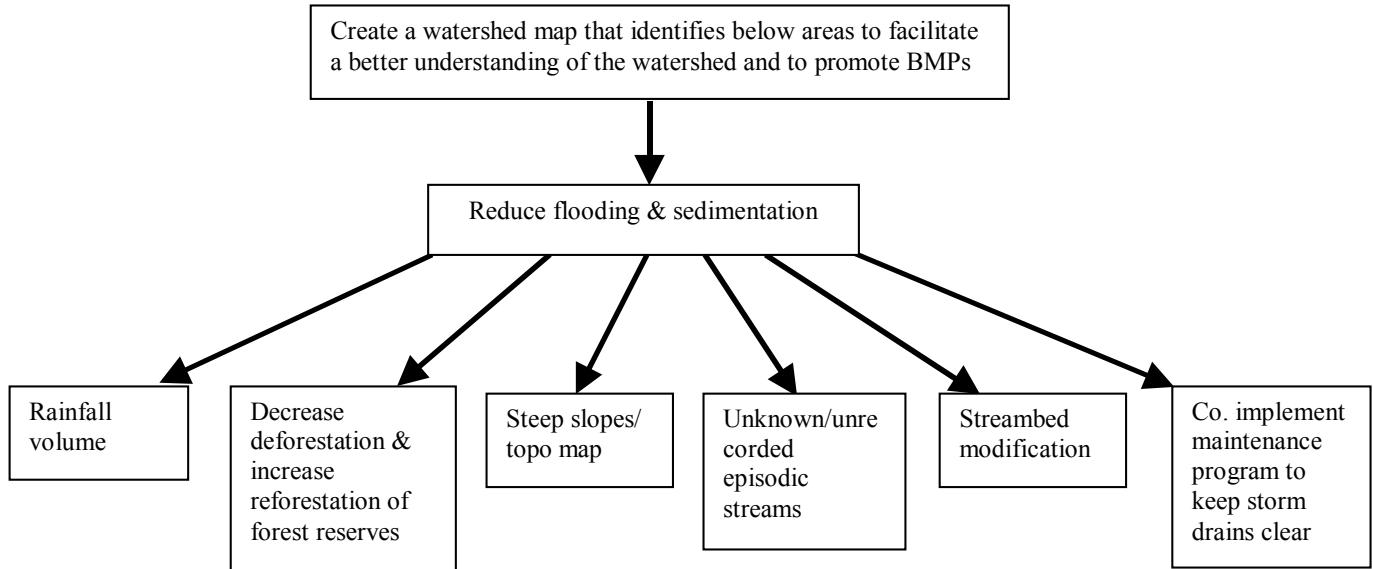
**Note 1:** Monitor and reporting to include: potable water sources adversely affected; human illnesses and diseases (pathogens, pollutants, sediments in bay); soil erosion/ sedimentation; oils, chemicals, heavy metals in bay; waters not suitable for water recreation; flooding; pollution hotspots in Hilo Bay; poor water circulation traps pollutants; accumulation of pollutants in fish tissue; low/declining fish and invertebrate populations; endangered species in upper watershed; impact of development on watershed habitat; eutrophication and ponds overgrown with mangroves and grasses; sharks attracted to offal impeding recreational use; bottles/cans disposed from cars

\* Communication includes outreach, education, coordination, culture, community involvement, obtaining funds, etc.

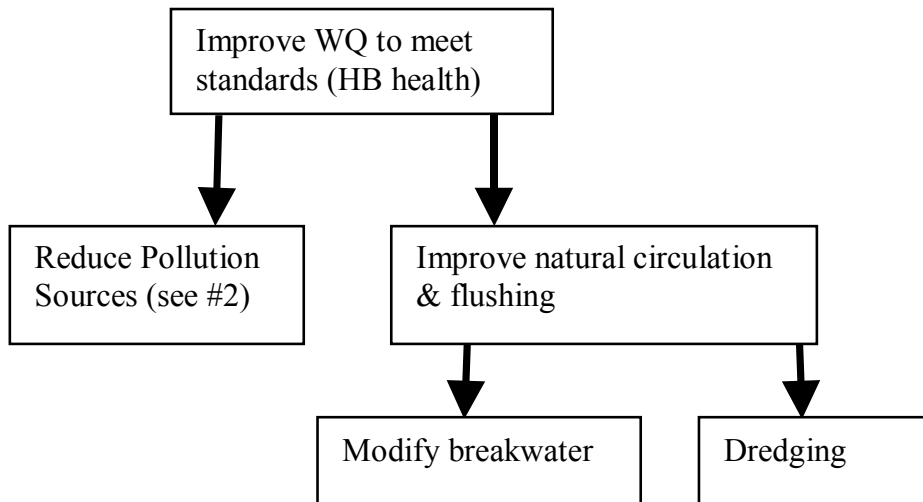
<sup>1</sup> Watershed Management Plan includes but is not limited to: policies, procedures, coordination and partnerships, monitoring, information, funding, and communication including outreach, education, cultural considerations, and community involvement

## Hilo Watershed Project Solutions Overview

### B. Solutions to Natural Causes (Rainfall, Geology, Topography, Etc.)



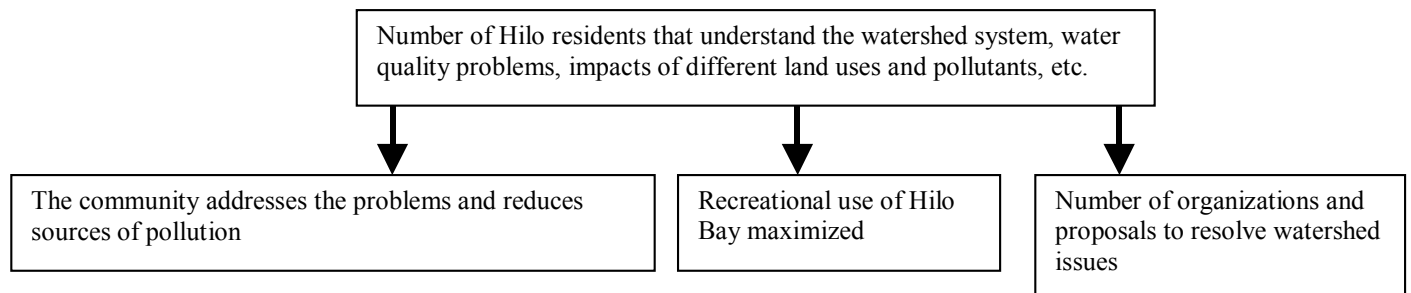
### C. Solutions to Human Activities/Impacts



Note 2: Human and animal activities that are sources of pollution include: cesspools, septic tanks and treatment plant spills; plantation camp sewage systems; storm water; cruise & other ships; unlined dumps; construction; wildlife (pigs, rodents) & domestic animals; runoff from golf courses, urban areas and ag (fertilizer, pesticides & herbicides, etc); grazing & crop production; illegal dumping; air pollution; improper waste disposal; leaking fuel storage tanks; arsenic in Wailoa ponds; past Canek production; past sugar cane waste; military waste; fishermen discarding offal; observatory activities; shampoos soaps and sunscreens; littering,

## Hilo Watershed Project Solutions Overview

### D. Effects on Hilo Watershed Health (Outputs or Indicators)



*Still to be incorporated.....*

Eradicate invasive plant and animal species, over fishing in Hilo Bay and ocean

# **Supplemental Information**

## Supplemental Information

Provided by Thomas Young, Hilo Bay Watershed Advisory Group Member

The study of a watershed requires baseline data, and benchmarks, so that you can view ecological changes over time. Historical publications provide technical information as to the conditions of the watershed at the earliest recording to the present. Quotes and anecdotal comments provide for a view of conditions prior to scientific investigation.

### Historical Background

Kamehameha was living at Waieka when Captain George Vancouver made his third visit to Hawaiian waters with his ships the *Discovery* and the *Chatham*. January 1794. Archibald Menzies, the naturalist aboard the *Discovery*, described their arrival at Waieka by the following quote when speaking of the bay and the productive land: “Round the bottom of this bay was a tract [sic] of low land that extended a considerable distance to the eastward and adorned with beautiful groves of cocoa nut palms and bread fruit trees, amongst which were scattered the habitations of the natives. The whole was fertilized by two considerable streams of fresh water that emptied into the bottom of the bay.”<sup>1</sup>

In 1823 William Ellis estimated the population of the bay area to be 2,000 people. Both “wet” and “dry” taro were grown in the bay area---. The wet taro of Hilo was not grown in pondfields (lo`i), so prevalent in valley cultivations, but in marshlands along the Waiolama and Wailoa rivers.<sup>2</sup> (1883:99) Cummins mentions seeing women washing clothes in the Wailuku River. During an eruption of the volcano in 1855, “the water in the river became black with ash from the burning forests,” and river water was temporarily unusable (Cumming 1883:230). Once, when the Wailuku was flooded, he watched the muddy river turn the sea red (Ibid.203).<sup>3</sup>

The Waiolama and Ponohawai dredge and fill projects took place in 1912-1923. Today the Waiolama stream does not exist. The Waiolama is merely a canal that drains water from Alenaio Stream into the Wailoa River and then into the sea.<sup>4</sup>

### Physical Setting

The northern part of the watershed, formed by Mauna Kea has, has a well-defined channel system on the middle and lower slopes. Recent lava flows from Mauna Loa have obliterated natural drainage ways, causing floodwaters to flow over wide areas. Large amounts of runoff water enter lava tubes and rock fractures in the area but some return to the surface as springs that flood the developed areas.<sup>5</sup>

The principal watershed problems consist of flood damage to agricultural lands, residential areas, and commercial developments; and sediment pollution of Wailuku River, Alenaio stream, and Hilo Bay.<sup>6</sup>

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<sup>1</sup> Source: Hilo Bay A Chronological History, Land And Water Use In The Hilo Bay Area, Island Of Hawaii by Marion Kelley, Barrey Nakamura, Dorthy B. Barrere, Department of Anthropology Bernice P. Bishop Museum, Prepared for U.S. Army Engineer District, Honolulu; March 1981; page 9

<sup>2</sup> Source: See footnote 1; pages 19-20

<sup>3</sup> Source: See footnote 1; page 66

<sup>4</sup> Source: See footnote 1; page 217

<sup>5</sup> Watershed Work Plan Wailuku-Alenaio Watershed; Hawaii County, Hawaii 1976; Soil Conservation Service Forest Service; page 3

<sup>6</sup> Source: Watershed Work Plan Wailuku-Alenaio Watershed; Hawaii County, Hawaii 1976; Soil Conservation Service Forest Service; page 1

Under the State water quality standard classification, all streams in the watershed are Class 2, except the Wailuku River tributaries that provide Hilo's water supply are Class 1. Hilo bay and adjacent coastal water is class A, except a limited area next to the boat docking facilities in the harbor, which is Class B.<sup>7</sup>

### Rainfall Characteristics

The island of Hawaii, lying in the path of the northeast tradewinds, has an orographic rainfall pattern typical of the larger islands in the Hawaiian chain. The moisture-laden trades are cooled as they raise up the mountain slopes and lose part of their moisture as rain. The prevalence of the trades throughout much of the year accounts for the high annual rainfall of 75 to more than 300 inches on the windward, northeast side of the island. Orographic rainfall increases with elevation, reaching a maximum intensity from 2,000 to 3,000 feet elevation and then diminishing, so that upper slopes are semi-arid.<sup>8</sup>

### Water Quality Characteristics

Surface water on the island of Hawaii is characterized by low concentrations of dissolved solids (salts and mineral constituents) averaging about 64 ppm, and minimal hardness, averaging about 29 ppm. Ground water, by contrast, has considerably higher concentrations of dissolved solids and greater hardness, averaging about 125 and 112 ppm, respectively. Hardness is caused principally by calcium and magnesium compounds, and somewhat by sulfate. The relatively high silica content of ground water on the island is associated with lava rocks comprising the principal aquifers.

Surface water on Hawaii is not uniformly characterized as any one particular chemical type or class. Either sodium or calcium may be the predominant cation, and bicarbonate, sulfate, or chloride the principal anion. The presence of carbonate and bicarbonate, reported as ppm calcium carbonate, may cause odor and color. Chloride affects taste, and a large amount will cause corrosion. Most of the chloride content of high-level ground water supplies on the island is probably due to the effect of salt spray carried in moisture-laden tradewinds. Chloride occurring in basal ground water is infiltration from sea water underlying the fresh water lens.

Taste, color, and turbidity are qualities of significance primarily for domestic water supplies. Color and turbidity are objectionable from an aesthetic standpoint. Limits recommended by the U.S. Public Health Service for drinking water supplies are 5 units for turbidity, 15 units for color, and threshold odor number 3.

Common characteristics of surface water originating in forested or heavily vegetated watershed areas are turbidity and yellowish brown color. The color bodies in the water are organic in nature, derived from humic and tannic acids in decomposing fern and other flora of the watershed. Studies of the stream waters of Kohala Mountain show that color values reach upwards of 300 units, typical values lying in the 50-100 unit range.

Public water supplies on Hawaii, from both ground and surface sources, contain chemical substances in amounts which are generally well below the recommended limits. However, basal ground water sources in the coastal areas, such as the wells and shafts, are susceptible to contamination from salt water intrusion.<sup>9</sup>

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<sup>7</sup> Source: See footnote 6; page 7

<sup>8</sup> Source: An inventory of Basic Water Resources Data: Island of Hawaii State of Hawaii Department of Land and Natural Resources Division of Water and Land Development Report R34; page 17

<sup>9</sup> Source: See footnote 8; page 181

Table 1. The percent difference in turbidity between the conservation lands in the upper reaches of the watershed and the more developed lands in the lower reaches of the watershed. This data suggests that turbidity is not solely a result of land use practices in the upper reaches of the watershed, but rather results from land use practices, as well as biological, physical and chemical processes in both the upper and the lower reaches of the watershed.

River	Date	Upper reaches		Lower reaches		% difference in turbidity between upper and lower <sup>1</sup>
		HaTurb (NTU)	Flow ft <sup>3</sup> /sec	HaTurb (NTU)	Flow ft <sup>3</sup> /sec	
Honolii	11/29/2000	1.73		4.24		145.09
	1/8/2001	0.71	17.17	0.76	10.04	7.04
	3/14/2001	3.57		5.38		50.70
	5/16/2001	6.42		1.93		-69.94
	7/9/2001	1.09	22.83	2.1	13.54	92.66
	10/3/2001	12.1		3.16		-73.88
	11/4/2002	1.02	28.86	0.88	16.18	-13.73
	12/2/2002	0.58	13.51	0.57	9.23	-1.72
	1/13/2003	1.18	16.45	0.74	10.93	-37.29
	2/10/2003	0.68	8	0.76	6.83	11.76
	3/10/2003	0.73	20.37	0.81	12.52	10.96
	7/8/2003	5.7		6.32	290.4	10.88
	9/29/2003	0.95	22.66	0.8	17.41	-15.79
	5/25/2004	1.28	45.26	1.24	41.22	-3.13
	6/22/2004	1.72		2.77	52.17	61.05
					<b>Mean</b>	<b>12</b>
Wailuku	11/29/2000	0.89		0.77		-13.48
	1/8/2001	0.77	67.95	0.21	2.7	-72.73
	3/14/2001	2.48		1.1		-55.65
	5/16/2001	2.02		0.46		-77.23
	7/9/2001	0.65	18.19	0.27	2.23	-58.46
	9/20/2001	2.99		1.29		-56.86
	11/4/2002	0.92	88.06	0.33	4.04	-64.13
	12/2/2002	0.73	29.44	0.27	0.57	-63.01
	1/13/2003	0.98	43.53	0.55	0.84	-43.88
	2/10/2003	0.54	20.58			~
	3/10/2003	1.25	29.44	0.38	0.35	-69.60
	7/7/2003	22.1	1222	3.43		-84.48
	8/18/2003	1.71	756.7	0.93	111.47	-45.61
	5/25/2004	1.16	124.7	0.78	41.3	-32.76
	5/22/2004	1.24	189.9	0.9	47.96	-27.42
					<b>Mean</b>	<b>-55</b>

<sup>1</sup> Difference in turbidity between upper and lower reaches expressed as a % of the turbidity in the upper reach.

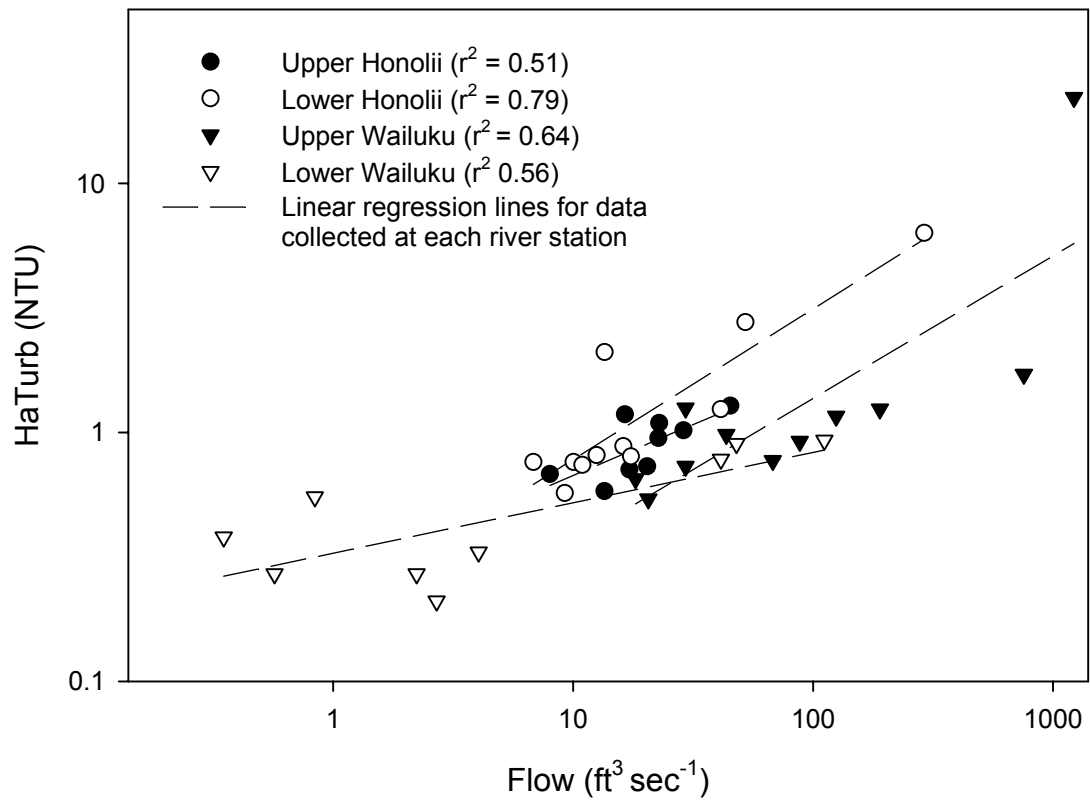


Figure 1. The relationship between turbidity and flow, for both the upper and lower Honolii and Wailuku Rivers. Data was collected from USGS monitoring stations between November 2000 and June 2004. There is a strong relationship between turbidity and flow rate, with higher rates of flow leading to higher rates of turbidity.

### Supplemental Field Information

#### State of Hawaii DOH Clean Water Branch Water Quality Monitoring Data Monitoring Data Wailuku & Honolii Rivers

Station	Name	Date	Time	Temp	DO%	DO(mg/L)	ORP(mV)	Sal	Cond	HaTurb	pH	Flow	Sampler	Comments
8-2-56-L	Honolii	11/29/00	1529	20.45	100.30	9.03	374.00	0.02	0.06	1.73	7.89		CF/GU	No hydro
8-2-56-L	Honolii	01/08/01	1245	21.23	95.00	8.43	350.00	0.04	0.10	0.71	8.22	17.17	CF/PC	
8-2-56-L	Honolii	04-Nov-02	910	21.60	98.50	8.69		0.10	0.11	1.02	7.38	28.86	cf/nn	No
8-2-56-L	Honolii	02-Dec-02	1015	21.00	98.70	8.80	359.00	0.04	0.10	0.58	8.00	13.51	cf/nn	
8-2-56-L	Honolii	13-Jan-03	1230	20.18	98.60	8.90	332.00	0.03	0.08	1.18	7.89	16.45	cf/nn	
8-2-56-L	Honolii	10-Feb-03	910	19.49	92.00	8.44	451.00	0.04	0.11	0.68	7.78	8	cf/nn	
8-2-56-L	Honolii	10-Mar-03	915	20.72	92.70	8.23	441.00	0.02	0.06	0.73	7.77	20.37	cf/nn	D.O. with
8-2-56-L	Honolii	08-Jul-03	1045	20.06	99.80	9.45	314.00	0.00	0.02	5.70	7.04		cf/nn	Not able to
8-2-56-L	Honolii	29-Sep-03	1255	24.34	98.90	8.26	315.00	0.02	0.07	0.95	7.82	22.66	cf/nn	
8-2-56-L	Honolii	25-May-04	945	22.07	98.10	8.57	466.00	0.02	0.06	1.28	7.77	45.26	cf/nn	
8-2-56-L	Honolii	22-Jun-04	920	22.26	93.60	8.14	517.00	0.01	0.06	1.72	7.71		cf/nn	Flow too
8-2-56-U	Honolii	04-Nov-02	1020	20.10	99.30	8.86		0.10	0.09	0.88	7.36	16.18	cf/nn	No
8-2-56-U	Honolii	02-Dec-02	1120	18.95	103.70	9.62	331.00	0.04	0.11	0.57	8.23	9.23	cf/nn	
8-2-56-U	Honolii	13-Jan-03	1140	18.21	99.30	9.37	323.00	0.03	0.08	0.74	7.84	10.93	cf/nn	
8-2-56-U	Honolii	10-Feb-03	1050	18.50	98.10	9.19	432.00	0.04	0.11	0.76	8.05	6.83	cf/nn	
8-2-56-U	Honolii	10-Mar-03	1030	18.54	94.80	8.85	419.00	0.02	0.06	0.81	7.89	12.52	cf/nn	D.O. with
8-2-56-U	Honolii	08-Jul-03	955	18.26	94.20	8.87	336.00	0.00	0.01	6.32	7.19	290.4	cf/nn	
8-2-56-U	Honolii	29-Sep-03	1200	20.85	99.40	8.88	326.00	0.02	0.06	0.80	7.98	17.41	cf/nn	
8-2-56-U	Honolii	25-May-04	1110	19.66	93.70	8.57	492.00	0.01	0.05	1.24	7.60	41.22	cf/nn	
8-2-56-U	Honolii	22-Jun-04	1030	20.55	90.80	8.17	498.00	0.00	0.03	2.77	7.51	52.17	cf/nn	
8-2-60-L	Wailuku	04-Nov-02	1130	23.10	106.50	9.15		0.00	0.07	0.92	7.30	88.06	cf/nn	No
8-2-60-L	Wailuku	02-Dec-02	930	21.33	100.10	8.86	384.00	0.02	0.07	0.73	7.71	29.44	cf/nn	
8-2-60-L	Wailuku	13-Jan-03	840	19.50	94.20	8.68	446.00	0.02	0.06	0.98	7.51	43.53	cf/nn	
8-2-60-L	Wailuku	10-Feb-03	835	20.80	90.20	8.06	482.00	0.03	0.08	0.54	7.75	20.58	cf/nn	
8-2-60-L	Wailuku	10-Mar-03	835	21.23	95.30	8.42	481.00	0.02	0.06	1.25	7.69	29.44	cf/nn	D.O. with
8-2-60-L	Wailuku	07-Jul-03	1050	22.15	102.00	8.84	353.00	0.01	0.05	22.10	7.64	1222	cf/nn	
8-2-60-L	Wailuku	18-Aug-03	920	21.52	100.40	8.86	369.00	0.00	0.03	1.71	7.60	756.7	cf/nn	
8-2-60-L	Wailuku	25-May-04	900	21.94	93.50	8.15	390.00	0.01	0.06	1.16	7.79	124.7	cf/nn	
8-2-60-L	Wailuku	22-Jun-04	845	22.36	92.50	8.04	507.00	0.01	0.05	1.24	7.74	189.9	cf/nn	
8-2-60-U	Wailuku	04-Nov-02	1235	22.60	98.90	8.49		0.00	0.04	0.33	7.22	4.04	cf/nn	No
8-2-60-U	Wailuku	02-Dec-02	1400	21.08	100.20	8.91	338.00	0.00	0.03	0.27	7.94	0.57	cf/nn	
8-2-60-U	Wailuku	13-Jan-03	945	17.44	92.30	8.84	234.00	0.00	0.03	0.55	7.60	0.84	cf/nn	
8-2-60-U	Wailuku	10-Feb-03	1230										cf/nn	No Flow
8-2-60-U	Wailuku	10-Mar-03	1200	22.78	97.20	8.37	259.00	0.00	0.03	0.38	7.94	0.35	cf/nn	D.O. with
8-2-60-U	Wailuku	07-Jul-03	1140	19.97	94.20	8.57	347.00	0.00	0.02	3.43	7.69		cf/nn	Not able to
8-2-60-U	Wailuku	18-Aug-03	1220	119.45	97.90	9.00	356.00	0.00	0.02	0.93	7.57	111.47	cf/nn	
8-2-60-U	Wailuku	25-May-04	1240	20.24	94.80	8.56	509.00	0.01	0.05	0.78	7.61	41.3	cf/nn	
8-2-60-U	Wailuku	22-Jun-04	1210	20.77	90.30	8.09	519.00	0.01	0.04	0.90	7.61	47.96	cf/nn	

### Supplemental Lab Information

#### State of Hawaii DOH Clean Water Branch Water Quality Monitoring Data Monitoring Data Wailuku & Honolii Rivers

Station	Station	Date	Time	<>	TSS	<> NH4	NH4	<> NO	NO3+NO2	<> TN	TN	<> TP	TP	<> Si	Si	Sampler
8-2-56-L	Honolii	04-Nov-02	0900		1.00		0.01		0.02		0.07	<	0.01		6.60	C.F./N.N.
8-2-56-L	Honolii	02-Dec-02	1015	<	0.50	<	0.00		0.01		0.07	<	0.01		8.80	C.F./N.N.
8-2-56-L	Honolii	13-Jan-03	1230	<	0.50		0.00		0.02		0.09	<	0.01		8.90	C.F./N.N.
8-2-56-L	Honolii	10-Feb-03	0910	<	0.50	<	0.00		0.04		0.09	<	0.01		9.50	C.F./N.N.
8-2-56-L	Honolii	10-Mar-03	0915	<	0.50	<	0.00		0.02		0.06	<	0.01		5.70	C.F./N.N.
8-2-56-L	Honolii	08-Jul-03	1045		3.00		0.00		0.01		0.14	<	0.01		1.50	C.F./N.N.
8-2-56-L	Honolii	29-Sep-03	1200		0.30		0.00		0.00		0.08		0.01		7.60	cf/nn
8-2-56-L	Honolii	02-Dec-03	0940		1.00		0.00		0.02		0.11	<	0.01		3.00	C.F./N.N.
8-2-56-L	Honolii	02-Dec-03	0940		1.00		0.00		0.02		0.11	<	0.01		3.00	C.F./N.N.
8-2-56-L	Honolii	25-May-04	0945	<	0.50	<	0.00		0.01		0.05		0.01		6.00	CF/NN
8-2-56-L	Honolii	22-Jun-04	0920		1.00		0.01		0.00		0.07		0.01		6.00	C.F./N.N.
8-2-56-U	Honolii	04-Nov-02	1020	<	0.50	<	0.00		0.01		0.05		0.01		8.10	C.F./N.N.
8-2-56-U	Honolii	02-Dec-02	1120	<	0.50		0.00		0.02		0.05		0.02		10.80	C.F./N.N.
8-2-56-U	Honolii	13-Jan-03	1140	<	0.50		0.00		0.01		0.06		0.01		10.70	C.F./N.N.
8-2-56-U	Honolii	10-Feb-03	1050	<	0.50		0.02		0.03		0.05		0.01		11.70	C.F./N.N.
8-2-56-U	Honolii	10-Mar-03	1030	<	0.50		0.00		0.01		0.04		0.01		7.00	C.F./N.N.
8-2-56-U	Honolii	08-Jul-03	0955		3.00	<	0.00		0.01		0.14	<	0.01		1.10	C.F./N.N.
8-2-56-U	Honolii	29-Sep-03	1255		0.70		0.00		0.02		0.10		0.01		7.50	cf/nn
8-2-56-U	Honolii	02-Dec-03	1110	<	0.50		0.00		0.01		0.09	<	0.01		2.20	C.F./N.N.
8-2-56-U	Honolii	02-Dec-03	1110	<	0.50		0.00		0.01		0.09	<	0.01		2.20	C.F./N.N.
8-2-56-U	Honolii	25-May-04	1110		1.00	<	0.00		0.01		0.06		0.01		5.10	CF/NN
8-2-56-U	Honolii	22-Jun-04	1030	<	0.50		0.01	<	0.00		0.06		0.01		3.80	C.F./N.N.
8-2-60-L	Wailuku	04-Nov-02	1130		1.00	<	0.00		0.04		0.08	<	0.01		6.60	C.F./N.N.
8-2-60-L	Wailuku	02-Dec-02	0930		1.00		0.00		0.06		0.11	<	0.01		7.10	C.F./N.N.
8-2-60-L	Wailuku	13-Jan-03	0840	<	0.50		0.01		0.08		0.12	<	0.01		7.70	C.F./N.N.
8-2-60-L	Wailuku	10-Feb-03	0835		1.00	<	0.00		0.07		0.11	<	0.01		7.60	C.F./N.N.
8-2-60-L	Wailuku	10-Mar-03	0835		1.00	<	0.00		0.04		0.10	<	0.01		6.50	C.F./N.N.
8-2-60-L	Wailuku	07-Jul-03	1050		14.00		0.01		0.02		0.34		0.02		5.50	C.F.
8-2-60-L	Wailuku	18-Aug-03	0920		1.00	<	0.00		0.04			<	0.01		4.00	C.F./N.N.
8-2-60-L	Wailuku	02-Dec-03	0900	<	0.50	<	0.00		0.06		0.12	<	0.01		3.90	C.F./N.N.
8-2-60-L	Wailuku	02-Dec-03	0900	<	0.50	<	0.00		0.06		0.12	<	0.01		3.90	C.F./N.N.
8-2-60-L	Wailuku	25-May-04	0900		1.00	<	0.00		0.05		0.11	<	0.01		6.90	CF/NN
8-2-60-L	Wailuku	22-Jun-04	0845		1.00		0.00		0.04		0.09	<	0.01		5.80	C.F./N.N.
8-2-60-U	Wailuku	04-Nov-02	1235	<	0.50		0.04		0.06		0.09		0.01		6.00	C.F./N.N.
8-2-60-U	Wailuku	02-Dec-02	1400	<	0.50		0.01		0.08		0.12	<	0.01		5.90	C.F./N.N.
8-2-60-U	Wailuku	13-Jan-03	0945	<	0.50		0.00		0.08		0.13	<	0.01		6.50	C.F./N.N.
8-2-60-U	Wailuku	10-Mar-03	1200	<	0.50		0.00		0.10		0.16	<	0.01		6.10	C.F./N.N.
8-2-60-U	Wailuku	07-Jul-03	1140		3.00		0.00		0.05		0.20	<	0.01		4.20	C.F.
8-2-60-U	Wailuku	18-Aug-03	1220	<	0.50	<	0.00		0.02			<	0.01		2.80	C.F./N.N.
8-2-60-U	Wailuku	02-Dec-03	1300	<	0.50	<	0.00		0.06		0.14	<	0.01		4.40	C.F./N.N.
8-2-60-U	Wailuku	02-Dec-03	1300	<	0.50	<	0.00		0.06		0.14	<	0.01		4.40	C.F./N.N.
8-2-60-U	Wailuku	25-May-04	1240	<	0.50	<	0.00		0.05		0.08	<	0.01		7.00	CF/NN
8-2-60-U	Wailuku	22-Jun-04	1210	<	0.50		0.01		0.04		0.08	<	0.01		7.00	C.F./N.N.

# **Hilo TMDL Projects**

## **What is the TMDL Process?**

The Total Maximum Daily Load (TMDL) Process identifies activities that may help reduce pollutant loads, improve water quality, and increase a waterbody's ability to support its legally-protected uses (such as public recreation and protecting the breeding stock of native animals). These activities 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. The process starts with identifying places where water quality is "limited" or "impaired."

## **Why is Hilo part of this process?**

After inspections in 1996, several Hilo waterbodies (Waiakea, Alenaio, Wailoa, Wailuku, Honolii) were placed on the 1998 State of Hawaii list of impaired waters under §303(d) of the federal Clean Water Act. Excessive turbidity (usually caused by sediment) is listed as a cause of poor water quality in Honolii, Wailuku, and Wailoa, and excessive nutrients (nitrogen and phosphorous) in Honolii, Wailoa, Alenaio, and Waiakea. Excessive pathogens, as indicated by measured enterococci levels, are listed as an additional cause of poor water quality in Wailoa.

These waterbodies all feed Hilo Bay, which has been on the list of impaired waters for decades. The complete statewide list of impaired waters and supporting information can be viewed online at [www.state.hi.us/doh/eh/epo/303dpcfinal.pdf](http://www.state.hi.us/doh/eh/epo/303dpcfinal.pdf) or requested from the State of Hawaii Department of Health (contact information listed on the other side of this flyer).

## **What happens next?**

To satisfy federal Clean Water Act requirements, the State of Hawaii Department of Health (DOH), the U.S. Geological Survey (USGS), and URS, Inc. will conduct a federally-funded water quality planning process for Waiakea and Alenaio Streams. We'll calculate existing pollutant loads, determine relationships between these loads and State water quality standards, and suggest how pollutants, pollutant source areas, and stream environments could be managed to achieve necessary water quality improvements. Total Maximum Daily Loads (TMDLs), which establish the maximum rate at which these waterbodies can receive certain pollutants (in this case, nutrients and sediments) without exceeding the State's water quality standards, will be submitted to the U.S. Environmental Protection Agency (EPA) for approval after a public review of the project results. This phase of the project will last about two years.

After EPA approves our technical report, DOH will work with the watershed community to plan actions for reducing pollutant loads, improving water quality, and supporting protected uses in specific problem areas. This "TMDL Implementation Plan" can be a big part of the community's prescription for watershed health, and ideally will be part of the bigger "Watershed Plan" funded by a different DOH program (Polluted Runoff Control). The actions identified in both plans 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? next page>**

# Hilo TMDL Projects

## 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. An intergovernmental work group, including representatives from federal, state, and county agencies, holds regular meetings about the overall TMDL program and specific TMDL projects.

A TMDL project cannot be successful without public participation. We hope that the Hilo Watershed Advisory Group (formed during a related DOH-funded project) will remain active and help us identify water pollution problems and create water quality solutions in the Hilo Bay watersheds.

### Department of Health Contact Information

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

(Chiyome Leinaala Fukino, M.D., Director)  
(Laurence K. Lau, Deputy Director)  
(June F. Harrigan-Lum, Manager)

**974-4000 + 64337 TOLL-FREE PHONE FROM HAWAII ISLAND**  
(808) 586-4337 PHONE  
(808) 586-4370 FAX

**David Penn, Total Maximum Daily Load Coordinator**  
**dpenn@eha.health.state.hi.us**

## Where do we get more information about TMDLs?

National TMDL program information [www.epa.gov/owow/tmdl](http://www.epa.gov/owow/tmdl)

The DOH Environmental Planning Office website at [www.state.hi.us/doh/eh/epo](http://www.state.hi.us/doh/eh/epo) includes:

- completed 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.state.hi.us/doh/eh/cwb](http://www.state.hi.us/doh/eh/cwb) includes:

- Water Pollution Control Permit information
- Polluted Runoff Control Program information (Clean Water Act Section 319(h) grants)

## What about enforcement?

Federal, state, and local law do not require TMDL implementation and TMDLs are not enforced by federal, state, and local authorities. Ambient water quality standards, permit conditions, and permit requirements are enforced by the Department of Health and the U.S. Environmental Protection Agency.