EXHIBIT "I-9"

PART M

CHAPTER 6-B

Wellhead Protection

Wellhead Protection Project Summary

The Maui County Department of Water Supply (DWS) is working with stakeholders, private water purveyors and land owners to develop a wellhead protection program for Maui County, which includes Moloka'i and Lana'i. The goal of this project is to establish effective wellhead protection through implementation of a local ordinance aimed at reducing` the risk of contamination in drinking water wells from potential contaminating activities (PCAs). The national Wellhead Protection Program was established under the 1986 Safe Drinking Water Act (SDWA) amendments. The law specified that certain program activities, such as delineation, contaminant source inventory, contingency planning and source management, be incorporated into state Wellhead Protection Programs, which are approved by EPA prior to implementation. State Wellhead Protection Programs vary greatly. Some states require municipal water systems to develop management plans. The State of Hawaii Wellhead Protection Program was approved by EPA-in 1995. The program provides guidance for development of protection measures but does not require local implementation. The SDWA Amendments of 1996 required states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. DOH has completed a SWAP report for Lanaʻi Company's wells. The report is still under revision. With the support from DOH, DWS continues to develop and implement a Wellhead Protection Program for the DWS water systems, and a protection incentive program. DWS has collected data followed by field surveys of wellhead protection areas (WHPAs) for Lanaʻi Company wells in preparation for future protection efforts. A first report was drafted for Lanaʻi in May 2004. This report serves as an update through addition of suggested protection strategies. DWS has drafted a county-wide ordinance based on strategy plans and input from stakeholders for continued review.

In summary, the Wellhead Protection Project consists of the following tasks:
Delineation of Wellhead Protection Areas (WHPAs). Land areas that could contribute water and pollutants to the water supply were mapped by University of Hawaii Water Resources Research Center as part of the State Source Water Assessment Program.

A review and documentation of the range in wellhead protection that is undertaken by utilities, counties, cities, districts and state agencies in the U.S. The research included the collection of 59 references and the preparation of an annotated bibliography. Programs and ordinances were reviewed and annotated, followed by a questionnaire to help evaluate the efficiency of each program.

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An inventory of land uses and PCAs in WHPAs. Land uses, facility type, nature of activities and site specific information were documented and mapped in GIS.

An inventory of contaminants typically associated with identified PCAs. Potential and confirmed contaminants are documented in databases, including descriptions of the environmental transport characteristics and toxicity.

Identification of best management practices for pollution prevention of PCAs, including checklists for public education

A review of the land use control structure and ground water protection programs in effect in Maui County.

With public participation, develop a wellhead protection strategy for Maui County. The Water Advisory Committees on Maui, Moloka'i and Lana'i have voiced support for an overlay zoning ordinance. DWS continues to solicit public input and participation throughout development of the Wellhead Protection Program.

Acronyms

AST	Above ground storage tank
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
CWA	Clean Water Act
CWRM	Commission on Water Resource Management
DWS	Department of Water Supply
DOH	Department of Health
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HAR	Hawaii Administrative Rules
HISWAP	Hawaii Source Water Assessment Program
HRS	Hawaii Revised Statues
NPDES	National Pollution Discharge Elimination System
PCA	Potential Contaminating Activity
PUD	Planned Unit Development
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SDWB	Safe Drinking Water Branch
SHWB	Solid and Hazardous Waste Branch
SUP	Special Use Permit
SWAP	Source Water Assessment Program
TSRA	Toxic Substances Control Act
UIC	Underground Injection Control
USGS	United States Geological Survey
UST	Underground storage tank
WHPA	Wellhead Protection Area

Aquifers & Well Sites

The Lanaʻi Company wells delineated and GPSd in this project are described in Table 1. The table includes wells that are developed for current or potential future potable use. Well 1, 9 and 14 are currently for irrigation use. All wells are overlying the Leeward and the Windward aquifers in the Central Sector. Well 6 overlies the Windward aquifer and the remaining wells overly the Leeward aquifer. The aquifers are high level, where fresh water is not in contact with seawater. Both are unconfined aquifers in dike compartments. Salinity is considered fresh (<250 mg/l Cl-) except for the South leeward aquifer where the salinity is high (250 – 1,000 mg/l Cl-). Both aquifers are classified as high sensitivity. Aquifer sensitivity is defined by the U.S EPA as "the relative ease with which a contaminant applied on or near the land surface can migrate to the aquifer of interest". It is determined by the characteristics of the geologic materials of the aquifer. Aquifers in Hawaii are described by Mink and Lau as either vulnerable or not vulnerable to contamination, based on geographical limits of the resources, confining conditions and the relatively rapid time of groundwater travel. (Mink and Lau 1993: "Aquifer Identification and Classification for Lanaʻi: groundwater protection strategy for Hawaii", Technical Report No. 190) When combined with factors of land use and contaminant characteristics, the aquifer's vulnerability to contamination can be further evaluated. Well information about each delineated well was gathered from State databases and from visual survey of the well sites. An example of well information for Lanaʻi 8 well is documented in Figure 1.

Table 1 – Lanaʻi Company Wells Delineated in SWAP

Well Number	Well Name	Year Drilled	Well Type	Casing Diameter	Ground Elevation	Well Depth	Solid Case	Perf Case	Use	Use Year	Init Water	Init Cl	Pump_ GPM
4852-02	Lanaʻi 5	1950		18	2296	1122	630	1120	MUNPR		1548.0	0	900
4853-02	Well 1	1945		12	1265	1274			IRR		876.0	0	700
4854-01	Lanaʻi 9	1990	ROT	14	1411	1451	510	766	IRRGC	94	803.0	0	300
4854-02	Lanaʻi 14	1995	ROT	14	1193	950	650	950	IRRGC	95		700	0
4952-02	Well 4	1950		18	2327	1178	669	1170	MUNPR		1576.0	0	900
4953-01	Well 2	1946		18	1510	609			MUNPR			0	1400
4954-01	Lanaʻi 3	1950		18	1850	1199	442	1189	MUNPR		1078.0	0	300
4954-02	Lanaʻi 8	1990	ROT	14	1902	1490	942	1485	MUNPR	95	1014.0	0	800
5054-01	Kaiholena TH-3	1950									1064.0	0	0
5055-01	Lanaʻi 7	1987	PER	8	2100	1650			MUNPR			67	500

FIGURE 6-1. Well Information

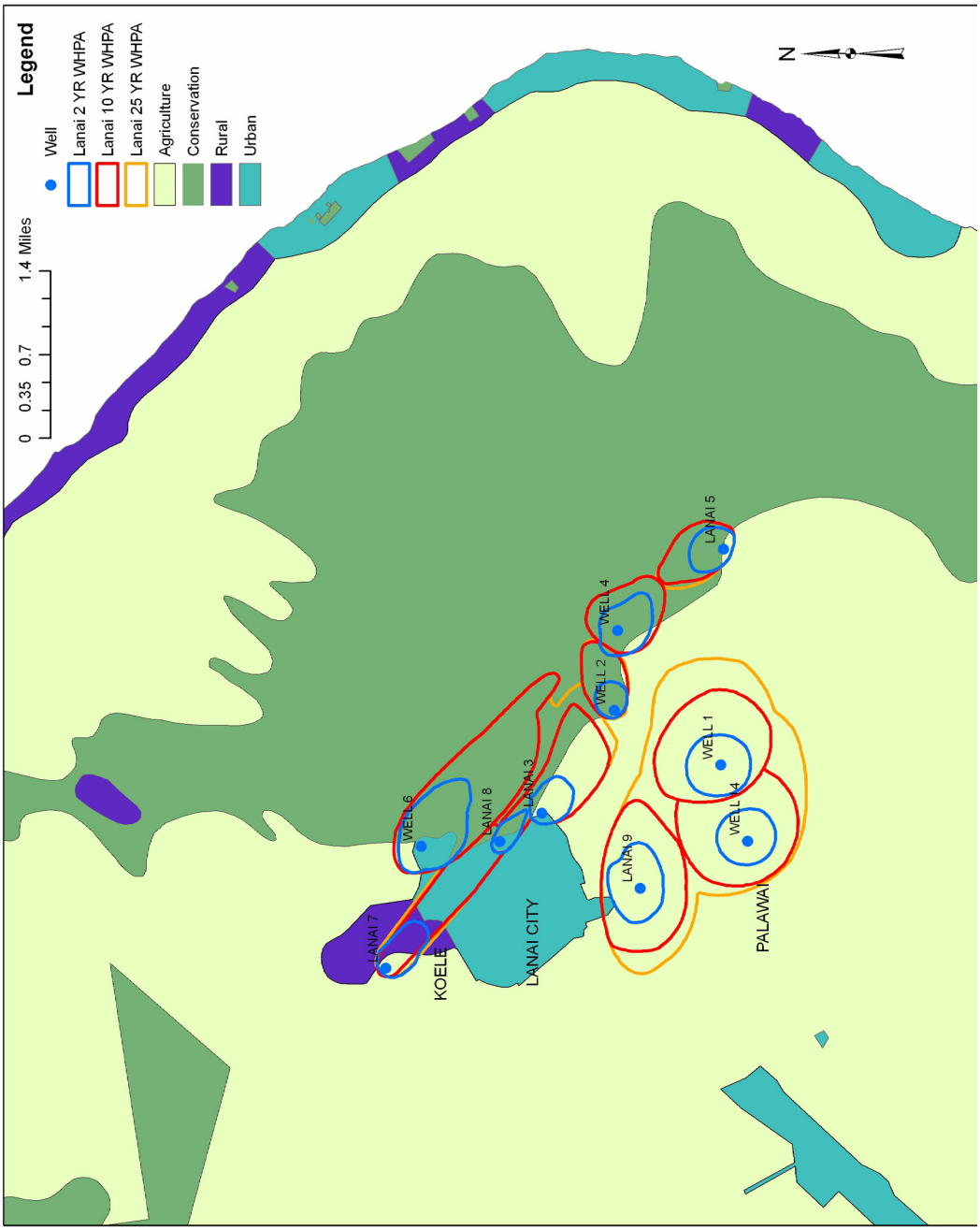
WELL NAME	Lana'i 8
WELL NUMBER	4954-02
OWNER/USER:	Lana'i Company
USE	Drinking water
AQUIFER SYSTEM	Leeward
AQUIFER HYDROLOGY	High Level : Fresh water not in contact with seawater
AQUIFER TYPE:	Unconfined
GEOLOGY:	Dike: Aquifers in dike compartments
DEVELOPMENTAL STAGE:	Currently used
UTILITY:	Drinking
SALINITY:	Fresh (<250 mg/l)

Wellhead Protection Area Modeling

Wellhead Protection Areas (WHPAs) for Lana'i Company wells were delineated by University of Hawaii Water Resources Research Center for the State SWAP. A WHPA is defined by the 1986 Amendments to the Safe Drinking Water Act as "the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field". The SWAP modeling uses MODFLOW, a three-dimensional numerical groundwater model, and MODPATH, a particle tracking program. WHPAs were delineated for a 2-year, 5-year, 10-year, 15-year, 20-year and 25-year time of travel. SWAP designates a 50 feet fixed radius around each well to provide protection from direct contamination from vandalism or accidental spillage of chemicals or microbes. DWS added a 1,000 foot fixed radius to account for existing regulatory setback from wells for certain PCAs. The 2-year time of travel zone is intended to designate a conservative estimate of the surrounding area which may contribute bacteria and viruses to the wellhead, based on typical survival times for bacteria and viruses in soil and groundwater (HISWAP Report Volume I, November 2006). The 10-year and higher time of travel zones would allow protective measures in the event of a contaminant spill. Any land use management in this zone needs to address hazardous and persistent contaminants. However, bacterial and viral risks may still be a concern. MODFLOW is a reliable and well documented model that allows new sources to be added to the model fairly easily. MODFLOW WHPAs based on 2-, 5-, 10- and 25-year time of travel are illustrated in Figure 2.

Wellhead Protection

FIGURE 6-2. Delineated MODFLOW Wellhead Protection Areas



Potential Contaminating Activities Inventory

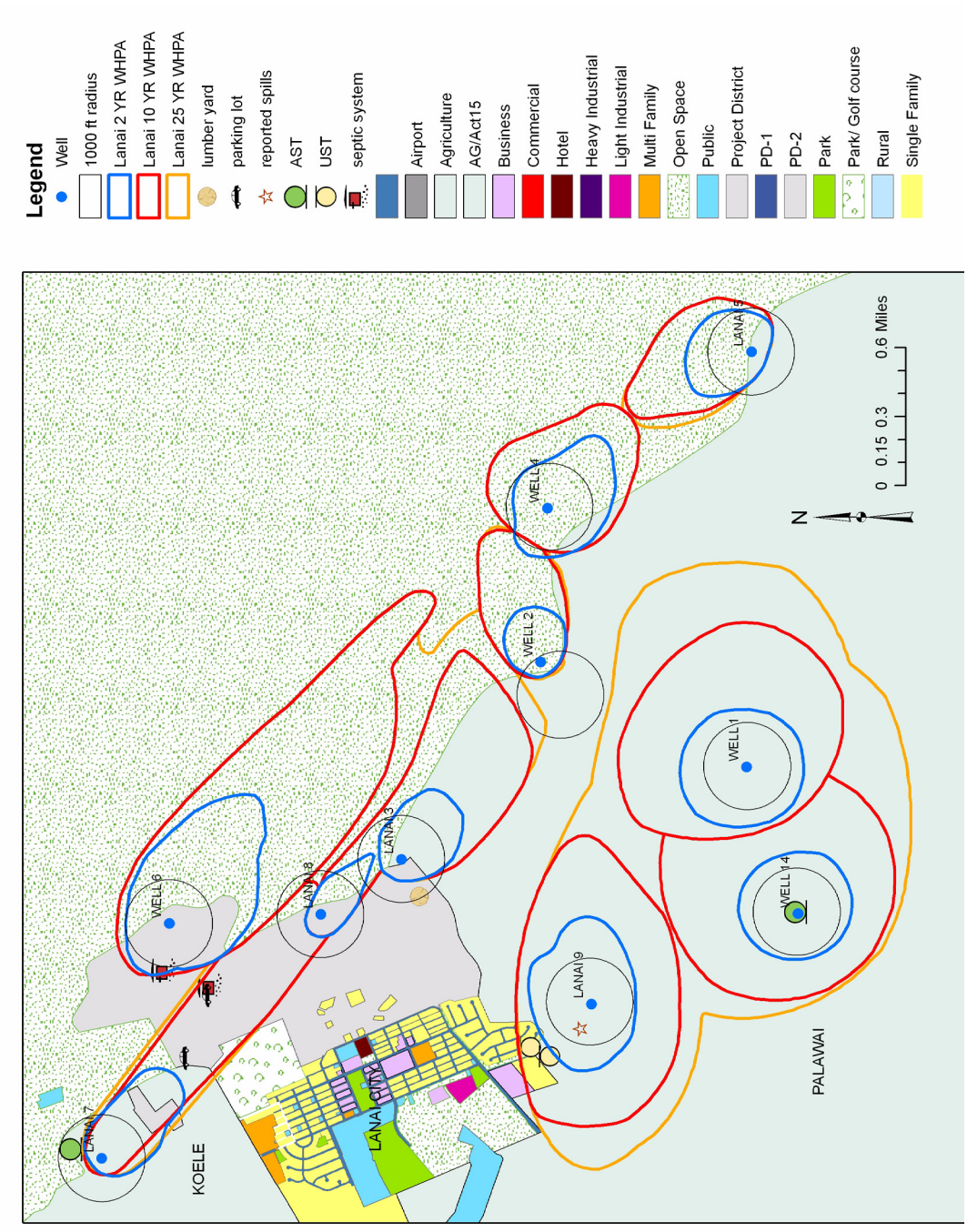
To identify the PCAs within the delineated areas, an in-office survey using public records and other information sources was completed, followed by field survey for visual inspection. Land uses considered PCAs are those facilities that typically use, produce, or store contaminants of concern, which, if managed improperly, could find their way to a drinking water source. Activities to be inventoried were selected referencing U.S. EPA and State WHP guidelines. Appendix A lists PCAs, categorized as Agricultural, Commercial – Industrial, Municipal or Residential. Contaminants of concern are chemicals and other material that can leach into and contaminate groundwater sources and that are commonly associated with PCAs. Those contaminants are in accordance with standard lists prepared by DOH and EPA. Less than half of these contaminants are regulated under State or Federal drinking water standards and monitored. Unregulated contaminants of concern include those on the EPA Drinking Water Contaminant Candidate List. Unregulated contaminants are known or anticipated to occur in public water systems, and may require regulation under the Safe Drinking Water Act, including so called emerging contaminants. Unregulated contaminants that are not subject to testing at the source can still be of concern if the PCAs they are commonly associated with are present, or could potentially be located within WHPAs. Contaminants of concern are listed in Appendix B.

Staff performed field surveys with assistance from Lanaʻi Company to verify PCA locations and to identify any additional PCAs in 2004. DWS staff updated the PCA inventory in April 2010. Mapped PCAs are illustrated in Figures 3 – 4.

Pollution potential is based on, but not limited to, the type and quantity of chemicals used or wastes generated by an activity, and the behavior and mobility of the pollutants in the soils and groundwater. The characteristics of chemicals and the processes associated with the presence of PCAs were researched during data collection for the island of Maui, including mobility (solubility in water and potential for a contaminant to adsorb to soil), persistence (the time it takes to lose chemical potency by 50%) and rated leachability (ability to dissolve out into soil or water). The chemical and biological processes that control contaminant movement are a function of the contaminant composition, reaction with other compounds present in groundwater, and the conditions of the aquifer system. Examples of these processes are sorption (to take up and hold by either adsorption or absorption), biodegradation (capable of being broken down especially into harmless products by the action of living things), and volatilization (to cause to pass off in vapor). Organic contaminants that are discharged to groundwater may adsorb (to take up and hold) more or less to organic material present in the water, and affect the rate the contaminant moves through the aquifer and the amount of contaminants dissolved in the groundwater. Biodegradation can reduce contaminant concentrations and slow movement of contaminants through the aquifer. Volatilization is the migration of contaminants in the gas phase to the atmosphere and may reduce the volume of a contaminant reaching the aquifer. The inventoried data can in conjunction with site-specific factors such as soil type, amount of rainfall, water table level, and topography be used in the susceptibility analysis.

Known contaminant detections in delineated wells were inventoried and federal and state drinking water standards identified. The Maui data inventory also researched health effects resulting from exposure through drinking water to contaminants.

FIGURE 6-3. Potential Contaminant Activitie



Lana'i 7

Lana'i 7 is a closed well not currently in use, but recommission of this well is an option included in the Water Use and Development Plan. It is located in brush area of a former pineapple field. Large-scale pineapple cultivation was largely phased out by the 1970s throughout the island. A rusting aboveground storage tank, likely formerly for fuel is within the 50 ft radius of the well. The entire 1,000 ft radius is former pineapple land, currently mowed pasture. PCAs at the Koele Lodge include: the golf course, commercial septic system, sewer lines, parking lot, and a horse stable. Reclaimed water irrigation of the golf course is R-1 quality, which is considered a medium risk PCA. The reclaimed water facility is located outside WHPAs. Roads and resort development are other PCAs. Historic applications of so called legacy pesticides on former pineapple fields in the immediate area surrounding the well should also be considered a PCA.

Lana'i 8

The well site is in a wooded area. The fixed 1,000 ft radius extends over portions of the Koele golf course. No other current PCAs were identified. However, former pineapple fields are in the 2 and 10 year WHPAs. The area may be subject to new residential development.

Kaiholena TH-3/Well 6

The well site is fenced and located in the wooded area. Portions of the Koele golf course are within the West section of the WHPA. A septic system located at the 7th tee is within the 2-year time of travel zone.

Lana'i 3

The well site is in a wooded area. No current PCAs were identified within any time of travel zone. A closed down lumber yard is found within the 1000 ft radius. Some metal and wood scrap remains at the site. The West portion of the WHPA was former pineapple cultivation and may be subject to future development.

Lana'i 9

The well is brackish, not used for potable consumption and is therefore not subject to wellhead protection under the proposed ordinance. The well is situated on a cement pad in a fenced grassed area. It sits below a former fill site. The South and West portions of the WHPA is former pineapple land. An underground storage tank in use for a wastewater pump station is located in the residential area within the 10-year time of travel zone. A permanently closed underground storage tank is located somewhere at field 5305, possibly within the WHPA. The tank was reported as leaking and site cleanup is completed. Alleged spills and/or dumping at former DDT storage tanks within the WHPA were reported to not require further action as DDT is known to degrade to the less toxic DDE, according to DOH Solid and Hazardous Waste Branch records. Other PCAs are retention ponds, roads, including Manele road, and a residential area with a sewer system.

Palawai Exploratory Well/Lana'i 14

The well is not used for potable supply. Surrounding land is former pineapple cultivation. The Western portions are possibly used for cattle grazing. There is a former hog farm located just outside the 25-year time of travel. The Manele road traverses the WHPA.

Well 1

Well 1 is a high-producing irrigation well, with chlorides in the 300 mg/l range. The well is not used for potable supply. Former pineapple cultivation is primarily at lower elevations than the well site. Historic water quality sampling data show Atrazine detected at 0.40 ppb in 1988, below the MCL set at 3 ppb (0.003 ppm). Current sampling does not show any contaminants detected at this site.

Well 4

This well is the primary source for Manele. The entire WHPA is in forested area. No PCAs were identified.

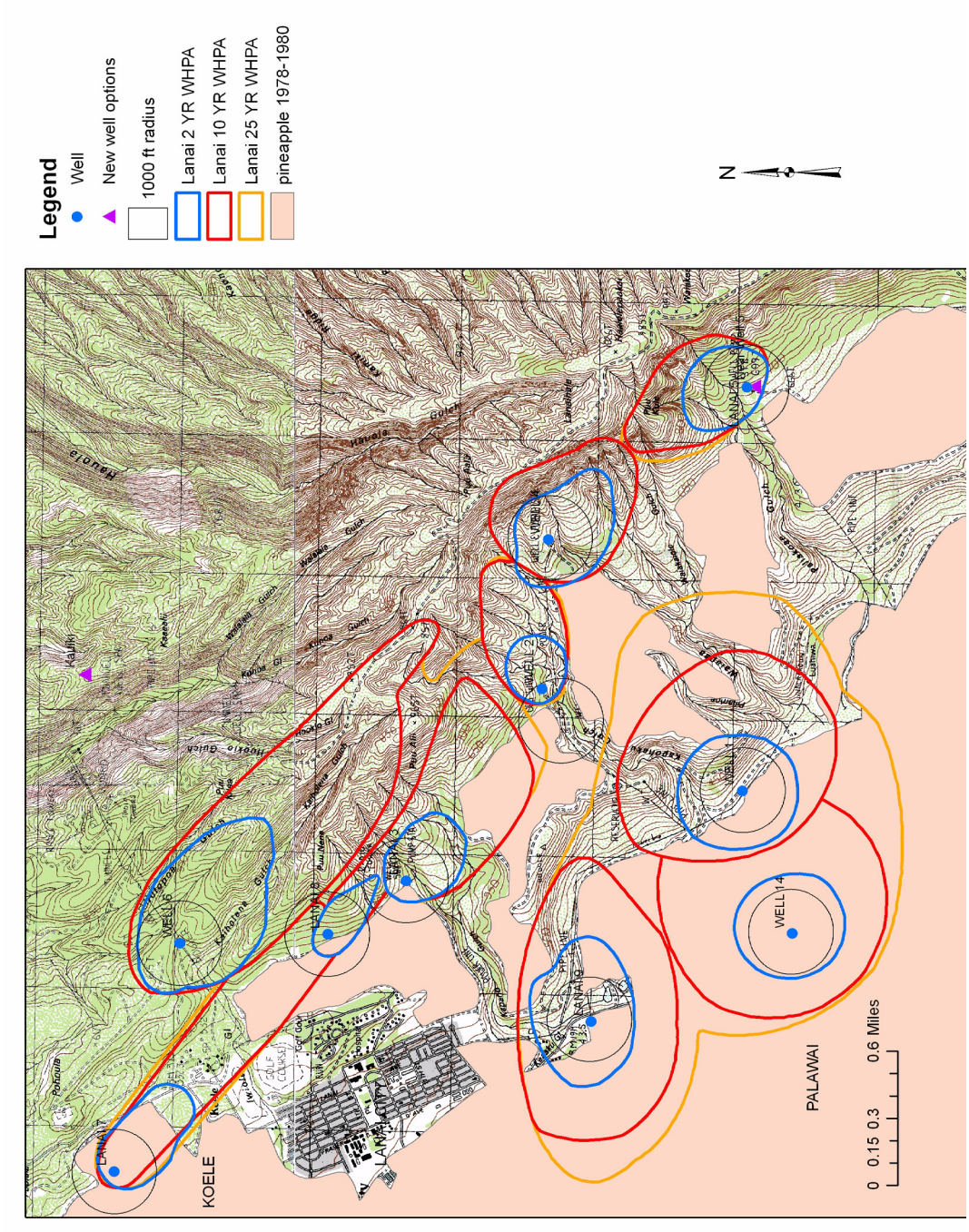
Well 2

The well is currently in use and located in a wooded area. However, the site delineated for SWAP is the old well site up situated approximately 800 ft North East. Should the WHPA be extended further South, no current PCAs are likely to be found, but former pineapple cultivation is immediate upgradient of the new well site.

Lana'i 5

This is currently a monitoring well that collapsed and needs to be re-drilled. The Department was not able to GPS this location. It is situated in an area of overgrown pasture and forest. The WHPA mauka of the well is all forested.

FIGURE 6-4. Historic Pineapple Cultivation



Potential Future Well Sites

Potential new well sites were identified and characterized in Chapter 5 of the Water Use and Development Plan Lanaʻi Chapter. There are 10 wells at 7 different well fields identified for potential potable use, including: Leeward High Level Potable Well Development (near Hi'i Tank), Leeward High Level Potable Well Development (near Well 5), Well 2-B at Shaft 3 Site, Windward wells at Malau, Windward wells at Maunalei Shaft and Tunnel Sites, Windward wells at Kauiki, and Windward well at Kehewai Ridge. Eight alternative sites were also proposed by Lana'i Company in May 2010. WHPAs for all potential future well sites were delineated by the U.H. Department of Geology and Geophysics. DWS staff inventoried PCAs for the first 10 well candidate sites and intends to expand the inventory to all proposed well sites. None of the potential new sites are proposed on lands in former pineapple cultivation. WHPAs for proposed well sites and PCAs identified in the areas to date are illustrated in Figure 5 and 6. WHPAs for the 10 well sites originally proposed in the WUDP and sites B, C, D and E supplementing/amending these are shown in blue. WHPAs for the 8 well sites most recent proposed by Lanai Company are shown in red. The "composite capture zones" shown in purple were modeled with all of the wells pumping. Other WHPAs are modeled with only the subject well's assumed or actual pumpage. Roads extend through most of the WHPAs. At Malau Site Option B there were dump sites of vehicles and mopeds and other debris along the road. A septic system is located in the WHPA of Well Option D. The Koele Golf Course extends into the WHPAs of Well Option B, C and D. The exploratory well sites were difficult to GPS because of trees and ridges surrounding the sites. Most exploratory sites were not reachable and therefore not possible to GPS. Satellite accuracy was also low for those readings that did register. As these sites are further refined, additional GPS surveys are needed.

Potential Future Well Sites

FIGURE 6-5. Wellhead Protection Areas and Potential Contaminant Activities of Proposed Well Sites

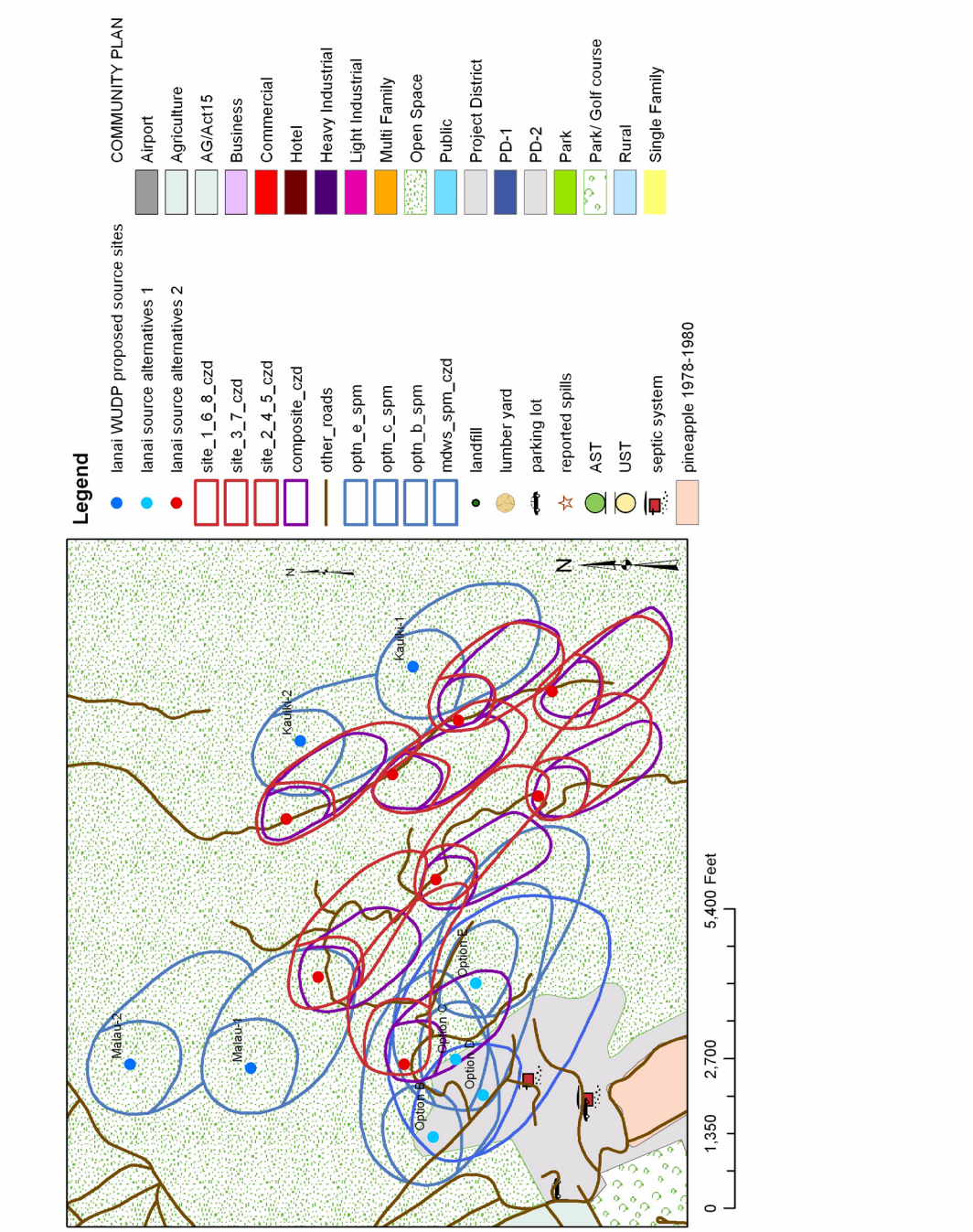
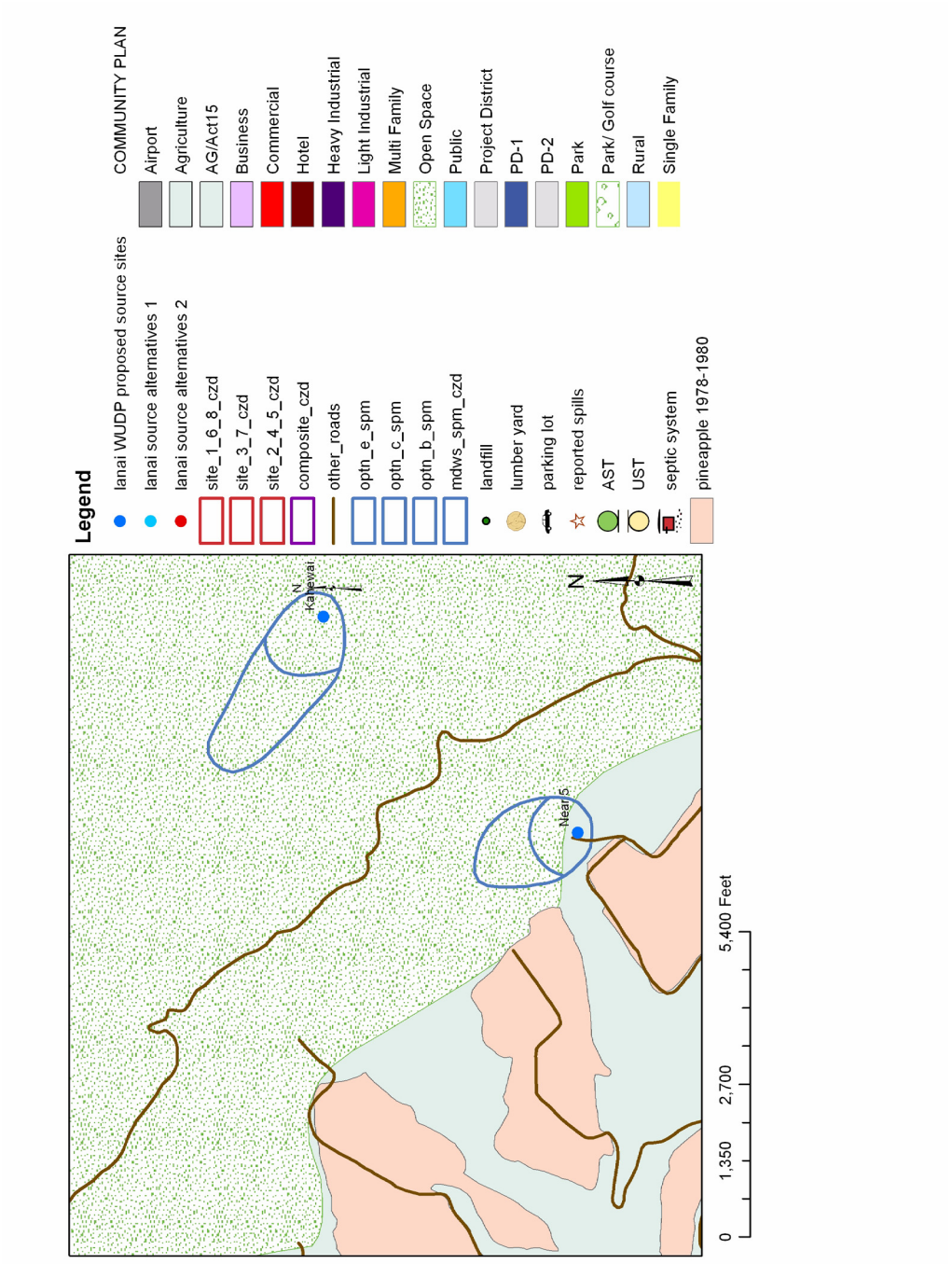


FIGURE 6-6. Wellhead Protection Areas and Potential Contaminant Activities of Proposed Well Sites "Kahewai" and "Near Well 5"



Land Use Changes

Land development must be consistent with the State Land Use Districts, the Community Plan and County zoning designations. The State Land Use districts are shown in Figure 2. The 2001 Lanaʻi Community Plan designations are depicted in Figure 3. Potential new residential development adjacent to the Koele golf course is shown in purple. Residential parcels are considered medium risk. Additional PCAs associated with residential development include vehicle parking, sewer systems, roads and storm drains.

Historic land use is primarily identified through land use GIS coverages from 1970s and 1980s, history recounts in the 1998 Lanaʻi Community Plan and personal communications. The phasing out of pineapple may be the major change potentially affecting water quality. The pineapple cultivation as of 1978-1980 is shown in Figure 4.

Potential Contaminating Activities Analysis

SWAP conducted a susceptibility analysis, defined by EPA guidance as "the potential for a Public Water System to draw water contaminated by inventoried PCAs at concentrations that pose concern." Susceptibility takes into account both site specific geologic/hydrogeologic factors (aquifer type) and characteristics of the PCA (e.g., nature of the activity, contaminants found in the well, distance from source, areal extent). The SWAP analysis incorporated five criteria in order to rank the potential of each PCA to adversely impact the water quality of each well:

1. Type of PCA: SWAP established PCA categories based on their potential to contaminate a drinking water source. A PCA was defined as very high, high, or medium risk based on specific characteristics of the PCA, namely, the nature of the activities, contaminants associated with the activities, and past history of contamination.
2. The distance of the PCA from the source: the closer a PCA is to the well, the higher the likelihood that a contaminant released would adversely impact the well.
3. The area occupied by the PCA: in general, the larger the spatial area that is impacted, the higher the potential for contamination. For PCAs such as cesspools, residential parcels, septic systems, sewer lines and parks, the scoring was assigned by the density.
4. Detection of potential contaminants commonly associated with PCA at the source: past detection demonstrates definite contamination risk. Scores were given on whether a contaminants is detected at concentrations above the MCL, detected at concentrations below the MCL (or has no MCL), not detected, or detection is unknown because contaminant is not monitored.
5. Aquifer sensitivity: The vulnerability of the geologic/hydrogeologic setting was discussed under the section "Aquifers and Well Sites". The aquifer sensitivity was rated as high, moderate and low. High sensitivity is characterized by basal and high level aquifers that are unconfined and may include aquifer types that are flank, dike, sedimentary, or a combination.

A numerical scoring system was used to relatively rank the susceptibility of the drinking water source to each PCA. The general concept is that the higher the score, the higher the potential for contamination from that particular PCA. (Hawaii Source Water Assessment Program Report Volume I, Approach Used

For the Hawaii Source Water Assessments. November 2006). The purpose of the analysis would be to indicate where source protection may be most needed and what PCAs should be targeted. The susceptibility analysis was included in Lanaʻi Company's SWAP report.

Protection Strategies

Lanaʻi has few current PCAs compared to more urban and developed areas. PCAs that are currently located in Lanaʻi WHPAs are discussed below. A regulatory approach can prevent undesirable and high risk PCAs from being located within WHPAs, while non-regulatory approaches may best address existing PCAs, such as best management practices education and agreements. Inventoried PCAs may in fact pose no or very little concern because of regulations and best management practices already in place. The regulatory framework of ground water protection was reviewed in the Maui process. State legislation and federal mandates provide for groundwater protection through land use and natural resource planning and programs specifically dealing with groundwater protection. A table of programs in place is provided as Appendix C. PCAs are administered by a range of state, federal and county regulations. Identified regulations of PCAs that directly or indirectly provide for ground water protection are described in Appendix D.

Cesspools and septic systems

Contaminants commonly associated with septic systems include nitrate, nitrite, viruses and bacteria as well as various household chemicals. Lanaʻi City is served by municipal and private sewer lines. HAR 11-62 regulates individual wastewater system siting, distance from groundwater table, design and installation. Septic tank effluent disposal systems must be located at least 1,000 feet from a drinking water well and at least 5 ft above groundwater table. Septic systems are allowed for new residential developments comprised of single-family dwelling units on a minimum lot size of 10,000 square feet, but hookup to sewer system is mandatory if available. Two septic tanks are located on parcels that could extend into the WHPAs of the Lanaʻi 7 and Lanaʻi 8 wells. Cesspools are used to receive untreated wastewater. Solids are retained in the cesspool and the liquid percolates into the surrounding soil. Virtually no treatment occurs that would protect the ground water. Installation of new cesspools is no longer permitted in unsewered areas. Large capacity cesspools – those designed to serve 20 or more people per day – have been banned. All WHPAs are in established Critical Wastewater Disposal Areas (CWDAs) where the director of DOH may impose more stringent requirements for individual disposal systems. Maintenance of the private wastewater systems are not monitored or enforced.

Suggested Protection Strategy:

In the event a cesspool would be identified within 1,000 ft of a drinking water well, an upgrade to septic tank would be required should a building permit be sought for the property. Development guidelines are proposed for all WHPAs that set a recommended minimum density of 1 septic unit/2 acres for new development in any unsewered areas. DWS could in cooperation with DOH Wastewater Branch distribute public education material to ensure proper maintenance and prevent use of improper septic tank cleaners.

Household hazardous products

Household chores involve a range of hazardous and non-hazardous products such as paints, solvents, synthetic detergents, pesticides, medicines, fuels, disinfectants, pool chemicals, oils, and batteries. These items can potentially enter groundwater sources when improperly stored through garage floor drains, spills and flooding, through disposal down household drains or through dumping and disposal on the ground. Pesticides, herbicides and fertilizers are sometimes over-applied on lawns and in flower and vegetable gardens and may infiltrate groundwater. Household hazardous products are exempt from hazardous waste and storage regulations, and can therefore be considered potentially significant PCAs.

Suggested Protection Strategy:

Public education for household practices should continue, including newspaper and radio advertisement, and public pollution prevention workshops. The potential contamination load would also be reduced with residential development density restrictions.

Pesticide application

There are no current large scale agricultural operations in WHPAs on Lana'i but pesticides are probably applied in small scale farming and home gardens. Applicators of registered pesticides must be licensed with DOA/EPA. The use of a pesticide can be cancelled, suspended, or restricted or limited to areas to protect groundwater, if it is determined that a particular pesticide or practice appears detrimental.

Suggested Protection Strategy:

Public education and workshops in coordination with the University of Hawaii College of Tropical Agriculture and Human Resources (CTAHR) or other appropriate agency can address Integrated Pest Management (IPM) practices. Application of pesticides and fumigants with high leachability should be avoided in the 2-year time of travel zone or, where no alternative pesticide is available, applied as part of an IPM program.

Pesticide storage and disposal

No pesticide storage was located within WHPAs, but storage could occur with small scale farming in agricultural and residential areas. Pesticides are commonly stored in above ground storage tanks. Unregulated tanks may pose a risk of contamination if not properly maintained. Tanks containing less than 660 gallons of non-hazardous chemicals are not regulated; therefore, the potential for greater hazards may exist. Larger storage must be labeled, and leak free containers and pesticides may not be disposed of except through regulated hazardous waste facilities. Pesticide wastes include leftover pesticides, unusable pesticides, pesticide containers, and rinse water Pesticide leftovers may not be accumulated by large quantity handler (>5000 kg/year) for more than one year. Empty containers must be triple rinsed and taken to landfill, or buried 1 ft deep in ground.

Suggested Protection Strategy:

Where possible, pesticide storage and mixing areas should be located outside WHPAs in order to prevent leaks and spills. Where location outside critical areas is not feasible, best management practices including a secondary containment system should be required.

Golf course

The Koele Golf Course extends into the WHPAs of Well 6 and Well 7. Contaminants commonly associated with golf courses are nutrients applied to the soil, primarily Nitrogen (N), Phosphorus (P) and Potassium (K) and pesticides, including herbicides, insecticides and fungicides. Without proper management, these contaminants may leach into groundwater. In a survey of 37 golf courses in Hawaii, researchers identified 30 different pesticides in use (Brennan et.al. 1992).

Suggested Protection Strategy:

Golf courses is a medium risk PCA. The Draft Wellhead Protection Ordinance prohibits new golf courses in the 2-year time of travel zone. Within the 10 year time of travel zone golf courses are prohibited unless they meet performance standards outlined in the ordinance. The existing golf course should meet "Golf Course Management Measure" outlined in Hawaii's Coastal Nonpoint Pollution Control Program Management Plan. Appropriate BMPs include:

Nutrient management:

Schedule fertilizer application so that the chance of leaching and run-off of soluble fertilizers is minimized

Apply slow release fertilizers that will release nitrogen at a rate comparable to the rate at which it is used by the turf

Apply slow release nitrogen fertilizer in an insoluble form. Calibrate fertilizer application equipment regularly.

Calibrate fertilizer application equipment regularly.

Implement an integrated pest management (IPM) plan that includes, among other things:

Emergency response procedures to be undertaken in the event of a spill or accident.

Avoid applying pesticides in areas where there is a high potential for leaching.

Avoid locating greens and tees that may require high amounts of pesticides within WHPAs

Avoid applying pesticides near well heads.

Apply pesticides when runoff losses are unlikely.

Ensure proper storage of pesticides, located away from wellheads, and if possible from WHPAs.

Well sites

Wells provide a pathway for contaminants associated with land uses around the well. Wells that are not serving a public water system are not subject to the same contaminant monitoring requirements or sanitary surveys as public water system wells. Private wells are often surrounded by farming and other business activities. Permit and registration with the Commission on Water Resource Management (CWRM) is required for new wells. Groundwater quality is not addressed through standard conditions but on a case-by-case basis. Abandoned wells require casing, plug back, cap, or cement fill and seal well in order to prevent seepage of contaminants directly into drinking water supplies. Abandoned or improperly sealed wells present a conduit effect for contaminants to enter an aquifer. DWS are investigating potential abandoned or unused wells during PCA field surveys. With the exception of Shaft 3, all delineated wells are owned by Lana'i Company.

Suggested Protection Strategy:
Siting of new wells should be preceded by delineation of a WHPA around the well, PCA identification and consultation of development plans in the WHPA to identify the impact of future land use and any need for land use controls to protect the well.

Overlay Zoning Regulation

Several existing PCAs may individually and cumulatively pose considerate threats to the underlying water supply. The Maui advisory committee suggested considering density of PCAs rather than individual sources. Clusters of small-scale businesses such as auto body shops and services, whose practices are not regulated by federal or state laws, use significant quantities of hazardous materials such as solvents. Lana'i fortunately has very few high risk PCAs. Although high risk PCAs are unlikely to locate in Lana'i WHPAs in the near future, prohibiting or restricting possible location of undesirable PCAs in WHPAs is recommended due to the nature of the activities, contaminants associated with them and past record of contamination elsewhere. Regulation by complete prohibition (no chemical use or storage in a WHPA) is consistent with most wellhead protection ordinances, regardless of site-specific history of contamination, to provide the greatest assurance that inadvertent discharge of pollutants into the groundwater supply will no occur. The prohibition list should represent changes in knowledge and technology so that as other polluting uses are discovered or as the employed technology reduces pollution potential, uses can be added or eliminated from the list.

There is currently merely a sliver of land zoned business within Well 9 WHPA. Business zoning could allow new establishments of automobile service businesses, printing shops, and other medium – to high risk uses, while light industrial zoned areas would potentially allow a range of high-risk uses. An overlay zoning district based on the delineated WHPAs could restrict uses that are incompatible with groundwater protection without changes to the underlying zoning districts. An overlay zoning ordinance would typically allow existing non-complying uses to continue operating, but subject to land use restrictions if any change in use is proposed. A Draft Wellhead Protection Ordinance for Maui County prepared in cooperation with the Maui Advisory Committee is attached in Appendix E. Regulatory and non-regulatory management approaches are illustrated in light of legal and administrative considerations in Appendix F.

Public Education

BMP education and compliance with applicable regulations in place should be further promoted. On Maui, DWS has distributed targeted pollution prevention material through direct mailings to businesses and residences, newspaper and radio advertising and workshops. A continued pollution prevention campaign in radio and newspaper media will continue that is expected to benefit the Lana'i water system as well. Targeted BMPs are recommended for identified PCAs such as integrated pest management for roadside weed control by Lana'i Company in WHPAs and by the County Department of Public Works.

Project district, mixed use & residential development design
While open space and low-intensity land uses are desirable in protection areas, these goals can pose conflicts with proposed land and resource use. Residential uses generally pose a low risk to water quality, but may not be desirable in protection areas unless appropriate sewer systems and design standards to minimize contamination are provided. Nitrates are commonly associated with septic systems and lawn fertil-

izing. An increase in residential density also brings along increased road runoff and use of household hazardous products.
The Lana'i Project District 2 (Koele) extends into the WHPA of Wells 6, 7 and 8. Permitted land uses in the project district include residential, multifamily, hotel, public use, park and golf course.

New development design could incorporate groundwater protection in the WHPAs in several ways, such as locations of park and storm water detention areas, as well as limiting residential densities. Low residential and commercial density in WHPAs is suggested to maintain groundwater recharge, prevent overloading of household hazardous products and septic systems and keep runoff basins outside WHPAs where feasible. Large-lot zoning is used to reduce the impacts from residential development by limiting number of units within WHPA. A minimum lot size of 2 acres for residential development has been reported to maintain compliance with nitrate standards (Stevens Point Whiting-Plover Wellhead Protection Program). On-site septic system density control should be provided at a minimum in the 2-year microbial contamination zone to prevent future contamination from viruses, bacteria and other contaminants typically associated with on-site septic systems. Maximum overall net density for single family development in the Koele Project District is two and one-half units per acre. Only un-sewered development would be subject to the density restrictions.

The following design guidelines are suggested for all new commercial, residential or mixed use development projects, excluding residential subdivisions of 2 lots or less, throughout the WHPAs:
2-year time of travel WHPA:
Commercial and high-density residential development should be minimized.
Appropriate uses are open space, parks, schools and low density residential (minimum 2-acre lots
for septic systems)
Projects should be designed such that more intense uses are as far as possible from the wellhead while areas closer to the wellhead are reserved for less intensive uses.
Storm-water infiltration basins should be located outside the WHPA where feasible.

10-year time of travel WHPA:
High risk commercial and high-density residential development should be minimized.
Appropriate uses are open space, parks, schools, low risk commercial and low density residential (minimum 1-acre lots
for septic systems)
Projects should be designed such that more intense uses are as far as possible from the wellhead while areas closer to the wellhead are reserved for less intensive uses.
Storm-water infiltration basins should be located outside the WHPA where feasible.

2-year and 10-year time of travel WHPA:
Proposed development entirely within the WHPA should be grouped and sited on the subject parcel at as far distance as possible from the wellhead.
Where development is proposed on property extending both inside and outside the WHPA, and where sufficient buildable land area exists on the portion of the property outside the WHPA boundary to accommodate the proposed development, and where applicable setbacks permit, that area in its entirety should be utilized before any land within the WHPA should be used. Where insufficient buildable land area exists on

the portion of the property outside the WHPA to accommodate the proposed development, as much of the development as possible should be sited outside the WHPA.
Expansions of existing uses should at least conform to these guidelines where
the use is expanding beyond its property boundaries.
Vegetative cover should be provided on all disturbed land areas, excluding fallow agricultural fields, not covered by paving, stone or other solid material. The maintenance or use of native plant materials with lower water and nutrient requirements is encouraged.

Program Implementation

Legal Issues and Potential Conflicts

The Maui advisory committee discussed whether siting of new wells down-gradient of private land could potentially reduce land value and utilization due to land use restrictions. This also raised the issue of takings. Restrictive government decisions may constitute a taking in cases where the regulation interferes with reasonable investments made prior to general notice of the regulatory program, where the regulation deprives the landowner of all, or substantially all economically viable uses for the property with no offsetting reciprocal benefits. A regulatory approach would need to consider existing uses and proposed projects under current zoning to ensure that no restrictions will constitute a taking of private property. In prohibiting certain land uses, there is a potential impact on businesses, farms and "the little guy". The Maui advisory committee commented that many land owners are already conscientiously implementing BMPs and are concerned that costly additional restrictions would be set. Technical and, where possible, financial assistance should be provided for implementation of BMPs so as not to overburden existing users. However, the overall impact and the benefits to the community must take precedence. The benefits of wellhead protection include public health, reducing liability from leaks and spills, decreasing emergency response costs, a safe and viable water supply, avoiding costly treatment systems to treat contaminated drinking water, replacing wells due to contamination and remediation costs to remove the source of contamination.

Administration & Financing

Implementation of an overlay zoning ordinance should rely on existing administration and staff for processing zoning requests. Non-regulatory management, such as BMPs and land use agreements requires coordination between DWS and the appropriate agencies for administration and technical assistance. Farming BMPs should be coordinated with the Natural Resource Conservation Service (NRCS); chemical use, handling and waste with the Department of Health offices and the County Department of Environmental Management; and individual PCAs with the appropriate agency as defined in the Appendix E. If an ordinance stipulates mandatory performance standards in addition to existing state and federal requirements, coordination and inspection by the approving agency will be necessary. An overlay zoning ordinance would be enforced, as other zoning, by the Police Department.

Wellhead Protection