E-1669 Kitsap-2

Kitsap County ground water management plan

Grant no. 2

98199529

KITSAP COUNTY GROUND WATER MANAGEMENT PLAN
GROUND WATER ISSUES PAPERS

FEBRUARY 15, 1994

			DRAFT DATE
I	**Education Programs**		
	A Adult & Youth	-	OCT 19, 93☺
II	**Ground Water Protection**		
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	Hazardous Materials	-	JAN 14, 93☺
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	Water Rights - general	-	JUN 15, 93☺
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V	**Monitoring**		
	Data Collection and Management	-	FEB 16, 93☺

☺ **SMOOTH ROUGH APPROVED BY COMMITTEE**
☹ **NEW DRAFT IN THE WORKS**

E-1669 KITSAP -2
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KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: EDUCATION

October 19, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

Public understanding of ground water, ground water management, and water related issues is basic to solving present and future water problems. Unfortunately, most people are only vaguely aware of the role ground water plays in their lives. This issue paper will outline the reasons for and benefits of a public education program. The components of a ground water education program will also be addressed.

B. Goals

The goals of a ground water education program are to make people water literate, to educate citizens with respect to the problems and complexities of supplying safe, affordable, and high quality drinking water from ground water sources.

C. Reasons for Education

Education can increase understanding and lead to greater support for the various activities required to carry out the Ground Water Management Plan (GWMP). Some components of the GWMP requires action by individual citizens. Education can bring about a widespread change of behavior as is being done with public education programs for smoke-free environments and recycling.

Public water conservation is a cost effective way of meeting increased drinking water demand that comes with population growth. The Kitsap County Regional Planning Council (Kitsap County-Wide Planning Policy, June 3, 1992 projects that by 2010 county population will increase to 280,985, an increase of 91,254 or 48% over the 1990 census. The expense of drilling new wells and laying transmission lines far exceeds the cost of a water conservation education program. Effective July of 1992, the Department of Health started requiring water conservation plans to be incorporated into the Water System Plans of larger purveyors.

Contaminated ground water is expensive and difficult to treat. Prevention is cheaper than treatment. Most people do not knowingly pollute their drinking water source. They need to know what to do to prevent ground water contamination. A public education program

can greatly help to protect the quality of water resources and therefore can be of great economic benefit.

Public education can lead to an increased understanding of the problems dealt with in the GWMP and pave the way for acceptance of the mitigating measures required by the Plan. An educated public has the ability and incentive to bring information, expertise, values, funding, and support to ground water decision making processes.

II. CURRENT LAWS PRACTICES AND PROCEDURES

A. Existing Laws and Procedures

The State has no specific laws that mandate ground water education but regulations for utilities specify the need for education in conservation programs. Most, if not all, resource management planning procedures requires a public education element.

Several departments, organizations, and boards have elected to incorporate education as an integral part of their programming. The State Board of Education adopted a resolution that calls for integration of environmental education into the K-12 curriculum and the Washington State Senate passed a bill to provide four field agents for the purpose of encouraging and directing water quality education. The Washington State Department of Ecology has adopted an education policy which reflects the contents and criteria of a long-range education strategy. Washington State University Cooperative Extension has reallocated resources in order to establish a water quality newsletter, to train staff on water quality issues, and organize numerous water related conferences for the public. Cooperative Extension currently promotes courses like the PUD sponsored Water Watcher's program. Conservation districts have hired educational staff, created videos and implemented demonstration projects. All of these agencies promote education but none of them are mandated by law to educate the public about ground water. The American Waterworks Association, the Water Environmental Federation, and American Water Resource Association as well as many special purpose districts and health departments have education programs. Educational materials, presentations, and tours are available to the public.

Long term support for research and education is one of the priorities in the 1991 **Puget Sound Water Quality Management Plan.** The plan supports improving education and public involvement programs in order to inform, educate and involve citizens of the region and the state in cleaning up and protecting Puget Sound. Ground water protection is an element of this plan.

The Department of Ecology (**Ecology**), the U.S. Environmental Protection Agency (**EPA**) and Puget Sound Water Quality Authority (**PSWQA**) are mandating public education as a necessary part of efforts which deal with water quality. The major industrial point sources of pollution have been identified and brought into compliance with regulations and fines. It is more difficult to identify the non-point sources of pollution. The finger points at the

cumulative effects of many individual actions: the farmer who lets his cows pollute a stream, the property owner who improperly stores or disposes of hazardous materials, failing septic tanks which pollute ground water and shellfish beds. The expression "we all live downstream" presents the idea that we are all affected by the water-use practices of everyone else. To create this kind of awareness demands a holistic approach to water education.

Ecology has mandated a watershed model for water quality planning and implementation of clean-up programs. A watershed is a geographical area which is the drainage basin for water and has an outlet into a receiving water body such as Puget Sound. The water that is captured in a drainage basin as both surface water and ground water is affected by the physical structures and human uses within that geographical area.

The focus on a watershed approach bring citizens, tribal and local governments together to work cooperatively. Educating citizens from a watershed prospective should increase public involvement and informed participation in water quality decisions.

In local efforts, Kitsap Public Utility District strongly emphasizes ground water and ground water related issues in its education and public outreach programs. For instance under the Water Watcher program, there is the Junior Water Watcher fourth grade curriculum, the adult Water Watcher program, Water Watcher citizen action projects, and a Water Watcher regular column in the local newspaper that addresses ground water.

III. PROBLEMS AND GAPS

Public awareness and understanding of ground water is lacking. Programs for ground water resource education needs to be enhanced and expanded. Public involvement and education on non-point pollution problems are included in local watershed management plans but the issue of ground water contamination is not specifically addressed. Surveys conducted by PSWQA show that there is a lack of public understanding and knowledge about ground water issues. Ground water protection is included in the PSWQA plan but an education program is not included or funded.

The problems associated with protecting ground water are long-term and the solutions will be long term as well. Ground water education must be funded and developed for the long term.

IV. RECOMMENDATIONS AND STRATEGIES

A. A water literacy program builds on many levels of knowledge. Program elements should include the following levels of learning:

1. Comprehension - a knowledge of facts and concepts with an ability to express them.

2. Attitudes - development of responsible and realistic attitudes based on learning.
3. Skills - development of an ability and willingness to act in direct response to what has been learned about water. The skills of observation, inference, classification and problem solving are examples.

B. The Ground Water Literacy Target Audience

Everyone needs a safe drinking water supply. In order to educate, the ground water message has to be presented many times in many different ways. A multi-focal approach to both adults and children is recommended. Mechanisms for developing partnerships for cooperation between the public sector, private sector and educational institutions should be encouraged.

C. The Public At Large

Methods of presenting ground water information to the general public should include: media coverage (e.g., newspaper articles and TV and radio public service announcements), displays at local fairs, malls, and other similar events, brochures, conferences and seminars, and presentations to civic groups.

1. **Media Coverage** is available in local papers for events and programs. A current, weekly column in one paper informs the readership on water quality/quantity issues. The format follows the Washington State University (WSU) Cooperative Extension model of presenting "how to" advice to the homeowner to decrease pollution-causing practices and decrease water use.

2. **Brochures** can be created by using examples from the State Departments of Health and Ecology on ground water. The WSU Cooperative Extension Office has resource material as well. This information can be adapted to fit the private well owner. Pesticide handling, septic citing and maintenance, and agricultural practices are examples of topics which should be covered. Distribution of brochures through local businesses and real estate offices would contribute to building partnerships for water quality.

3. **Local fairs and mall shows** offer a unique opportunity to meet the public, answer their questions, hand out informational brochures and present informative displays on ground water.

4. **Conferences and seminars on water quality/quantity** at the local and regional level give professionals in the field an opportunity to network with other professionals for information sharing and mutual problem solving. A ground water conference for the region should be pursued.

5. **Presentations** and participation in community and civic groups should be a significant part of the ground water education program. The value of networking and informing community groups would raise the basic knowledge level of the leaders in the community and possibly enhance volunteer recruitment. A comprehensive program will be necessary to generate support for the GWMP. Presentations will also help to develop partnerships between the public and private sector and educational institutions.

6. **Newsletters** to water utility customers, water resource professionals, governmental decision makers, and individuals interested in water resources is a very effective communication method. Sharing information about ground water resources of both a general nature and data specific to the region helps people make informed decisions about water use and protection. Sharing information with water purveyors and governmental decision makers will help coordinate resource planning.

Evaluation of public outreach programs can be done by questionnaire, surveys, response to requests for participation in water quality programs, and requests for further information. Participation in public forums and support for financing ground water initiatives could also be used to evaluate the success of a public information program.

D. An Adult Education Course

A comprehensive adult education course on water resources is being presented by Kitsap Water Watchers under the sponsorship of Kitsap Public Utility District. The course is utilized by community groups and agencies to train volunteers for local water quality projects. The GWMP should support continuation of this effort. An outline of the program follows:

1. **Watershed Education:** Presentations are made to interested citizens by local water quality professionals, government representatives, teachers and business people working with various aspects of water quality in the watershed.

2. **Course Content:** The nine week course which is offered periodically during the year covers the following watershed attributes: historic values, ground water principles, water conservation, local government planning, fisheries, forest practices, wildlife, agricultural practices, hazardous waste, best management practices(BMPS) for small businesses and the home owner,geology, soils and erosion, recreational boating, stream and wetland ecology. Field trips are taken to illustrate water problems and solutions and to practice monitoring techniques.

3. **Credit for Teachers:** College credit and clock hours are offered to teachers.

4. **Volunteer Opportunity:** After taking the course, participants have the opportunity to volunteer their time in water-related volunteer projects. Creation of ground water educational materials and public presentations are examples of projects.

5. **Communication:** An informational newsletter is sent to graduates every month.

6. **Evaluation:** Participants fill out a pre-test before the start of the program and a post-test and evaluation form after each class. Student suggestions are incorporated into the program. Public comments and follow-up evaluations of the program indicate increased awareness.

Agencies should be encouraged to ask for class graduates to participate in projects.

E. Youth Programs

Several programs aimed at educating youth in Kitsap county about water related issues are being conducted by Kitsap Public Utility District in coordination with several other organizations. The programs are as follows:

1. **The school classroom program** offers ground water education in a watershed curriculum to elementary school-age children. It includes hands-on learning about water quality and quantity, ground water, streams and wetlands. Emphasis is placed on the part individuals play in causing non-point pollution, water conservation, protecting the water supply, and participating in clean-up activities.

2. **Day camp** offers a summer on-site, outdoor education program. Watershed education is presented in an outdoor setting. On-site learning directly demonstrates concepts that can be only simulated in a classroom. Curriculum covers the same basic ideas as the classroom presentations.

3. **Consultation** to middle and high school teachers consists of a range of support activities including presentations and materials. Environmental clubs have been set up in some schools which require projects for the students. Assisting teachers with ideas and materials for ground water/watershed education has helped to facilitate including ground water educational material in the curriculum. The teachers most receptive to the program come from those who have taken the adult watershed education program.

4. **Grant writing partnerships** help teachers incorporate water quality curriculum into the schools. Collaboration with teachers in writing education grants creates a business and school partnership for water quality.

Evaluation of the success of education programs for youth should include the number of schools requesting the classroom support program and the number of children participating

in the day camps. A review of the action projects conducted by youth is also a good measure of the success of the program. The extent of upper grade level teacher requests for assistance is an indicator of the effectiveness of that program. Comments of students participating in programs are currently evaluated for positive/negative feedback. Teacher evaluation forms are reviewed and intra-staff evaluations are held after each school program is completed. Suggestions and recommendations are incorporated into curriculum revisions. The programs should be refined and expanded.

DRAFT DRAFT

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: GROUND WATER RECHARGE AREA PROTECTION ~~ENVIRONMENTALLY SENSITIVE AREAS~~ (WATER QUALITY)

October 19, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines historic and existing approaches to protecting aquifer recharge areas from a water quality perspective. Other issue papers will address factors that affect aquifer recharge from a quantity viewpoint. This paper proposes an approach to aquifer protection that is responsive to the unique circumstances of Kitsap County. The paper will also address well head protection and in particular the State's developing Well Head Protection Program. ~~of the county which provide aquifer recharge.~~

Potable water is necessary to maintain human life. ~~Much of Washington's drinking~~ Most of Kitsap County's potable water comes from ground water supplies. Once ground water is contaminated it is difficult and sometimes impossible to clean up. ~~Cleaning~~ Remediating contaminated ground water is always costly to do. ~~Accepted practice is to~~ Actions which prevent contamination avoid unnecessary costs, hardships, and potential ~~physical harm~~ damage to ~~people~~ human health and the environment.

Ground water reservoirs, or aquifers, hold nearly 50 times the volume of the Nation's surface waters, constitute approximately 96% of all the fresh water in the United States, and serve as the primary drinking water source for half of the population, nearly 117 million people. Every state has experienced some ground water contamination.

Although it is not yet possible to assess the extent of ground water contamination on a national level, information available provides sufficient cause for concern:

* Within the past few years over 2,800 wells have been closed and sealed in California; 2,600 on Long Island, New York; 700 in Connecticut; 500 in New Jersey; and 250 in Massachusetts because of contamination concerns.

* In 1984 alone, 4,400 well contamination incidents were reported by 21 states.

* Over 70% of the 888 hazardous waste sites reported on the Superfund priority list of June 1986 involved ground water contamination.

* In Kitsap County, where 80% of the water supply is ground water, four National Priority List (NPL) hazardous waste sites, rapid development, and increased knowledge of potential sources of contamination, have caused citizens to be very concerned about protecting aquifer recharge areas.

* The Kitsap County Historical Record of Ground Water Contamination contains many incidents of contamination in addition to the designated and proposed National Priority List(NPL) hazardous waste sites (frequently called superfund sites). Ecology ~~data contains~~ records document information on 98 leaking underground storage tanks. ~~The Health District Ecology~~ BKCHD has records on 46 investigations of significant pollution (Affected Media Contaminants Report). The two data sets have some duplication of information. The total number of contaminated sites is probably around 120 of which 36 have resulted in confirmed ground water contamination problems.

Seventeen percent of leaking underground storage tanks and 41% of sites listed in the affected media contaminants reports indicate that group waters have been contaminated. An additional 24 sites have been assessed as posing a threat to ground waters.

Data is not available on sum total of acreage contaminated or the extent of contamination involved. Some of the sites are in the process of being cleaned up. The on going monitoring program carried out by the PUD has not revealed problems of contamination in the known aquifers. Investigation needs to be conducted on the relationship between the 36 confirmed ground water problems, which appear to be related to shallow unconfined smaller aquifers, and the potential threat to the larger aquifers.

~~Every state has laws to protect ground water resources, but they vary significantly; many have to do with quantity and supply issues (water rights) rather than protecting ground water quality. The interstate nature of many aquifers and difficulty in evaluating the effectiveness of the various State laws have raised questions about the need for greater Federal leadership in ground water protection issues.~~

B. Approaches to Protecting Ground Water

Communities have used several approaches ~~have been used by communities~~ to ~~develop~~ address ground water protection strategies. One is to identify ~~sensitive areas relative to~~ aquifer recharge areas and well locations. ~~or points of water withdrawal.~~ A second approach involves developing ground water models to estimate the effects of development, land use management alternatives and other activities ~~could have~~ on ground water resources. ~~A third approach involves systematically ranking and controlling existing and potential threats to ground water.~~ Each approach has inherent benefits and disadvantages and not all approaches are appropriate ~~possible~~ for all areas of the country. This paper reviews the approaches used in various parts of the country, evaluates their applicability ~~within our community, suggests those techniques which may be beneficial,~~ and ~~ultimately~~ recommends

a policy ~~which, if implemented by appropriate authorities the Kitsap County Commissioners, will serve~~ to protect Kitsap County ground water resources. This paper closely parallels. ~~follows and often extracts from~~ "Ground Water Resource Protection, A Handbook for Local Planners and Decision Makers in Washington State", prepared by the King County Planning Division and Washington State Department of Ecology.

~~Background~~

C. Environmentally Sensitive Areas

Aquifer recharge areas are environmentally sensitive for a number of reasons. One of the underlying problems of discussing environmentally sensitive areas (ESA's) is defining an ESA. In addition, the ability to conceptually define an ESA is one matter; physically identifying or to isolating one is another. Community land use policies and practices ~~may suggest ESA concerns that might be quite different from those associated with resource protection strategies.~~ include a broad definition of environmentally sensitive areas. This paper only deals with areas that are environmentally sensitive because of their association with ground water resources.

For example, the Kitsap County *Bainbridge Island Subarea Plan* states:

> "Environmental concerns and land use are closely related. When development occurs without careful examination of effects on its surroundings, several undesirable outcomes are possible. Hazards to that development or adjoining properties may be created or increased. Natural resources may be damaged. Governmental costs from environmental degradation may be incurred in the future which a developer may not consider during his one-time contact with a project."
>
> "ESA designations are intended to flag ~~concerns in the review process and to make applicants aware of~~ potential problems caused by ~~hazards or natural resources which may be damaged by~~ unsound ~~development~~ land use decisions. The designations are not intended, however, to eliminate all development. Compatible development ~~will be allowed~~ which either avoids designated ESA's or mitigates potential problems through engineering, siting, design or other techniques may be approved by county or city authorities. Proposals are examined on a case-by-case basis to allow for creative solutions (although some mitigative techniques are suggested in the discussions below) and to assure that the special combinations of factors in a particular case are addressed."

This land use definition of ESA's incorporates a significant measure of interest in socio-economic matters such as loss of property or life as the result of utilizing unsafe construction sites (e.g., unstable slopes). Concern about the safety of resources (e.g., water, wildlife) is sometimes of a lower ~~appears to be of lesser interest or~~ priority.

D. Aquifer Recharge Areas

Aquifer recharge areas are environmentally sensitive for various reasons and to different degrees. Jaffe and Dinovo, in applying the ESA concept to ground water suggested that a sensitive area is an area in which ground water can be easily ~~polluted~~ contaminated. They proposed two commonly used approaches to define sensitive areas within a hydrogeologic study area. One approach identifies **recharge areas** (geographic locations in which ground water is replenished) where flow has a strong downward component that can carry contaminants into the aquifer. These areas are frequently characterized by very permeable soils or a shallow water table.

The other approach involves a focus on ground water use, particularly ~~pumping~~ drilled wells. Wells draw water from the surrounding area of the aquifer, called the **area of influence,** whose boundary depends on the transmissivity, thickness, and lateral extent of the aquifer and the pumping rate of the well. Areas of influence are sensitive because contaminants introduced into these areas ~~inevitably will~~ could be drawn into the well.

E. Aquifer Classification

An alternative, but similar method of identifying specific sensitive areas involves an evaluation of an entire area including the mapping and classification of aquifers. Aquifer classifications usually take two forms. First, aquifers may be classified according to existing or intended ground water uses, such as public drinking water supply, irrigation, or waste assimilation. The acceptability of a land-use activity in a given area would therefore, be based upon the potential threat that the activity poses to the assigned use of the aquifer. Although adopted by several states and promoted by the Environmental Protection Agency (EPA), this approach is controversial because some aquifers assigned to lower uses (such as waste assimilation), would incur certain levels of pollution that could lead to contamination of other aquifers assigned to higher uses (such as drinking water supply). It is also controversial in that it implies that some aquifers will essentially be "written off" and consigned to some level of permanent contamination.

The aquifer identification approach includes mapping aquifer boundaries. Classifications are assigned to different aquifer areas, based upon a variety of criteria. A recently developed list of criteria includes:

* Existing use
* Water quality, primarily based on total dissolved solids
* Land use
* Aquifer characteristics, such as soils and geology
* The yield and accessibility of water, regardless of quality ~~(less than 350 gallons per minute is considered uneconomical for community water supply development)~~
* The ability of an aquifer to attenuate and assimilate wastes
* The existence of multi-aquifer flow systems

* Mineral deposits
* Geothermal sources
* Continuity with surface waters
* Socio-economic factors

Aquifer classifications are often used to set the degree of protection for the aquifer recharge areas. Protection may be implemented by establishing ambient ground water quality standards for each aquifer, which are used as ~~performance~~ standards to control activities above the aquifer. Classifications may also be used as a basis for land-use controls to directly regulate potential contaminant sources in each area.

Aquifer classification may be important in the future because it is a major component of the EPA's Ground Water Strategy. Proposed federal classification would recognize three classes of aquifers:

Class I - "Special aquifers", those that are highly vulnerable to contamination and irreplaceable as a water supply.

Class II - All other aquifers that are current and potential drinking water sources.

Class III - Aquifers that are not considered to be potential drinking water sources because they are too brackish or have been contaminated.

These classifications are not used to establish the degree of protection for different aquifers, since the EPA guidelines protect all aquifers for their "best and highest use" under current regulations. The classification system is used to set priorities for remedial action where contamination has occurred, but it is not binding on the states.

F. Aquifer Susceptibility to Contamination

A second ~~and less controversial~~ aquifer classification approach involves mapping soils, surficial geology, depth to ground water, and other factors, in order to establish the susceptibility of an aquifer to contamination. This approach is based upon a single standard of aquifer protection - usually "non-degradation." Assessment of the suitability of sites for different land-use activities is based solely on the susceptibility of the aquifer to ~~pollution~~contamination, regardless of its present condition or use.

If sensitive areas are identified ~~where the~~ in geologically complex areas, it may be necessary to conservatively enlarge estimated recharge boundaries in order to provide a greater buffer zone or expand the area where site-specific studies are required. The hydrogeological characteristics of an area, the nature of threats to ground water, the pattern of water use (e.g., discrete public well sites or dispersed private wells), and the general vulnerability of the area under consideration, dictate the extent of protective measures required.

When ~~considering~~ designating aquifers as being sensitive, it is essential to consider the "recharge areas" associated with them as being environmentally sensitive areas. Recharge areas are identified as surface geological formations which are permeable enough to permit surface waters to flow downward and recharge the aquifer ~~by the flow of water within the hydrologic cycle~~. Ground water flow systems in aquifers are analogous to surface water drainage patterns and, like them, contain smaller local flow systems within the larger regional flow system of the aquifer. Regional flow systems can be quite extensive and can encompass multi-county or even multi-state areas. Localized flow systems are defined by the size and location of aquifer recharge areas (collection basins).

Both local and regional flow regimes may be present, each with its own recharge area. In regional recharge areas, water flows into deeper aquifers. ~~than in recharge areas for~~ Local flow regimes are generally shallower. Pollutants in regional flow regimes may travel farther ~~and reside in the aquifer for a longer time~~, thus contaminating greater volumes of ground water.

Existing land use and ground cover, as well as soil permeability and overlying geologic material, are important factors for defining ~~critical~~ recharge areas. The recharge area of a deep ~~consolidated~~ aquifer is often smaller ~~percentage of the~~ surface area ~~above the aquifer~~ than the recharge area a shallow aquifer above it. This situation occurs where a deep ~~bedrock~~ aquifer is ~~not~~ overlain by consolidated rock or other impervious material and not by permeable soil and unconsolidated deposits. Recharge to a deep consolidated or bedrock aquifer tends to be complicated when it is in contact with other aquifers; that is where there are no intervening confining ~~beds~~ layers or where intervening confining ~~beds~~ layers leak.

G. Aquifer Recharge Area Protection Methods

Any of these approaches to ground water recharge sensitive area identification ~~identification of recharge areas, the~~ (e.g. delineation of area of influence, classification of the aquifer, evaluation of aquifer susceptibility to contamination) may be used by communities to protect their ground water resources. No single approach is best for all communities and for all ground water contamination threats. Communities ~~must therefore~~ should work with water resource professionals to determine:

* What system best applies to their specific area;
* On what scale ground water protection must be undertaken (from specific well fields to jurisdiction-wide aquifer protection); and
* Which approach is most practical, given the community's ground water protection planning goals and the quality of data available.

These considerations can be complex. The selection of an appropriate approach to

delineating sensitive recharge areas should include the following factors:

* the quantity and quality of available hydrogeological information
* the hydrogeological characteristics of the area
* the identification of specific ground water threats
* the pattern of ground water use (e.g., public wells vs. dispersed private)
* the community's overall ground water protection objectives

Generally, there have been ~~two~~ three approaches to protecting ground water:

* Focus on protecting entire aquifers

* Focus on protecting the portions of aquifers that supply public drinking water

* Address specific threats to aquifers

The sensitive areas defined in each case are different. In the two latter categories, a more limited approach is to protect ground water at a particular location from a specific source of potential contamination, such as a landfill. In these cases, the portions of the aquifer that would be most affected if contamination did occur are identified as sensitive areas.

1. TOTAL AQUIFER PROTECTION

For approaches that focus on protecting entire aquifers, the sensitive area classification methods involve identifying areas where human activities could contaminate an aquifer. Methods, such as the DRASTIC System described below, focus on the hydrogeologic conditions between the surface and the water table. Sensitive areas are defined as the areas that could easily transmit contaminants to the water table.

Classifying aquifers is a means for establishing which resource need to be protected most. Usually, aquifers are classified by how much they are used. An aquifer may also be classified by capacity, quality and vulnerability to contamination or depletion. For example, the EPA proposed, in its draft "Ground Water Strategy", to classify aquifers into three classes, distinguished by their relative values as sources of drinking water ~~(see page 4)~~. Washington's Department of Ecology is developing an aquifer classification system as part of the state's ground water protection strategy. Aquifers will be classified based on their existing or potential beneficial uses. In Kitsap County where ground water is the source for 80% of the potable water, all aquifers will most likely be classified to require a high level of protection.

Other methods involve deeper and more complex hydrogeologic investigations. In addition to evaluating hydrogeologic conditions above the water table, these methods examine the aquifer(s) that could be contaminated. Sensitive areas may be defined

by the potential for damage to a number of aquifers or just one especially important aquifer. For example, if aquifers have been classified, areas that would transmit contaminants to a high ranked aquifer would be more sensitive than areas that would transmit to lower ranking aquifers.

The following are examples of ground water recharge sensitive area classification systems that focus on aquifer protection.

a. DRASTIC System

The DRASTIC system uses ~~commonly available~~ hydrogeologic information to evaluate and rank ground water ~~pollution~~ contamination potential. It begins by identifying key hydrogeologic parameters including:

* Depth to water table
* Recharge (net)
* Aquifer media
* Soil media
* Topography
* Impact of the unsaturated zone
* Conductivity (permeability) of the aquifer

A ranking system is used to assign a numerical value to each parameter. The relative pollution potential is determined by adding these numbers. This information is then used to develop maps showing areas that are most vulnerable to contamination.

The DRASTIC system is ~~recommended as one of the more easily implemented~~ a workable method for identifying areas sensitive to contamination. It was developed for use by a wide range of people, including those with limited technical knowledge. It does require a significant amount of information and involves detailed modeling. DRASTIC is intended to be used for the evaluation of areas larger than 100 acres.

b. The Clover/Chambers Creek System

The Clover/Chambers Creek System (Pierce County) uses another hydrogeologic rating system. In the Clover/Chambers Creek area, which is underlain by a thick sequence of inter-bedded glacial and non-glacial sediments, four aquifers and three confining beds have been identified. A study has defined seven degrees of surface sensitivity based upon the presence/absence of the various confining beds. The least sensitive category includes areas capped with confining beds of glacial till; the most sensitive category includes areas where all three confining beds were absent. In the first case, aquifers are protected from contamination by the glacial till cover. In

the latter case, the aquifers were evaluated to be open to vertical contamination from the surface. It should be noted that till layers often are not continuous and sometimes are shaped so as to concentrate per collating fluids.

c. Department of Health (DOH)

<To be added later>

2. Partial Aquifer Protection (Well Head Protection)

With systems that focus on protecting wells or springs, a hydrologic study is conducted to identify a well-head protection area which is generally associated with the well's **area of influence**. The area of influence is defined by the outer limits of the zone of contribution ~~cone of depression formed by the well~~ which encompasses the areas of an aquifer that are drawn to the well.

Regional flow within the aquifer ~~may~~is also ~~be~~ taken into consideration in identifying well-head protection areas. This process involves outlining the areas where ground water is flowing towards the well and will be intercepted by its zone of contribution ~~cone of depression~~. By accounting for regional flow, the well-head protection area includes ~~encompasses~~ land beyond the wells immediate area of influence. In complex geological areas like Kitsap County, local flow regimens are more dominant, and more difficult to define.

3. Specific Threat Protection

Sensitive area classification systems that identify the impacts of a specific contamination source could have on ground water, are used to indicate what aquifers, portions of an aquifer or wells could be contaminated by a high risk activity such as a land fill. They are also used to compare the impact of locating a high risk activity at one site versus another. Such systems evaluate hydrogeologic factors, but may also reflect the value of aquifers and wells threatened and the relative level of health risk.

Two other systems, the LeGrand and Hazard Ranking System(HRS) ~~described below~~ were developed to identify the potential impact of hazardous waste generators on ground water. They can also be used to evaluate the impact of other high risk activities.

a. LeGrand System

The LeGrand System assigns numerical values to factors intended to reflect the hydrogeologic vulnerability of an aquifer recharge area to ground water contamination. It also assigns values to parameters intended to reflect the resource value and degree of threat. Factors included in the LeGrand system are:

* Distance between contamination source and water supply
* Depth to water table
* Hydraulic gradient (slope)
* Permeability of the soil
* Degree of confidence in values
* Degree of seriousness which includes contaminant toxicity, importance of aquifer, and general aquifer sensitivity.

b. Hazard Ranking System (HRS)

The EPA Hazardous Waste Site Ranking Model or Hazard Ranking System (HRS) assigns values which represent resource value and degree of threat.

HRS factors are ranked and added to provide an overall risk rating. The factors include:

* Measured level or evidence of contaminants
* Depth to aquifer
* Net precipitation
* Permeability of unsaturated zone
* Method of waste management
* Physical state of wastes
* Contaminant persistence in the environment
* Contaminant toxicity/infectiousness
* Total waste quantity
* Ground water use
* Distance to nearest down-gradient well
* Population served by ground water within a 3 mile radius

H. THREAT BASED AQUIFER PROTECTION

As a Hydrogeologically Sensitive Area(HSA), Kitsap County faces a number of threats to its ground water resources. ~~It is the intent of this report~~ The following is an attempt to identify those threats and to suggest measures to safeguard the water resources. There are two basic classes of threats against ground water resources, quantitative and qualitative.

~~The first addresses those threats which, if unmitigated, would reduce the amount or quantity of the resource available for use. The second class includes those threats that relate to the general quality of the water.~~

1. Quantitative Threats

The amount of ground water available for public use is a difficult value to determine. Part of the problem centers around the difficulty of estimating the capacity ~~nature~~ of Kitsap County aquifers and their associated recharge systems. Quantitative threats include those factors that would reduce the ability of an aquifer to provide a reliable, long-term supply ~~amount of ground water available for extraction~~. These threats include: (1) over extraction of ground water (removing ground water at a rate greater than natural recharge can accommodate) and (2) those activities that impede recharge ~~capacity of the soil. These activities~~ (e.g. grading, paving, building over, changing vegetative cover, or otherwise altering the recharge potential of the soil).

2. Qualitative Threats

Factors which adversely affect the general quality of ground water ~~qualitative threats,~~ are usually the result of some form of ground water contamination. Ground water contamination is most often caused by the release of a harmful substance (contaminant) into an aquifer. Contamination of an aquifer by salt water intrusion, for the purposes of the Ground Water Management Plan, will be ~~treated as a~~ covered under quantitative threats as the intrusion is generally the result of over-withdrawal of water from an aquifer.

3. Types of Contaminants

~~Generally speaking,~~ There are four general types of contaminants:

* microbial pathogens
* organic ~~chemicals~~ compounds
* inorganic minerals and metals
* radionuclides

Microbial contaminants occur naturally in ground water, but usually in small quantities. Soil structure filters out some organisms while others are incapable of surviving once they reach the water table. Some microbial contaminants can cause serious depredation of human health. Microbial contaminants are usually either bacteria, viruses, or parasites. The most common sources of microbial contamination are septic systems, leaking sewer systems, and farm livestock.

State water quality standards establish a maximum contaminant level for coliform bacteria, ~~the most common form of microbial contamination~~, and all public water systems must test for the presence of this organism. The presence of coliform bacteria can serve as an indicator of the potential presence of other, similar organisms.

While some **organic compounds**, like lignins and tanins can occur naturally in ground water, some are chemicals synthesized for industrial or home use

present a human health concern ~~purposes~~. The effects of consuming harmful organic chemicals can include death, disruption of normal neurological functions, and genetic alterations. It is important to remember that nearly all foods and nutriants are organic. State water quality standards establish maximum contaminant levels for some of these chemicals.

Common organic compounds can be conveniently classed into five chemical groupings:

* aliphatic hydrocarbons - gasoline paint thinners
* aromatic hydrocarbons - solvents, gasoline,preservatives, lubricants, resins, plastics, and coal tar ingredients
* halogenated hydrocarbons - plastics, refrigerants, wood preservatives, solvents, paint strippers, de-greasers and dry cleaning agents
* pesticides and herbicides
* oxygenated hydrocarbons - dyes, solvents, pharmaceutical, and fungicides

~~These contaminants occur naturally in very low concentrations in ground water.~~

Common sources of contamination by **inorganic minerals** include septic systems, animal wastes, sea water intrusion, and industrial wastes. The health effects of inorganic contaminants are varied and similar to those of organic compounds. State water quality standards establish maximum concentration levels of many of these items. Some relate directly to health issues, while others are regulated mainly for aesthetic reasons, such as color, hardness, taste, odor and turbidity.

Radionuclides are radioactive forms of elements like strontium, uranium, or cobalt. These occur naturally at low levels in ground water, but ~~are most concentrated in~~ may be present at higher levels due to wastes from nuclear industry as a result of past practices. Health risks associated with these products include radiation sickness, cancer, and mutations. Both federal and state governments have established maximum levels for radionuclide contamination. At the present time, contamination of ground water by radionuclides is a relatively small threat within our county and a matter of federal jurisdiction.

4. Sources of Contaminants

Contamination of ground water resources can occur as the result of many human activities. Consequently there are many sources of contaminants. Sources may be grouped into five major categories which reflect pollution by various systems designed for handling potential contaminants.

* Group 1: contamination by systems designed to **discharge waste** onto or into the ground for treatment or disposal such as a septic system

* Group 2: contamination by systems designed to **store** potential pollutants such as under ground storage tanks

* Group 3: contamination by systems designed to **transport** potential pollutants such as pipelines

* Group 4: contamination as a result of discharging pollutants as the result of other activities such as unlawful discharges or accidental spills

* Group 5: contamination by ~~pollutants~~ contaminants **discharged into conduits installed to serve other functions** or which results from the other function such as improperly constructed wells or a rock quarry

Group 1 contamination sources include: on-site waste disposal facilities including, septic systems, land applications of domestic and commercial waste products, and waste water injection wells. On-site waste disposal methods, primarily septic systems and cesspools, rank highest in the total volume of waste water disposed into the ground. These methods are the most frequently cited sources of ground water contamination.

Land application of waste water is one way of treating wastes. Some municipal sewage processing agencies discharge treated waste water or spread bio-solids (sludge) from treatment facilities over land reserved as treatment areas.

Treatment of wastes by on-site disposal or land application methods does not always remove potential contaminants. Some contaminants may reach the water table and accumulate over time. Failing septic systems are a frequent source of this type of pollution. Sanitary sewers are often installed to replace failing systems. Leaks in septic systems can create localized areas of extreme contamination.

Disposal of waste water into deep aquifers by injection wells, though common in many states, is prohibited in Washington.

Group 2 sources of contaminants include:

* landfills
* illegal dumps
* surface detention facilities (ponds and pools)
* waste tailings

* waste piles
* stockpiles of materials
* storage tanks
* containers

Waste storage and the storage of materials containing contaminants represents a serious threat to ground water. Pollution occurs as a result of leaching from landfills, illegal dumps, surface impoundments, mine waste tailings, or from piles of waste or materials that contain contaminants. Leakage from storage containers is another major cause of pollution. Many regulations have recently been established to prevent pollution by leaks from storage tanks.

Group 3 sources of contaminants include: sanitary sewers, hazardous materials pipelines, and discharges from tank trucks or trains.

The transport of hazardous materials represents a serious threat to ground water when accidental or illegal discharges occur. Numerous accidental spills have occurred during the transport of contaminants by truck or rail causing severe localized pollution. Criminal or negligent dumping is also a problem.

Group 4 sources ~~include several types of~~ contaminants: agricultural chemical use; improper irrigation practices; animal feeding operations; urban runoff; and mine operation drainages.

Agricultural chemicals, applied usually in the form of pesticides or fertilizers, tend to migrate to the water table. Irrigation can accelerate this process as well as leach mineral salts and metals from the soil.

Application of chemicals through the irrigation system by chemical injection can also contaminate ~~water resources~~ wells if the irrigation system lacks back-flow safety devices which prevent transfer of the chemicals back into the source water lines.

Animal feed lots can accumulate high concentrations of animal wastes that can lead to nitrate and/or bacterial contamination.

Urban run-off has been widely recognized as a source of pollution. Run-off of rainwater accumulates contaminants from streets, roofs, construction sites, industrial and commercial areas and residential gardens. Toxic and hazardous substances accidentally spilled may also be picked up by the run-off. As a result, run-off can often contain organic and inorganic contaminants as well as microbial pathogens. If allowed to accumulate in retention or holding ponds, polluted run-off can contaminate ground water. They can also pollute the ground water when discharged into "dry wells", a common practice in Washington.

Group 5 contamination sources include pollution through conduits such as abandoned wells, excavations, ~~or by~~ from actions such as well over-pumping.

Any well or hole represents a possible conduit for ground water contamination. Improper well construction or abandonment can allow contaminated water to migrate from the surface to deeper aquifers. Quarries, particularly ones that contain water (i.e., they have penetrated an aquifer) are direct paths for aquifer contamination. In certain areas, over pumping can cause contamination by inducing salt water intrusion.

All of these contamination threats exist in Kitsap County in varying degrees. Individual issue papers will deal with these contamination threats in detail and propose actions to minimize their impact in Kitsap County.

J. Summary of Protection approaches

Sensitive area classification systems, such as the DRASTIC system, focus on protecting aquifers and involve regional ground water assessments. As a result, they can be used as comprehensive land use planning tools. They can help evaluate the impact of development on the ground water and assist in making comprehensive land use and zoning decisions which will protect ground water.

Sensitive area classification systems that focus on protecting water supply sources involve a more limited geographic assessment. ~~of the ground water.~~ They can be useful, on a small scale, in making land use and zoning decisions. More often, however, these systems are used to restrict development or regulate activities within well-head protection areas.

Sensitive area classification systems that identify contamination source impact on the ground water, such as the LeGrand or Hazard Ranking System, also involve limited geographic assessments of ground water. These methods are most often used to select the best location for specific high-risk activities. They can also be used to develop special design and operating standards to mitigate the impact of such activities.

~~The previous portions~~ This paper has reviewed definitions, classification systems, and protection strategies developed for aquifer recharge area protection ~~environmentally sensitive areas~~. Because of the relative vagueness of the term "environmentally sensitive area" and the confusion caused by its uses in other contexts, this paper proposes the term "hydro-ecologically sensitive areas" (HSA) to refer to environmentally sensitive areas associated with aquifers, recharge areas, wetlands, and similar geologic features associated with ground and surface water resources.

Because of the size of ~~the area encompassed,~~ the diversity of land uses, the variations in topography, and the complexity of geology, ~~this subcommittee proposes to address~~ protection of Kitsap County ground water resources should take an approach which avoids specific aquifer recharge area identification ~~from a perspective rather than attempt to geologically~~

~~classify identify aquifers and recharge areas.~~ In light of the geologic complexity of the county, all of Kitsap County should be identified as hydro-ecologically sensitive. A distinction could be made, however, between Growth Management, designated Urban Growth areas and Rural areas of the County with respect to aquifer protection measures. In addition, measures could be targeted against specific threats to ground water. Separate issue papers have been developed on individual threats to ground water.

II. CURRENT LAWS, PRACTICES AND PROCEDURES

Despite their diversity, state regulations associated with ground water protection generally fall into three broad categories: those that deal with particular **sources of pollution,** such as septic systems and waste disposal sites; those that establish and implement **water quality standards for potable water supplied from aquifers;** and those which **regulate the uses of land** in areas overlying critical aquifer recharge zones.
<See Kitsap County Association of Realtors comments on deleting reference to actions taken in other states.>

A. Controlling Sources of Contamination

A great many states ~~have primary authority~~ are lead agencies under the Resource Conservation and Recovery Act (RCRA) to regulate waste disposal, under the Clean Water Act (CWA) to regulate surface discharges into waterways, under the Surface Mining Control and Reclamation Act (SMCRA) to regulate coal strip mining activities. In addition, many states have established more restrictive controls at their own initiative. Given the documented gaps in federal programs, state initiatives are essential for insuring more comprehensive protection of ground water.

[New Jersey, for example, has an extensive regulatory program to control numerous sources of ground water contamination: spray irrigation, overland flow, rapid infiltration, pits, ponds, lagoons, landfills, injection wells and land applications of sludge. New Jersey defines water to include ground water under the state's general water quality legislation, thereby extending to the State Department of Environmental Protection regulatory authority over ground water similar to the authority over surface water as provided under the Clean Water Act. Exercising this jurisdiction, that state recently adopted regulations under the New Jersey State Pollutant Discharge Elimination System Program. These regulations require that anyone desiring to discharge wastes onto the land or into ground water must obtain a discharge permit from the department just as they would for discharges into surface waters. The permits contain effluent limitations designed to conform to recently adopted ground water quality standards. This type of regulatory approach provides a basis for both controlling existing ground water pollution sources and for preventing the development of future problems.] **DELETE THE ABOVE PARAGRAPH?**

The characteristics of ground water pollution generally necessitate regulatory efforts that focus on prevention of ground water contamination through restrictions of the activities that

generate it. Regulations applicable to specific contaminant sources usually require dischargers to obtain a permit from the state's environmental agency. Virtually every state has regulatory program(s) to control certain contaminant sources.

No state government, however, has fully addressed the wide range of sources that can contaminate ground water. Of particular concern is the wide range of activities that are unrelated to waste disposal, such as leaks from gasoline and solvent storage tanks, saltwater intrusion, pesticide applications, and acid mine drainage. The impact of these activities on ground water has not been systematically studied nor extensively regulated.

B. Aquifer Quality Standards

Washington state has primary authority under the Safe Drinking Water Act (SDWA) to regulate potable water quality and control recharge injection. The SDWA provides for ever increasing standards which periodically add new monitoring requirements. The Environmental Protection Agency (EPA) is required to expand the number of contaminants for which limits in drinking water have been set. When contamination limits are reached, the affected water supply must be treated before use. The source of the contamination should be identified and eliminated if possible.

C. Land Use Regulation

Land use regulations which are based on aquifer recharge area identification ~~an aquifer classification system based on land use,~~ requires a major investment of resources and presents many politically difficult decisions. ~~time and labor.~~ Delineating aquifers and their recharge areas is often the most difficult and time consuming step. Such an approach may be the most sensible for highly developed states where population growth and industrialization are not likely to change drastically for many years.

Land-use options have traditionally been the prerogative of local and state governments. Many towns and counties have adopted ordinances to protect their ground water supplies. State and local authorities can significantly reduce the potential for ground water contamination by adopting wise and far-sighted land-use planning and zoning controls.

Zoning techniques for protecting ground water include regulating minimum lot sizes to prevent intensive residential or commercial development over recharge areas, limiting the location of facilities which involve hazardous materials or disposal of waste, and restricting the density of septic systems within a given area. Even conventional urban zoning, though not primarily designed to protect ground water, may have a beneficial effect by limiting the density of residential development, taking development pressure off rural areas through urban concentration, or by channeling industrial activities into specified areas.

[Land-use regulations have been most often applied at the local level. For example, in parts

of Dade County, Florida ~~that lie within the recharge area of the Biscayne Aquifer,~~ the county commission has issued a zoning ordinance imposing a minimum lot size of five acres. The purpose of the ordinance is to protect the Biscayne Aquifer and to prevent the development or use of the land on the recharge areas in any manner that might tend to adversely affect the quality of the water or reduce recharge.] **DELETE THE ABOVE PARAGRAPH?**

Closer to home, in response to a hydrogeologic inquiry into the ground water resources of Vashon Island, local residents elected to adopt zoning densities based upon recharge potential. Following a consultant's recommendations, residents adopted a zoning limitation of one family unit per ten acres in high recharge potential areas not served by sewers. Additionally, for low to medium recharge areas, one dwelling per four to five acres is permitted. When possible, high recharge potential areas are preserved as parks or recreational spaces.

[Some states, recognizing that certain activities can have adverse impacts well beyond their immediate vicinity, have imposed activity base land-use controls. For instance, the Edwards Underground Reservoir, an aquifer that provides water for over one million South Texas residents, is protected by relatively comprehensive regulation on human activities which extend over an large area. Since 1970, the Texas Water Quality Board has promulgated "Board Orders" regulating certain activities in the recharge area. The orders contain specific requirements to be met by sewage treatment plants, septic systems, proposed subdivisions and facilities for transmitting and storing toxic and hazardous chemicals. In addition, the orders state the Board's intention not to authorize industrial or sanitary landfills and confined animal feedlot operations in the recharge zone. The Board may also exclude sewage treatment plants from the zone or impose strict design and operating criteria to ensure protection of the aquifer. Septic systems are limited to one per acre and are subject to a five-year renewal license. Before being approved, subdivisions must meet certain conditions including concrete encasement of sewer lines, frequent street cleaning, minimum topsoil depth, use of ground water monitoring wells, restrictions on lawn fertilizers, and use of holding and settling ponds to retain storm water run-off.] **DELETE THE ABOVE PARAGRAPH?**

[Another example of state imposed land-use controls is New Jersey. The state designated the Central Pine Barrens, a largely undeveloped area characterized by sandy soils that quickly pass precipitation through to a large water table aquifer, as a **critical area.** New Jersey defines a critical area as one that contains or affects state or regional environmental, historical or archaeological resources, or is affected by a proposed public facility or major development. The Central Pine Barrens is a potential source of public drinking water. Because the porous sandy soils provide little protection from surface contaminants, the aquifer is particularly vulnerable to industrial, commercial, and residential development. Such development now threatens the Pine Barrens as a result of continuing expansions of the New York and Philadelphia metropolitan areas.

To protect the aquifer, New Jersey set ground water quality standards and limited septic system permits in conformance with the standards. In addition, Congress passed legislation in 1978 establishing the Pinelands National Reserve, as well as a Pinelands Commission, to search out ways to protect the land and the water resources of the Pinelands. To this end, the Commission completed a Comprehensive Management Plan, which includes the use of state and local police powers to protect the sensitive ecology of the area. The Plan calls for redistributing future growth away from sensitive areas to other designated growth areas.] **DELETE THE ABOVE TWO PARAGRAPHS?**

D. Aquifer Recharge Area Regulation

A ~~recently distributed draft~~publication entitled **Minimum Guidelines to Classify Agricultural, Forest, and Mineral Lands and Critical Areas** prepared by the Washington State Department of Community Development offers relevant guidance and suggestions pertaining to critical areas including aquifer recharge areas. Pertinent portions of this document are paraphrased
below.

The quality of ground water in an aquifer is inextricably linked to its recharge area. Few studies have been done in Washington state on aquifers and their recharge areas . In cases where studies of aquifers and their recharge areas have been completed, affected counties and cities should use this information as the base for classifying and designating these areas.

When no specific studies have been done, counties and cities should use existing soil and surficial geologic information to characterize the recharge area. To determine the threat to ground water quality, existing land use activities and their potential to lead to contamination should be evaluated. Lack of sufficient ground water data should not serve as an excuse to postpone or ignore resource planning.

Counties and cities shall classify recharge areas for aquifers according to the susceptibility of the aquifer. High susceptibility is indicated by land uses in the aquifer recharge area which are likely to result in contaminants in the ground water. Low susceptibility is indicated by geological characteristics and land uses which are not likely to result in contaminants in the ground water.

To characterize the susceptibility of the recharge area to contamination, counties and cities should consider the following physical characteristics:

* Depth to ground water
* Aquifer properties such as hydraulic conductivity and gradients
* Soil (texture, permeability and contaminant attenuation properties)
* Characteristics of the Vadose Zone(unsaturated zone) including permeability and attenuation properties
* Other relevant factors

The following should be considered to evaluate the potential contaminant loading:

* General land use
* Waste disposal sites
* Agricultural activities
* Well log and water quality test results
* Other information about the potential to cause contamination

Management strategy for recharge areas of low susceptibility to contamination should be to maintain the quality of the ground water. In recharge areas of high susceptibility to contamination, study should be initiated to determine if ground water contamination has occurred. Management strategy for these areas should include consideration of the degree to which the aquifer is used as a potable water source, protective measures to preclude further degradation, treatment measures to maintain potability, and alternative potable water sources.

Examples of areas with a critical recharging effect on aquifers used for potable water, may include:

* Sole source aquifer recharge areas designated pursuant to the Federal Safe Drinking Water Act where there is evidence the aquifer is vulnerable to contamination that would create a hazard to public health.

* Areas established for special protection pursuant to a ground water management program, chapters 90.44 and 90.54 RCW, and chapter 173-100 WAC.

* Areas designated for well head protection pursuant to the Federal Safe Drinking Water Act.

* Other areas meeting the definition of "areas with a critical recharging effect on aquifers used for potable water" in these guidelines.

E. SPECIAL AREA DESIGNATIONS TO ENHANCE GROUND WATER PROTECTION

There are a number of special federal state, and local area designations that may be used to enhance a Ground Water Management Program (GWMP). Incorporating them may offer such benefits as a source of funds to implement ground water protection measures, enhanced eligibility for grant funds, or expanded review of development proposals. Increased public recognition of the value of an aquifer may be another important result of special area designation.

The special area designations include:

* Areas with a critical recharging effect on aquifers used for potable water per RCW 36.70A Growth Management;

* Wellhead Protection Areas per the 1986 amendments to the federal Safe Drinking Water Act;

* Environmentally Sensitive Areas per WAC 197-11 State Environmental Policy Act Rules;

* Special Protection Areas per WAC 173-200 Water Quality Standards for Ground Waters of the State of Washington;

* Sole Source Aquifers per the federal Safe Drinking Water Act of 1974;

* Aquifer Protection Areas per RCW 36.36.

1. Areas with a critical recharging effect on aquifers used for potable water per RCW 36.70A Growth Management Act

The Growth Management Act (GMA) of 1990 requires all counties and cities in Washington to plan in order to manage growth. This act, much of which is codified in RCW 36.70A, requires that the largest and fastest growing counties (and the cities within them) plan extensively in keeping with the following goals:

Conservation of important timber, agricultural and mineral resource lands;

Protection of critical areas;

Planning coordination among neighboring jurisdictions;

Consistency of capital and transportation plans with land use plans;

Early and continuous public participation in the land use planning process.

Counties and cities must adopt comprehensive plans and regulations to protect designated critical areas and timber, agricultural and mineral resource lands.

The GMA requires the designation and protection of the following critical areas: wetlands; areas with a critical recharging effect on aquifers used for potable water; fish and wildlife habitat conservation areas; frequently flooded areas; and geologically hazardous areas. The GMA also requires that the comprehensive plans contain land use controls to protect quality and quantity of ground water used for public water supplies (RCW 36.70A.070(1).

The GMA requires that the comprehensive plans of adjacent jurisdictions or those who share related regional issues must be coordinated and consistent - a requirement of utmost importance for effective ground water protection. Meaningful protection of a dynamic resource that is shared by several jurisdictions is impossible without the cooperation of these jurisdictions.

Chapter 365-190 WAC, Minimum Guidelines to Classify Agriculture, Forest, Mineral Lands, and Critical Areas (Guidelines) were adopted by the Washington Department of Community Development (DCD) pursuant to the GMA. The Guidelines, which are advisory in nature, provide a general framework for classification, designation, and regulation of critical areas.

The Guidelines define "areas with a critical recharging effect upon aquifers used for potable water" as "areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water." Although this definition is somewhat circular, it is clear that aquifers used for drinking water are deserving of particular attention. In addition, it is suggested that those aquifers that are vulnerable to significant contamination be targeted.

The Guidelines refer frequently to "aquifer recharge areas" without defining the term. The term is used very generally and appears to refer to the entire drainage basin in which an aquifer is contained and from which it receives water due to infiltration of precipitation, run-off, and other surface water.

Mapping known critical areas is encouraged as the best way to communicate to developers and regulators the location of the protected lands. It is recognized, however, that mapping wetlands and aquifer recharge areas can be difficult and imprecise. Section 040(2)(g) of the Guidelines recommends that changes in designated areas be allowed as new information is available and errors are found.

The Guidelines suggest that the following be included in local government designation of critical areas that are to receive protection under the GMA:

* Sole Source Aquifer recharge areas designated pursuant to the Federal Safe Drinking Water Act of 1974;

* Special Protection Areas designated pursuant to Chapter 90.54 RCW, Water Resources Act of 1971, and Chapter 90.48 RCW, Water Pollution Control;

* Wellhead Protection Areas designated pursuant to the 1986 amendments to the Federal Safe Drinking Water Act.

Kitsap County and cities have ~~not~~ adopted "strategies for critical area designations and interim development regulations" which addresses areas with critical recharging

affect on aquifers as outlined in the Washington State Department of Community Development minimum guidelines, Chapter 36.5.190 WAC. This document regulates development by land use through SEPA in areas located around principle aquifers. ~~interim criteria for designating aquifer critical areas.~~ Comprehensive inter-jurisdictional coordination envisioned by the GMA ~~has not occurred.~~ should be provided by the "Kitsap County-Wide Planning Policy" developed through the Kitsap Regional Planning Council.

2. The Wellhead Protection Program under the federal Safe Drinking Water Act

The 1986 amendments to the Safe Drinking Water Act established a Wellhead Protection Program (WHPP) intended to safeguard ground waters that are tapped by public water supply wells. Each state is required to develop and implement a WHPP in accordance with criteria established by the Environmental Protection Agency (EPA).

A state WHPP must:

Specify the roles and duties of state agencies, local government entities, and public water suppliers in a wellhead protection;

Provide the criteria for delineating the boundaries of Wellhead Protection Areas (WHPAs);

Establish procedures for identifying sources of contamination within each WHPA;

Develop management programs to protect ground water supplies within each WHPA from sources of contamination;

Develop contingency plans for each public water supply system to respond to well contamination;

Provide citing criteria for new public water system wells to maximize yield and minimize contamination; and

Ensure public participation.

A WHPA is defined in the Safe Drinking Water Act as "the surface and subsurface area around a 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" (42 U.S.C.A. 300h-7(e)). The first step in the implementation of a WHPP is to delineate the WHPA boundaries.

The Washington Department of Health (DOH) has been designated by the governor as the lead agency for developing and administering the WHPP in this state. Approximately 12,000 public water systems (PWS) in the state will eventually be included in the WHPP. The Drinking Water Regulations (Chapter 246-290 WAC) will be revised to contain the WHPP requirements.

Due to the nature of wellhead protection, much of the actual implementation efforts will be done by public water systems, local governments and by those agencies with source-specific jurisdictional responsibilities. For example, the Washington Department of Ecology (Ecology) regulates underground storage tanks while the Washington Department of Agriculture regulates pesticide use. Those agencies would be responsible for emphasizing protection of the WHPA within their jurisdictional authority.

The following are highlights of the preliminary draft WHPP for Washington:

Delineation of WHPAs primarily based on the area immediately surrounding the well casing and areas describing the 1, 5, and 10 year time of ground water travel (TOT) to the well from the recharge area;

Inventory of potential sources of ground water contamination within the WHPA;

Development of management strategies to eliminate or minimize the possibility that these potential sources contaminate ground water.

PWS purveyors are responsible for delineating the WHPA and inventorying sources of contamination within the WHPA. State agencies are responsible for integrating wellhead protection measures into their existing programs. In many cases, this will primarily be done by placing a priority on existing activities to emphasize protection within the WHPA. Local land use authorities (cities, counties) are responsible for zoning controls and pollution sources outside the authority of the federal or state government. Local governments, where necessary, may also be responsible for developing more stringent programs than federal and state governments currently provide.

It is clear that a WHPP will be of particular value to municipal water systems whose WHPAs are located completely or primarily within their boundaries. A number of municipal cities including the City of Renton and the City of Tacoma have already successfully implemented a form of wellhead protection. The effectiveness of these programs was largely predicated on the ability of the municipal well owner to directly regulate land-use in all or a large portion of the zone of contribution.

However, where PWS do not control surrounding land-use, the success of the WHPP

will depend on the willingness of other city and county governments to impose necessary land-use or other restrictions.

Considering that there are approximately 1000 large and small public water system wells within Kitsap County, individualized land-use controls for each public well or well field in the county would be unworkable. It may be possible to develop a generic, county-wide WHPP under which water purveyors could apply to the county for protection. This type of WHPP could be implemented under the auspices of the aquifer recharge area provisions of the Growth Management Act. The preference towards county-wide requirements is reinforced in situations where well or well field owners lack sufficient resources to develop an individual WHPP. The state Wellhead Protection Program recommends a county-wide approach to wellhead protection although it is not required at present. While a cooperative, multi-jurisdictional program would, by definition, involve compromise, individual PWS could build upon the basic program at their discretion.

Development of minimum county-wide WHPP strategies involves an investment of time and money by the county, cities, and PWS purveyors. It will be technically demanding and politically challenging to develop a program that both provides necessary protection for WHPAs and complements the GWMP and other existing ground water protection efforts. The way would be made easier, however, by taking advantage of the recent experience gained in many cities and states around the nation. There are now many models for well head protection to be studied.

Local jurisdictions in Washington are beginning to develop programs to facilitate the development of individual WHPPs. There are also some efforts to develop coordinated approaches. For example, the adopted Northern Thurston County Ground Water Management Plan (GWMP) contains a provision for joint development of a county-wide WHPP by the County and cities. Jurisdictions will establish by inter-local agreement a committee to cooperatively develop the WHPP.

Clark County is also making headway towards the cooperative development of WHPPs. It has been awarded a Centennial Clean Water Fund grant to convene and staff a process to develop a minimum county-wide WHPP.

3. Environmentally Sensitive Area Designation Under the State Environmental Policy Act.

The State Environmental Policy Act (SEPA) (RCW 43.21C) is intended to provide decision makers and the public with sufficient information to evaluate the environmental consequences of proposed land, air, or water-use activities when those activities involve an action by a governmental agency. Such an action could range from the issuance of a building permit to undertaking a major construction project such as a dam or a highway. The procedural provisions of SEPA attempt to outline

a process for distinguishing between actions that are likely to have a significant adverse environmental impact and those that are not. In cases where significant adverse impacts are anticipated, an environmental impact statement (EIS) must be prepared.

The State Legislature authorized the Department of Ecology to develop rules for the implementation of SEPA. The rules that were subsequently developed and adopted by the Department of Ecology, WAC 19 7-11 SEPA Rules, are intended to provide a uniform environmental review process in all political jurisdictions within the state. They are also intended to help define what constitutes a significant adverse environmental impact and to outline the content of environmental documents prepared under SEPA.

In developing the SEPA rules, the Department of Ecology determined that some classes or types of activities, because of their size or nature, are not likely to represent a significant environmental impact and should, under ordinary circumstances, be exempt from SEPA requirements. Section 197-11- 800 (WAC) of the SEPA rules contains a list of these exempted types of activities, termed categorical exemptions. The categorical exemptions include some activities that could potentially represent a significant adverse environmental impact in areas of unusual ground water sensitivity.

These activities include:

The installation of underground chemical storage tanks with a capacity of less than 10,000 gallons;

The construction of commercial buildings of less than 4,000 square feet and associated parking for up to 20 automobiles;

The construction of parking lots for up to 20 vehicles;

The construction of agricultural structures of under 10,000 square feet;

The periodic use of Washington Department of Agriculture approved chemicals to maintain a utility or transportation right-of-way in its design condition;

The appropriation of 2,250 gallons per minute (GPM) of ground water for any purpose.

Local governments have the authority to lower thresholds for requiring environmental review by designating certain portions of their land use jurisdiction as Environmentally Sensitive Areas (ESAs). These areas are generally more vulnerable

to the adverse affects of land and water-use activities. The SEPA rules state that ESAs may include

> "but [are] not limited to areas with unstable soils, steep slopes, unusual or unique plants or animals, wetlands, or areas that lie within flood plains."

In designating a portion of its jurisdictional area to be an ESA, a county or city can eliminate many of the categorical exemptions found in Section 197-11-800 (WAC), including all but one of the land and water uses listed above. Categorical exemptions regarding appropriations of ground water cannot be revoked.

An ESA designation may provide several important benefits for an area that is susceptible to ground water contamination. First, it would assist in raising the level of awareness of both the public and governmental agencies regarding the sensitivity of the aquifer system to contamination from overlying land-use activities.

Secondly, designation would permit the Kitsap County Commissioners and city councils to eliminate many of the categorical exemptions from environmental review that are currently allowed under the SEPA rules. As a result, certain exempted land-use activities that pose a relatively high risk of contaminating ground water, such as installation of underground chemical storage tanks of under 10,000 gallons, could be required to undergo environmental review.

In determining the number of categorical exemptions to be eliminated, caution should be taken to revoke only those exemptions that bear a direct and significant relationship to ground water quality. A wholesale elimination of categorical exemptions might result in an unfavorable public reaction since many relatively innocuous activities such as adding a recreation room to an existing house or constructing a garage would require environmental review. Not only would such a broad-brush approach add an unnecessary burden on the public, but it would potentially create a glut of environmental checklists that would significantly add to the workload of agencies that must review or process environmental documents without actually affording better ground water protection.

One significant shortcoming of the SEPA process is that while environmental review assists the public and decision makers in identifying the probable adverse environmental impacts of a proposed activity or action, it does not provide basis for mitigation of the adverse impacts. Mitigation measures cannot be imposed unless some legally adopted ordinance, regulation, or policy exists that supports the requirement for mitigation. Adoption of the GWMP will provide the County and cities in the GWMAs legal basis for requiring mitigation because it contains policy for lands within the GWMA. This policy would be in addition to any existing regulations or policies already adopted.

4. Special Protection Areas Established Under Washington Water Quality Standards for Ground Waters

WAC 173-200-090 outlines procedures for Ecology to designate Special Protection Areas within the State of Washington. The purpose of designating Special Protection Areas is to identify portions of the state with ground waters that require extraordinary consideration or increased protection because of one or more unique characteristics.

Such characteristics include, but are not limited to:

Recharge areas and wellhead protection areas that are vulnerable to pollution because of hydrologic characteristics

Ground waters that support a beneficial use or ecological system requiring more stringent ground water quality criteria than those based primarily on drinking water standards

Sole Source Aquifers

Ecology will grant a Special Protection Area designation if an area contains one or more of the three aforementioned characteristics and such a designation is deemed by Ecology to be in the public interest.

Ecology can designate a Special Protection Area at its own discretion or at the request of a federal agency, another state agency, an Indian tribe, or local government. Requests for designation prepared by entities other than Ecology must provide sufficient information in support of the request to demonstrate that the designation would be appropriate under the conditions set forth in Chapter 173-200 WAC. At a minimum the following information is required:

A rationale for the proposed designation,

Supporting technical and hydrogeologic data,

A description of proposed boundaries for the Special Protection Area,

Documentation of coordination with affected state and local agencies, tribes, and water users.

Compliance with general procedures for public hearings, public involvement, and notification of affected governments including tribes is required before Ecology renders a decision concerning a request for designation of a Special Protection Area.

Ecology will consider the unique characteristics of a Special Protection Area when developing regulations, guidelines, and policies; when regulating activities; and when prioritizing department resources for ground water quality protection programs. Within Special Protection Areas, Ecology can choose to establish more stringent ground water quality criteria and contaminant enforcement limits.

In addition, Ecology can impose special requirements for permits issued under authority of Ecology administered programs. Examples would be the State Waste Discharge Permit Program (Chapter 173-216 WAC) and permits for the withdrawal of ground water (water rights) issued pursuant to Chapter 90.44 RCW (Regulation of Public Ground Waters).

5. Sole Source Aquifer designation under the federal Safe Drinking Water Act

The Sole Source Aquifer Program was established under section 1424 (e) of the Safe Drinking Water Act of 1974 and is administered by the Environmental Protection Agency (EPA). The primary intent of the program is to prevent projects that receive federal financial assistance from contaminating aquifers representing the sole or principal source of drinking water for an area. Projects that receive a portion, but not 100%, of their funding from the federal government are affected. An example would be a highway construction project funded jointly by the federal and state government. By contrast, a military installation is wholly financed by the federal government and thus is not restricted by the provisions of the Sole Source Aquifer Program.

In order to qualify for Sole Source designation, an aquifer must meet the following basic criteria:

> It must supply 50% or more of the drinking water consumed within the area for which the aquifer is supplying water,
>
> Alternative sources of drinking water must be of inadequate quantity or not be economically feasible to develop as a replacement for the aquifer.

The EPA is authorized to declare a ground water system to be a Sole Source Aquifer upon receipt of a satisfactory petition requesting such a designation. A petition can be submitted by any individual corporation, company, partnership, municipality, state, or federal agency. The petition must contain sufficient technical documentation to demonstrate that the aquifer meets the criteria for Sole Source designation (U.S. Environmental Protection Agency, February 1987).

There are no Sole Source Aquifers in Kitsap County.

6. Aquifer Protection Areas per Chapter 36.36 RCW

The Washington State Legislature passed legislation in 1986 which provided the authority for creation of local Aquifer Protection Areas (APAs). The purpose of an APA is to establish a funding base for ground water protection, preservation, and rehabilitation programs. APAs are established through an election ballot issue requiring approval from a simple majority of voters within the proposed APA. If voters approve the APA, the county can collect modest water and septic system user fees. Fees may only be collected from users of water withdrawn from an aquifer as opposed to a surface water source (RCW 36.36).

In 1987, voters in a portion of Spokane County established the first APA in Washington State. The water user fees established by the voters of Spokane County amount to $1.25 per month per residential equivalent. Septic tank user fees are also $1.25 per month per residential equivalent.

Until recently, the use of revenues generated from an APA has been limited to ground water protection planning, ground water treatment facilities, and waste water treatment facilities. As originally adopted, the law did not authorize use of the APA revenues for a full spectrum of ground water protection activities. For example, regulatory programs aimed at controlling pollution from underground storage tanks, hazardous wastes, or on-site sewage disposal systems were not covered.

However, the 1991 Legislature rectified this shortcoming through passage of Substitute House Bill (SHB) 1019. SHB 1019 amends Chapter 36.36 RCW to allow APA revenues to be used to fund the following activities in addition to those described above:

Monitoring of ground water quality and quantity;

Ongoing implementation of comprehensive plans to protect, preserve, and rehabilitate ground water, including Ground Water Management Programs;

Enforcing compliance with standards and rules relating to the quality and quantity of ground water;

Public education related to protecting, preserving, and enhancing ground water.

Thus, with these amendments, APA funding can support virtually all activities associated with the implementation of a Ground Water Management Program.

Potential drawbacks to the use of an APA to fund the implementation of the GWMP include the following:

firms and persons involved in UST-related activities. Some of the activities that must be done in the presence of licensed personnel are:

* All facets of installation of the tank and associated piping
* Retrofitting existing tanks to meet new requirements
* Installation and testing of cathodic protection systems and release detection equipment
* Testing of tank and piping tightness
* Decommissioning including excavating around the tank, tankpurging, removal of sludge and vapors, and removal of the tank

Owners of all tanks covered by the regulations must apply for and obtain an annual permit in order to operate. Permit requirements include (1) a properly completed installation checklist filled out by an Ecology-licensed installation supervisor, and (2) certification of compliance with corrosion protection of tanks and piping, financial responsibility requirements, and release detection requirements. Owners or operators of existing tanks must report their tanks to Ecology. Owners and operators of new tanks must annually certify compliance with the requirements of the regulations in order to obtain the subsequent year's operating permit. Permits may be revoked for non-compliance. Penalties may be levied against persons who violate regulations. It is illegal for suppliers to deliver a product to a tank unless a valid permit is displayed. It is also illegal to deliver to a tank known to be leaking. Authorized representatives of the State may gain access to premises for inspection of records, to sample, or otherwise monitor tank operation. Performance standards are provided for new tanks. Existing tanks must be upgraded according to a schedule.

D. Clean Up Programs

In addition to the above, programs exist at both a federal and state level to assure cleanup of contaminants released from underground storage tanks. **Section 205 of the Superfund Amendments and Reauthorization Act of 1986** created an Underground Storage Tank Trust Fund intended to pay for the cleanup of hazardous substance releases, including petroleum products, from underground storage tanks. The fund, administered by the EPA Office of Underground Storage Tanks (OUST), is making available a total of $500 million over a five year period ending in 1992. The life of this fund was recently extended by Congress for an additional five years.

The fund is intended to support cleanup of leaking underground storage tanks in cases where no financially solvent owner/operator can be identified, where the owner/operator refuses or is unable to promptly respond to the problem, or where an imminent hazard to public health or the environment exists. The fund also provides financial assistance to State governments for developing a state leaking underground storage tank response programs.

Ecology received assistance from the fund to develop this State's LUST Program, which was finalized in September of 1989. Ecology currently uses money from the fund to offset salaries and related expenses for the State LUST Program.

Releases of hazardous substances from underground storage tanks in Washington are currently addressed by tank owner voluntary cleanup actions or enforcement actions under the **Washington Model Toxic Control Act** passed by the voters as Initiative 97 in 1988. One of the main purposes of this act was to raise sufficient funds to clean up all hazardous waste sites in the State. The bulk of the revenue is generated through a tax on industry. The act creates the Topics Control Account and describes the many possible uses of revenues, one of which is funding for the Ecology LUST Program cleanup activities. In cases where a financially solvent owner/operator cannot be identified or is unwilling to undertake appropriate cleanup actions, Ecology will directly undertake the cleanup of a site under this act. If a financially solvent responsible party can be identified, Ecology will seek to recover costs incurred in any cleanup action.

E. Other Underground Storage Tank Issues

Ecology has developed a six-page informational document on Unused Underground Residential Heating Oil Tanks (UURHOTs) including considerations for operational home heating oil tanks. Installation and removal of abandoned home heating oil tanks are regulated by the Kitsap County Fire Marshal's Office, local fire districts, and cities under Article 79 of the UFC. The UFC requires that tanks which have been unused longer than a year be properly closed in a manner approved by the appropriate fire official. The Kitsap County Fire Marshal's Office is a part of the Department of Community Development (DCD).

III. GAPS AND PROBLEMS

Federal, State, and local regulations relating to USTs are very comprehensive and, if fully implemented and enforced, reduce the risk of degrading ground water quality through leaking USTs. Because of the great importance of ground water to Kitsap County residents, remaining concerns should be addressed and potential remedies identified where feasible.

Additional concerns center on:

(1) the capability of Ecology to administer the UST program in Kitsap County, in view of resource limitations,

(2) determination of whether a part or all of Kitsap County should have more stringent UST requirements than provided by state and federal regulations,

(3) the lack of environmental review (SEPA compliance) for USTs with a capacity of 10,000 gallons or less,

(4) the lack of an education or awareness program concerning USTs which are exempt from federal and State regulations,
(5) the lack of knowledge concerning the contamination potential presented by unused, underground home heating oil tanks.

It is important to note that state and federal UST regulatory programs do not cover all USTs. Notable exceptions are:

1. Farm or residential UST systems of 1,100 gallons or less capacity used for storing motor fuel for non-commercial purposes, and
2. UST systems used for storing heating oil for consumptive use on the premises where stored, except that systems with a capacity of more than 1,100 gallons have a reporting requirement.
3. USTs with a capacity of 10,000 gallons or less are exempted from environmental review under SEPA.

The first two exceptions noted above are subject to local regulatory authority under Article 79 of the Uniform Fire Code (UFC) which has been adopted by Kitsap County Ordinance.

According to DCD staff (Gillis, personal communication, April 1992), the public is generally unaware of home heating oil underground storage tank regulations and general enforcement of Article 79 relating to UURHOTs is not rigorous; and inspections of operational tanks are minimal.

IV. RECOMMENDATIONS AND STRATEGIES

The term home heating industry includes gas companies, electric companies, fuel and oil companies, and contracted installers. This term is used in the subsequent recommendations.

1. Request that Kitsap County and the cities insure the compliance with the existing rules for reporting releases from Home UST following positive discovery. Insure compliance with the Model Toxic Control Act.

2. As Wellhead Protection Areas are established by individual utilities and as critical aquifer recharge areas are identified under the Growth Management Act, Kitsap County and the cities should seek designation of Environmentally Sensitive Areas under Chapter 90.76 RCW by Ecology in order that more stringent UST regulations can be put into effect, as required. Action must be accomplished before 1996 for rules to apply to all USTs, existing and new.

3. Kitsap County and cities, if appropriate, seek establishment of Environmentally Sensitive Areas under SEPA (WAC 197-11-908) so that the exemption of 10,000 gallons or less USTs be eliminated.

4. BKCHD will work with the home heating industry(ie., gas, electric, and oil) to increase the level of public and the home heating industry awareness concerning potential ground water problems associated with environmentally sensitive areas (the operation and abandonment of underground storage tanks).

5. Kitsap County and cities will set a requirement for disclosure of abandoned USTs on a property, prior to property ownership transfer. (Private industry-real estate agents have adopted this practice through their associations standardized process of the sale agreement process and form used).

6. Kitsap County and cities will require home heating industries and their contracted installers to assure that the consumer is aware of the requirement for proper abandonment of Home Heating Oil tanks whenever a home heating oil source is converted to gas or electricity. The requirement should also include revisions to recently passed standards for tank abandonment.

7. Kitsap County and cities will work with the industry to set standards for Home Heating Oil Tank (HHOT) installation.

8. Kitsap County should require abandoned tanks to be pumped of all material and properly closed. The County should also annually review new laws and codes as they occur to ensure compliance with the new standards.

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KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: SOLID WASTE DISPOSAL

January 14, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper discusses the groundwater quality issues relating to solid waste disposal facilities in Kitsap County with the major emphasis being on landfills. Previously developed information found in other final and draft groundwater management programs (see References) has been extensively used in developing this paper. For reading ease, citations, except for statutes or rules, have not been used.

Goal: To prevent the occurrence of groundwater contamination through closed or operating landfills in Kitsap County.

B. Background

Solid waste landfills can pose a threat to groundwater quality due to leachate production. Leachate is water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases therefrom (see WAC 173-304-100(44)). Leachate can be produced by rainfall percolating through landfill waste materials, addition of liquid wastes to a landfill, or a high water table easing direct contact of the wastes and groundwater.

Leachate generally consists of a mixture of chemical and biological substances. The precise composition of the leachate generated by a solid waste facility is dependent on the nature of landfill materials. While landfill operators currently take steps to ensure that hazardous and dangerous wastes are not accepted for disposal, this was not the case until recent years. Therefore, the risk of potential contamination of groundwater is likely higher in old landfills than in currently operated solid waste facilities that are complying with current laws and regulations. In addition to a lack of control over the type of wastes that were disposed of in old landfills, the citing of such landfills in the past in old gravel pits, gullies, or ravines without regard to the groundwater table relationship increases the potential for groundwater contamination.

In Kitsap County's "Final Amendment to the 1990 Final Comprehensive Solid Waste Management Plan," fifteen closed or abandoned landfills have been identified throughout Kitsap County. Olympic View Sanitary Landfill (OVSL) is now the only operating mixed municipal solid waste (MMSW) facility in Kitsap County. The Morrison Demolition Landfill, an active construction and demolition waste landfill was closed in November, 1992 .

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Federal

Resources Conservation and Recovery Act, 42 USC Section 6901. Amends the 1965 Solid Waste Disposal Act. Outlines Federal government program to manage solid and hazardous wastes and establish standards for treatment, storage, and disposal of solid and hazardous wastes. Encourages the development by states of environmentally sound methods of solid waste disposal. Washington State is called on to develop a plan to implement the guidelines and to assume enforcement responsibility. However, EPA has no legal authority to require states to follow the guideline. This Act prohibits solid waste facilities from contaminating current or potential underground drinking water sources beyond the solid waste disposal site boundary, or an alternative boundary selected by a court. Maximum contamination limits established in the Safe Drinking Water Act will be used as groundwater standards where possible. Otherwise, there is to be no increase over background levels.

Comprehensive Environmental Response, Compensation, and Liability Act, 42 USC Section 9601. Known as "Superfund," the Hazardous Substances Response Fund finances government containment or clean up responses to actual or threatened releases of substances that may harm human health or the environment, including groundwater. It is sustained mainly by taxes on petroleum products and chemicals. The liability provisions authorize EPA to hold polluters liable for the expenses of removal, cleanup, and containment, as well as to force the responsible parties to undertake such actions at their own expense. The response provisions obligate private and government entities to report spills of hazardous substances in excess of specified quantities to EPA or the Coast Guard. It is designed to remedy existing contamination rather than to prevent such problems.

Federal Insecticide, Fungicide and Rodenticide Act, 7 USC Section 136. The polychlorinated biphenyl (PCB) regulations contain restrictions designed to prevent and clean up spills that could enter groundwater. Landfills permitted by EPA to receive PCB wastes are required to conduct groundwater monitoring pursuant to 40 CFR 761.75.

B. State

In 1969, the Washington State Legislation enacted our first Solid Waste Management laws, Chapter 70.95 RCW, which was most recently amended in 1989 and 1991. The 1989 amendments were significant in that priorities for solid waste management were set in descending order as follows:

(1) Waste reduction

(2) Recycling, with source separation of recycled materials as the preferred method.

(3) Energy recovery, incineration, or separated waste landfills.

(4) Energy recovery, incineration, or mixed waste landfills.

The State's goal was enunciated "...achieve a 50 percent recycling rate by 1995." This program directional guidance should extend the life of existing landfills and provide more time for a careful site selection process for new landfills.

Chapter 70.95 RCW establishes permitting, financial, and technical review procedures for solid waste facilities. It gives primary responsibility to local governments for solid waste handling. Cities have the option to write their own solid waste plans or cooperate with counties in the development of a county or regional plan, which the Department of Ecology (Ecology) would approve. These plans may be more stringent than the State requirements. Ecology reviews all permit applications and may appeal the issuance of permits. This law, Chapter 70.95 RCW, also authorized Ecology to promulgate the "Minimum Functional Standards for Solid Waste Handling," Chapter 173-304 WAC, which is described below.

WAC 173-304 The "Minimum Functional Standards for Solid Waste Handling" (MFS) contain solid waste disposal facility standards for leachate management, ground and surface water monitoring, facility citing operations, and other factors important to groundwater management. All active landfills in Washington State are required to comply with MFS regulations or obtain a variance, temporarily suspending this requirement, from Ecology. The following summarizes important elements of the MFS as they relate to groundwater management at active as well as closed solid waste disposal facilities.

WAC 173-304-130 Locational Standards for Disposal Sites. Ten citing criteria are described in this section of the MFS. these criteria include geology, groundwater, natural soils, flooding, surface water, and land use.

WAC 173-304-407 and 467 General Closure and Post-Closure Requirements. These sections establish requirements for developing closure and post-closure plans for landfill facilities and procedures for working with local health jurisdictions during the closure process. Also, Section 467 requires financial assurance for twenty years following closure for maintenance and monitoring.

WAC 173-304-460 Landfilling Standards. These regulations govern landfill design, landfill maintenance and operation, leachate management, and ground and surface water monitoring. WAC 173-304-460(2)(a) maintains that "An owner or operator of a landfill shall not contaminate the groundwater underlying the landfill, beyond the point of compliance." The "point of compliance" is the part of groundwater that lies beneath the perimeter of the active area as that active area would exist at the closure of the facility. This minimum compliance level for Washington State is set at the standard as defined in WAC 246-290, the Sate Drinking Water Standards. Local health jurisdictions have the option to establish a stricter point of compliance.

WAC 173-304-490 Groundwater Monitoring Requirement. These requirements apply to the number and location of groundwater monitoring wells. Monitoring frequency and the parameters requiring testing are also included in this section.

WAC 173-304-9901 Maximum Contaminant Levels for Groundwater. References for Federal and State regulations that define maximum contaminant levels for groundwater are provided in this section.

C. Local Programs

Administration and enforcement of solid waste regulations in Kitsap County is the joint responsibility of the Bremerton - Kitsap County Health District (BKCHD), the Kitsap County Solid Waste Division (KCSWD) of the Department of Public Works, the incorporated Cities, Tribes, and the Navy.

The County has the authority to own and operate solid waste disposal facilities or to contract for these services. County control of disposal of solid waste generated within incorporated jurisdictions requires interlocal agreements between the County, City, or Tribes.

The County has the authority and responsibility to prepare comprehensive solid waste management plans (CSWMP) for unincorporated areas and for jurisdictions that agree to participate in the planning process. Cities may also develop their own and operate solid waste handling systems and prepare their own CSWMP, but in Kitsap County, the four cities (Port Orchard, Poulsbo, Bremerton, and Winslow) have participated with County staff (KCSWD) in developing one CSWMP. The most recent CSWMP work is the previously referenced "Final Amendments to the 1990 Final Comprehensive Solid

Waste Management Plan," June 1992. All cities, as well as the Suquamish Tribe and Port Gamble Klallam Tribe, have participated in this work.

The BKCHD issues permits for solid waste facilities and enforces solid waste handling regulations in the County. BKCHD inspects different facilities at various frequencies, and regulates the storage, treatment, transportation, and disposal of special waste materials. In 1992, BKCHD had 4.0 Full Time Equivalent(FTE) budgeted for solid and moderate risk waste operations and management. BKCHD is the primary regulatory authority for solid waste management in the cities and the County. Solid waste management on reservations is under tribal and/or Federal regulatory authority.

III. GAPS - CONCERNS

The potential for groundwater contamination resulting from existing operational and future solid waste disposal landfills is reduced because of strict regulatory controls for operating and closure and stringent citing criteria for new landfills. There is, however, concern relating to the fifteen closed landfills that have been identified in Kitsap County as shown on Figure 8-1 and described on Table 8-1 of the June 1992 Final Amendment to the 1990 Final Comprehensive Solid Waste Management Plan for Kitsap County. The table indicates that seven of the fifteen landfills had accepted MMSW, demolition, and industrial wastes, and twelve of the fifteen have had no post-closure maintenance. The June 1992 Amendment, although very comprehensive in such areas as waste reduction and recycling and looking toward the future, does not directly address existing or potential contamination problems that may result from the closed landfills. The plan does show that twelve identified closed landfills are monitored by the BKCHD on a limited basis, but for the most part it appears that the impacts of the closed landfills on groundwater are not known. Fortunately, few, if any, of the landfills appear to overlay any of the principal aquifers (see Exhibit II-8 of Vol. 1, Kitsap County GWMP, Grant No. 1).

It is important that the State goal of a 50 percent recycling rate by 1995 be achieved to extend the life of the OVSL. Even with this, Kitsap County will still have to locate a site for a new landfill to be available at some presently undetermined future date. Notwithstanding the present strict regulatory control over new landfill development, proper site selection is a concern.

IV. RECOMMENDATIONS

1. Request BKCHD develop an abandoned (or closed) landfill investigation program to determine whether landfills have caused groundwater quality problems, either underlying or down gradient.

< NOTE: BKCHD Expressed great concern over the cost of this proposal>

2. Support and encourage more comprehensive County efforts in the recycling program.

3. Petition Kitsap County and Cities to preclude new landfill citing within principal aquifer areas as identified in Vol. 1, Kitsap County GWMP, Grant No. 1 or aquifer recharge areas as identified by the County pursuant to the requirements of the Growth Management Act.

IV. REFERENCES:

Chapter 70.95 RCW, Solid Waste Management Reduction and Recycling.

Chapter 173-304 WAC, Minimum Functional Standards for Solid Waste Handling.

Clover/Chambers Creek Basin Ground Water Management Program, prepared by Brown and Caldwell Consultants, and other, December 1991.

Final Comprehensive Solid Waste Management Plan (for Kitsap County). prepared by Kitsap County Department of Public Works, October 1990.

Final Amendment to the 1990 Final Comprehensive Solid Waste Management Plan, prepared by Kitsap County Department of Public Works, Solid Waste Division, and others, June 1992.

Ground Water Quality Issues Related to Solid Waste Landfills, prepared by Trudy C. Rolla, Seattle-King County Department of Public Health, Draft Issue Paper, August 1, 1991.

Kitsap County Ground Water Management Plan, Grant No. 1, Basic Data Collection and Management Issues, Volumes I and II, prepared by Kitsap County Ground Water Advisory Committee, and others, April 1991.

North Thurston County Ground Water Management Plan, prepared by Thurston County Health Department, and others, Draft February 1992.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: HAZARDOUS MATERIALS

January 14, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the danger to ground water posed by hazardous materials. It will describe and define the nature of hazardous materials of concern and examine pathways by which contaminants can enter aquifers. Existing regulatory and non-regulatory programs for risk reduction and control will be reviewed. Gaps and problems will be identified along with recommended actions and strategies.

1. Threat

Hazardous materials represent a variety of threats to drinking water supplies. Both surface and ground water sources can suffer if hazardous materials are introduced. Pollution can be much more severe for ground water, since contamination can be persistent and difficult to clean-up or mitigate. Hazardous materials are abundant. Seemingly harmless chemicals, that we come in contact with routinely, can become hazardous if introduced to an aquifer in sufficient quantities. Large quantities of potentially hazardous materials are produced, transported, consumed, and disposed of every day. Hazardous materials are in constant motion on rails and highways. The threat to water supplies is significant. Therefore, programs and regulations to control hazardous material production, transportation, storage, and disposal must be comprehensive.

2. Goal

The goal is to minimize the risk to ground water associated with hazardous material production, transportation, storage and disposal. Local actions must be practical, comprehensive, creative, and achievable. They must also complement state and federal government laws and regulations.

B. Definition

Various definitions for hazardous materials exist. In order to be appropriate and comprehensive enough for ground water protection, the definition of hazardous material in this issue paper draws on definitions from various regulations. It is conservative and

broad. It recognizes the threat various chemicals can present to ground water.

> **Definition: Hazardous Material: Any substance which has the possibility of being introduced into an aquifer in sufficient quantity and strength to threaten the aquifer's beneficial use.**

This definition will facilitate a more comprehensive approach than would be possible if only regulated hazardous materials and household hazardous wastes were considered. Before discussing programs to control substances, we will review the various pathways contaminants can reach ground water. Given the fact that chemicals are useful and in some cases essential, controlling pathways to ground water is frequently a more feasible approach than eliminating the chemical. Understanding pathways can help define strategies for risk reduction. Lack of knowledge of the potential threat, or chemical content, often leads to improper application or disposal of chemicals.

C. Risk Pathways

Pathways will be examined in four basic categories. Just as the chemicals or hazardous materials can be characterized by type of user, contaminant pathways can be similarly characterized by source. The four categories are home, commercial/industrial, agricultural and transportation.

1. Home Use

Pathways for contaminant entry into ground water from homes generally fall into two categories: inside use and outside use or spills. Lack of knowledge of chemical content or the hazard a certain chemical presents, often leads to improper application or disposal.

Inside. A threat from inside the home results primarily when hazardous materials are poured down a drain and a septic tank and drain field is used for sewage disposal. Home chemical use is a threat in sewered areas only if the community uses a method of sewage disposal which includes land disposal. Large spills inside a home could be a threat if not properly cleaned up, but such accidents are unlikely to be a significant threat.

Outside Use: Storage/Application/Spills. Typical chemicals used or stored outside the home include fertilizers, pesticides, petroleum products, and paints. If these materials are managed properly, there should be little or no waste. Too often, however, materials are stored improperly, spills occur, or the "more is better" thinking leads to over application of pesticides. Improper disposal or handling of antifreeze, motor oil, and gasoline can contaminate the ground around a home. As a result, the potential for ground water contamination exists.

Septic. The spectrum of chemicals used inside the home is generally greater than those used outside, but the volumes are smaller, and the pathway to ground water usually involves a septic system. Cleaners, polishes, waxes, and paints, are the primary materials of concern. Some of these products contain toxic, long lasting chemicals, which when coupled with a high density of septic fields, can cause low level aquifer contamination. Like outside applications, proper handling of hazardous materials should result in little or no waste, and therefore, little or no contamination.

2. Commercial

Commercial use of chemicals presents contamination pathways similar to home use. However, the potential magnitude of contamination is much greater. While there are inherent releases of chemicals to the environment with most chemical use and handling, most releases of liquids occur in one of three ways.

The most obvious pathway is through accidental releases or spills. Handling materials always presents a risk of spills. However, handling materials properly, taking measures to prevent spills, and preparing to respond to an accident can significantly reduce the degree of damage.

Improper disposal directly to the environment is the second pathway. Most materials judged to be hazardous are regulated except in small quantities (defined later). For regulated materials, disposal decisions must be documented and reported. The receiving disposal facility must be licensed. For small regulated quantities of hazardous materials, and other un-regulated materials, disposal can occur virtually anywhere and cause problems. Many businesses do not follow proper handling procedures and send hazardous waste to local landfills along with other solid wastes. Others dispose of material on site, ignoring the potential hazard to ground water.

The third pathway is through septic systems. In some areas, business and commercial facilities use on-site septic systems for sewage disposal. Illegal and thoughtless disposal of used chemicals at businesses, such as dry cleaners and photo processors, has lead to serious aquifer contamination. Business, commercial, and industrial operations who use on-site systems sewage disposal, need to take special precautions to avoid introducing hazardous materials into septic drainfields.

Materials disposed through the solid waste stream are becoming less of a threat to ground water because of new landfill construction standards. Most landfills now has liners and leachate collection to minimize contamination of ground water. As non-conforming landfills are closed and covered the threat of past dumping practices will diminish.

In most cases, improper disposal is the result of a lack of knowledge. Because legal penalties and potential liabilities are so high, few businesses knowingly subject

themselves to the risk of intentional disposal violations. The pathway of concern, therefore, is on-site handling and disposal by inadequately trained people.

3. Transportation

Transportation Spills. The risk of spilling hazardous materials as the result of a traffic accident is a major concern. A wide variety of materials are transported by rail and road every day.

Transportation Maintenance. Another pathway for contamination from transportation is through application of chemicals as part of right-of-way maintenance. Herbicides and pesticides are routinely used to control weed and plant growth along corridors. Even when chemicals are applied by a licensed applicator, the risk of a spill or over application exists.

4. Disposal - Landfills.

Some older landfills may be a contaminant pathway. New landfills and new areas within landfills, should now be operating under the State's Minimum Functional Standards which call for liners, leachate collection, ground water monitoring, and closure of non-conforming landfills. Consequently, landfills (new and properly closed) should not represent any significant hazard to ground water.

Older landfills which closed prior to 1989 as required in the State's Minimum Functional Standards may still present a hazard to ground water. Past hazardous material dumping can cause delayed ground water contamination. The State Department of Ecology (Ecology) has an active program to assess potential or reported dumping sites.

5. Contaminated Sites

Ecology has identified over 900 contaminated hazardous waste sites in Washington state. If these sites exist in an aquifer recharge area, a risk exists. In Kitsap County, several National Priority List's hazardous waste sites are located in recharge areas. The significance of the risk depends on the vulnerability of the aquifer to contamination. Vulnerability is determined by the nature of the chemical contaminant, the hydrogeologic characteristics of the area, and the speed with which contamination is migrating.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Introduction

Depending on how a hazardous material is used or stored, it may or may not be regulated. Hazardous materials are regulated under several different statutory authorities and with different requirements. For example, there are many hazardous materials (chemicals) regulated under the Superfund Amendments and Reauthorization Act (SARA). The chemical list developed under this act has the purposes of providing a "Community Right to Know." Categorization of materials under the Department of Transportation's (DOT) Hazardous Materials Regulations is broader and is concerned with transporting a variety of chemicals. Some materials are regulated only when certain large quantities are assembled. Many common household chemicals, for example are regulated if stored in large quantities.

B. Unregulated Materials

Home uses of hazardous materials include pesticides, drain cleaners, motor oil, and gasoline. While these materials are generally kept and used in small quantities, they can represent a significant low level and long term threat to aquifer water quality. A list of typical materials used in the home and some of the hazardous chemical they contain is presented in Table I.

1. Chemicals - Home

Chemical employed in the home, for the most part, can be used in a way which avoids contamination of ground water. The threat can be avoided as long as the materials are not dumped on the ground or in the drain. Unfortunately, many materials are expressly designed for cleaning toilets and drains. Homeowners are often not aware of the hazards some materials present. As a result, wastes end up in disposal systems and over application results in migration of hazardous materials to the ground water.

2. Petroleum - Home

Petroleum products have a variety of uses around the home. Fortunately, most of these uses consume the hazardous material (e.g., gasoline is burned in the lawn mower, heating oil provides heat in the winter). Storage of petroleum products results in the most significant threat to drinking water. For a variety of reasons, large quantities of gasoline are generally not stored around the house. Deteriorating underground tanks are a well known threat to ground water. Both Federal and State Governments have enacted legislation to regulate many of the larger, commercial storage tanks and facilities because of risk. Home tanks, however, remain exempt

from regulation. The enormous number of these tanks is the primary reason for the exemption.

3. Other materials

A variety of materials, not considered to be hazardous, might pose a problem for aquifers if introduced in significantly large quantities. For example, for years, used tires were stockpiled with no realization of some of the risk they presented. Although there has always been concern over fire potential and mosquito breeding, it was only after a few large piles had burned that concern was raised about contamination from the ash residue. Subsequently, several expensive clean-up actions were required as the result of tire, a non-hazardous material, burning. Other uncontrolled chemicals which could concentrate in ground water to potentially toxic levels include fertilizers and pesticides.

C. Regulated Materials

Most chemicals are regulated at some point in their production, transportation, use, or disposal. The following is a general overview of chemical regulations.

1. Chemicals - Commercial Use

Large quantities of hazardous chemicals are used in industrial and commercial applications. Regulations often occur early in the life of a given chemical. For example, under the Toxic Substances Control Act, new synthetic organic chemicals are required to be registered prior to production. In this way, some of the hazards are documented and predicted in advance of their sale, and a data base of information is created to assist worker safety and emergency response. Other chemicals (organic and inorganic) become regulated at other points in their pathway from production to product, by-product, or waste.

The laws include: Resource Recovery and Conservation Act (RCRA), Toxic Substances Control Act (TSCA), DOT Hazardous Materials Regulations, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and Superfund Amendment and Reauthorization Act (SARA).

2. Petroleum - Storage

Petroleum storage, as already mentioned, is regulated when amounts of material are above certain thresholds. Regulatory attention has focused on underground tanks through recent regulations and laws under the RCRA program and state legislative action. Spill response plans have been required for several years under the provisions of the Clean Water Act for above ground storage. As with underground tanks, the

provisions apply to large storage facilities.

3. Petroleum - Transport

As with many hazardous materials, petroleum transportation is controlled under transportation regulations (US DOT - Hazardous Materials). These rules basically call for a warning placard to be placed on the vehicle and require shipping papers and emergency information to be kept in the vehicle cab.

4. Wastes - Chemical

For years, chemical wastes (or hazardous wastes) had no perceived value and were dumped indiscriminately. More recently, federal and state governments have imposed severe restrictions on hazardous waste disposal. Unfortunately, a portion of the chemical waste stream continues to avoid regulation under the term Small Quantity Generator or Household Quantities.

5. Pesticides/Herbicides - Commercial/Farm

Farm use of pesticides and herbicides are regulated to the extent that a licensed applicator must apply most of the materials. Like other regulations, quantities and type of chemical determines which materials are controlled.

D. Regulatory Programs

As mentioned, regulatory programs cover many hazardous materials. Hazardous materials regulated under RCRA, SARA, TSCA, FIFRA, and DOT are generally hazardous to humans or the environment because of toxicity, flammability, reactivity, or corrosivity. In other words, ingestion, inhalation, or contact with these materials is hazardous to human health and/or other life forms.

1. RCRA/Solid/Dangerous Wastes Regulations

The Federal Resource Conservation and Recovery Act (RCRA) of 1976 (40CFR 260) - as amended in 1984 - is a comprehensive piece of legislation created in reaction to improper handling of waste materials. The legislation contains provisions for handling a variety of "hazardous" and other waste streams. It addresses three major waste categories: 1) Hazardous Wastes, 2) Solid Wastes, and 3) Underground Tanks.

a. Hazardous Waste

The hazardous waste stream has the highest priority for EPA. Consequently this section of the law has had the most attention and notoriety. RCRA was termed

the "Cradle to Grave" legislation which regulates hazardous wastes from the time of creation to ultimate disposal.

Washington was one of the first states to pass legislation in support of RCRA. Actually, Washington which has been regulating hazardous waste since 1984, has more stringent regulations than the federal government.

Under the State's "Dangerous Waste Regulations"(Chapter 173-303 WAC), waste materials thought to be hazardous must be "designated" through a process which determines the characteristics of the material. As in federal regulation, hazardous waste generation of small quantities is exempt from most provisions of the state rules. The regulatory threshold amounts are 10 times lower under the state rules. Larger generators must meet strict requirements for record keeping, storage, and disposal. However, small quantity generators are relatively uncontrolled and free from requirements. Small quantity can be amounts of hazardous waste up to 220 pounds per month.

Washington State has recently required businesses to conduct Waste Reduction Planning (Hazardous Waste Reduction Act of 1990). Under the terms of this legislation, large, regulated generators of hazardous waste must develop plans for the reduction of hazardous wastes. The overall goal of the legislation is a 50% reduction by 1995.

Other than fire codes, there are currently no programs which regulate hazardous wastes at the local level.

b. USTS

Underground Storage Tanks are regulated under RCRA by the Federal Government (EPA) and under specific legislation by the State (Ecology). Background, issues, and options have been covered in another Issue Paper, and therefore, will not be covered here.

c. Landfills

A portion of the RCRA statute covers solid waste. Activity under that portion of the statute has lagged behind Ecology's action under the state's solid waste legislation (Chapter 70.95 RCW). Ecology has developed "Minimal Functional Standards" (Chapter 173-304 WAC) which require lined landfills, leachate collection, and a variety of measures which Federal rules have only recently required. Consequently, Washington is generally ahead of many parts of the nation in environmental protection from landfill operation. All non-conforming landfills should have been closed by October 1989.

Under the State Solid Waste Laws, local governments are charged with administration of the Solid Waste Regulations as they apply to landfills and transfer stations. This function has been handled by local health districts and departments throughout Washington.

Currently in Kitsap county, site compliance is good. All operating landfills are in compliance with standards or are operating under compliance schedules issued by the Health District or Ecology.

2. CERCLA (Superfund)/Model Toxic Control Act (MTCA)

The Federal "Superfund" legislation of 1980 (Comprehensive Environmental Response, Compensation and Liability Act - CERCLA) was created to assure that the nation's worst contaminated sites were cleaned-up. It has received considerable attention because of large, highly toxic waste sites in the program (e.g., Times Beach and the Love Canal). This very expensive program has been criticized for its slow progress, excessive red tape, and lack of cost-benefit criteria.

It was clear from the start that the Superfund program was faced with more contaminated sites than it could reasonably manage. Many sites will simply not get attention. Washington State began a clean-up effort in the early 1980's and identified over 500 contaminated sites by the middle of the 1980's. This effort was largely funded by general tax revenue and because of limited funding, targeted cleanup for only a few sites. The legislature subsequently provided State Superfund legislation (1986) which was followed in two years by the Model Toxic Control Act - an initiative from the people (Initiative 97).

RCRA and the Dangerous Waste programs are designed prevent new sites from being created and the clean-up programs should eventually correct existing hazardous waste sites. Two factors have caused the number of sites to increase from nearly 500 to over 900. First, existing sites, which were previously unknown, have been discovered. Second, new spills, fires, and chemical applications have created new sites.

The Federal process is limited. Only sites which rank high in the Hazard Ranking process can be nominated for the National Priority List (NPL). The process is lengthy and expensive. Superfund money is limited to NPL sites. The state has instituted a similar, but less lengthy process to prioritize and cleanup state designated sites. Even with this less cumbersome process, progress is relatively slow.

Both the State and Federal process frequently have become bogged down in legal maneuvering. The stakes, in terms of clean-up costs and liability, are generally high. The State Supreme Court recently ruled that parties cleaning up a site voluntarily (without orders from Ecology), could not file a subsequent suit against other

responsible parties to share in the costs of the clean-up. This ruling is expected to slow action on sites where Ecology has not been involved. Legislative action is needed to assure parties, who want to begin cleanup, that they will have the potential to recover some of the costs from other responsible parties at a later date.

Leaking underground storage tanks (LUSTs) are handled separately from non-leaking tanks. Both EPA and Ecology have programs for cleaning up Leaking Underground Storage Tanks. EPA has participated primarily by funding state clean-up programs. Ecology has developed reporting requirements and clean-up standards. The Bremerton-Kitsap County Health District (BKCHD) is involved in locating and monitoring treatment of petroleum contaminated soils.

3. SARA Title III

The Superfund Amendments and Reauthorization Act of 1986 (SARA) contain numerous sections or titles. One section, Title III, contains provisions for "Community Right to Know" and Emergency Response.

a. Community Right to Know

Under the terms of this section, entities handling hazardous materials come under varying levels of reporting requirements which enable the community (especially emergency response groups and agencies) to know the types and amounts of chemicals on hand. Reportable Quantities vary from chemical to chemical. In addition, businesses or companies must report annually, accidental or process related releases of controlled chemicals. EPA maintains a data base of reported releases.

b. Emergency Response

An emergency response organization is required for each state. In Washington, the base level of this structure is a County or local Emergency Response Committee. Reports of chemical storage or release are primarily intended for this group and local fire fighters. Kitsap County has created a Local Emergency Response Committee and has an Emergency Response Coordinator on staff. This group has been working closely with the Kitsap County Disaster Assistance Council to develop an integrated Disaster Response Plan.

Like many legislative fixes to problems, funding for Emergency Response committees has been inadequate. Consequently, many local structures have been established which suffer from a lack of resources to fully meet the intent of SARA Title III.

Kitsap has an excellent emergency response capability for a largely suburban or

rural County. There are several well trained first responders in local fire departments. In addition, the U.S. Navy, with two large facilities in the county, has a comprehensive HAZMAT response capability. Navy response off-base is limited to situations of "eminent danger," which is when they would be needed most. State officials are considering creation of regional HAZMAT response units in order to make more effective use of expensive resources.

Section I of SARA, contains provisions for worker training relating to hazardous materials. Federal and state rules require any business which handles hazardous materials to provide training for their workers in emergency response. The training is required at differing levels depending on the level of emergency response expected from the worker.

4. Transportation Labeling, Placarding, Shipping Papers

U.S. Department of Transportation Regulations (US DOT Regulations) for hazardous materials focuses on three areas: Labeling, placarding, and Shipping Papers (Manifests). DOT has very specific requirements for labeling hazardous materials. Vehicles carrying materials must be placarded with appropriate DOT signs. Recent changes to DOT regulations require placement of emergency information on shipping papers (such as a phone number where 24 hour emergency response information is available) and emergency response information in the vehicle (generally a copy of the DOT publication Emergency Response Guidebook).

Hazardous wastes (under RCRA) utilize a specific manifest form which was developed to track waste material from point of origin to disposal.

Regulations do not require notification to local government related to hazardous material transport.

5. Fire Regulations

State and local fire regulations can help control the amount and type of hazardous materials stored at any location. For example, above ground storage of gasoline is generally prohibited in most counties. Under the Uniform Fire Code (Articles 79 and 80), heating oil tanks which are not in use must be closed, and spill prevention measures need to be taken for storage of materials above ground. Instances of chemical fires, injuries, evacuations, and environmental contamination have led to regulations covering the manner in which specific types and amounts of chemicals, such as pesticides and fertilizers are stored.

E. Non-Regulatory Programs

A powerful adjunct to regulatory programs are the endless variety of creative educational, informational, preventive, and response oriented programs which have been and continue to be developed at all levels of government. Implementation funds have been, and are, the limiting factor. Despite the scarcity of funds, several programs are directly reducing risk to ground water and are described in the following paragraphs:

1. Department of Ecology Help/Education

The Department of Ecology has provided a variety of educational materials pertaining to hazardous material management and compliance with hazardous waste regulations, underground tank rules, and general environmental protection. In addition, they have offered help to business in recycling efforts. Recently they have offered a pilot program to help several businesses develop Waste Reduction Plans required under the Hazardous Waste Reduction Act (1990).

2. Local Information/Education

BKCHD has undertaken an information program which targets small business. Under a grant from Ecology, this Coordinated Prevention Program offers information, and business audits upon request. The current effort is modest, involving one staff member, yet its scope is large. Currently, about two audits are completed a week. In addition, BKCHD is working with Ecology information and outreach programs to provide curriculum materials for schools.

3. Spill Response

The effectiveness of spill response is dependent on the capability and training of the first responders. Depending on event timing and location, local fire departments, local police, and the State Patrol are usually the first to arrive on the scene of a spill. Their primary mission is human safety followed by environmental protection.

First responders take immediate action to protect the environment from chemical contamination. Immediate action can effectively reduce the risk to ground water if initial decisions are correct. Spill response training, therefore, is critical.

The level of environmental protection training offered to hazardous spill first responders have varied from place to place in the state. Rural areas, where volunteer emergency and fire responders are frequently used, are generally less prepared than urban areas. Consequently, a preparedness gap may exist.

Generally, environmental protective measures and clean-up are left to specialty

contractors or secondary responders. Ecology has spill response staff in their four regional offices, but their capability is limited. If they respond, they have a dual role of regulatory enforcement and emergency response. When they respond, Ecology generally relies on specialty contractors to take mitigative action, especially in large spills.

4. Emergency Planning and Response

Contingency planning varies from business to business. Many large and small businesses have recognized that emergency preparedness is required, reduces liability, and makes sense. For example, in Kitsap County the Navy has developed detailed contingency plans for various incidents. Many small businesses have undertaken Worker Right to Know programs which include emergency response elements.

5. Household waste disposal

Many local governments have developed programs for handling household hazardous wastes recognizing the need to prevent such materials from entering the environment. Some communities hold special Hazardous Waste Days while others provide routine handling at local landfills.

Kitsap County sponsors a Household Hazardous Waste Collection Day and an event for small quantity generators. The County does not yet have routine household or small quantity generator disposal options. As part of Kitsap County's Moderate Risk Plan, a permanent facility is planned for 1993. Also, routine collection facilities for used oil is planned throughout the County.

BKCHD is developing a program to provide hazardous waste disposal services to small quantity generators. Under this program, wastes could routinely be dropped off at a county facility. The cost to the business would be disposal costs only. The County would pay the cost of the facility and personnel to handle the material and arrange for disposal.

III. GAPS AND PROBLEMS

A. Lack of Implementation and Enforcement

A variety of programs which have been legislated or created which deal with hazardous materials. Often time good ideas have outstripped available resources, therefore, implementation has lagged enactment. Hazardous material regulatory and non-regulatory programs suffer from a lack of resources (money and staff). Local programs for information, education, and household waste control need to be expanded.

B. Surveillance/Inspection

As with any program, monitoring progress is critical to attaining the program objectives. For hazardous materials, monitoring for compliance is critical. Most of the regulatory programs cannot monitor a large percentage of the regulated community. Targeting the larger generators covers a significant proportion of the generated waste, but leaves a tremendous gap in the regulatory net.

Enforcement can tie up available resources and lower the number of contacts with the regulated community, inhibiting information flow and cooperative ventures. More important, once enforcement starts, the pathway to correcting a problem is a legal or adversarial process, which are time and resource consuming. It is difficult for an enforcement agent to be effective at education.

Hazardous material transportation risk reduction needs to be improved by increased inspections of roads and roadbeds, vehicles, and containers which carry materials.

C. Transportation within groundwater recharge areas.

The State or County does not restrict transport of hazardous materials in critical recharge areas such as wellhead zones.

D. Transportation of highly toxic/concentrated materials - notification.

Currently, there are no regulations which require notification of first responder units and local government of highly toxic material shipments through the county.

E. Contingency Planning

Although RCRA and SARA Title III require contingency planning, more comprehensive planning, which covers all hazardous material operations and provides for emergency response training, is needed.

F. Zoning/Domestic Density - low enough?

Septic disposal of hazardous materials does occur. Consequently, zoning to preclude concentrations of materials from contaminating aquifers may be necessary.

G. Model Toxic Control Act Deficiency

A recent State Supreme Court decision will discourage clean up of contaminated sites voluntarily (without formal Ecology involvement). The decision states that after a site is cleaned-up, a business or industry cannot seek recovery of costs from responsible parties unless Ecology has been formally involved in the clean-up process. This will tend to inhibit voluntary clean-up actions which could be a key part of timely clean-up activity in the state. Legislation is needed to fix this deficiency.

H. Old Landfills

Some old landfills which were closed prior to implementation of Ecology's regulation may still pose a groundwater threat, and may need to be assessed for future action.

I. Education

General education of the population on hazardous material handling, usage and storage needs to be more pervasive. Efforts to educate small businesses would benefit from more money and government outreach efforts.

IV. RECOMMENDATIONS AND STRATEGIES

1. **Modest Audit/Inspection/Surveillance Program**

   Expand the existing BKCHD Hazardous Material Audit Program. Dollar for dollar, efforts by local government to compliment state and federal enforcement programs with non-regulatory "help" programs can be an effective expenditure of funds.

2. **Transportation re-route/notification**

   Kitsap County and cities should develop a procedure which requires notification of local government officials and first responders of shipments of highly toxic materials through the county. Conduct an evaluation of measures which could be implemented to reduce the risk to ground water of transporting hazardous materials in the County such as restricting the routes and hours of such transport. Local government may want to restrict traffic of certain types of materials to certain routes and time of day. In this way the risk associated with such transport can be isolated and reduced.

3. **Contingency Plans**

   Local programs to help foster and complement Labor and Industry programs for Worker Right to Know and Emergency Response should be encouraged and expanded where they exist.

4. **Restrictive Zoning**

   Kitsap County should evaluate the desirability of more restrictive zoning with respect to hazardous material usage and storage. It is possible that current zoning is not adequate for protecting groundwater from low level, long term contamination.

5. **Education**

   Increase education programs in schools and the community to assure necessary

information relative to hazardous materials and ground water protection.

6. **Legislative Change to the Model Toxic Control Act**

   Support efforts to enact legislation to enhance the Model Toxic Control Act so responsible parties cannot escape liability because a voluntary clean-up is undertaken by another party without Ecology involvement.

7. **Hazardous Waste Sites**

   Identify small quantity hazardous waste sites which are not currently in a state or federal clean-up program.

8. **Hazardous Material Assistance Programs**

   Encourage and expand local government programs to help businesses with environmental audit programs in a non-regulatory framework.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: FERTILIZERS AND PESTICIDES

April 20, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper discusses the potential for ground water contamination from using pesticides and fertilizers for agricultural and other purposes.

1. **Threat**
The degradation of ground water quality as a result of contamination by fertilizers and pesticides.

2. **Goal**
To prevent the occurrence of ground water contamination by misuse of fertilizers and pesticides.

B. Definitions

Pesticides are a large and varied group of substances that are specifically designed to kill biological organisms including weeds, insects, and rodents. Fungicides, herbicides, insecticides, nematicides, rodenticides, fumigants, disinfectants, wood preservatives, and antifoliants are examples of pesticides (Puget Sound Water Quality Authority (PSWQA), 1991). All pesticides are designed to be toxic to one or more forms of life. Many will persist in the environment for a long time, affecting plant and animal life. Pesticides such as DDT, aldrin, and dieldrin have been banned, because of their persistence in the environment. Others, such as the organophosphate pesticides, break down in the environment in a relatively short period of time, but are initially highly toxic and may constitute a health risk (Seattle-King County Local Hazardous Waste Plan (LHWP), 1991).

Fertilizer, as defined in Washington law (Chapter 15.54 RCW), is any substance which contains one or more recognized plant nutrients, is used for its plant nutrient content, and/or is used to promote plant growth. Limes, gypsum, and processed animal and vegetable manures are examples of fertilizers.

Pesticides and fertilizers are in everyday use all around us. The major uses are agriculture (commercial and hobby farms), urban (lawn and garden), forestry, and right-of-way maintenance. All uses of pesticide and fertilizer have the potential to contaminate ground water when they are used improperly.

Home use accounts for approximately twenty percent of pesticide use in the Puget Sound region. Unlike licensed pesticide users, homeowners are not trained in proper application procedures or in diagnosing whether a particular pesticide is needed.

C. Hazards

Pesticide use raises significant concern about long-term, chronic exposure from low concentrations in drinking water. Our knowledge of chronic health effects for humans is limited, but lab studies with animals and various studies looking at human exposure to pesticides suggest that cancers, tumors, birth defects, and other chronic illness are related to exposure to certain chemicals. In addition, there is the potential for adverse impacts on sensitive ecosystems and wildlife habitats, where contaminated ground water discharges into surface water bodies.

A significant problem with fertilizers, is problems stemming from nitrates. Concerns have generally centered around nitrates role in methemoglobinemia (Department of Health, 1990). This ailment is a blood disorder caused by high levels of nitrates. It can affect people of all ages and has resulted in death. While the problem is relatively well understood, there are no accurate statistics on its occurrence. Even though there have been no deaths reported in Washington State during at least the last fifteen years, acute cases still occur. The drinking water standard for nitrates has been set at ten parts per million (State Strategy, 1992). Recent research suggests that older children and adults also may suffer other health effects from long-term exposure to nitrates. Excessive consumption of nitrates can result in gastroenteritis and diarrhea. Nitrates may be converted by the body into compounds known to be carcinogenic. High nitrates in ground water cannot be automatically attributed to fertilizer. Other potential sources include on-site sewage disposal and animal waste.

D. GROUND WATER CONTAMINATION OVERVIEW

In 1979, dibromochloropropane (DBCP) was found in numerous wells in California's Central Valley. The same year, aldicarb was found in wells on Long Island, New York. The next year aldicarb was found in Wisconsin ground water. Since then, aldicarb has been found in wells at levels of concern in eleven other states. In each of these instances, contamination is thought to be the result of previously approved field application at recommended rates.

In California, over 50 pesticides have been found in ground water. About half can be attributed to leaks and spills, while the other half is most likely the result of normal field application. Long Island, New York, has 2,000 wells contaminated with aldicarb. Half of those had levels above the New York standard of 7 ppb. In Iowa, nine herbicides and two

insecticides have been detected in ground water. Though concentrations are low, the data show that more than a quarter of the population of Iowa is drinking water contaminated with agricultural chemicals.

In 1982 ethylene dibromide (EDB), (a chemical used as a fungicide) and nematicide, were discovered in two California wells and three Georgia wells. By the end of the following year, EDB contamination of ground water had been found in 16 different counties in four states: California, Florida, Georgia, and Hawaii. According to a survey conducted in 1988 by Oregon State University, EDB is found in ground water in at least 14 states, including Washington (Parsons and Witt, 1988). EDB is no longer registered for use, though the contamination remains.

Misuse, poor storage practices, and improper mixing or disposal practices account for some of the problems that have been documented. In the case of certain chemicals, conventional usage, application to field crops in accordance with recommended procedures, is also responsible for contaminating ground water. More than 60 pesticides have been found in ground water in the United States, including Washington State.

1. National Pesticide Survey

In 1990, the Environmental Protection Agency (EPA) conducted a nationwide survey of pesticides in ground water. The survey had two purposes: (1) to assess the frequency and concentration of nitrates and pesticides in drinking water wells under all conditions nationwide, and (2) to look for ground water vulnerabilities associated with use of pesticides and nutrients. The study sampled 1,300 randomly selected wells, both community systems and rural domestic wells. According to a preliminary report of statistical results from the survey, 10.4 percent of the community wells and 4.2 percent of the domestic wells were positive for pesticides. Nitrates were reported in 50.9 percent of the community wells, with another 1.2 percent above the Maximum Contaminant Level (MCL) of 10 ppm. Nitrates below the MCL were found in 54.6 percent of domestic wells, and 2.4 percent were above the MCL (USEPA, 1990).

2. Washington State Ground Water Contamination

In January 1984, EDB was found in a private well in Skagit County. The Department of Social and Health Services (now Department of Health (DOH)) conducted a study that found EDB in domestic wells in Skagit, Whatcom, and Thurston counties. Thirteen of the wells had levels of EDB above the health advisory of 0.02 ppb (parts per billion). Ten wells were public water supplies serving a total of about 550 persons. EDB has also been found in wells in Snohomish County (DSHS, 1985).

The EDB contamination focused attention on the potential for contamination of ground water by pesticides in Washington State. Since then, limited monitoring has provided additional information including the Agricultural Chemical Pilot Study conducted by the

Department of Ecology (Ecology) with the cooperation of the Departments of Health and Agriculture; and a study being conducted in Franklin and Benton Counties by the United States Geological Survey (USGS).

Information concerning specific contamination events relating to fertilizer or pesticide use or misuses in Kitsap County is lacking, but does not mean there are no problems. It may simply reflect a lack of monitoring and/or water quality testing.

3. Areas of Particular Relevance

Home owner use, improper disposal of fertilizers and pesticides, and right-of-way maintenance deserves increased attention.

The urban population is not trained in the proper use and disposal of pesticide and fertilizer. One study estimated that half of the pesticides used in the Puget Sound basin are used in urban areas. Many urban applications of pesticides occur directly adjacent to waterway and roadside ditches. Pesticides applied to lawns, gardens, and street side trees can be washed by rain or sprinklers into storm or sanitary sewers where they are conveyed to streams, lakes, and Puget Sound (State Strategy, 1992).

Homeowners may not be aware of appropriate practices because they are not required to obtain applicator's licenses. Only a few active pesticide ingredients are approved for home and garden use. The active ingredient in some pesticides used by homeowners may be the same as that used by farmers and commercial applicators, but in lower concentrations.

In the Puget Sound area, the potential for contamination by homeowner use of pesticide and fertilizer is recognized by the Puget Sound Water Quality Plan (PSWQA). The plan includes a course of action for educating and training the public both in the appropriate use of house and garden chemicals and in selecting safe alternatives (State Strategy, 1992).

Right-of-way (ROW) maintenance is done by a variety of entities, including county public works, electric companies, State Department of Natural Resources, railroads, natural gas companies, and oil pipeline companies. ROW maintenance is conducted by a combination of herbicides and physical methods, such as mowing. Some communities have looked at reducing chemical maintenance. In response to public concern about the effect of herbicides, Jefferson County commissioners decided to maintain the county road shoulders and ditches with mechanical means only. Mechanical ROW maintenance will probably be more costly as it is more labor intensive and the overall effectiveness may be limited. Documentation of the impact, reduced herbicide use has on ground or surface water contamination is not available.

II. EXISTING LAWS AND PRACTICES

The federal government as well as Washington State has instituted programs to help decrease the possibility of ground water contamination due to fertilizers and pesticides.

A. Federal

Federal programs that relate in varying degrees to the fertilizer and pesticides are:

* **The U.S. Environmental Protection Agency** has numerous responsibilities including:

  *Registering and establishing pesticide usage regulations

  *Enforcing pesticide regulation compliance

  *Overseeing state programs for training and licensing program for pesticide applicators

  *Establishing drinking water and surface water quality standards and monitoring requirements

  *Taking enforcement action as appropriate

  *Conducting research on health effects and methodology for identifying contaminants

  *Providing technical support to federal, state, and local agencies

  *Developing public education materials and programs

  *Providing financial assistance to states

* **Federal Insecticide, Fungicide, and Rodenticide Act, 7 USC Section 136** provides direct control over the sale and use of pesticides. All pesticides must be approved by EPA through a mandatory registration process. Products that pose unreasonable risks to human health or the environment can be denied registration, thus preventing their distribution and use. Registration sometimes results in restrictions being placed on the use of certain classes of pesticides. Pesticides are classified either general use or restricted use. Restricted use pesticides must be applied only by certified applicators and may involve additional use restrictions. General use pesticides may be sold without restrictions on who may use them.

* **Comprehensive Environmental Response, Compensation, and Liability Act, 42 USC Section 9601 (CERCLA).** Known as the "Superfund," the Hazardous Substances Response Fund set up by CERCLA, finances government containment or cleanup responses to actual or threatened releases of substances that may harm human health or the environment, including ground water. The liability provisions authorize EPA to hold polluters liable for the expenses of removal, cleanup, and containment, as well as to force the responsible parties to undertake required actions at their own expense.

The applicability of CERCLA to problems associated with agricultural chemicals is limited. The act contains exemptions which appear to grant substantial immunity from liability under CERCLA to farmers who contaminate ground water. However, application of other provisions of CERCLA to farming operations is not as clear. For example, the CERCLA authorization for EPA to order abatement actions in cases of imminent and substantial threats to health or environment do not contain an exemption for pesticide users.

* **U.S. Department of Agriculture (USDA).** The Farm Bill of 1990 authorized $80 million over five years for USDA research into how farmers can reduce their dependence on chemicals by changing to low-input, sustainable agriculture. The act requires individuals who use restricted use pesticide to keep records. This law also includes financial assistance to farmers in preventing surface and ground water contamination.

* **The Soil Conservation Service** provides technical assistance on soil and water conservation practices directly to users and through local conservation districts; assists in developing farm management plans; provide on-farm technical assistance and support to dairy, livestock, dry land, and irrigated farmers, and works with conservation districts and support districts on their information and education activities.

* **The Agricultural Research Service** conducts research on cropping systems, pest and nutrient management, pesticide movement, water and soil management and conducts studies on "minor uses" of pesticides.

* **U.S. Department of the Interior, United States Geological Survey (USGS)** conducts geologic research and monitoring surveys on ground water in cooperation with other agencies; publish research reports and provides technical assistance to state and local agencies.

B. State

* **The Washington State Department of Agriculture** registers and regulates the use of pesticides, registers and has authority to regulate commercial fertilizers, licenses,

recertifies pesticide applicators and dealers, monitors pesticide use, investigates complaints of improper use, and enforces regulations.

* **Chapter 15.09 RCW Horticultural Pest and Disease Board.** The purpose of this regulation is to enable counties to more effectively control and prevent the spread of horticultural diseases and pests. Counties are able to form a horticultural pest and disease board, which includes four county appointed members, a member appointed by the Director of Washington State Department of Agriculture (WSDA), and a non-voting member from the county extension agent. The board is able to investigate and order abatement of the spread of pests and diseases.

* **Chapter 15.54 RCW Fertilizers, Agricultural Minerals, and Limes.** This chapter requires that every registrant (a commercial fertilizer distributor) must file a report twice a year to WSDA on the net tons of fertilizer they distribute in Washington. WSDA may, upon request, require registrants to report on the net tons of fertilizer distributed to each location in Washington. It also allows the Director of WSDA to cooperate with and enter into agreements with other governmental agencies to carry out the purposes of the regulation. The act has provisions for protecting ground water.

* **Chapter 15.58 RCW Washington Pesticide Control Act.** This law addresses the formulation, distribution, storage, transportation, and disposal of pesticides determined to be important and vital to public health. The chapter requires pesticide dealers and private and public pest control consultants to be licensed. Pest control consultants and pesticide dealer managers must demonstrate knowledge of pesticide laws, hazards, and the safe distribution, use, application, and disposal of pesticides. Licensed persons may be required to keep records, including quantity of pesticide, date of shipment and receipt, name of consignor and consignee, and any other information required by the Director of WSDA.

* **Chapter 16-228 WAC Rules Relating to General Pesticide Use.** These rules are promulgated pursuant to Chapter 15.58 RCW. They include a list of pesticides that are defined as restricted use, and that may not be distributed to homeowners (see Appendix: Restricted Use Pesticides). This regulation also contains restrictions on transporting, handling, storing, loading, applying, or disposing of pesticides, to prevent ground water, streams, lakes, and other water source pollution.

* **Record Review Pilot Project.** WSDA conducted a pilot project to explore the feasibility of requiring record submittal and development of a pesticide and fertilizer data base. The project, which was conducted in Franklin and Thurston counties, is part of a state geographic information system (GIS) development project. WSDA reviewed pesticide records for a 30 square mile area in each county. They found that the farmers in eastern Washington were better at record keeping and voluntary submittal of those records than those on the west side. This is probably because the

east side has mainly business type farms, while those on the west side are predominantly small or hobby farms. Commercial landscaping services, such as ChemLawn, provided better information than agricultural users. Wholesalers and the railroads were not forthcoming with the requested information. WSDA found that requesting voluntary reporting by these groups did not work. WSDA analyzed the information to estimate how many of certain pesticides were going into various basins. WSDA found that the process to be expensive and time consuming.

* **Chapter 17.21 RCW Pesticide Advisory Board.** The board advises the director of WSDA on problems relating to the use of pesticides. Most of the voting members of the board are directly involved in pesticide application, and include three pesticide applicators, a licensed dealer, an entomologist in public service, a health care practitioner, representatives of the agricultural chemical industry, labor, agricultural producers, and others. Representatives of state agencies are nonvoting members.

* **Washington Department of Ecology (Ecology)** develops and implements policy and rules relating to protection of the environment, including surface and ground water quality. Ecology sets standards for water quality, conducts monitoring of selected areas or sites, investigates threats to water quality, regulates potential contamination sources through permits, enforces compliance, and provides technical and planning assistance to other agencies.

* **Chapter 70.105D RCW, Model Toxics Control Act and Chapter 70.95 RCW Solid Waste Management Reduction and Recycling.** Chapter 70.95 RCW requires cities and counties throughout the State to develop local solid waste management plans. Chapter 70.105 RCW requires local governments to develop hazardous waste management plans. Both laws direct that the first priority for these plans is minimizing the waste stream. House and garden pesticide and fertilizer use are among the sources being addressed by these plans including programs to educate urban homeowners about using pesticide and fertilizer appropriately and about non-toxic alternatives. Several areas, such as King and Spokane counties, have well-developed education programs aimed at the urban user. Their programs address both the use and the disposal of home and garden chemicals (State Strategy, 1992).

* **Chapter 173-200 WAC, Water Quality Standards for Ground Water of the State of Washington.** The goal of this regulation is to maintain the quality of the state's ground water and to protect existing and future beneficial uses through reduction or elimination of the discharge of contaminants to ground water. It establishes ground water quality standards for protecting the environment and human health. It also protects existing and future beneficial uses of ground water. These standards, adopted in December 1990, provide numeric values, or criteria, which must not be exceeded to protect the beneficial use of drinking water.

The standards incorporate an existing part of state water quality law: the

antidegradation policy. The policy requires that no degradation shall take place unless both the following conditions are met: (1) all known, available, and reasonable methods of prevention, control, and treatment (AKART) is applied, and (2) it can be shown that an overriding public interest is served. The policy strictly forbids degradation which would harm existing or future beneficial uses of ground water; AKART must be used regardless of the quality of the receiving waters. As technology and preventive controls are refined to protect water quality, AKART is also redefined. In individual cases where AKART fails to protect water quality, the activity must apply additional controls.

The standards apply to all underground waters in the saturated zone (generally at or below the water table), with few exceptions. One of these exceptions is that the standards do not apply in the root zone of saturated soils where agricultural pesticides or fertilizer has been applied for agricultural purposes. In general, agricultural activities are managed through implementing farm management plans. These plans would incorporate State approved Best Management Practices (BMPs) that can protect the saturated zone below the root zone. State approved BMPs may be considered one type of AKART for agriculture. WSDA may implement a management plan for a specific chemical of concern that establishes appropriate conditions for its use (State Strategy, 1992).

*** Chapter 43.21C RCW and Chapter 197-11 WAC: State Environmental Policy Act and Rules.** The State Environmental Policy Act (SEPA) is intended to provide decision makers and the public with sufficient information to evaluate the environmental consequences of proposed land, air, or water use activities, particularly activities involving action by a governmental agency. The procedural provisions of SEPA attempt to outline a process for distinguishing between actions that is likely to have a significant adverse environmental impact and those that are not. In cases where significant adverse impacts are anticipated, an Environmental Impact Statement (EIS) must be prepared. The State Legislature authorized Ecology to develop rules for the implementation of SEPA, Chapter 197-11 WAC. These rules are intended to provide a uniform environmental review process in all political jurisdictions within the State. They are also intended to help define what constitutes a significant adverse environmental impact and to outline the content of environmental documents prepared under SEPA.

In developing the SEPA rules, Ecology determined that some classes or types of activities, because of their size or nature, are not likely to represent a significant environmental impact and should, under ordinary circumstances, be exempt from SEPA requirements. WAC 197-11-800 Section of the SEPA rules contains a list of exempted types of activities (categorical exemptions). The categorical exemptions include some activities that could potentially represent a significant, adverse environmental impact in areas of unusual ground water sensitivity. Exempt activities include:

* Utility-related actions, including periodic use of chemicals to maintain a utility or transportation ROW; provided that the chemicals used are approved by WSDA and applied by licensed personnel. This exemption does not apply to chemicals used within controlled watersheds.

* Natural resource management actions, including all Class I, II, and III forest practices as defined in RCW 76.09.050, and periodic use of chemicals to maintain public park and recreational land, provided that the chemicals used are approved by WSDA and applied by licensed personnel. This exemption does not apply to chemicals used within controlled watersheds.

A county or city can eliminate the categorical exemptions by designating a portion of its jurisdictional area to be Environmentally Sensitive under SEPA.

* **The Washington Department of Health** develops and implements water policy relating to human health. It sets human health standards for drinking water, monitors drinking water supplies, and enforces compliance.

* **The Pesticide Incident Review and Tracking Panel.** Established under Chapter 70.104 RCW, serves as a scientific body which reviews pesticide issues and makes recommendations to the legislature and appropriate agencies. By law, the panel is convened by the Department of Health. It includes representatives from the departments of Agriculture, Ecology, Health, Labor and Industries, and Wildlife, as well as the University of Washington, WSU Cooperative Extension, and the Poison Control Network. A toxicologist and citizen representatives also serve on the panel. Responsibilities include reviewing making recommends procedures for investigating pesticide incidents, monitoring response times to reported incidents, and evaluating the adequacy of laws aimed at protecting public health from pesticides.

* **The WSU Cooperative Extension Service** develops and implements a broad range of educational programs, resource materials, and technical assistance. Technical assistance includes selecting and implementing "Best Management Practices" and integrated pest management systems for specific sites and circumstances. The service also provides training to private and commercial pesticide applicators to prepare for licensing and recertification exams.

C. Local

The Bremerton Kitsap County Health District(BKCHD) has programs which test potable water under the Safe Drinking Water Act and regulations regarding chemical applications to golf courses. The latter is intended to control the impact caused by surface run-off. BKCHD intends to embark on a much larger program in the near future.

III. GAPS AND CONCERNS

The PSWQA found that "a reduction in pesticide use and disposal will not occur until significant numbers of urban and suburban residents are educated about pest management, the use of pest-resistant species, and proper pesticide application. This will require both research to determine alternative pest management practices tailored to this region and methods to get these practices to the home user through education and marketing. Agencies or groups such as Cooperative Extension and the Washington Toxics Coalition have conducted some research on these topics, but more is needed. Some nurseries are knowledgeable about pest-resistant species and native plants, but need more information and an educated market in order to sell them. Very few garden store retailers and very few garden writers encourage people to design and care for lawns in a way that will reduce pesticide use." (PSWQA, 1992)

Wholesalers are not required to report information about sale of pesticides, but are required to keep records. State law would have to be changed to make this a requirement.

Based on a lack of documented events, the threat of ground water contamination through fertilizer and pesticide use or misuse does not appear to be significant in Kitsap County. Some areas warrant attention in order to minimize the potential for contamination. Problems may exist and simply have not been detected. Extensive testing will be required for public water suppliers under provisions of the Safe Drinking Water Act.

A major concern is a lack of awareness by the general public as to the potential for contamination through improper use or disposal of fertilizers and pesticides. Although Ecology's "Protecting Ground Water: A Strategy for Managing Agricultural Pesticides and Nutrients," April 1992, specifically addresses agricultural activities, the findings are generally applicable to the full spectrum of users and misusers. The core of the Strategy is research, education, and technical assistance.

IV. RECOMMENDATIONS AND STRATEGIES

1. BKCHD, and the Kitsap Conservation District shall implement a public information and education program that emphasizes the importance of proper use (and disposal) of fertilizers and pesticides including the use of non-toxic alternatives whenever possible. The program will be directed to individuals, farmers, appropriate businesses, and government entities and be coordinated with the WSU Cooperative Extension Service.

2. Support Ecology's recommendations to enhance fertilizer and pesticide research, education, and technical assistance.

3. Kitsap County and the cities should have a program for household fertilizer and pesticide hazardous waste disposal.

4. It is strongly recommended that the BKCHD proceed with a full scale program that will establish a series of advisories and controls on the application of pesticide and fertilizers.

5. The state should evaluate the possible impact on water resources of chemical applications of fertilizers and pesticides in well head protection areas.

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Federal Farm Bill of 1990

7 USC Section 136 Federal Insecticide, Fungicide, and Rodenticide Act

42 USC Section 6901 Resource Conservation and Recovery Act

42 USC Section 9601 Comprehensive Environmental Response, Compensation, and Liability Act

Chapter 15.09 RCW Horticultural Pest and Disease Board

Chapter 15.54 RCW Fertilizers, Agricultural Minerals and Limes

Chapter 15.58 RCW Washington Pesticide Control Act

Chapter 70.105D RCW Model Toxics Control Act

Chapter 16-228 WAC Rules Relating to General Pesticide Use

Chapter 222 WAC Forest Practices Act

Chapter 173-200 WAC Water Quality Standards for Ground Water of the State of Washington

APPENDIX: RESTRICTED USE PESTICIDES

Home Use Restricted List:

DiNitro-O-Sec Butyl Phenol(DNOSBP)
Endothall (20 percent and above)
Ethion (26 percent and above)
Guthion (16 percent and above)
Hydrogen Cyanide (Hydrocyanic acid)(HCN)
Methyl Bromide
Strychnine and its salts (Strychnine Alkaloid 1.1 percent and above)

State Restricted Pesticides, Certified Applicator List:

alachlor
aldicarb
atrazine
bromacil
carbofuran
cyanazine
1,3-dicloropropene
disulfoton
diuron
heptachlor
hexazinone
metolachlor
metribuzin
oxamyl
picloram
prometon
simazine
tebuthiuron

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: SAND AND GRAVEL MINING

Jan. 14, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines contamination of groundwater through sand and gravel mining operations.

Goal: To ensure that regulatory programs are adequate to prevent adverse effects from sand and gravel mining operations upon groundwater quality .

Sand and gravel operations do have the potential to adversely impact groundwater quality, both as a result of the extraction process and in site reclamation. However, sand and gravel mining is also an important economic resource as well as a necessary resource for transportation and development purposes. Unfortunately, some of the characteristics that make sand and gravel resources valuable, also make them very good aquifer and/or recharge materials.

Sand and gravel mining within an aquifer recharge area will, at a minimum, increase the vulnerability of an aquifer to be contaminated because it decreases the distance between the groundwater table and land surface. In some cases, the excavation actually penetrates the shallow aquifers, creating a pond or lake and a direct access to groundwater.

The primary effluent discharged at a sand and gravel mine operation is turbid rinse water. Generally, operators are required to collect waste water on-site in retention and settling ponds where the fine sediment settles out. The collected water is then allowed to infiltrate back to the water table. Often the excavation pit is a component of the treatment system. High concentrations of suspended solids in the wash water does not pose a serious groundwater problem since sediment is unable to migrate beyond the immediate infiltration site. Even though the turbid wash water at a gravel mine is not a significant groundwater pollutant, the excavation pit and the continual collection and infiltration of wash water does raise the potential for other sources of contaminant to migrate to the aquifer. Hydrologic susceptibility is increased at the pit site when saturated or near saturated conditions exist under the pit. Any chemical contaminants that are allowed to enter the pit via wash water or spills in the area would have quicker access to the aquifer. Once in the groundwater, a chemical substance would be free to move with the water in the aquifer. Possible contaminants found at a mining site include lubricants and fuels. These materials may be

stored on-site or may enter the excavation pit from contaminated road and work area runoff.

Beyond the risks associated with active mining, one of the largest threats to groundwater appears to be the excavation pit itself. Reclamation of a site may include refilling a pit as well as slope and drainage stabilization. Within the recharge areas of a vulnerable aquifer, the decision to fill or not fill an excavation is one of the most critical with regards to water quality. Excavation pits have been used both legally and illegally as dump sites for a variety of wastes. In the past, little care has been given to the classification of the material used as fill. Many community landfills have been developed in "reclaimed" gravel pits. Industries have used excavation pits as disposal sites for mixed wastes. Over the years it has not been uncommon to find pits used as "dumps" for a variety of potentially hazardous fill materials. In many cases, materials historically used to fill pits would today be classified as a dangerous waste, not inert material (Ch. 173-303 WAC).

Future land use is an important factor to consider in reclamation of a site. The increased vulnerability of underlying aquifers to contamination should be factored into any land use permitting decisions. Additional controls to be established under the Growth Management Act should address sand and gravel mining and reclamation operations which overlie aquifer recharge areas .

The exact number of sand and gravel operations (existing and old) in Kitsap County is not known with certainty. However, the State Department of Natural Resources (DNR), which has permitting authority over all sand and gravel mining operations of greater than three acres, has identified 43 existing, closed, or potential sites (29 active; 10 terminated; 2 pending applications; and 2 cancelled).

Notwithstanding the potential for groundwater contamination from sand and gravel mining, there have been few, if any, documented incidents in Kitsap County. This may indicate that existing controls (and operations) are adequate to generally protect groundwater, or it may only mean that monitoring is lacking, so problems go undetected.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. DNR has had the direct permit authority since 1971 for surface mines (e.g., sand and gravel) under Chapter 78.44 RCW and Chapter 332-18 WAC. Small pits, under three acres, do not require permits from DNR. All new sand and gravel mining operations must comply with the State Environmental Policy Act (SEPA). In general, this requires that a preliminary evaluation of environmental impacts (SEPA checklist) be made; this may result in a requirement for an environmental impact statement (EIS). Kitsap County (Department of Community Development) would be the primary reviewer of the project for SEPA compliance. Concerns identified in this review can be addressed and/or mitigated by terms or conditions placed on the DNR permit. The permit also includes a reclamation plan to be put in effect during phased operations or at termination of a project. Annual reports are required from the operator and DNR does have inspection authority and responsibility.

Like many other State (and local) regulatory programs, staffing and funding constraints limit the effectiveness of the regulatory program, although complaints about improper operation can generally be addressed. The program has no major emphasis on the protection of groundwater (quality or quantity).

Groundwater resource protection is the responsibility of the Department of Ecology (Ecology). Ecology's role in sand and gravel operations is at least twofold. First: Ecology has an opportunity for environmental review of a proposed project. Second: In the past several years, Ecology as a water quality authority has identified some best management practices (BMP's) for sand and gravel operations. Originally, Ecology planned to adopt BMP's as either guidelines or formal rules for industry to follow in order to comply with the requirements of chapter 173-200 WAC Water Quality Standards for Ground Waters of the State of Washington. Some of the BMP's first identified are:

1. For sites with a planned excavation depth lower than the groundwater table, a detailed hydrologic report should be filed. The report may be a part of a complete EIS or an appendix to a SEPA check list.

2. When mining activities are to be located in designated wellhead protection areas, special protection areas, sensitive aquifer areas, or principal recharge zones, an EIS should be considered.

3. Mining activities located in designated wellhead areas or special protection areas identified under Ch. 173-200 WAC should be considered for a State Waste Discharge Permit by the regional office of the Department of Ecology. If Ecology determines specific protection measures should be required to protect water quality, they may be incorporated into the terms of the DNR operation permit or established as a separate permit administered by the regional office of Ecology.

4. Where possible, mining sites should utilize internal drainage, in order to support continued groundwater recharge and minimize off-site discharges.

5. When groundwater is exposed during the mining operation and the resulting impoundment is larger than three acres, groundwater should be monitored for both water level (monthly) and water quality (quarterly to semi-annually) over the life of the operation. Water level and water quality monitoring should also be considered when depth to seasonal high water is reduced to five feet or less.

6. Associated activities such as concrete, asphalt, and other industries located at sites described in 2 above, will be reviewed for State Waste Discharge Permits by Ecology.

7. Associated activities such as concrete, asphalt, or other batch processing plants shall not be located immediately adjacent to exposed groundwater.

8. Truck and equipment wash runoff should be routed to an approved retention and treatment facility, equipped with an oil-water separator prior to its release to retention ponds.

9. Fuel (oils) storage and handling facilities should be located some distance from the main sediment and wash water retention facility. All such facilities should be equipped with approved containment, monitoring, and collection systems. Fuel storage should be above ground. These sites should be lined and bermed with sufficient capacity to accommodate spills and leaks. Runoff from adjacent surfaces should be routed to a retention pond that can be monitored and cleaned in the event of a spill.

10. All sites should maintain a fuels/hazardous waste management plan. The plan will be maintained by the operator and be available on the site at all times.

11. At the closure of the site, after accidental spills, or at the request of DNR/Ecology, all contaminated material will be removed and disposed of with approved methods and at approved disposal sites. Contaminated material will not be used as fill at the site.

12. In general, impoundments of greater than three acres should not be filled. These sites should be stabilized as lakes and ponds and the surrounding area revegetated to ensure stability of the site. Future land use decisions should reflect increased groundwater vulnerability at the site. Individual sites may be filled if it can be demonstrated that sufficient inert material can be obtained to serve as fill. Impoundments of less than three acres should not be filled if there is doubt as to the quality or supply of inert fill.

13. Excavation pits should not be used as landfill disposal sites for unclassified or non-inert wastes. In general, municipal landfills are not an appropriate use for sand and gravel sites located over semi-confined and unconfined groundwater.

14. Pits with standing water that are slated to be filled may use only approved inert earth materials (native fill/overburden) to fill the area up to the high water table. The remaining fill should meet the conditions described in 12 and 13.

15. Future land use should reflect the increased vulnerability of groundwater at the site.

After further evaluation, Ecology determined the above BMP"'S, or modifications thereof, will not be formalized. Rather the water quality (both surface and ground waters) will be protected through the Waste Discharge General Permit Program (see chapter 173-226 WAC); or the standard individual National Pollutant Discharge Elimination System (NPDES) or state waste discharge permit systems. Some of the above BMP'S (and possibly a few others) probably will be incorporated as conditions of the permits issued under the general permit program for surface mining which includes sand and gravel operations. This change of direction does not preclude DNR from using BMP'S to encourage development of new mining and reclamation technologies designed to protect ground water.

In Kitsap County, a new sand and gravel operation requires an Unclassified Use Permit (even for a site less than three acres). The application for permit triggers the SEPA process and also a public hearing process (Renee' Beam - personal communication, June, 1992). DNR normally give much weight to the local evaluation in its permit-decision process.

III. GAPS AND PROBLEMS

A. Although not discussed above, there are several other laws and federal and State agencies that are peripherally involved in sand and gravel mining to some degree. For example, the State Department of Fisheries regulates mining in river channels as part of its Hydraulic Permit process under Chapter 75.20 RCW. DNR has proposed amendments to Chapter 78.44 RCW to clarify and tighten up the regulatory guidance in existing statutes, but they have not been passed by the Legislature. The proposed amendments are intended to clarify local vs state authorities. For example, county government would have the authority to regulate mining operations such as truck traffic, public safety and noise; and could become the sole regulation of mine reclamation. The amendments would codify reclamation requirements and ensure the right of local government to regulate land use. However, according to DNR staff (Personal communication. Norman, November 1992), the department does not intend to offer the amendments as an Agency-request bill during the 1993 Legislative session.

The apparent low DNR priority (possibly not shared by dedicated staff) has precluded a push for stronger controls, and may indicate the department does not consider sand and gravel mines to be a significant threat to ground water.

IV. RECOMMENDATIONS AND STRATEGIES

1. Kitsap County, through its Department of Community Development, should utilize the draft BMPs in SEPA review of new sand and gravel mining proposals to assure adequate consideration has been given to groundwater protection in the project design.

2. Kitsap County and cities include a policy in their Comprehensive Plans which provides that land use of reclaimed sand and gravel mines be carefully evaluated because of the increased susceptibility of aquifers to contamination due to the mining activities.

3.Encourage DNR to fully consider Ecology's draft BMPs to assure permits are conditioned, as they relate to operation and site-reclamation, to ensure groundwater protection.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON:

WELL CONSTRUCTION AND DECOMMISSIONING

April 20, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines prevention of aquifer contamination through proper well construction and/or decommissioning practices. It also addresses well construction practices of the past, such as multi aquifer perforation, which are a hazard to ground water.

Goal: An effective ground water management program must ensure that proper well construction and decommissioning procedures are required and followed.

B. Kitsap County Well Status

The precise number of active wells in the State of Washington and Kitsap County is not known, primarily because the submittal rate for well driller reports (commonly known as a well log) has been less than 100% since 1973 and was required only for permitted wells before 1973. The total number of active wells in the state is probably in the hundreds of thousands according to estimates from representatives of the State Department of Ecology (Ecology) and the United States Geological Survey (USGS) (Walsh, Fueste, personal communication). The actual number of active wells in Kitsap County is unknown at this time, but is thought to be substantial (over 10,000) based on recorded well logs and the rural nature of the county. (Deeter, Bremerton-Kitsap County Health District(BKCHD))

C. Well Decommissioning

Resolving the issue of potential aquifer contamination by improper well construction or decommissioning involves ensuring that existing regulations pertaining to construction and decommissioning are followed. Problem well construction practices of the past may have resulted in wells that should be decommissioned. Given a sufficiently large work-force and ample budget, the Washington Department of Ecology (Ecology) could inspect every new well that is constructed; inspect every existing well that is decommissioned; locate, inspect and properly decommission wells

that have been decommissioned or were constructed before WAC 173-160 was adopted. In reality, however, Ecology has sufficient work-force and budget to inspect only a fraction of the wells constructed and decommissioned each year. The number of older wells in need of proper decommissioning can only be estimated. Few records exist for wells installed before submittal of drillers' logs became a legal requirement in 1973. The lack of records for older wells makes locating them largely a matter of chance, community memory, and detective work.

The principal objective of proper decommissioning procedures is to restore, as far as practicable, the original hydrogeologic conditions at the well site. Proper decommissioning procedures entail sealing the well in such a way that water is excluded from the well and no vertical movement of water is possible. An improperly decommissioned well may serve as: (1) a conduit for contaminated ground or surface water, (2) permit continued flow of water to the surface from an artisan aquifer, (3) alter the pressure conditions within a confined aquifer which may enable water from separate aquifers to mix, therefore allowing poor quality water to mix with good, or (4) present a potential source for personal injury, loss of life and/or property damage at the surface.

D. Multi Aquifer Taps

The casing in some of the older, deeper wells in the county are perforated at more than one aquifer level. Such multi aquifer taps effectively cross connect aquifers. A review of cross-section diagrams in Volumes I and II of the Groundwater Management Plan show several wells with multi aquifer taps. The practice is no longer permitted for several reasons. Contamination of an upper aquifer can quickly be spread to a lower aquifer through a well which taps both. Water can be drained from an upper aquifer to a lower aquifer through a connecting well, adversely affecting the water level in the upper aquifer.

II. CURRENT LAWS AND PRACTICES

A. Laws and Codes

By design, wells provide a link between an aquifer and the surface of the earth. In some cases, more than one aquifer may be tapped by the same well. Modern wells generally consist of well casing that extends downward from the ground surface to an aquifer within a cylindrical bore hole. Washington Administrative Code (**WAC**) Chapter **173-160**, Minimum Standard for Construction and Maintenance of Wells, requires that the space between the casing and the wall of the bore hole be sealed to prevent vertical movement of water along the outside of the casing. If this space is not adequately sealed, it may serve as a conduit by which contaminated surface or subsurface water may travel into an aquifer. Inadequate well sealing may also permit soil to come in contact with the well casing which can cause corrosion and perforation

of the casing.

Under **Chapter 173-160, WAC** any well that is unusable, whose use has been permanently discontinued, which is in such disrepair that its continued use is impractical, or is an environmental, safety, or public health hazard, must be decommissioned.

Ecology is the agency responsible for regulating well construction and decommissioning. State standards for well construction and maintenance **(WAC 173-160)** were originally adopted in 1973; the current version was adopted in April 1988. The standards are administered by Ecology. They describe both general requirements for well construction, such as notification and permitting, sealing of the well casing, and enforcement, and specific requirements for construction and maintenance of water supply and resource protection (monitoring) wells. Because of Ecology's budgetary limitations, well construction and decommissioning is largely self-policed by well owners and contractors. Well drillers are required to obtain a license for construction of water wells. Chapter **18.104 Revised Code of Washington (RCW)** Water Well Construction requires that "no person may contract to engage in the construction of a water well....without first obtaining a license by applying" to Ecology. This license may be revoked or suspended for violating the provisions of chapter **18.104 RCW** or regulations of the Washington State Department of Health. Chapter **173-162 WAC** contains the administrative requirements for examination, licensing and regulation of water well contractors. Well contractors are required to notify Ecology of their intent to construct, reconstruct, or decommission a well at least seventy-two hours before starting work; notification is made using forms commonly known as "start cards." A permit must be obtained from Ecology to construct a well that is intended to withdraw more than 5,000 gallons per day or irrigate more than one-half acre of noncommercial lawn and garden. Within thirty days after completion of a well, every well contractor is required to submit to Ecology a complete record (the well log) on the construction or alteration of the well which must include geologic and hydrologic information.

The well log and start card requirements were introduced in 1973 and 1988, respectively (Liszak, personal communication). Prior to 1973, Ecology did not require well contractors or owners to submit well logs except for wells under water right permit. As a result, an unknown number of wells exists in the state without any record. In addition, the State has never required identification numbers for private wells. Recognizing the advantages of a statewide well identification system for information retrieval and ground water resource planning, Ecology has established and filled a permanent Planner 3 position in the Policy and Management Section to serve as the lead for the task. The planner has formed a Well Identification Task Force (Task Force) that includes representatives from federal, state and local governments, the drilling industry, consulting firms, the Washington Department of Health(DOH), USGS, and other branches of Ecology. The Task Force is currently

evaluating proposed well identification systems and implementation schemes (Walsh, personal communication). The Task Force includes in its goals, tagging every well with a unique identification number and developing and maintaining an identification program as the first step toward determining the number of wells in need of proper decommissioning in the state. The Task Force will conduct a three month pilot program in Kitsap County to label wells with identification numbers or tags. The Public Utility District will tag operational and other wells (e.g., monitoring, decommissioned) both public and private. Drillers participating in the pilot program will tag all new wells and existing wells which need maintenance service.

Once a well identification program has been developed, the Task Force will change its name to the Well Abandonment Task Force and shift its focus to developing a strategy for decommissioning appropriate wells. The Well Abandonment Task Force will also be under the lead of Ecology. As preliminary tasks, the Task Force will explore funding options, research well decommissioning programs in other states, and investigate ways in which authority may be delegated to local government. Public cooperation and education will be essential in both the well identifications and well decommissioning projects. According to an Ecology representative, gaining public support for the projects will require public education.

Substitute House Bill (**SHB**) **2796**, enacted by the 52nd Legislature, 1992 Regular Session, provided Ecology the authority to delegate a small portion of the Water Well Construction Program to a local health district or county. Upon written request, Ecology may delegate the well sealing and decommissioning portions of the program. The requesting entity must show it has the resources, capability, and expertise, including field inspectors, to administer the delegated program. The delegation includes no funding and is implemented through a memorandum of agreement between the local governing body and Ecology. The act has a "sunset" provision and will expire on June 30, 1996, unless the legislature takes further action on the issue prior to that date.

B. DOH and BKCHD

Public water supply wells are under the authority of DOH. Before a public water supply well is constructed, the site must be inspected and the plans reviewed and approved by DOH. The site may be inspected again after construction is completed. Under an interlocal agreement between DOH and BKCHD, the Health District performs these functions for systems with fewer than 25 connections.

The BKCHD as part of Ordinance 2-1991, performs inspections when a new private well is proposed to serve a new residence with an on-site sewage system. The District ensures that: (1) the well meets proper siting and setback requirements; (2) the on-site sewage system is properly constructed and located at least 100 feet from the well; and (3) all other sources of contamination meet proper setback requirements. Also,

a private well may be inspected when a lending agency requests a report on the water supply for a house. A complete sanitary survey may be done, including a bacterial analysis, with a report sent to the applicant and a copy kept on file at the BKCHD. The Health District also investigates complaints about wells. BKCHD inspectors perform inspections for a variety of purposes that do not involve wells directly, but that bring inspectors into close proximity to wells. According to a representative of Ecology, BKCHD inspectors are commonly the first to notify Ecology of well problems (Liszak, personal communication).

C. Kitsap County Department of Community Development, Building, Zoning and Land Use Sections

The Kitsap County Department of Community Development (Building, Zoning and Land Use sections) is not directly involved in well construction or decommissioning. According to a representative of Ecology, however, inspectors of these sections have, in the past, encountered unused or abandoned wells in the course of performing site inspections and have notified Ecology or the BKCHD who in turn notifies Ecology of the well locations (Liszak, personal communication). At this time, it is not possible to estimate the frequency with which this occurs in Kitsap County, but the number is not substantial (Thompson, personal communication).

D. USGS

The USGS maintains a ground water database that includes well data acquired for specific projects. The database includes information, such as the latitude and longitude of the well, the Section-Township-Range location, the well depth, well owner, water use, and the lithologic interpretation (i.e., geologic description of rock layers). The database is not a complete inventory of wells in the state. A representative of the USGS estimated that fewer than one-third of the wells in Kitsap County have been entered into the database (Fueste, personal communication). The USGS lacks the personnel needed to expand the database to include all the wells in the state.

E. Well Identification Program

The PUD is conducting a pilot well identification program for the state. Unique well identification numbers are assigned to individual wells and a permanent tag with the number is attached to the well head. The number will serve to correlate all data base information on the well. Over a thousand existing wells have been tagged and some well drillers are tagging new wells as part of the evaluation.

III. GAPS AND PROBLEMS

A. Inspection and Enforcement

In order for any of the construction requirements to work adequately, there must be a better inspection and enforcement program by DOE or an authorized representative of DOE.

A representative of the Northwest regional Office of Ecology (NW Office) estimated that the NW Office receives approximately 285 drillers' logs for new wells each month, or approximately 3,400 logs each year, from a seven-county area that includes Kitsap County. Of these new wells, only about 15 each month receive initial inspections; approximately 15 additional wells are inspected each month in response to complaints. (Huggins, personal communication). The number of well inspections by DOE is inadequate to ensure all well drillers use proper construction and sealing techniques, as well as make accurate well information reports.

The most obvious data gaps include: (1) knowledge about where and how many existing unused and abandoned wells there are in Kitsap County is lacking; (2) no process has been established to ensure that wells going out-of-service will be properly decommissioned, and (3) the true degree of risk to ground water quality from unused, but not properly decommissioned wells is not adequately documented. Not withstanding item (3) above, the potential for contamination through either improperly constructed wells or improperly abandoned wells is a recognized fact. Existing statutes and regulations for well construction and decommissioning are generally adequate to protect the aquifer systems, but implementation, regulation, and enforcement is deficient. Ecology does not receive enough funding to inspect more than a small percentage of wells during construction or decommissioning. Additional funding for the water resources program will probably be directed toward other higher priority activities. The public, in general, lacks an awareness and good understanding of the importance of proper well decommissioning.

IV. RECOMMENDATIONS AND STRATEGIES

1. Support sufficient funding for the well construction and decommissioning program.

2. BKCHD evaluate its capability to assume portions of the water well construction program as provided for under SHB 2796 and request delegation of authority to conduct appropriate portions of the program.

3. Support legislation or establish local ordinances which require sellers of property to disclose to buyers the existence of all wells on the property whether in use or not.

4. Kitsap County and cities revise land use and assessment procedures to require property owners to report the number and condition of wells on land they own.

5. Support Ecology's well identification program and establishment of a Well Abandonment Task Force to develop a statewide program that is adaptable to implementation at the local level.

6. Request BKCHD, in conjunction with Ecology, to develop an education brochure concerning proper well construction and decommissioning practices and their importance to the protection of ground water quality.

7. Rescind the "sunset" provision of SHB 2796.

8. Support legislation which requires individuals who become aware of abandoned wells to report them to BKCHD.

9. Support legislation to fund a 5 year well decommissioning incentive program.

10. PUD develop a data base of wells with multi aquifer taps. Identify these wells as primary candidates for decommissioning.

V. REFERENCES

The materials for this paper have been, for the most part, obtained from a draft issue paper entitled, "**Ground Water Quality Issues Related to Well Construction and Abandonment**" written by Jacqueline A. Smith of Geraghty and Miller, Inc. and Trudy C. Rolla of the Seattle King Department of Public Health. Additionally, other ground water management programs have been reviewed and information used, as appropriate.

Batra, Mo. Drinking Water Operations, Washington Department of Health. 464-7672

Bishop, Roy. Well Construction Regulations, Washington Department of Ecology, N.W. Regional Office, Bellevue, 649-7000.

Deeter, Jerry. BKCHD Drinking Water Section. 478-5285

Huggins, Herman. Well Inspections, Washington Department of Ecology, N.W. Regional Office, Bellevue, 649-7000.

Liszak, Jerry. Well Construction and Abandonment, Washington Department of Ecology, N.W. Regional Office, Bellevue, 649-7000.

Moseng, Ethan. Drinking Water Operations, Supervisor, Washington Department of Health. 464-7670

Scott, Randy. Legislation, Washington State Association of Counties. 753-1886.

Walsh, Brian. Water Resources and Planning; Well Identification Task Force, Washington Department of Ecology, Olympia. 438-7471.

Woods, Mike. Legislation, Association of Washington Cities. 753-4137.

REGULATIONS

Chapter 173-160 WAC - Minimum Standards for Construction and Maintenance of Wells.

Chapter 173-1162 WAC - Rules and Regulations Governing the Regulation and Licensing of Well Contractors and Operators

Chapter 246-290 WAC - Drinking Water Regulations - State Board of Health

Chapter 18.104 RCW - Water Well Construction Act (1971)

Bremerton-Kitsap County Board of Health Ordinance 2-1991, Rules and Regulations for Public and Private Water Supplies.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: WATER BALANCE AND CARRYING CAPACITY

June 15, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the dynamics which are changing Kitsap County's ground water supply. The population in Kitsap County has grown rapidly in recent years and is expected to increase substantially in the future. Demand for water will increase with the population. Ground water provides 80% of the water resource in Kitsap County. That percentage is expected to increase due to stream closures and the expense associated with processing surface water. Best estimates of the amount of ground water available is important to planning and evaluating what monitoring is prudent to track the actual impact of increased withdrawal on the county's aquifers.

B. Water Balance

Evaluating the capacity and status of an aquifer system is complex. At best, currently developed math models provide rough estimates of aquifer parameters. One frequently used method is a Water Balance which measures rainfall and evaluates what happens once it reaches the ground. The Water Balance equation is:

Precipitation = Evapotranspiration + Run-off + Recharge

The water balance is not a fixed condition. It will change during a given year and from year to year. For the most part, precipitation will not vary significantly on an annual basis. The other components, however, can deviate dramatically from previous average values. Changes in run-off and evapotranspiration will change the water that is available to recharge the ground water supplies. Clear-cutting, for instance, will decrease the evapotranspiration and could temporarily increase run-off depending on slope, soil characteristics, and mitigating action taken.

It is important to have an understanding of the Water Balance Components and changes in them caused by man, in developing actions and procedures which will help maintain or increase the ground water supply. As an example, water from run-off can be detained, treated if necessary, and reintroduced into the ground water system.

Water Balance Components:

Precipitation varies dramatically in Kitsap county from 20+ inches a year in the North to 80+ inches a year in the Southwest. Annual, average precipitation will remain more or less the same from year to year.

Evapotranspiration is water that goes back into the atmosphere. It consists of the moisture that is absorbed by plants and evaporated from both hard surfaces and from vegetation. The vegetation loss occurs mostly during the summer when moisture is absorbed by the root system and transported to the leaves were it is evaporated back into the atmosphere.

Run-off is the amount of water that avoids evaporation or soaking into the soil. It consists of water that collects on the land surface or subsurface and flows to the streams, rivers, and urban drainage systems. In Kitsap County, run-off quickly ends up in the Sound or Hood Canal and is lost for beneficial use. The over land flows are largest during storm events and are less noticeable during periods of light rain. The amount of run-off is directly proportional to the imperviousness of the land's surface, the steepness of the slope, and the amount and type of vegetation on the ground. Vegetation and porous soils absorb storm water. Flat surfaces and retention features slow down the over land flow, thereby giving water more time to be absorbed into the soil.

Recharge is precipitation that is absorbed into the ground. Recharge percolates down through the soil until it reaches the water table or an impermeable surface. Some ground water re-emerges into lakes and streams, and can be a substantial component of surface water flows during the summer. The geology of the county is such that impermeable layers cause significant amounts of ground water to move in a horizontal direction toward the sea. A portion of recharge infiltrates to the deepest aquifers. Under natural conditions, all of the recharge eventually will pass to the sea through rivers and streams or by directly welling up in underwater springs. Water pumped from aquifers interrupts this natural balance. The amount of recharge is directly related to the amount of run-off and evapotranspiration. If run-off is a large component of the water balance, less water will be available for recharging ground water supplies.

The largest factor in changing the recharge component of water balance is land use activities. Development can have a dramatic effect on recharge. It alters evapotranspiration and expands impervious surfaces thereby increasing run-off. The percentage of precipitation which recharges ground water is reduced by paving or diverting rainwater away from recharge areas. (Note TR-55 US. Soil Conservation Service, Urban Hydrology for Small Watersheds, the Changing Characteristics of the Water Balance Components). Manipulating water balance components, in particular large scale run-off, can impact ground water supplies favorably. In some cases where

run-off has been controlled, removal of vegetation has decreased evapotranspiration and increased recharge.

Ground Water Yield Terminology

A rough estimate of the amount of renewable water available from rain water recharge is here-in referred to as Hypothetical Groundwater Yield (HGY). Potential Developable Yield, Hypothetical Developable Yield and Safe Sustainable Yield (SSY) are similar estimates of available ground water. The term HGY is preferred by Ecology. (Note: SSY is used in RCWs (RCW 94.44.130)) HGY estimates for Kitsap County when compared to projected growth, should provide a strong incentive to establish comprehensive conservation and water reuse programs in the near future.

In 1965, a study estimated Kitsap County would experience ground water depletion (also called over-drafting) between the years 2000 and 2025. This assessment used existing population growth and was based on Safe Deliverable Yield (an earlier variation of HGY). (See PRELIMINARY ASSESSMENT OF WATER RESOURCES AND PUBLIC WATER SERVICES ISSUES IN KITSAP COUNTY, completed by Kitsap County Dept. of Community Development of Kitsap County and Kitsap Public Utility District #1, 1986.)

HGY is the amount of water (expressed as a percentage of precipitation) that can be safely withdrawn from a ground water resource without resulting in over-drafting. HGY calculations require determining the percentage of the rain water that recharges the ground water aquifers. Some experts feel only 30% to 50% of recharge can be withdrawn without causing an overdraft of ground water resources, others recommend an even more conservative number (definition and discussion on problems associated with applying HGY is on page II-42, and Table II-15, grant I, vol. I). Each geographical area has different recharge characteristics due to soil, vegetation, climate, and precipitation differences. In Kitsap County it is estimated that 44% of the annual precipitation recharges the ground water (Grant 1 Vol. I).

TOTAL AVERAGE PRECIPITATION

36%	20%	44%
Evapotranspiration	Run-off	Ground water recharge

Carrying Capacity

Using the County's average 45 inches of annual precipitation and 30% to 50% recharge percentages, HGY is between 5.9" and 9.9" of water per acre. In terms of gallons this equates to 160,244 gal. per acre and 268,884 gal. per acre respectively. These amounts would supply the needs of 4.4 to 7.4 persons per

acre, at 100 gallons a day per person. This HGY range would support 1.6 to 2.7 houses per acre at 2.7 persons per household.

At this time, Kitsap County's ground water aquifers are, as a whole, not being over-drafted, however, individual aquifers may be in jeopardy (Exhibit II). The Island Lake aquifer is under investigation to determine if it is being over-drafted due to land use developments and new high capacity wells. The state suspended granting new water rights in the aquifer pending completion of the investigation. Because land use changes are unpredictable and the impact on ground water supplies is variable, HGY evaluations are difficult to project into the future.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Water Availability Assessment

Of vital interest to ground water administration and growth management is devising a reasonable method to assess the amount of water available for beneficial use without causing a depletion of the resource. (Note: Discussion on Water Balance and Recharge in section G page II-38 Vol.1 of Grant 1 which points out the difficulty in developing long-term management of ground water supplies without a proper monitoring system.) The Growth Management Act makes counties responsible for investigating and determining if enough water is available before issuing a building permit.

Methods and models are available to make HGY assessments, but their uncertain accuracies, especially for the complex geology of Kitsap County, make extensive use of comprehensive, sophisticated computer modeling of questionable benefit.

III. GAPS AND PROBLEMS

A. Safe Sustainable Yield (SSY)

The SSY is an estimated safe amount of ground water that can be with-drawn from ground water supplies without depleting the resource. It is not a fixed quantity due to conditions that change the recharge rate in the water balance. Drought and land use activities are two major factors that can effect SSY. Drought conditions are generally very apparent when they occur. Changes in recharge rate due to changes in land use activity are more difficult to quantify. If run off is increased due to an increase in impervious surfaces, recharge diminishes. If the infiltration that is occurring from septic systems is eliminated when a sewer line is installed, recharge will decrease. Methods to mitigate these and other factors which degrade the water balance has not been developed. Water Quality

concerns associated with enhancing recharge complicate the process. Water demand estimates should drive water supply planning, in other words, if demand exceeds the projected supply, action to improve the SSY should be one of the options considered.

B. Data Collection and Monitoring

The Data Collection and Analysis Plan (DCAP) for ground water, July 1989, and Volume 1 of the Kitsap County Ground Water Management Plan, Background Data Collection and Management Issues, identifies seven Kitsap County aquifers which may be showing signs of depletion. The studies indicate certain sections of the county could experience water supply problems early in the next century. These trend assessments are preliminary due to data limitations. Additional monitoring and analysis of county aquifers need to be conducted.

C. Seawater Intrusion

Because the county is surrounded almost entirely by the Hood Canal and Puget Sound and since rain fall in the northern sections is low, seawater intrusion is a significant threat. Monitoring and analysis for seawater intrusion as a result of increased water withdrawal is currently inadequate.

IV. RECOMMENDATIONS AND STRATEGIES

1. County and city government gather data on the dynamic nature of the relationship between surface activities and their impact on surface and ground water.

2. Kitsap County Public Utility District develop an educational program for the public, public officials, and the business community on the effects of run-off on the water balance and the impact development has on storm water and ground and surface water supplies.

3. County and city government adopt economical and feasible run-off practices which enhance ground and surface water supplies.

4. Appropriate government entities continue to search for policies and practices that are beneficial to enhancing water supplies.

5. Kitsap County Public Utility District develop a comprehensive aquifer monitoring plan that will provide data which can be analyzed to spot over-drafting trends and facilitate corrective action.

6. County and city government develop building codes which enhance retaining and recharging as much run-off as possible.

7. County and city governments in conjunction with Ecology, investigate the feasibility of collecting and artificially recharging run-off during periods of high precipitation.

8. Kitsap County Public Utility District conduct a comprehensive evaluation of the south and west areas of the county for water supply potential.

9. If County and City governments convert significant numbers of households from septic to sewer, consideration should be given to processing sewer water for reuse in order to compensate for lost recharge from the abandoned septic systems.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: AQUIFER MINING AND OVER-DRAFTING

October 19, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the identification of and potential responses to Aquifer Mining and Over-drafting. Preventing aquifer mining and over-drafting is necessary to protect ground water resources from detrimental impacts and assure future water availability. Aquifer mining and over-drafting generally results from altering the land surface, excessive pumping, or a combination of the two, which excessively upsets the natural water balance. Additional information on water balance is available in a separate issue paper.

B. Background

Aquifer mining and over-drafting are general terms used to denote the condition caused by extracting more water from an aquifer than is being recharged. Over-drafting occurs whenever pumping exceeds the Safe Sustaining Yield (SSY) of an aquifer. When mining and over-drafting activity continues unchecked, the volume of water in the affected aquifer will continue to be reduced until wells go dry and/or the natural outflow from the aquifer is decreased. Natural outflow is discharged into lakes and streams through springs and seeps on the surface of the land and through underwater springs to lakes or sea water. Adequate natural outflow is essential for sustaining stream base flows, maintaining lake levels, and preventing sea water intrusion.

Water naturally discharges from aquifers at a rate which is controlled to a large extent by the amount of recharge. In a geological area like Kitsap County, some fresh water flows directly from aquifers to seawater. Well pumping can cause aquifer levels to drop without causing mining to occur. A lowered aquifer water level reduces the differential pressure between the aquifer and the Hood canal or Puget Sound. The reduced differential pressure results in a decreased flow from the aquifer to seawater. When the reduced flow to sea balances the increased extraction through wells, the aquifer water level will stabilize at a new lower level. If extraction reaches too great a rate, a steady lowering of the aquifer water level will occur over time, causing over-drafting or mining.

Over-drafting ground water from the shallower aquifers can have an adverse impact on surface waters and wetlands.To determine if mining is occurring, careful monitoring must be conducted over an extended period of time and careful analysis of the data collected must be conducted. The County has many shallow and deep aquifers, some of which may be connected vertically as well as horizontally. As a result, determining with accuracy the amount of water that can be safely withdrawn from an individual aquifer before over-drafting will occur is perplexing. Monitoring aquifer capacity is important to prevent over-drafting. Predicting the capacity of a Kitsap County aquifer is difficult and expensive using existing data and analysis capabilities. Changing factors, such as land use modifications which impact recharge rates, complicates the process. The current best means of detecting aquifer overdraft conditions are to record and analyze static water level, over a long period of time, and observe the strain on an aquifer which is caused by a sustained pump test.

C. Aquifers

An aquifer is an underground water resource storage area. These storage areas are geological formations which are porous enough to allow large quantities of water to fill the void spaces between their particles. Aquifers have some form of bottom to them, such as bedrock or other impervious or semi-impervious layer, which helps to contain the ground water. Clay or silt or a combination of the two are common aquifer bottoms or aquitards. In some cases the ground water is trapped between a bottom and a top layer. If the geological formations are porous enough and large enough they can hold tremendous quantities of water. Aquifers in Kitsap County are normally recharged by rain water which percolates down through the ground. The actual water available for beneficial use on a sustained basis is much less than the total recharge. Part of the recharge water is held in the soil. Part is discharged to streams, lakes, seeps, and other wet lands. The remainder enters aquifers. In general, the percentage of recharge going to shallow aquifers is greater than that which reaches the deeper aquifers.

Extracting ground water from aquifers sometimes can be difficult as some geological formations will not yield large enough quantities of water to make extraction cost effective. As a result, the sum total of the water available on a sustained basis from the producing aquifers is usually much less than the total ground water existing in an area.

D. Water resources:

It is estimated that 70% to 80% of the water now being used in the County comes from ground water; the rest from surface water supplies. Surface water supplies are taken from both lakes and streams. The largest supply of surface water in the County is the Casad Dam which serves the City of Bremerton. This dam supplies

approximately 65% of the water needs of the people living in Bremerton's service area (Table II.8 Grant I, Vol I.) A precise evaluation of surface water and ground water available for source development is difficult to make. An early study, the Comprehensive Water Study of Kitsap County for Public Utility District No 1, by Ingam, Hill, 1966, noted that of the 426 separate streams on the Kitsap Peninsula, only 12 have drainage areas larger than 10 square miles and that most of the remainder have less than 1 square mile. As noted in the Ingam/Hill study, not all of the 12 larger streams are suitable for development. In any case, most of the larger streams and rivers in the county have been closed to further appropriation of water (see WAC 173.515). As a result county residents are becoming more and more dependent on ground water.

Thousands of home owners are dependent on shallow aquifers for their water supply. A healthy aquifer level is vital to preventing sea water intrusion. The larger public water system can be expected to continue their pattern of drilling deep, high capacity wells. The County will become even more dependent on ground water in the future, therefore, we must protect individual aquifers from over-drafting.

D. The Safe Sustaining Yield of an aquifer

A general estimate of the SSY for the entire County is 16% of the annual precipitation. (The actual amount of water available could be more or less.) (See Vol. I, GWMP for details on SSY or Hypothetical Groundwater Yield (HGY)). The size of aquifers, recharge rates, and yields can vary to a large extent.

Although it is difficult to estimate the water available from an aquifer for use on a sustained basis, it is possible to monitor for over-drafting by tracking well levels over time. Comprehensive monitoring is recommended by the State Dept. of Ecology (Ecology) (Steve Hirschey personal contact 7/92).

Monitoring is needed to determine if over-drafting is occurring. When a continuous drop in the static water level of an aquifer occurs over a period of years , the aquifer should be carefully evaluated taking into account rainfall during that period. When over-drafting is indicated, water extraction should be reduced. Ecology has the responsibility under state law for protecting water rights and restoring or stabilizing stream, lake, and aquifer water level when required. The law provides for curtailing junior water rights to correct over-drafting.

E. Recharge and the effect on over-drafting

Sustainable yield can be lowered if recharge is modified by activities which occur as a result of development. A reduction in recharge rate can trigger over-drafting. Recharge is reduced if an aquifer recharge area is partially covered by an impermeable surface such as a building or parking lot. Diverting storm water flow

to the sea or shifting from septic systems to sewer also reduces recharge. Installing sewers in an area may be necessary in order to prevent ground water contamination, however, a loss of both ground water and base stream flow may result. For example, over 130 square kilometers (50 square miles) of a suburban area on Long Island, New York experienced a water level drop of 3 meters (10 ft.) when the area installed sewers. (Franke 1968, Water In Environmental Planning). See Attachments A for a general explanation of reduced ground water availability as a result of development.

F. Problems caused by over-drafting

Aquifer mining or over-drafting can result in sea water intrusion, subsidence, or contamination. Sea water intrusion into an aquifer is prevented by the fresh water in the aquifer pushing against the sea water, keeping it from flowing into the aquifer. Should the aquifer level be lowered sufficiently, sea water intrusion can occur. If salt pollution is at a high enough level, the Bremerton-Kitsap County Health Department (BKCHD) and the state Department of Health will close down all wells in the polluted area. Sea water intrusion policies set by Ecology will be applied in restoring or stabilizing sea water intrusion conditions. (Please note Sea Water Intrusion Issue Paper for more details.)

Subsidence is the lowering of the ground level caused by the removal of large amounts of ground water. In some cases where over-drafting has occurred, the soils of the geological formation of the aquifer and/or the confining layers have collapsed in on themselves.

The amount of subsidence is dependent on the loss of the aquifer water head and the compressibility of the geological formations of the aquifer and the confining layers. We do not know how much compressibility will occur if the aquifers of the County are over-drafted. John Vaccaro of the US Geological Survey has noted that no subsidence problems have occurred in Puget Sound to date. (Personal contact 7/92.)

Contamination from sources other than sea water is a potential result of over-drafting. Contamination can occur when over-drafting causes water above or around an aquifer to flow toward it. If the outside water is contaminated it will eventually contaminate the aquifer.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Revised Code of Washington (RCW) and Washington Administrative Codes. (WAC)

The Department of Ecology (Ecology) is responsible under **Chapter 90.03** and **90.04 RCW** for water resource conservation and maintenance of a sustained yield. The protection of water rights is extended to waters appropriated for their beneficial use. All waters in the State are held in trust by the State for the benefit of the citizens.

Chapter 90-44 RCW the regulation of public ground waters. This law applies surface water regulation to ground water. It grants Ecology jurisdiction over the withdrawal of ground water. Water rights allocations are fully discussed in a separate Issue Paper.

The law also provides for the protection of water rights. If a problem arises which requires a cutback in the amount of water withdrawn from an aquifer, the older or senior water right is the last to be affected. Junior water right holders may be temporarily limited in the in the amount of water they may take. Ecology has "The jurisdiction to limit withdrawals by appropriators of ground water so as to enforce the maintenance of a safe sustaining yield from the ground water." In order to verify conditions Ecology can require all wells in an area where problems are occurring to have meters placed on them.

Ecology can "designate separate depth zones within any such area or sub-area or to modify the boundaries of such existing area, sub-areas" or zones to the end that the withdrawals therefrom may be administratively controlled as prescribed in RCW.90.44.180 in order that overdraft of public ground waters may be prevented "so far as is feasible."

These administrative controls are used to set limits on the amount of water that can be taken from an aquifer within an area, sub area, or zone. For example, the 173-132A Duck Lake Ground Water Management Subarea boundary was set up to match the aquifer's boundaries because the aquifer was used to store artificially recharged waters. Withdrawal of water from the aquifer is controlled. (Please note 173-134A Quincy Ground Water Subarea Management Policy.) The withdrawal of ground water from both shallow and deep aquifers is controlled to specific amounts.

Under RCW 90.44.180, the definition of a zone is: "Underground geological formation areas capable of holding accessible ground water for beneficial use." Once a zone has been established as having a problem, hearings are to be held in order to determine whether the water supply is adequate for the current needs of all the holders of water rights. If cut backs are required, the junior water rights are the first to be considered for modification or closure. WAC 173-150-80 contains the procedures for rescinding or reducing junior water rights to correct an impairment and new withdrawals are not permitted. If all parties holding water rights in a zone choose, they can make an ordered decrease in withdrawal provided that a waiver of all or specified parts of the senior right is made in favor of the junior right holder(s).

Under **RCW 90.44.230**, a court can determine the water rights and "the level below which the ground water body shall not be drawn down by appropriators, or shall reserve jurisdiction for the determination of a safe sustaining water yield."

Chapter 90-54 RCW, the Water Resources Act of 1971, provides for coordination and

development of comprehensive water resource planning. Section 90.54.020, Fundamentals of Utilization and Management, part 4, states: "Adequate and safe supplies shall be preserved and protected in potable conditions to satisfy human domestic needs." This RCW sets the GWAC's responsibility for planning at the local level. The Ground Water Management Plan as drafted by the GWAC, is a recommendation to County Officials (County Commissioners) who in turn consider enacting local ordinances to carry out the recommendations. (Please note chapter 6, Ground Water Resource Protection, A Handbook for Local Planners and Decision Makers in Washington State. Ecology, and King County Planning Division, 1986.)

Chapter 173-100 WAC, Ground Water Management Areas and Programs, outlines the planning process for the protection of ground water supplies.

WAC 173-100-100 provides for the identification of ground- water problems or potential problems and development of strategies for correcting them via a ground water management plan. Evaluation of over-drafting is part of the process.

Chapter 173-150 WAC. Protection Of Withdrawal Facilities Associated With Ground Water Rights. This WAC establishes policies and procedures for Ecology to follow in regard to protection of ground water availability as it pertains to water facilities. That is, if an application for the withdrawal of water is determined to result in a lowering of the water level below a feasible pumping lift, the application can be rejected.

Chapter 173-154 WAC, Protection of Upper Aquifer Zones. Because upper aquifers are used extensively and are usually of limited capacity, they are more tightly controlled to protect against depletion. Depletion can be caused by water leaking to a deeper aquifer around or through well casings. All well casings going through shallow aquifers must be sealed. Upper aquifers are vital to the maintenance of springs, base flows of streams, and lake levels that are in hydraulic continuity with them.

The Growth Management Act of 1990 (Chapter 36.70 RCW), is intended to regulate growth in order to prevent the depletion and degradation of the natural and physical resources of the State. Under section 63 of this act, a developer is required to provide a statement of sufficiency of water to local government before a building permit is issued. For each project, the Department of Health (DOH) must assure that an adequate supply (including water rights issued by Ecology) is available before a permit is issued. Section 53 and 54 of the act require the counties to investigate and determine if adequate water is available. The act requires that water be available for beneficial use on a sustained basis. The act also requires that aquifer recharge areas be located and protected.

Chapter 36.36 RCW, Aquifer Protection Areas. This law provides funding necessary

for the protection of aquifer recharge areas. The County legislative authority may create one or more aquifer protection areas with the voted consent of the public. The Funds can be obtained from a levy imposed on all properties using an aquifer.

The Comprehensive County Land Use Plans. With the passage of House Bill 1138 in 1984, all of the Comprehensive Plans must address protecting ground water quality and quantity for public use. **Chapter 36.70 RCW,** the Planning and Enabling Act, specifically RCW 36.70.330, notes that the land use element of the plan must provide for protecting the quality and quantity of ground water. At the present time, the Comprehensive Plan for Kitsap County is being updated. All of the older Sub Area Plans contains references to the need to protect ground water both in quality and quantity. The Sub Area Plans will be incorporated into the Comprehensive Plan. Although over-drafting aquifers is not mentioned in this RCW, protection of ground water for public water supplies is covered.

III. GAPS AND PROBLEMS:

A. Current Overdraft Process Deficiencies

Most corrective actions for over-drafting are triggered by persons who notice a drop in the water level of their well and notify Ecology. Once a bona fide over-drafting problem is verified, Ecology sets in motion the processes and procedures prescribed under the water laws of the State. This process is crisis oriented. In most cases some existing water rights are curtailed and no new withdrawal is permitted. Property values (and taxes) can be affected. Actions to correct problems can be costly.

B. Limitation on the Department of Ecology

Ecology is responsible for maintaining the SSY of an aquifer and can modify or stop pumping in order to correct over-drafting. They can also define the aquifer boundaries in order to identify the corresponding water rights within the boundary. Ecology or the courts can set the SSY.

Ecology cannot dictate all of the actions necessary to correct a problem. Under RCW 90.54.130 they can only recommend land use and other policies deemed necessary to protect ground and surface water resources. Many of the corrective actions necessary for preventing over-drafting can only be carried out through coordinated efforts at the local level. The process requires a commitment on the part of all of the involved entities to work together.

C. Information Gaps

All water purveyors are now required under the Interim Guidelines For Public Water Systems Regarding Water Use Reporting, Demand Forecasting Methodologies, and

Conservation Programs, to develop plans containing estimates of the amount of water needed to serve future demands. Without an accurate estimate of the SSY of each aquifer, purveyors will not know if their present resources will be capable of supplying future needs. Information on alternative water supplies is lacking.

Comprehensive monitoring and modeling programs have not been established for most principle aquifers. Aquifers should be carefully monitored and their status analyzed to identify developing problems before a crisis occurs. Ecology needs adequate information to issue a moratorium on additional water rights or take preventive action to stop over-drafting in a timely manner.

Accurate and comprehensive ground water information is not available for growth management decisions associated with establishing land use controls and aquifer protection regulations.

Presently, accurate accounting of the water taken from County aquifers is limited. Historical aquifer water level data should be compared to data from a comprehensive monitoring program to detect the onset of over-drafting. Eight aquifers in particular, should be analyzed. (Note Kitsap County Management Plan, Data Collection And Analysis Plan for details.)

The eight aquifers are:

Hansville-Indianola Sub Area:
- The Upper Peninsula aquifer

Bainbridge Island Sub Area:
- Meadowmere Aquifer
- Eagle Harbor Aquifer

Bremerton/Poulsbo Sub Area:
- Island Lake Aquifer
- Gilberton-Fletcher Aquifer
- Manette-Bremerton North Aquifer

South Kitsap Sub area:
- Clam Bay Aquifer
- North Lake-Bremerton South Aquifer

Within the last two years, Island Lake and the aquifer that is in hydraulic continuity with the lake (the Island Lake Aquifer) have been closed by Ecology to anyone applying to appropriate ground water, including applications for single family wells. Ecology is attempting to determined the cause of decline in the water level of the lake. Water from outside the aquifer is periodically pumped into the lake by the County to maintain the water level. The junior water rights holder (Silverdale Water District) must limit its pumping to a fraction of its former right. (North West Region DOE 1990.) Ecology imposed these controls based on limited information.

Because of the lack of data, it is highly unlikely that all of the aquifers in the County have been identified. Additional well drilling and pumping data needs to be gathered, particularly in the west and south areas of the County. Because few deep wells have been drilled, the extent of the deep aquifers which have been identified is not known. (Please note Background Data Collection and Management Issues, Grant I, Vol II, for details on aquifer locations by sub areas, also Exhibit II Location of principle aquifers Grant I, Vol I.)

Sufficient information on aquifers which are shared with Pierce and Mason Counties is not available.

Some of the aquifers appear to be connected vertically as well as horizontally, but data is insufficient to evaluate this hypothesis.

IV. RECOMMENDATIONS AND STRATEGIES

1. Ecology, in coordination with local governments should develop a comprehensive aquifer monitoring plan to identify over-drafting trends and facilitate corrective action when necessary.

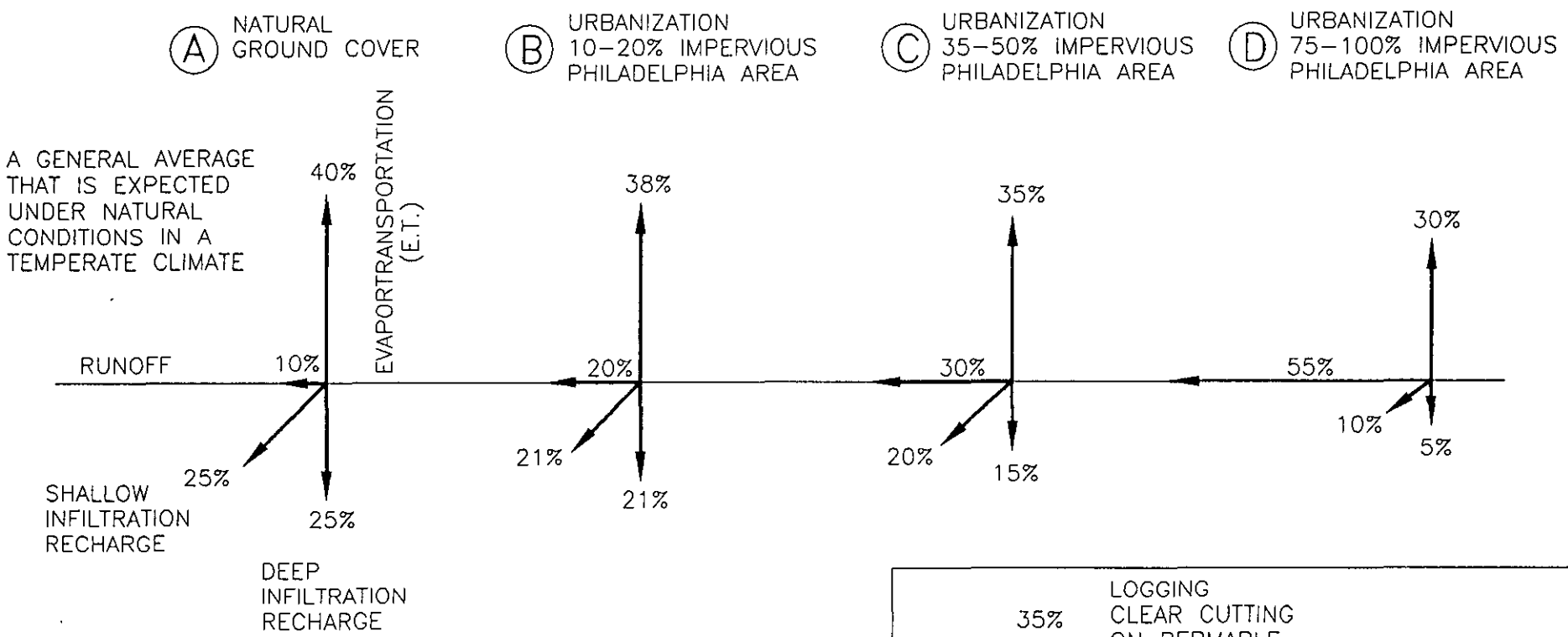
2. Create a local board composed of general purpose government officials, Indian Tribes, major water purveyors, and Ecology, to review aquifer capacity and over-drafting problems. The board should evaluate and recommend to the county and cities appropriate land use and other regulations to mitigate problems created by over-pumping. The Chelan Process should govern establishment of the board.

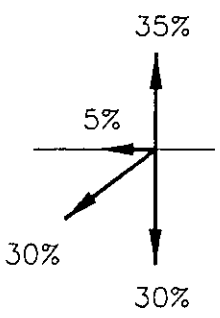
3. PUD evaluate the feasibility of obtaining a computer model to evaluate SSY. The model should be capable of predicting impact that various land use options will have on recharge rates. The modeling system should apply to of the principal aquifers in the County. It should be able to estimate long term trends.

4. County and city government should consider the impact actions taken under the Growth Management Act have on aquifer over-drafting.

A

GRAPHIC EXAMPLE OF WATER BALANCE TAKEN FROM WATER RESORCES PROTECTION TECHNOLOGY. J. TOBY. TOURBIER, RICHARD WESTACOTT, THE URBAN LAND INSTITUTE 1981, PHILADELPHIA AREA.





LOGGING
CLEAR CUTTING
ON PERMABLE
SOILS

ESTIMATION OF WATER BALANCE BASED ON WATER A ENVIRONMENTAL PLANNING, DUNN & LEOPOLD. 1978

NOTE: THIS IS THE SINGLE CASE WHERE RECHARGE MAY BE INCREASED.

NOTE: GROUNDWATER SUPPLIES CAN BE TAKEN FROM BOTH SHALLOW AND DEEP AQUIFERS.

Public Utility District No. 1
Kitsap County

ACAD/S /WAT-BAL

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: SEAWATER INTRUSION

April 20, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This Issue paper examines the threat to Kitsap County ground water supplies posed by seawater intrusion. The County consists of two islands and a peninsula which is almost completely surrounded by seawater. With over 200 miles of coastline, the potential for seawater intrusion is a significant concern, although few cases have been officially recorded to date. Action to support the State's seawater intrusion program will be addressed, as well as items for the County's Ground Water Monitoring Program.

Definition: For the purposes of clarification, seawater intrusion will be defined as the underground displacement of freshwater by seawater and does not include geologically old waters with high mineral content.

B. Health

U.S. Public Health Service drinking water standards indicates two percent of seawater in fresh ground water will make it unusable. The State Department Of Health (DOH) has set a limit of 250 milligrams per liter(MG/L) Chloride for potable water. Above this level, water is considered to be polluted.

The movement of ground waters in an aquifer can be painfully slow. In such situations it is difficult to flush seawater contamination from an aquifer and re-establish an original freshwater/seawater interface. Once contaminated, an aquifer may remain polluted for decades. In aquifers with high transmissivity and flow, cleansing can occur rapidly (Processes, Procedures and Methods for control of Pollution from Saltwater Intrusion. EPA, 1973, National Technical Information Service PB 256 457 draft). A good, local example is the Bangor Aquifer which was pumped down during construction of a dry dock at the Submarine base. Seawater did intrude inland during the process, but was quickly flushed out by the considerable flow of freshwater from the aquifer to Hood Canal (Ground Water Hydrology at The Naval Submarine Base Bangor, Washington, Robinson, Noble & Carr, Inc. July, 1981)

C. Intrusion Characteristics

Freshwater, being lighter, will float on top of seawater. Mixing of the two does not take place rapidly because of their different densities and as a result, a gradational boundary normally forms between them. Movement of ground water caused by pumping, changes in recharge, or tidal action can cause a larger interface layer. Where there is little movement of ground water, the interface layer may be only several feet in thickness. When substantial aquifer activity is present, the freshwater/seawater interface may be as much as several hundred feet thick.

D. Monitoring and Early Detection

Small amounts of salt in freshwater (i.e., below 100 MG/L Cl.) are not considered harmful for human consumption and are difficult to detect by taste. Much smaller concentrations can contribute significantly to corrosion and cause damage to pumping equipment over time. The associated sodium contamination is of concern to people with high blood pressure. Early warning of contamination can be provided by a monitoring system because salt is fairly easy to detect in small amounts through testing. Monitoring is typically conducted at selected domestic, public and specially drilled monitoring wells, located where movement of the freshwater/seawater interface can be detected.

E. Hydraulics and the Interface Layer

The seawater interface layer position is determined by the difference between the hydraulic heads of the seawater and freshwater and the volume of freshwater available. If the freshwater head (or height above sea level) is great and the aquifer water balance is adequate to maintain flow to the seawater, the interface layers can be close to vertical and located off the shore line. As the freshwater head decreases, the interface layer becomes less vertical and moves inland. In this condition, seawater, being heavier, can flow under the freshwater and push it up slightly forming a Ghyben-Herzberg lens (i.e., the lens is the underground freshwater that floats on top of the seawater). If the freshwater head is maintained, the interface layer will remain static.

On the Kitsap Peninsula, some movement of the boundary occurs due to seasonal fluctuations in recharge and tidal movement. If the freshwater head is lowered because the recharge rates drop and/or well pumping is excessive, seawater intrusion can occur. If the differential head is large, a small drop in the freshwater head will not have a great influence on the movement of the interface layer. If the differential head is small, a modest drop in the freshwater head can trigger a large movement of the interface layer and a large intrusion of seawater. Under Ghyben-Herzberg conditions, a one-foot drop in fresh waterhead may result in a 40-foot movement in the freshwater/seawater interface layer. Maintaining recharge as well as controlling the amount of pumping that is taking place, in either a high or low freshwater head condition, may be required to prevent intrusion (Water Resources Planning and Management and Urban Water Resources, American society of Civil Engineers

1991, pp 840, Model for the control of seawater intrusion).

F. Aquifer Characteristics

Ground water geology in Kitsap County is complex. No single, large underground resource is available on which everyone is dependent. Over twenty-five major, individual aquifers have been identified throughout the county (Exhibit II-8, Vol 1, grant 1). In parts of the county (particularly south and southwest), the number of deep wells is insufficient to identify the extent of water available. It is likely that additional aquifers will be identified as more data is collected. The presence of major aquifers is found at varying depths and there is a good chance that some of them are interconnected. Insufficient data is available to firmly establish the extent of most of the major identified aquifers.

Hydrogeologists have identified five principle aquifer bearing formations. Two are generally located above sea level (Qg1 and Qg2). The third one (Qg3) is more regional and extends from just above sea level to several hundred feet below in some locations. Two deep aquifers (Qg4 and Qg5) have been identified in many locations.) The aquifer locations in Q3, Q4, and Q5 are located below sea level and are vulnerable to sea water intrusion.

G. Aquifers and Intrusion Problems

While unsubstantiated reports exist on seawater intrusion, documentation of its occurrence in Kitsap County has not been verified. The Bremerton-Kitsap County Health Department(BKCHD) has only one recent report of intrusion. That case, which occurred in the Hansville/Kingston area, was evaluated to be caused by seasonal fluctuation in ground water pressure.

Seawater intrusion has been reported near the beach at sea level in the Lofall area. Other areas in which unofficial reports have been made are along the shoreline of the Jefferson Beach and Bainbridge Island areas. Seawater intrusion in these areas needs to be evaluated.

In addition, well drillers have noted indications of seawater during drilling operations. Such cases have frequently gone unreported because the wells were drilled to lower aquifer levels where uncontaminated water was obtained. No official records were kept of these occurrences. (Ron Wiley, personal contact, GWAC meeting, 12/15/92.)

Documented seawater intrusion has occurred in the Gig Harbor area within the Kitsap Peninsula, but because the glacial geology is different, it would be unwise to assume the same intrusion conditions exist in Kitsap County. Kitsap geology does not contain as much clay and silt.

H. Ground Water Recharge Management Conjunctive Concerns

An aquifer is a geological formation which has the capacity for storing water under the ground and is replenished through recharge. Any surface activity which serves to reduce aquifer recharge has the potential to effect seawater intrusion. When the water level (head) in the aquifer is lowered, the flow of freshwater to seawater is reduced. If the flow is reduced sufficiently, the seawater-freshwater interface will move inland.

Seawater intrusion can be controlled by limiting pumping and assuring that recharge is maintained. The key is to maintain the dynamic balance between seawater and freshwater in the aquifer. With adequate monitoring and enhanced recharge, greater supplies of ground water can be withdrawn while minimizing the threat of intrusion.

II. Current Laws And Practices:

A. Federal

Federal Public Health Drinking Water Standards have set chloride limits at 250 MG/L. No universally acceptable policies have been adopted for the prevention of seawater intrusion.

B. State

The State Department of Health has set the level of acceptance for chloride contamination at 250 MG/L, based on the Federal Standard.

C. Bremerton Kitsap County Health Department

The local health department follows State standards. They respond to individual requests for water testing.

D. Kitsap County Department of Community Development

The Counties comprehensive land plan does not contain provisions for monitoring or preventing of seawater intrusion. County Environmental Impact Statements require a delineation of the relation and distance of subject property to seawater. County review includes an evaluation of the potential for seawater intrusion when appropriate.

E. Kitsap County Shoreline Master Management Program, 1977

This program has a goal of preserving natural shoreline conditions. It gives preference to water dependent and water related uses while encouraging development activities that co-exist in harmony with the natural conditions of the shoreline. The Program maintains "adequate water supplies should be available so that ground water quality will not be

endangered by over pumping." Seawater intrusion is not mentioned by name in the associated documentation.

F. Revised Code of Washington (RCW) and Washington Administrative Code (WAC)

The following RCW's and WAC's address seawater intrusion.

RCW 90.03 and 90.04, Resource Conservation and Sustained Yield

WAC 173-150-100 Water rights quality issues

WAC 173-150-110 intrusion and ground water contamination
RCW 18.104 Water Well Construction Act, Maintenance standards for the construction and maintenance of wells and restrictions for well drilling in sensitive areas

WAC 173-200 Water Quality Standards which sets the maximum contamination for chlorides at 250 MG/L

G. The State Department of Ecology

Action for seawater intrusion-

Ecology has proposed four action levels for protecting aquifers from seawater intrusion which vary depending on the extent of contamination.

1. Intrusion Prone Areas
All coastal areas of the state have been designated as seawater intrusion prone areas. Wells drilled in these areas are granted a standard permit subject to additional testing for chloride and conductivity. Samples are taken during the beginning, middle and end of the pump test. In some cases, a monitoring well is drilled between the well in question and the shore line.

2. Low contamination
Chloride levels of 25 mg/1 to 100 mg/1 in a well, test well, or general ground water basin, or within a half mile radius of a well. Ecology may place controls on affected wells.

3. Medium contamination
Chloride levels of 100 to 200 mg/1. Low contamination areas may be classified medium if trend analysis indicates that chloride concentrations are increasing, even if the 100 mg/1 threshold has not been reached. Ecology will deny new well permits in such areas unless an applicant can show that additional withdrawals will not cause additional intrusion. Water permit holders must monitor for chloride in April and August and submit reports to Ecology.

4. High contamination
Chloride levels in excess of 200 mg/1. Ecology requires the same monitoring and reporting requirements as medium contamination areas. In addition, Ecology will specify mitigating actions to stabilize or correct the intrusion. Actions will include mandatory well monitoring and pumping cutbacks.

Where intrusion has been detected, all wells within a half mile radius are subject to testing. Wells in low contamination areas do not require the same level of testing and monitoring as wells in high contamination areas. In addition to monitoring and reporting, each contaminated area is required, depending on its risk level, to carry-out the following mitigating efforts:

Institute a water conservation program
Raise pump intake points to increase aquifer storage capacity
Reduce well pumping rates
Halt development
Install individual water service meters (single domestic included)
Report on water consumption
Relinquish options to perfect water rights
Relinquish unused water rights

As noted in the Data Collection and Analysis Program (DCAP), the potential for seawater intrusion exists for several of the County's aquifers. Under the States' seawater intrusion policy, a well field will be closed when the Chloride level reaches 250 MG/L. The BKCHD maintains records and reports seawater contamination problems to the state.

(Refer to Ecology's Seawater Intrusion Policy for details.)

III. GAPS AND PROBLEMS

Seawater intrusion considerations have not specifically been included in the Growth Management Plan. The impact of increasing stormwater run-off, installing sewer lines to replace septic systems, developing water supplies and similar growth related actions is not evaluated for the impact they may have on seawater intrusion. Areas where seawater intrusion is an identified problem are not given a sensitive area classification.

The State's Seawater Intrusion Policy does not comprehensively address the relationship between ground water recharge and seawater interface layer migration.

To prevent seawater intrusion, adequate aquifer levels need to be maintained. Consequently, aquifer pumping rates must be controlled if recharge is inadequate. .

All local reports of seawater intrusion received by the BKCHD, State Department Of Health, the PUD, and other agencies are not filed and analyzed in one location.

There is a wide variation in the strategies that can be applied to prevent intrusion in areas where it has not occurred and to control it in areas where it has occurred. In Kitsap County we do not have a program which monitors for indicators of seawater intrusion or its precursors.

Current preventative strategies depend on data from existing wells to determine if intrusion is occurring. In areas where wells are a significant distance from the shoreline, intrusion already may be a problem by the time it is detected.

Because few cases of seawater intrusion have been recorded in Kitsap County, little if any attention has been paid to the threat. The Group A water system wells have been monitored for chlorides but Group B and single domestic wells are rarely tested. The dramatic growth that is occurring in the County could bring on seawater intrusion as recharge is reduced and ground water pumping increases to keep up. No plan currently exists to provide early detection and mitigation actions.

IV. RECOMMENDATIONS AND STRATEGIES.

1. County government adopt the Seawater Intrusion Policies of Ecology as part of the Comprehensive Land Plan for the county.

2. BKCHD and the PUD develop educational material and establish a program to inform County citizens about seawater intrusion.

3. BKCHD and the PUD establish a monitoring program to collect and analyze data on seawater intrusion in Kitsap County. Include all reports on seawater intrusion associated with seasonal characteristics as part of the historical record. Implement a coastal zone management policy which contains an effective monitoring program that uses existing and new monitoring wells, and requires sampling every six months.

4. PUD obtain a mathematical model that can track conjunctive activities that impact aquifers. Ensure any ground water modeling program adopted will address seawater intrusion.

5. BKCHD and the PUD develop contingency plans for the onset of seawater intrusion. Should significant seawater intrusion be detected the plan should provide for establishing a committee composed of interested agencies and persons to make recommendations on monitoring and mitigation efforts as well as evaluate the economic impact of those efforts.

6. County government develop and implement a program to prevent seawater intrusion composed of the following elements:

* Adopt a policy that will protect aquifer recharge areas in the vicinity of the shoreline.

* Apply zoning ordinances in the costal zone management area which will slow growth where water and sewer are not available.

* Designate the costal zone management area as a special protection area under the Water Quality Standards found in WAC-173-200 to facilitate stringent review by Ecology of new water rights.

* Include as part of growth management requirements, a provision which controls building permits in areas where there is evidence of seawater intrusion.

7. PUD develop a Ground Water Basin Management Plan for the aquifers of the county which includes the following elements:

* Data on the geology of each aquifer and the water balance in each drainage basin.

* A monitoring program that will accurately determine the freshwater/ seawater boundary along the county shoreline.

* Identification of sources that can be used to supplement aquifers that are under stress(e.g., aquifers and recharge resources, such as stormwater run-off.

* Identification of Best Management Practices (BMP) that can be used to maintain aquifer water balance.

B

	LAND USE INTENSITY	PERCENT OF IMPREVIOUS COVER	ASSUMED RUNOFF GENERATION (INCREASE IN MEAN ANNUAL FLOOD)					
			% OF AREA SERVED BY STORM SEWERS					
			0	20	40	60	80	100
WOODLAND	1	0–2.5	1.0	1.1	1.1	1.1	1.1	1.1
	2	2.5–5	1.1	1.2	1.2	1.2	1.2	1.2
	3	5–10	1.2	1.3	1.4	1.4	1.4	1.4
	4	10–20	1.3	1.4	1.7	2.0	2.1	2.1
	5	20–33	1.4	1.8	2.0	2.4	2.5	2.5
	6	33–50	1.5	2.2	2.4	2.7	2.8	3.0
	7	50–75	1.8	2.5	3.0	3.8	4.0	4.2
HEAVY DEVELOP.	8	75–100	2.5	3.0	4.2	5.0	5.4	6.0

NOTE:

DATA TAKEN FROM WATER RESOURCES PROTECTION TECHNOLOGY, A HANDBOOK OF MEASURES TO PROTECT WATER RESOURCES IN LAND DEVELOPMENT BY J. TOBY AND RICHARD WESMACOTT, THE URBAN LAND INSTITUTE 1981.

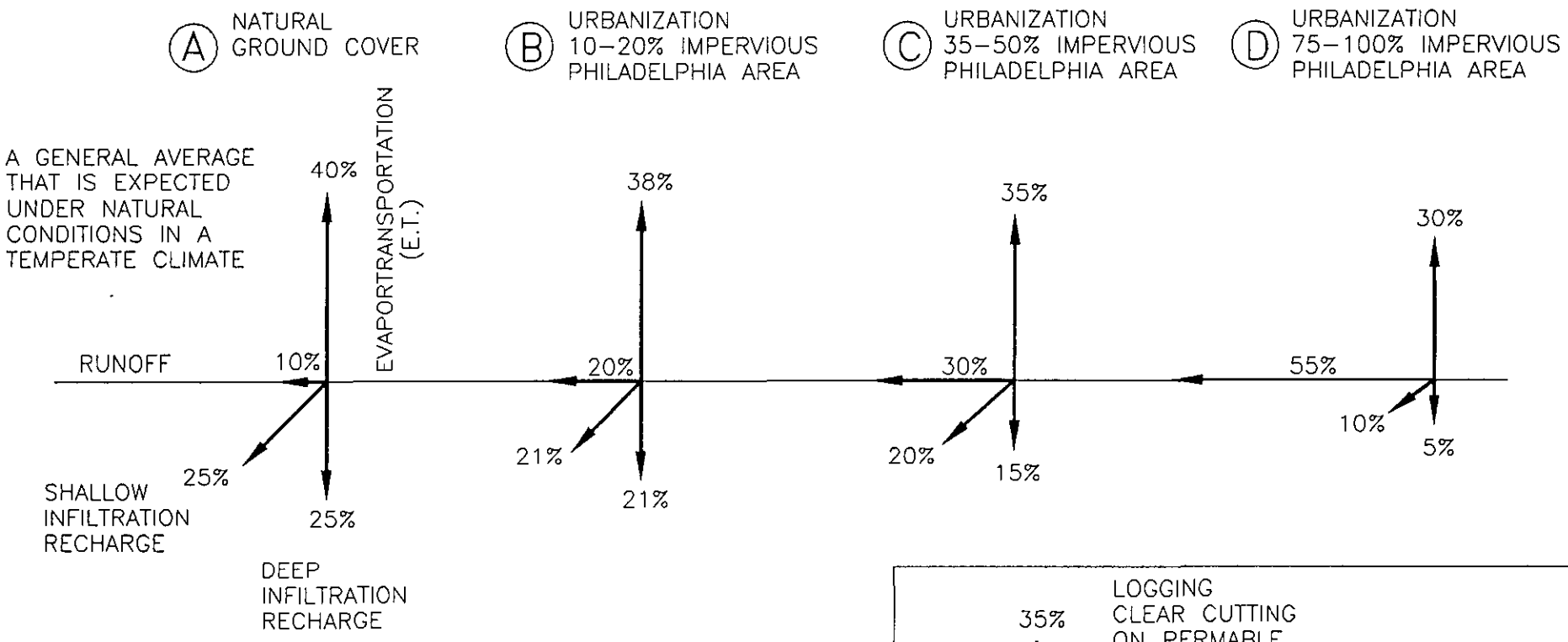
Public Utility District No. 1
Kitsap County

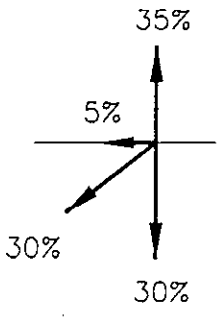
WATER RUNOFF

ACAD/APRIL 93/VIEW 2/SEDIMENT

A

GRAPHIC EXAMPLE OF WATER BALANCE TAKEN FROM WATER RESORCES PROTECTION TECHNOLOGY. J. TOBY. TOURBIER, RICHARD WESTACOTT, THE URBAN LAND INSTITUTE 1981, PHILADELPHIA AREA.





LOGGING
CLEAR CUTTING
ON PERMABLE
SOILS

ESTIMATION OF WATER BALANCE BASED ON WATER A ENVIRONMENTAL PLANNING, DUNN & LEOPOLD. 1978

NOTE: THIS IS THE SINGLE CASE WHERE RECHARGE MAY BE INCREASED.

NOTE: GROUNDWATER SUPPLIES CAN BE TAKEN FROM BOTH SHALLOW AND DEEP AQUIFERS.

Public Utility District No. 1
Kitsap County

ACAD/SEPT93/WAT-BAL

V. REFERENCES

Water in Environmental Planning. Thomas Dunne and Luna B. Leopold, 1978. Chapter 15. Hillslope Precesses.

Water Resources Protection Technology, A Handbook of Measures to Protect Water Resources in Land Development. J. Toby Tourbier and Richard Westmacott, Publishers the Urban Land Institute, Chapter 2 Erosion and Sediment Control.

Soil and Water Resources Conservation Act,(RCA), National Manual.

4. County and City governments, when developing storm water plans should consider the relationship between surface water and ground water and the impact of storm water on surface water flow and ground water recharge.

5. The Surface Water Management Plan should incorporate a surface water run-off inventory process which should be used to determine the feasibility of using storm water run-off for recharge; considering factors such as quality, quantity, and economic cost.

paper.

At the present time, most detention ponds are operated under E.P.A. regulations which require that contaminated water be treated before it is released to streams. How much of this resource could be used to recharge ground water is unknown.

Impervious surfaces:

The following percentages of impervious surfaces in Kitsap county is taken from Kitsap County Ground Water Management Plan. data Collection and Management Issues, Vol 1, Table II-5

Category	Percent Impervious	
	Future	Existing
Urban	70	70
Semi Urban	50	3-15
Semi Rural	30	3-15
Rural 1 acre	15	3-15
Rural 2.5 acre	10	3-15
Parks	0	0
Industrial	90	90

Note: Percentages of total land mass were not given.
Future percentages are estimated at 100% build out.

The above figures, which indicate the potential increase in storm water run-off associated with population increases, are sobering.

IV. RECOMMENDATIONS AND STRATEGIES

1. County and City governments with the assistance of the PUD, gather data on the dynamic nature of the relationship between surface activities and their impact on surface and ground water.

2. County government and the PUD develop an educational program for the public, public officials, and the business community on the effect of storm water on the water balance and the impact that development has on storm water run-off and consequently on ground and surface water supplies.

3. County government ensure economical and feasible storm water practices which enhance ground and surface water supplies are included in the Surface Water Management Plan.

The county follows two policies when evaluating drainage plans:

1. Post development flows cannot exceed pre-development flows.
2. Developments should retain as much water as possible.

An engineering estimate which considers soil type, slope, removal of vegetative cover, addition of impervious surfaces (e.g., streets, driveways, and roofs), plus pre-development run-off, is used to determine the size of detention or retention ponds.

Currently, for homes that are being built on soils that accept water readily, the county is requiring as much roof run-off as possible to be diverted into small catch basins where it will recharge. Using a typical annual rainfall of 54 inches, the amount of rain water on the 3000 square feet of impervious surfaces associated with an average size home is 100,980 gal. If that could all be recharged it would be enough to supply the water needs of 2.7 persons (100 gal. a day each) for one year.

Various levels of government are requiring on-site control and retention of storm water to enhance recharge. The Retention and Recharge Issue Paper covers this subject more thoroughly.

C. Surface Water Management Plan (SWMP)

Kitsap County government is developing a comprehensive Surface Water Management Plan. The cities are also developing storm water plans for their jurisdictions. The SWMP will deal comprehensively with storm water.

III. GAPS AND PROBLEMS

A. The problem of retaining as much run-off water as possible from developed properties is not simple. A number of factors must be considered, several of which are related to the soil type (e.g., soil permeability and slope). Surveys conducted by the U.S. Geological Service indicates that more than half the soils in Kitsap county would have some difficulty absorbing water.

The Kitsap County Ground Water Management Plan, (Volume 1, data collection and management issues, page II-37 Recharge/Aquifer Vulnerability Potential, page II-38 Water Balance and Recharge, page II-39 Recharge) discusses in detail the problems associated with trying to determine actual recharge potential. On the other hand, approximately one half of the county's land surface has a high infiltration potential.

The second problem with run-off is a matter of quality. Run-off which comes from roof tops, streets, drive ways, parking lots, and even residential yards may contain pollutants. In urban areas, no division is made between polluted and clean run-off. A number of studies have been conducted to evaluate contaminants in storm water. No on going programs to evaluate the extent of contaminants in various sources of run-off at the local level were found in the process of conducting research for this

Clear cutting or grading can increase run-off.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Forest Run-off

Native forests present the best control of storm water run-off in Kitsap County. Logging practices influence run-off both during the logging activity and for the time it takes to re-vegetate the new stand. Best Management Practices (BMP's) can reduce adverse impacts to near zero.

The State of Washington Forest Practices Board under Chapter 222 WAC regulates logging practices to insure that BMP's are followed and that water shed values are protected. Kitsap County Department of Community Development reviews forest practice applications required under Chapter 222 WAC for environmental compliance and for plans to convert forest land to other uses. The county environmental checklist for converting forest to other uses addresses storm water control.

Most forrest practices are designed to improve stream flows, manage flooding, and increase water availability for agriculture and hydro-electric power. The extra water available from these practices is normally generated during the winter months and partially shows up on stream hydrographs as increased flow. The additional water generated in Kitsap County is not being diverted for out of stream uses. How much of this resource is economically available for recharge, is not known.

B. Urban Run-off

Water run-off increases as an area becomes urbanized. Increases in impervious and semi-pervious surfaces cause proportionate decreases in recharge and increases in run-off. The Washington State Department of Ecology and Kitsap County are both re-drafting storm drainage rules to retain and clean a larger percentage of run-off from urbanized areas.

Presently the county requires developers of large projects to submit surface drainage plans. The plans must contain estimates of how much water will run-off during a 25 year storm and describe the methods to be used to handle excess water. County policy requires that post development flows do not exceed pre-development flows and that as much water as possible is retained on the development site. In recent developments, most of the water is currently diverted to detention ponds which are maintained by the county. Most ponds are designed to meter the collected water out slowly into streams so that flooding and soil erosion are kept to a minimum. A few of the present ponds are designed to retain run-off to allow it to be absorbed into the ground and become ground water.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: STORM WATER RUN-OFF

October 19, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines storm water run-off as a potential for recharge to ground water . Run-off could be an important source of additional ground water. The following are estimates of run-off in Kitsap county compiled by Economic Engineering Services (EES) by subareas:

	Precipitation	Run-off	Percentage
Hansville-Indianola	25"	3"	12%
Bainbridge Island	37"	6"	16%
Poulsbo-Bremerton	45"	9"	20%
West Kitsap	70"	19"	27%
South Kitsap	50"	9"	18%

NOTE: The data above is taken from VOL I of the GWMP (1989 draft). Please note Attachments A and B which show how run-off increases with increases in impervious surface.

B. Retention and Recharge

Storm water run-off varies with soil type, changes in storm intensity and with changes in land use. Sandy or gravely soils accept more recharge and contribute less run-off than clay or glacial till. Heavy rains contribute proportionately more water to run-off than do light rains. Replacement of natural vegetation with impervious surfaces turns potential recharge into run-off. Run-off can be reduced (and recharge increased) by retention of storm water in ponds or diversion into recharge enhancing areas such as a swale.

Storm water run-off is not a constant quantity. Increases in impervious surfaces through activities such as soil compaction, paving, or roofing can increase run-off.

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KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: RETENTION AND RECHARGE

October 13, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper explores controlling storm water run-off so that it can be retained and diverted to recharge ground water. Storm water from developed land is frequently channeled to storm drains which normally discharge to the sea; so the water is lost to beneficial use. Problems associated with this loss of recharge include:

1. The water available from aquifers is reduced.

2. Subsurface flow and the discharge from aquifers in hydraulic continuity with surface waters reduces. This loss of base flow in streams and rivers can result in damage to fisheries, wet lands, and other beneficial uses ascribed to surface waters.

3. The loss of recharge can lower the ground water table and consequently the water pressure differential between freshwater and seawater. If the pressure head is lowered enough, sea water intrusion can result.

See attachment A. for a generalized example of the relationship between increases in impervious surfaces and the loss in recharge. In addition to lost recharge, contamination increases with land use development limiting the beneficial uses of ground water or making expensive processing necessary. In this issue paper, contamination will be addressed only as it relates to limiting ground water quantity. Several other issue papers address ground water contamination in detail.

B. Recharge

Land use development will, in most cases, cause a loss in recharge. The loss is primarily caused by increases in impervious surface, diversion of rain water to storm drains, compaction of the soil, and loss of vegetation which slows water run-off. Retaining storm water trough applied technology and development practices to increase the amount of recharge, increases the amount of ground water available for beneficial use. The following table shows a typical impact development can have on recharge if mitigating actions are not taken. Results can vary for different surface conditions and geology.

SURFACE CONDITIONS - RECHARGE RATES

	Shallow	Deep	Total
Natural Conditions	28%	25%	58%
10 to 20 % impervious surface.....	21%	21%	42%
35 to 50 % impervious surface.....	20%	15%	35%
75 to 100 % Impervious surface.....	10%	5%	15%

C. Dependency of the County on Ground Water

All of Kitsap County's water is derived from precipitation, a renewable but limited resource. The possibility that some of the count's ground water comes form the Olympic Peninsula is slim, based on the depth of the Hood Canal and bed rock beneath the canal. The Kitsap peninsula is essentially an island with no surface or subsurface flow of water from neighboring areas.

An estimated 70 to 80% of the County's current consumption is ground water and the percentage will increase with time. Surface water supply is primarily from Bremerton's Casad Dam, with some small extractions from lakes and streams. (Note Grant I, Volume I for data on water uses for the County). Most surface water sources in the county are closed to further appropriation.

D. Limitation on Ground Water Use

Various studies carried out by the U.S. Geological Service (USGS)(1965 to 1980) indicate that the growing use of ground water in the County could result in localized over-drafting some time between 2000 and 2025. These estimate were based on growth and water use projections at the time of the studies.

Economic and Engineering Services (EES) projections contained in the Background Data Collection and Management Issues, Grant 1, Vol 1, 1989, combined water use trends, estimated water from known sources, existing growth rates, and a 10% conservation saving factor, to predict water depletion could start to occur between 2020 and 2040. These two evaluations support each other to a degree.

The older USGS estimates were based on the assumption that ground water was consumptively used; that is once used its no longer available for recharge. USGS assumed

100 Gallons of water per person per day were consumed and all areas are sewered. They also assumed all storm water is collected by a drainage system which dumps to sea and that no recharge occurred from retention ponds or other similar devices. A portion of used water is returned to ground water by processes such as septic system discharge and plant irrigation. As the County pursues surface water management, more storm water is expected to be diverted to recharge. An estimate of the amount of used water and storm water in the county that is currently recharged, is not available. Projections of ground water capacity need to consider these and other factors to improve their accuracy.

E. Increasing Dependency on Ground Water

Most surface waters in the County (lakes and streams) have been closed to additional water appropriation. Consequently, dependency on ground water will increase in order to satisfy a population expansion which is projected to grow at a rate exceeding 3% a year. Some sub areas of the County are growing in excess of 6% a year. (Forecast, Analysis Zones, and Population Trends are from the Puget Sound Council Of Governments).

Ground Water also will be required to maintain stream flows and provide other beneficial uses. The base flow of streams and rivers in the County are dependent almost exclusively on the waters supplied by the shallow aquifers and the water held in the soil (field capacity of the soils). Maintaining the base flow of the streams can be critical to fisheries and other beneficial uses. At present, 36 streams and 2 lakes have been closed or have partial closures placed on them to the taking of waters because of the danger to fisheries and the loss of other beneficial uses (Please note WAC 173-515 Instream Resources Protection Program Kitsap Water Resources Inventory Area (WIRA) 15 for closure data). An estimated 60 % of the land surface in Kitsap County is recharge area critical to the maintenance of stream base flow. Maintaining recharge rates within each drainage basin will be important to maintaining base flows (Note WAC 173-515-50 protection of base flows).

The County is dependent on ground water for both human needs and for the maintenance of natural systems, wetlands, lakes, and streams. Enhancing the ground water supply by increasing recharge will be critical in accommodating growth and preserving natural systems.

The specific quantities of water that can be safely extracted from the aquifers (SSY) is unknown. Contamination negatively impacts the quantity of ground water that can be put to beneficial use. The quantity of contaminated ground water in Kitsap appears to be small, is limited to shallow aquifers, and most probably is very localized. No contamination of the 27 known, principal aquifers has been recorded.

F. The impact of development

Land use development can have both negative and positive impacts on retention and recharge rates. Without careful planning and mitigating action, development generally has a very negative impact. Under natural conditions (not logged) the ability of the top layers

of the soil to retain precipitation is at a maximum, recharge is very high, and run-off is nil. Retention is primarily caused by vegetation and duff which retain the precipitation, prevent run-off and allow water more time to infiltrate. The forest floor in undeveloped forest conditions readily absorbs and transmits downward the water from even extreme intensities of rainfall. Very little overland flow occurs. Flooding under these conditions is primarily the result of excessive shallow subsurface flows. (Forests and Water, Anderson, Hoover and Reinhart, USDA, Forest Service General Technical Report PSW 18/1976. Infiltration Process page 11. Water Resources Protection Technology, A Handbook of measures to Protect Water Resources in Land Development, By J Tourbier and Richard Westmacott, The Urban Land Institute. Page 3 Typical Hydrography changes due to land use changes and increases in impervious surfaces).

G. Logging operations

Some studies have observed increased stream base flows and higher ground water levels rising following some logging operations. Both European and U.S studies have shown a rise in ground water levels following clear-cutting which employs Best Management Practices (BMPs). Some thinning operations have resulted in smaller increases. (Page 20 Forest and Water, Anderson, Hoover and Reinhart, 1976). The opposite effect has also been observed, as vegetation increases both ground water level and stream flows have been reduced. (Water in Environmental Planning by Thomas Dunn and Luna B. Leopold, chapter 5, Water use by vegetation).

The probable cause of this phenomena is that the infiltration capacity of the soil above of the aquifer is grater than the recharge rate. The full potential for recharge (infiltration capacity of the soil) is not be reached because heavy vegetation extracts a significant percentage of rain water before it enters the soils laying below the root zone. If the increase in run-off caused by clear-cutting is reduced to a point where it is less than the amount extracted by trees before logging, the net result is increased recharge. Increased recharge rates will increase aquifer levels and subsurface flow.

Logging operations which remove vegetation and compact the soil will increase run-off and reduce retention. Burning will compact the soil and create a similar effect. In general, run-off increase as retention time decreases. Unmitigated clear cutting causes the most run-off. On the Kitsap Peninsula, excess run-off is not captured in dams (with the exception of Casad Dam) or used for irrigation purposes; it is lost of beneficial use.

H. Retention and Recharge Rate Changes Due to Development.

The rate of recharge is diminished as an area undergoes development because of an increase in impervious surfaces. The surface waters that were retained and recharged becomes run-off. (Note page 3, typical hydrographic changes do to increasing the area of impermeable surfaces, Water Resources Protection Technology, Tourbier and Westmacott, the Urban Land Institute. Ground Water Resource Protection, A Handbook for Local Planners and

Decision Makers in Washington State, King County and DOE, 1986. The reduction of recharge and aquifer storage due to development, Page 3.2 and 3.3).

While development typically brings a reduction in recharge, exceptions can be created by technological application. Most of the roof top run-off in some urban and suburban areas are retained and released to the surface of the ground or to small catchments below the surface were they are kept long enough to infiltrate and recharge ground waters. Some of these practices for on site controls of run-off are recommended in the States Storm Water Controls Manual. The extent of mitigating actions to preserve retention and recharge in the County is unknown.

J. Technological Application

As indicated above, technology can be applied to minimize the impact of development or actually increase retention and recharge. Besides the technological application noted above others are called out in different publications. Methods range from those that can be applied in forestry and farming to those applicable to urban settings. Several methods are contained in the Washington State Water Quality Guide, Integrating Water Quality and Quantity into Conservation Planning. This guide provides a source of information and tools to aid agricultural land owners and operators in making acceptable decisions with respect to all water resources. Deals with both water quality and quantity as related to ground and surface waters. The guide contains 144 technical approaches that can be applied as BMPs in rural farming communities. Some applications can be applied in urban areas. (Also see Water Resources Protection Technology, A Handbook of Measures to Protect Water Resources in Land Development, By Tourbier and Westmacott, The Urban Land Institute. A resource of technical BMPs that can be applied in land use development that relate to both ground and surface waters in urban and suburban applications, 1981. Contains technical information on infiltration, erosion, storm water controls, and pollution controls).

K. Aquifer Storage and Recovery (ASR)

ASR, an emerging technology is being applied at over 30 sites in the United States. Surface water is used to recharge an aquifer during the wet time of year to support water extraction in the high demand summer months. The water for storage is taken from streams, rivers, or lakes, cleaned to drinking water standards, and pumped into the aquifer. Not all aquifers can be used as reservoirs because of storage capacity limitations or permeability and aquitard conditions. The process is not promising in Kitsap County where water from most aquifers continuously flows to Hood Canal or Puget Sound.

L. Storm Water Management Manual for the Puget Sound Basin

One of the prime objectives of the manual is to maintain recharge through on site controls of storm run-off. It covers erosion and sediment controls, run-off controls, and development of BMPs to control run-off in urban areas. Fortunately, many of the on-site controls and

retention BMPs used to mitigate storm water run-off also are helpful in maintaining recharge. A general source (under one cover) of information relative to retention and recharge technology and practices and their cost effectiveness was not found in the course of developing this paper. Please see the bibliography for information on research and demonstration projects being carried on recharge under PL-98-434. (Interim Report 10/92)

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. County

1. Storm water controls

At present Kitsap County requires developers who are planning large projects to submit a surface drainage or run-off plan to the county Public Works Department. Each plan must be in compliance with the county's surface Drainage Ordinance. Among the policies contained in the ordinance is a requirement that pre- and post-development run-off must be equal to each other. Although not an objective of this policy, recharge rates could be increase by the facilities constructed to keep the run-off generated by impervious surfaces on site. The County reviews each plan to ensure compliance reviewed for impact on the Comprehensive Drainage Plan for each drainage basin.

The objective of the Comprehensive Drainage Plan is to prevent disruptive run-off. Additional objectives are "to preserve the suitability of the waters for contact recreation and fishing, to preserve and enhance the aesthetic quality of the waters, to maintain and protect valuable ground water quantities, locations and flow patterns." (Kitsap County Surface Drainage Ordinance 117, 1987, States Storm Water Controls Manual).

Because it is not always possible to have pre and post development run-off equal through grading and landscaping, extra surface flows are generated. These flows are created by increases in impermeable surfaces which converts some of the precipitation from recharge to run-off. The excess run-off must be collected in either detention or retention ponds.

The detention ponds are designed to temporarily hold and then release the water at a slow rate which prevent the run-off from causing erosion and flooding. Retention ponds are designed to retain the water and allow it to infiltrate the subsoils were it can recharge ground waters. At the present time, over 100 detention and retention facilities have been built in the County and more being planned. Data is not available on how many of these ponds are retention facilities or the amount of water captured in them. Not all of these facilities are located near aquifers which will benefit from the recharge.

Retention ponds can be two to three times larger than detention facilities and require more maintenance. The run-off water in a retention facility needs to be of high quality. Both types of impoundments create additional costs and take up development space.

On site retention of run-off is County policy. Annual rainfall in most parts of the County is high enough to provide significant recharge from the average impervious surface associated with a typical single family residence. Rain water from the 4,200 square feet of impervious surfaces associated with an average size home, (Kitsap County Surface Water management Program) is considerable. Using 45 inches for annual rainfall (the range in the county is 20-80 inches) and assuming all the rain that falls on the 4,200 square feet of impervious surface could be saved, 117,826 gallons, or enough to supply the water needs of 3.2 persons could potentially be realized (using 100 gallons per day per capita). Not all of the captured run-off will be recharged and not all of the recharged water can be recovered for human use. Keeping the recharged water free from contamination is also a problem.

The water from the roof tops is estimated to average a little less than 50% of impervious surface of a typical home. Roof top water may be clean enough to be retained in catchments where it can be filtered and used to recharge ground waters. Research is needed on roof top run-off and the relation between the roofing materials and run-off contamination including airborne contamination that collects on the roofing materials.

2. Comprehensive Land Plans (The Planning and Enabling Act)

With the passage of HB 1138 in 1984, Comprehensive plans must contain provisions for protecting the quality and quantity of ground water used for public water supplies. Comprehensive Plans must estimate population growth, indicate land uses for parcels of land, and recommend development densities. The densities are controlled through zoning Ordinance. The plans do not specifically have to require retention of surface water to enhance ground water supply.

3. Environmental Protection Act

The County follows the State Environmental Protection Act (SEPA). Requirements of the act provide a wide range of protection for surface and ground water.

4. The Soil Conservation Service / Kitsap Conservation District.

A. Farm plans - A service to land holders who wish to improve use of natural resources and farm practices including soil erosion and pollution control practices for both land surface and stream beds.

B. Burley and Minter creek - A program which protects the water in the creeks from the effects of soil erosion and pollution. The program is primarily concerned with surface water quality and down stream effects on shell fish and oyster beds located in the head waters.

5. County Forest Practices

The County has adopted Washington State Forest practices. These practices provide for decreasing excess sedimentation in stream channels through practices which decrease storm water run-off. Logging operation must provide for prevention of excessive run-off through a logging operation plan submitted to the Forestry Department. Vegetative buffers must be provided along stream corridors to catch the extra run-off. Proposed logging operations forest practices are reviewed under the Timber Fish and Wildlife agreement for impacts on fish and wild life. Base flows are expected to be maintained through this process.

6. County Environmental Impact Statement (EIS)

Site plans and the EIS for a proposed development are reviewed by the County Department of Community Development to evaluate its impact on the environment. The amount of impervious surfaces expected are recorded. The amount of surface run-off and where it is expected to be discharged are noted. After review, site plans determined to have significant impact (e.g., a large amount of impervious surface is generated) are required to include mitigating actions to correct the problems they cause. Site plans are not assessed as to the accumulative impact with other developments. Estimates of factors such as the total loss of recharge in a drainage basin which results from several developments is not evaluated.

7. Water Shed Management (None Point pollution control)

The Dyes and Sinclair Inlet projects are two water shed management plans which have been started in the county. In order to protect Puget Sound waters, the County has started a program designed to mitigate non-point pollution problems in water sheds that have been evaluated as causing major problems. The projects develop BMPs for pollutant source control, to limit run-off, and to minimize sediment problems. Ground water protection is a goal of these projects.

B. State

RCW 36.70 A Growth Management. Section 63 of the act notes that before approval to start a development is given, water must be available. DOE is responsible for determining sufficiency of water supplies for all uses including stream flows. The act also provides for the protection of aquifer recharge areas via sensitive area designation but does not provide for the need to retain recharge at or near pre-development levels.

RCW 43.21C The States Environmental Policy Act provides the procedures which counties and cities must follow in determining environmental impacts. RCW 43.21C.010 section 2 purposes reads: "....promote efforts which will prevent or eliminate damage to the environment and biosphere." Kitsap County EIS requirements only address quantity

of ground water withdrawn or discharges which could impact ground water. The percentage of impervious surface which will be developed at a site and the type of soils present must be listed as part of an EIS. No assessment of impact on recharge is required. Accumulated impact on the environment (i.e., evaluation of the conjunctive impact of two or more developments) is not required for an EIS. Small developments may not be required to submit an EIS.

RCW 90.22 Minimum Water Flows and Levels. Ecology may establish minimum water flows or levels for streams, lakes, or other public waters for the purposes of protecting fish, birds, or other wildlife resources or maintaining aesthetic values.

RCW 90.44.120 addresses **aquifer storage capacities** or the amount of waters that can be safely withdrawn without causing depletion (also referred to as Hypothetical Ground Water Yield (HGY) or the Safe Sustainable Yield (SSY)). In Kitsap County where the geology is complex, it is difficult to calculate SSY and for the most part, more accurate long term pump tests and monitoring assessments have not been conducted. Aquifers should be classified as confined or unconfined to assist in determining their capacity and recharge area. Shallow, unconfined aquifer generally receive larger portion of the recharge than deeper ones.

Please note that neither HGY or SSY terminology is used to denote area wide or county wide estimates of ground water availability. They relate only to individual aquifers. **RCW 90.44.130** refers to SSY in respect to the State's right under the Trust Doctrine to protect the ground water resources and to "limit withdrawals by the appropriators of ground water so as to enforce the maintenance of a safe sustaining yield from the ground water body." The procedures for this regulatory process are described under RCW 90.44.130 and 90.44.180. The primary corrective action is to limit pumping.

RCW 90.44.130 provides for the rights of persons, firm or corporation who artificially store water in an aquifer, to processes for the taking of that resource under vested rights and under procedures established by the State. It is not clear who has the right to additional ground water accumulated as a result of numerous small recharge efforts as might be part of a Surface Water Management Plan.

RCW 90.70 Puget Sound Water Quality Authority. The Authority's primary concern is protection of water quality around Puget Sound. Preventive practices focuses on control of pollution and run-off in water sheds.

WAC 173-200 Ground Water Quality Standards. The goal is to maintain the highest quality of the state's ground water and protect existing and future beneficial uses. Maintenance of quality is to be accomplished through the elimination of contaminants and practices which can cause harm to the state's ground waters.

WAC 173-218 Discharges to Ground Waters. This regulation applies maximum water

quality standards to waters used to artificially recharge ground water.

WAC 173-270 Puget Sound Highway Run-off Program and the State Department of Transportation Run-off Program. Retention time for storm water run-off from highways is increased through new practices. Grassy swells and specially designed shoulders can detain run-off, filter out some of the contamination and allow a larger quantity of storm water to infiltrate the soil, recharging ground water.

WAC 173-515 Instream Resources Protection Program for Kitsap Water Resources Inventory Area (WRIA) 15. The purpose of the program is to maintain river, stream and lake flows and levels as necessary to preserve and protect wildlife, fish, aesthetics, and other environmental values as well as recreation and navigational values. The WAC notes closures and partial closures to the taking of surface waters on 36 streams and 2 lakes in Kitsap County as a result low levels or base flows.

WAC 400-12 Local Planning and Management of Non-point Source Pollution. The WAC applies to water shed management. It provides for the development of on site strategies to prevent contamination and slow run-off of surface water. Some mention is made about protecting ground water, however the main concern is controlling both the quantity and quality of run-off to protect Puget Sound from degradation. Coordination between both surface and ground waters programs is to occur wherever possible. Concurrence between programs is a requirement.

C. Federal

Thirty-three U.S. Code 1251, Title XIV as amended - the Clean Water Act was developed to protect both surface and ground water from non-point and point source pollution.

Soil and Water Resources Conservation Act, (RCA) is a soil and water conservation program, based on the appraisal of land conditions which directs USDA farming activities and the Soil Conservation Services plans for preventing soil erosion and depletion of water resources. The act does not specifically address the need to maintain recharge.

PL-98-434 High Plains States Ground Water Demonstration Program Interim Report, US Department of the Interior, Bureau of Reclamation in cooperation With, US Geological Survey and EPA, 10/92. The purpose of this program "is to study the potential for artificial ground water recharge in the 17 Western States and to demonstrate artificial recharge technologies under a variety of hydrogeologic conditions. Demonstrations sites are located in areas having a high probability of physical, chemical and economic feasibility for recharge. Not all the findings, on the issues associated with the project have been completed."

III. GAPS AND PROBLEMS

In the past, surface water management practices and laws were primarily concerned with controlling storm water and channeling it to sea. Little attention was given to the negative effects that were occurring as a result of the decrease in recharge. While it has been recognized that recharge is important to ground water, little effort has been made to maintain or increase it.

Some retention practices and facilities are starting to appear which compensate, to a limited extent, for increases in impervious surfaces brought on by development. Many of the new surface water practices are not designed with ground water recharge as a primary objective. The full range of existing retention technology is not being applied to maximize recharge via BMPs and retention facilities. Current drainage basin run-off models are not designed to estimate the impact land development has on recharge and the resultant loss of ground water supplies.

A lack of research and technology for diverting storm water run-off to recharge is hampering more comprehensive programs. Practices and facilities for storm water diversion are expensive. This is true for regional retention and treatment facilities as well as practices for channeling run-off from single family home impervious surfaces to recharge. Many storm water quality and processing questions remain unanswered. Few model projects are available to serve as examples of what is cost effective. Without adequate data it is difficult to justify expenditures required to correct storm water run-off problems.

Master drainage plans do not include components to maintain recharge. EISs do not include an assessment of the impact on recharge from increases in impervious surfaces.

Not all surface water is suitable for recharge. Some is contaminated to a degree which is not cost effective to correct. The extent of contamination of surface water at various locations in the county is not known.

The Storm water Management Manual for the Puget Sound Basin has as a first priority for storm water diversion, infiltration wherever possible. The policy was not established, however, to maintain recharge rates. Recharge is frequently a secondary consideration in storm water management policies and surface water controls. (Gary Kuger DOE Storm water section, personal contact 7/93).

Large scale retention facilities which are part of a development may not be located in an aquifer recharge area. When this condition exists, the utility of retention facilities is limited unless the collected water can be transferred efficiently to a location were it can be used. Comprehensive basin planning should be part of planning retention facilities.

Growth Management Planning efforts have not yet addressed the impact to recharge which results from increases in impervious surfaces.

IV. RECOMMENDATIONS AND STRATEGIES

A. If no action is taken.

The new Forest Practices and the Timber Fish and Wild Life agreement will aid in maintaining the recharge rates in logging areas. Base flows, in all likely hood, will remain adequate in these areas. In areas undergoing transition from rural to suburban to urban, impervious surfaces will increase, run-off will increase and recharge will decrease. Because of current storm water control practices for on site retention, some recharge will take place. As a net effect, however, ground water supplies will decrease.

B. Recommendations

1. County Commissioners evaluate the advisability of adopting a no loss of recharge policy as part of the County's Comprehensive Plan.

2. County Department of Community Development (DCD), employing the County's Geographic Information System (GIS), adopt a planning model and process for determining and recording the percent of impervious surface on existing parcels and the projected increase of impervious surface which will result from proposed development. In conjunction with the PUD, establish a process for using the information generated to evaluate the impact of proposed land use developments on recharge within each drainage basin.

3. County government include in the Surface Water Management Plan (SWMP) facilities and practices for maximizing ground water recharge with storm water where technically and financially feasible.

4. County Government revise the EIS evaluation procedures to assess accumulated impacts on recharge by multiple adjacent developments.

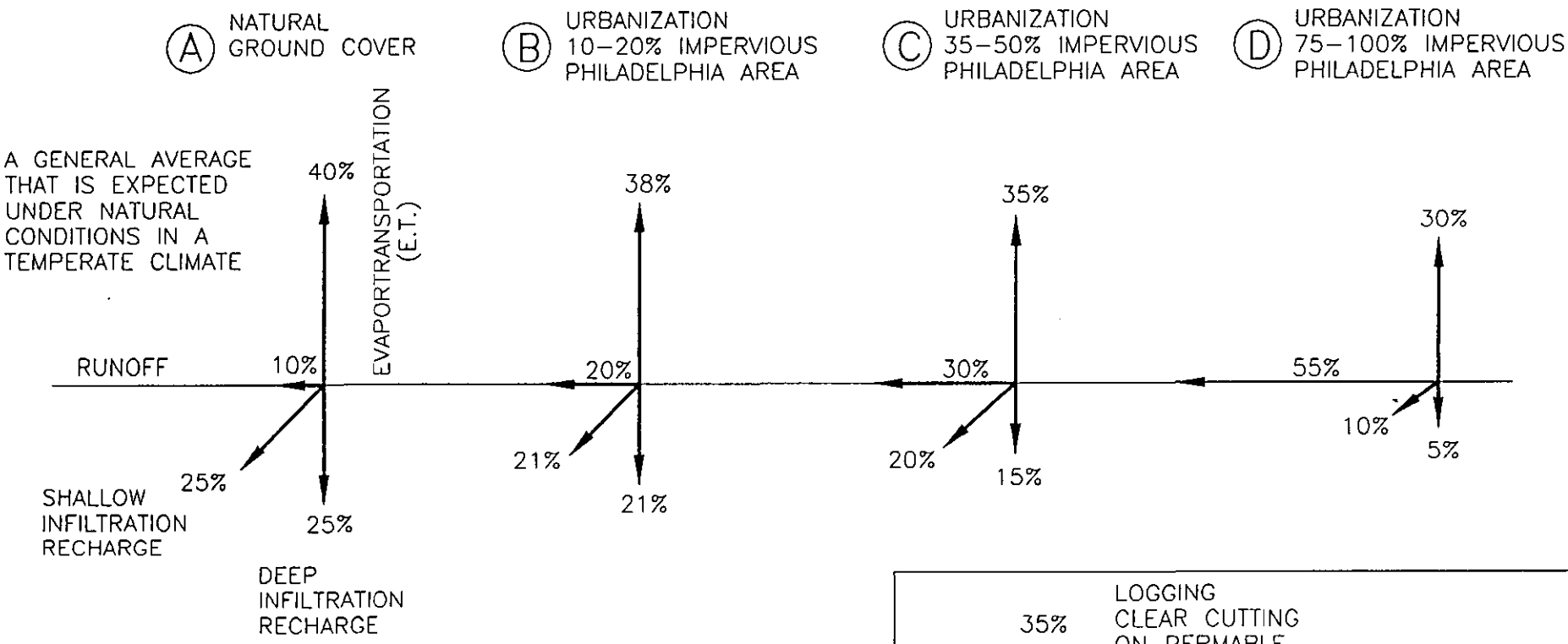
5. County Government review and revise storm drainage practices to maintain or enhance ground water recharge rates.

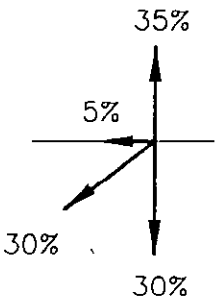
6. Because of the symbiotic relationship between surface and ground water (in particular surface waters which recharge ground waters through on site controls or direct recharge activities), County Government should establish a surface water/ground water management process. Appropriate agencies should participate in establishing goals and coordinating action which will result in a net gain of beneficial use of the water resources in the County.

7. Support the current efforts of the State's Water Forum as it develops state wide recharge policies and practices.

A

GRAPHIC EXAMPLE OF WATER BALANCE TAKEN FROM WATER RESORCES PROTECTION TECHNOLOGY. J. TOBY. TOURBIER, RICHARD WESTACOTT, THE URBAN LAND INSTITUTE 1981, PHILADELPHIA AREA.





LOGGING
CLEAR CUTTING
ON PERMABLE
SOILS

ESTIMATION OF WATER BALANCE BASED ON WATER A ENVIRONMENTAL PLANNING, DUNN & LEOPOLD. 1978

NOTE: THIS IS THE SINGLE CASE WHERE RECHARGE MAY BE INCREASED.

NOTE: GROUNDWATER SUPPLIES CAN BE TAKEN FROM BOTH SHALLOW AND DEEP AQUIFERS.

Public Utility District No. 1
Kitsap County

ACAD/SEPT93/WAT-BAL

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: DEVELOPMENT IMPACT

December 14, 1993

I. INTRODUCTION

A. Purpose and Scope

This issue paper examines the impact of development on ground water supplies. It will address development problems associated only with ground water quantity (e.g., increases in impervious surfaces). For information on ground water quality protection, please refer to the applicable GWAC issue papers. Development impact on ground water results primarily from an increase in impervious surfaces. Because development and ground water supply are interconnected, analyzing each separately facilitates identifying the components which cause one to impact on the other. Please note attachment A, which identifies the components of an urban hydrological system (outlined in the boxes). This diagram has been extracted (and modified) from Urban Hydrology, by M.J. Hall, Elsevier Applied Science Publishers, London and New York, 1984. Scope of Urban Hydrology, Fig 1.4, Page 7.

The cumulative impact of population driven demands on water and expansion of impervious surfaces are altering the natural water balance within watersheds. Please note Attachment B for an example of changes in the water balance caused by varying degrees of development. (Water Resources Protection Technology, A Handbook of Measures to Protect Water Resources in Land Development, By J. Toby Tourbier and Richard Westmacott, Urban Land Institute publishers, 1981. Page 3). While the graphic explanations are representative of conditions found in the Philadelphia, Pennsylvania area, they can be applied generally for water resource planning in Kitsap County. Additional supportive data and documentation can be found in Water In Environmental Planning by Thomas Dunne and Luna B. Leopold, 1978 Chapters 8 and 9 Water Balance and Run-off.

B. Background

In the past, development usually has occurred in stages around economic activities. Residential living quarters and public services formed concentric rings around economic centers. If growth was slow, development would take decades to occur. The concentration of growth around economic centers resulted in high land use densities and a large percentage of impervious surfaces. Urban densities caused local ground water resources to become depleted and, in some cases, polluted. Large volumes of waste water (storm and sewer) are generated by urban areas. In some cases, additional water supplies had to be imported from distant resources to satisfy increasing demand.

As transportation became more available to the individual, changes in this pattern occurred. Many individuals moved away from urban centers. Development costs were lower in outlying areas making affordable housing attractive to the buyer. This migration resulted in urban sprawl as suburban and urban concentrations leapfrogged each other, moving the place of residence further and further away from the work place. Strip cities developed along transportation corridors linking suburban and urban centers.

This new development pattern on the periphery of cities, occurred through successive stages of building single family residences in various size groupings with business centers and shopping malls near by. This new development process resulted in land use densities which were lower than those found under older development patterns. As a consequence, the amount of impervious surface per capita has increased. In Kitsap County, ground water is the primary source of supply. Approximately 50 percent of the population's water supply is obtained from private domestic or small community wells.

C. Effects on Aquifers

Safe Sustainable Yield(SSY) is the quantity of water that can be safely withdrawn from an aquifer without causing adverse impacts such as reduced stream flows or seawater intrusion. Calculating SSY is difficult, if not impossible, especially in complex geologies such as Kitsap County. Only by monitoring long-term aquifer water levels and water quality data can the impact of development on the ground water supply be accurately evaluated. The impact of development on ground water quantity is in general proportion to the increase in population (water supply demand) and increase in impervious surfaces (reduction in recharge area).

Under natural conditions, an aquifer is in dynamic equilibrium when recharge is equal to discharge and aquifer water levels are reasonably steady. When pumping is introduced, eventually natural discharge will decrease. This can be represented by the following simplified equations.

Under natural conditions: recharge = discharge
Under development conditions: recharge = discharge + pumping

If the natural discharge becomes adversely affected by either pumping or loss of recharge due to an increase in impervious surfaces, aquifer levels will decline unless pumping is reduced or recharge increased. (For additional information see Groundwater: The Water-Budget Myth, by John D. Bredehoeft US Geological Survey, Stephen S. Papadopulos, S. S. Papadopulos and Associates, Inc. and H. H. Cooper, U.S. Geological Survey. National Research Council, Geophysics Study Committee 1982).

D. Adverse Impacts

a. **Demand:** If pumping exceeds the safe sustainable yield (SSY) of the aquifer, an over-drafting condition will occur which if not reversed will deplete the aquifer.

b. **Increase in impervious surface:** An increase in impervious surfaces upsets the natural water balance within a drainage basin because it decreases natural recharge and increases run-off. A decrease in natural recharge or infiltration rates can be created by changes in the land surface. Decreases in soil permeability from development vary in magnitude and have many causes including compacting soil with vehicles, covering original soil with blacktop, or erecting a building. Decreases in natural recharge and increases in impervious surfaces may lower the SSY of an aquifer.

E. Cumulative Effects

Rates of pumping and impervious surfaces have a cumulative affect on ground water. If both factors are increased at the same time, the aquifer will be depleted faster than if either factor were acting alone. A depletion trend in aquifer water levels may indicate that the original carrying capacity of an aquifer(SSY) has been exceeded. To compensate for a decrease in recharge area and an increase in demand, recharge rates must be increased above pre-development rates if aquifer decline is to be avoided. If a new SSY is not established above the previous pre-development mark, cut backs in pumping will be necessary. An alternative to water use reduction is to bring waters from an outside source to supplement the supply or to increase recharge.

Additional water from an outside source can support higher development densities which will increase impervious surfaces, decrease recharge, and decrease the SSY of the local aquifer even further. New development in areas where the possibility of over-drafting exists must compensate for the loss in recharge. Examples of compensation include septic system recharge, roof run-off infiltration systems and storm water retention facilities.

Both the Bremerton-Kitsap County's Health District (BKCHD) and the State Department of Health (DOH) estimates that 80% of the water which enters a septic system is available to recharge ground water. As a result, domestic households which use septic systems, return an estimated 60 % of water used to ground water. Once an area is sewered, this water is diverted from recharging locally.

Current Surface Water Management practices attempt to meet applied to new developments require that post development run-off attempt to meet pre-development run-off. However, mitigation is seldom totally effective. Two common methods of mitigating run-off are detention and retention ponds. Detention ponds

hold the water for only a short time, releasing it slowly to prevent stream channel erosion. Retention ponds retain run-off on site so it can recharge ground water.

Each drainage basin will have a mixture of old and new developments. It is important to know the run-off and recharge characteristics for each type of existing development and potential impact from future development activities.

II. CURRENT LAWS AND POLICIES

A. Aquifer Water Levels

The State's process for evaluating a loss in ground water is to conduct a trend analysis of aquifer static water level. If water level drops over a period of years and the drop is not attributable to drought conditions, over drafting may be indicated. Based on the data available, Ecology determines if action is required.

Under the Public Trust Doctrine, the state is responsible for all water sources and maximizing beneficial use. The first in time, first in right principle requires the state to protect water rights based on the chronological order in which they were established. If cutbacks are necessary to stop over-drafting, the most recently obtained water rights are the first to be affected. RCW 90-44-230 gives responsibility for corrective action to Ecology and the courts. Ecology and the courts findings and judgements "shall determine the level below which the ground water body shall not be drawn down by appropriators, or shall reserve jurisdiction for the determination of a safe sustaining water yield as necessary from time to time to preserve the rights of the several appropriators and to prevent depletion of the ground water body." No mention is made of maintaining recharge rates. The state will regulate pumping and make advisory recommendations (RCW 90.54.140) on land use management policies at the local level in order to maintain a SSY. The land use activities and controls to mitigate development impact are left to local government. An understanding of the impact created by development is necessary to establish land use controls and other strategies which will protect water recharge and quality. A recent State Supreme Court decision has limited actions Ecology can take when water rights are in conflict.

B. The Growth Management Act (GMA)

In Washington State, the Growth Management Act (GMA) has been established to require planning for growth and the evaluation of impacts from development. Measures such as concentrating growth in designated urban areas helps to minimize the impact of development. An important objective of GMA is to protect critical areas which should, in turn, enhance ground water resource protection.

C. Environmental Impact Statements (EIS)

The State Environmental Policy Act (SEPA), Chapter 43.21C RCW, requires all governmental agencies to consider the environmental impact a purposed development will have and what actions must be taken in conjunction with the development to protect the environment. This policy is carried out under Kitsap County Ordinance 99-A1. The environmental review and mitigating actions to protect the environment are triggered only when a project includes over 4,000 square feet of impervious surface for non-farm buildings (10,000 square feet for farm buildings), parking lots for more than 20 automobiles, buildings having more than 4 living units, short plats, planned unit developments, or when it disturbs the land surface. Individual residential projects which fall under 4,000 square feet are exempt.

Projects which fall under SEPA require an Environmental Check-list to evaluate if an environmental threat will result. The completed check-list is reviewed by the SEPA coordinator who determines if significant impact will result from the project. If impact is non-significant, the project can proceed. If impact is significant, the project is reviewed by appropriate city, county, state, and/or federal agencies to determine what mitigating actions are required. Public notice and an opportunity for comment are part of the process.

The EIS Environmental Checklist includes the following items:

* The amount of impervious surfaces
* Composition of impervious surfaces
* Source of the water supply
* Quantities of water to be used
* Nature of the waste materials generated
* Where waste materials are discharged
* Source of run-off, including storm water
* Method of storm water collection
* Disposal and quantities storm water expected
* Probability of waste waters entering the ground
* Proposed measures to reduce or control run-off impacts

D. Surface Water Management

Chapter 90.70. RCW requires the Puget Sound Water Quality Authority to develop and keep updated, a Storm Water Management Manual for the Puget Sound Basin. The practices contained in the manual will be a guide to counties for developing surface water controls. The new control practices are to be in place by 1994. The objective of the controls will be to reduce run-off volume and pollution contamination. A major objective is to contain storm water on site so that pre- and post-development run-off are equal. (Volume III Run-off control, note III-3-3 Feasibility Analysis and General Limitations for Infiltration BMP)

Equal pre- and post-development run-off is difficult to achieve when the development includes a large increase in impervious surfaces. Some run-off may occur even if the impervious surface area is small. Site selection for infiltration must consider the ability of the soil to allow infiltration and at the same time remove both organic and inorganic contaminants from the run-off. Many sites do not facilitate these objectives. Selecting sites for development under growth management is constrained when consideration is given to both the increase in impervious area and the ability of the soil to absorb run-off. A goal of site selection under GMA is to maintain the original recharge rate while accommodating development.

E. Forestry Practices

The County's forest practices have been adapted from the State's Forestry Practices, Rules and Regulations. Timber harvesting on lands which will not be reforested because of future conversion to urban development is classified as Class IV General and requires a SEPA check list. If an EIS is required, impacts relating to surface disturbances, road building, and close proximity to sensitive areas must be addressed in the statement.

The practices prescribed for logging operations must mitigate the run-off effects created by compacting the soil and creating roads. Controlling run-off can help to minimize loss of recharge.

F. Growth Management, Critical Areas, and the Comprehensive Land Use Plan(Comp Plan)

One goal of growth management is to encourage growth where infrastructure support is available. Some GMA proponents believe concentrating growth in urban areas could conserve resource land (farm, forest, and other productive lands) and protect critical areas (aquifer recharge areas, wet lands, geologically hazardous areas, wild life habitat, and frequently flooded areas). In addition, section 63 of the act requires evidence of water availability before a building permit is issued. The evidence can be certification from a water purveyor who has the capacity to serve the proposed building site, a water right from the Department of Ecology, or a Health Department approved private well. The increasing difficulties associated with securing water rights could make obtaining permits to build more complex. In areas where Ecology has documented evidence of ground water problems (quantity or quality), development may be limited and private domestic wells may be regulated or constrained.

Growth management policies are to be incorporated into the Comp Plan for the county. The Comp Plan should ensure that local ordinances and land use activity policies are initiated to protect both the quality and quantity of ground water. (See House Bill 1138, 1984, RCW 35.36.090 as amended by HB 1136. Note: Appendix 1 of Ground Water Resource Protection, A Handbook for Local Planners and Decision Makers. Department of Ecology and King County Planning Division, 1986). If the urban concentration concept

under Growth Management is successful, water may eventually have to be moved from rural sources to support the urban concentration areas. The resulting preservation of rural recharge areas will help to provide the necessary water supply while maintaining base flows of the streams at the same time.

G. The Coordinated Water System Plan (CWSP)

The Coordinated Water System Plan is designed to facilitate the efficient use of water resources. The plan provides for maximum integration and coordination between public water systems. The plan also sets standards for providing reliable, high quality water service. Water systems are required to identify present and future needs in terms of system improvements, water supply demand forecasts, and future service area designation. New developments are discouraged from building their own water systems if existing systems can provide service.

H. Watershed Management Plans and Non-point Source Pollution

Non-point source pollution is defined as contamination which originates from many small sources such as homes, roadways, farms, and some other developed lands. Watershed Management Plans contain measures to deal with non-point source pollution. An objective of Watershed Management Plans is to "provide a coordinated program of effective actions to be implemented to prevent and abate non-point source pollution within the watershed." (WAC 400-12-500, Part 4 Problem) The plan should contain a description of water quality problems in the planning area, including but not limited to: beneficial uses of water bodies, threats to water quality standards, and impacts or potential impacts from non-point source pollution on ground water.

Watershed Plans are to be tailored to each watershed. Pollution Source Controls (WAC 400-12-600) include special considerations and provisions to control polluting agricultural practices, on-site sewage disposal, storm water and erosion, forest practices, marinas and boats and other non-point sources such as landfills, mines, sand and gravel pits.

While ground water quantity is not mentioned in most watershed plan guidelines, pollution source controls should decrease the amount of water that becomes polluted. Some measures may have the collateral effect of reducing run-off and as a result maintain if not increase recharge. On-site sewage systems in high risk areas, are required to be properly maintained to prevent contamination of both ground and surface waters.

III. GAPS AND PROBLEMS

A. Data and information currently available is insufficient to comprehensively predict the degree of impact a specific development or series of development activities will have on ground water quality and quantity.

B. Models for estimating run-off from developments do exist but they do not include ground water impact assessments. Some run-off will end up recharging ground water, but most water impact studies associated with development do not include it in the assessment. For example, water from roof drain down spouts, open unlined water ways, and retention ponds can be recharged. In addition, an estimated 80% of the waste water that enters a septic drain field is available to recharge ground water. These and other recharge sources have not been factored into the water use equations used to evaluate development impact.

C. The County policy of requiring pre- and post-development run-off to be equal is frequently violated .

D. Many innovative possibilities for diverting storm water run-off from developed areas to ground water recharge are not encouraged by existing regulations (e.g., propensity for detention vice retention facilities)

E. Land use controls and technical processes specifically tailored for recharge preservation have not yet been incorporated into the County Comprehensive Plan. Specifically, aquifer recharge rates should be maintained when possible, the ratio of impervious surfaces to raw land should be kept low, and run-off should be reclaimed for use or recharge where feasible.

F. Recharge has the potential for contaminating ground water. The magnitude of the risk is unknown.

G. EIS are reviewed on a case by case basis. The EIS process focuses on each individual project and not the cumulative impact many small or exempt projects may have on ground water quantity.

H. Decisions associated with surface water, non-point source pollution control, and ground water management are regulated by numerous entities and jurisdictions. The individual efforts are not adequately correlated and integrated.

I. The accumulative effects of many small land use conversions occurring in a drainage basin are not evaluated, because each assessment is done on a case by case basis.

J. Watershed plans have not been developed for most of the County.

IV. RECOMMENDATIONS and STRATEGIES

A. If no action is taken.

Storm water management programs and Non-Point Source Pollution planning efforts should help to lessen the impact of development on recharge, but these efforts will not provide other useful and feasible steps which can mitigate the impact of development on recharge. Some additional run-off will occur as impervious surfaces are increased. As recharge is decreased and water use increases, the potential for over-drafting effected aquifers will increase.

B. Recommended Actions

1. County government should investigate obtaining a computer model for assessing the impact of various development activities on ground water. The model should be capable of evaluating various run-off control measures and assessing the impact new land developments have on recharge. The model should facilitate evaluating the suitability of sites proposed for new developments. It should facilitate evaluating whether pre- and post-development run-off remains the same.

2. County and city government should adopt comprehensive plans under GMA which contain policies and ordinances to protect critical areas. Specific project reviews should focus on conformance with those protective measures.

3. The county and cities should adopt a technical/educational manual which will aid developers in selecting economical and feasible Best Management Practices (BMP) that will help maintain recharge rates.

4. Kitsap PUD should include run-off and recharge considerations in the draft county water conservation plan.

V. REFERENCES

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KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: EROSION CONTROL

October 19, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

The purpose of this issue paper is to evaluate the impact of erosion on ground water supplies in Kitsap County, review current policies and practices on erosion, and consider the advisability of changing those policies and practices.

B. Background

Surface erosion is a term that relates to the movement and removal of soil by wind, storm water, or a combination of the two. Other types of soil movement include land slides, stream bank erosion and erosion caused by freezing and thawing. The amount of vegetative cover, the shape and slope of the land, types of soils, climatic conditions and exposure time are among the factors that determine the amount of erosion that can occur.

a. Natural erosion

Natural erosion occurs over long periods of time. Depending on the geographical location, the rate of erosion can vary greatly. Natural erosion in Western Washington is generally very low due to the dense vegetative cover and long periods of relative light rain fall.

b. Accelerated erosion

Accelerated erosion is much more rapid than natural erosion. It is caused by human and animal activities or as a result of catastrophic events occurring in nature which expose the soil surfaces; fire for example. (Soil Survey of Kitsap County, US Department of Agriculture, 1977).

C. The Erosion Process

The top layer of the soil (top-soil) is usually porous and forms a protective layer over the underlying materials. Protection is afforded by vegetation growing in the porous top layer. Roots systems and dead vegetative matter shield the under lying soils from the erosive effect

of wind and rain. Top-soils are formed from the parent soils underneath by weathering and chemical action. They contain organic matter, are some what "glued together," and have been created over long periods of time. Some top-soil layers are relatively thin. The top layer holds moisture readily but its porosity allows precipitation to filter through and recharge ground waters or run-off very slowly. Once the vegetative layer has been removed and the bare soil exposed, a much more rapid erosion process is set in motion. This process can be stabilized if the vegetative cover returns and or the soil surface is protected by mulches or impervious coverings.

Some soils are more susceptible to erosion than others. Those that are composed of unconsolidated clay, silt or fine sand are more subject to erosion than others. (Note soil erosion index by the U.S Soil Conservation Service, Table 15 Physical and Chemical Properties of Soil, Soil Survey of Kitsap County)

The total volume of eroded materials may or may not indicate that large tracts of land are being impacted. The eroded soils are usually a composite, derived from flat surfaces as well as from gullies and mass wasting as stream banks are undercut. As a result the total area effected by erosion is difficult to determine without field surveys to verify how much acreage is involved. In other words it is possible to have a large volume of eroded materials without much acreage being involved. For this reason large amounts of eroded materials may not be an indication that ground waters are being impacted. Land slides or mass movement of earth are some times classified as erosion; this paper will not address these processes.

The largest cause of erosion in Kitsap County is uncontrolled run-off . As droplets of water land on bare surface, they break up the lumped together clays and silts from their moorings in the native soil. Particles are lifted into the air, scattered about and floated off. Some earth particles are suspended in the water that collects on the surface. Some of the loosened particles plug the voids between the naturally formed soil, decreasing permeability and causing puddles of water to accumulate in depressions in the land surface.

As the holding capacity of depressions are exceeded, the run-off and erosion process begins in earnest. Sheets of water which contains clay and silts begins flow. Rill erosion is usually the next step as small, finger like channels are formed. Small rills eventually become inter-connected and enlarged further down slope and form gullies. This process cuts deeper and deeper into the soil profile. As the run-off volume and velocity increases, more and larger particles of the soil are picked up and carried by the water. The particles help to dislodge other particles adding to the erosion problem.

Streams and rivers have two components of flows - base flow and storm flow. The base flow occurs during the summer and early fall when there is little precipitation available to increase flow through run-off. The base flow primarily comes from ground water (eg. springs and seeps). Run-off entering the stream channels causes additional erosion as stream banks are under cut and the bed scoured out. Most of the soils carried away are silts and clays. When a granulated condition in the top layers of the soil have been

changed, run-off will increase and infiltration decrease. (Personal contact Roger Veseth, Department of Soil Science, University of Idaho, Moscow Idaho. 3/93.).

Further down stream, as run-off and water velocity decreases, the displaced particles begin to settle out (sedimentation), the heavier ones first. Small particles eventually settle out to the stream bottom if water flow remains slow. A sufficient quantity of small particles settling on the bottom will decrease infiltration as they cover gravel on the stream bed bottom. Recharge and valuable fishing habitat can be destroyed by this process.

Whereas where flooding occurs, soil contained in the water is deposited in depressions . Clays and silts can plug the pores of the native soils. Clay deposits will tend to seal the underlying soils from infiltration.

D. Accelerated Erosion

1. Logging operations

There is little argument and general agreement that increased run-off and erosion occurs shortly after timber harvesting. In forested water sheds in the Pacific Northwest, clear-cutting produces the most run-off and erosion. Impact at a specific location depends on forest practices used, soils present and the slope of the land. Road building, scarifying, burning, and compacting of the forest floor predispose the soils to erosion. Harvesting when fine soils are wet can lead to compaction. Under the new Forest Practices Act, erosion has been reduced. In general erosion, will diminish over a 5 year period to almost nothing as an area regrows. Excess run-off, however, can continue over a 20 to 30 year period if mitigating actions are not taken. The half life of increased run-off after clear-cutting has been estimated at 7 years. (Note: Water in Environmental Planning. Dunn and Leopold).

Impact on ground water from logging operations can be both negative and positive. In some cases, stream base flows have been increased and in others flow has been lost. (Base flows are created by ground waters which feed into the streams and lakes in the late summer.) Some experts believed that increases in base flow are caused when nearly bare soils are exposed to direct rain fall and excessive run-off is prevented by forest floor litter which allows time for impounded water to infiltrate.

Studies in Australia, England, and the United States have shown that under some circumstances direct measurement of ground water conducted in conjunction with logging operations, showed increases in ground water levels. The increase was caused by converting water previously used or transpired by plants into recharge. These assessments did not considered the condition of the soils and measurements did not include changes in infiltration rates caused by changes occurring to the top soil. (Impacts on ground waters due to timber harvesting: Timber Cutting and Water Yields, H.G. Wilm, Yearbook Agriculture, 1949. Forests and Water: effects of forest

management of floods sedimentation and water supply, Anderson, Hoover, Reinhart, USDA Forest Service General Technical Report PSW-18/1978).

2. Live Stock and Soil Erosion

Most of the farms in Kitsap county are hobby farms. No large cattle industry exists. (US Department of Agriculture Census report, Kitsap County). Some erosion, however, has been observed in or near stream banks by the Kitsap County Conservation District. Erosion has occurred where too many cattle were pastured and live stock have compacted soils and denuded vegetation close to stream banks.

3. Development Impacts

Erosion can be severe during early building stages as the vegetation and top soil are removed and run-off increased. The amount of erosion depends upon the time of year and duration of exposure, as well as the type of soils involved. As an area undergoes development, local erosion diminishes as top soil is covered over with impervious surfaces or is replanted. A completed development with paved over surfaces, lawns, and landscaping will not produce the amount of erosion typical in early development stages. (David Dixon Kitsap County Public Works Department, personal contact 3/93).

Run-off, however, will not return to its former forested condition, primarily because of impervious surfaces but also because vegetation is usually not replaced in the same densities and types that existed under pre-development conditions. Increased run-off causes off-site erosion through increased volume and velocity. Vertical (bank) erosion is more likely when run-off is diverted into narrow channels. Please note insert A for explanations of the amount of erosion which will occur due to various land use practices. It is not clear from logging operation data, if an erosion profile can be extrapolated for urban areas.

E. Summary

In either logging or development activities, removal of native vegetation will increase erosion in direct proportion to the volume and intensity of run-off. Not all soil losses can be attributed to surface run-off. A portion of the total loss can be attributed to widening and deepening of stream channels. Erosion can expose deeper soils and depending on the nature of the soils, infiltration can be either increased or decreased. (DR. Roger Veseth, Department of Soil Science, University of Idaho, Moscow Idaho, Personal contact 3/93.)

Planning activities in developing areas should consider the impact of exposing underlying soils, especially if the top soils and underlying soils are both susceptible to erosion.

Some individuals in the county who are knowledgeable believe that erosion is not impacting

ground waters to any great extent at this time. (Farming practices which expose soil are not of a large enough magnitude to cause problems and erosion caused by development is for a short duration.) Rapid re-growth of the vegetation at land development and logging sites is an important mitigating factor. (Ken Drecksel Soil Conservation Service, and David Dixion Public Works Department Kitsap County 3/93.)

II. CURRENT LAWS AND PRACTICES

A. State and County

1. A new State Storm Water Manual is scheduled to be implemented by the County Public Works Departments by 1994. (Chapter 173-275 RCW.) The Public Works Departments will update the surface drainage plans and develop Best Management Practices (BMP) that can be carried out by developers to control erosion and run-off. County policy currently requires control of run-off during construction and specifies that post-development run-off must not exceed pre-development run-off. Developers are required to develop site plans with these objectives in mind. (Note Ordinance No. 148-1992 Interim Ordinance for the control of Erosion and Sedimentation on Construction sites).

2. Surface Water Management Plan
   The County is in the process of developing a surface water management plan which will deal comprehensively with storm water.

3. Detention and Retention ponds

   Detention and retention ponds are frequently used to control excess post-development run-off. There are more than 60 such ponds in the county, less than half of which are retention facilities.

   Detention ponds are designed to capture and temporarily hold and control storm water. Eroded sediments and run-off pollution have an opportunity to settle out before they reach Puget Sound.

   Retention ponds are designed to hold run-off long enough for significant recharge to occur. Generally water diverted to retention facilities should be of a higher quality than storm water in detention ponds because it will recharge ground water. Both types of impoundments are subject to siltation. (Kitsap County Drainage Ordinance No. 117, 1987. State Department of Transportation (DOT)).

   Run-off from roads is now being slowed by use of grass covered shoulders and lined ditches. The rocks and grasses capture eroded sediment in run-off increasing filtration of storm water.

4. Environmental Impact Statement- County

Site plans for development are reviewed by the County Department of Community Development (DCD) to evaluate their impact on the environment. DCD also reviews for proximity to areas that are prone to flooding and landslides. Guidelines for shallow, erodible soils have not been incorporated into the EIS process, because of the lack of data on erosion prone surface areas.

5. Water Shed Management (Non-Point pollution control)

Water shed management is a program designed to mitigate non-point source pollution problems for the protection of Puget Sound waters. It develops BMP for source control to limit run-off and resultant sediments and pollution.

6. Water Watchers/and other stream related programs
Water Watchers is an educational program designed to educate the citizens of Kitsap County about fresh water quality and quantity issues. Information is presented on erosion, its impact, and actions small landowners can take to minimize erosion effects. Both land and stream bank erosion are covered.

7. Forest Practices- State and County

The County has adopted the States Forest practices. These practices provide for decreasing excess sedimentation in stream channels. Logging operation must include measures to prevent excessive run-off and soil erosion and a logging operation plan must be submitted to the Forestry Department. Vegetative buffers must be provided along stream corroders to catch excess run-off and sedimentation.

8. The Soil Conservation Service/Kitsap Conservation District

a. Farm plans
The District provides a service to land holders who wish to conserve natural resources and improve farm practices. Plans includes soil erosion control practices for both the land surface and stream banks.

b. Burley and Minter creek
This program is designed to protect these creeks from the effects of soil erosion and pollution. Measures are primarily concerned with surface water quality and down stream effects on shell fish and oyster beds located in the head waters of the creeks.

B. Federal

1. Soil and Water Resources Conservation Act, (RCA)
RCA is a soil and water conservation program which appraises land conditions and

employs USDA farming activities and the Soil Conservation Services plans for preventing soil erosion and depletion of water resources.

III. GAPS AND PROBLEMS

Specific scientific investigation is lacking on changes to infiltration rates as a result of the erosion process.

Data is needed on the rate of erosion over time associated with development activities and the resulting impact on ground water quantities. Significant erosion can occur during development and then decrease quickly when work is completed and site landscaping is finished. After completion, major erosion problems can occur off site, particularly to stream channels if run-off is increased. If storm water run-off is diverted from natural lakes and wetlands to sewers and storm water systems which dump to the sea, lake levels and recharge can be adversely affected (e.g. Island Lake).

Data on permeability rates for specific layers of each soil type and their erodability are shown in the Kitsap County Soil Survey. The characteristics of deeper layers of soil are not always given consideration in planning activities.

IV. RECOMMENDATIONS

A. County government sponsor research and evaluation on infiltration rates of soil and other pertinent information for areas of the County that have experienced significant erosion. Continue to upgrade the Soil Survey Data for Kitsap County.

B. County and City government continue and extend the current State and County practices on erosion control.

C. Appropriate organizations disseminate educational materials on soil erosion control. Soil Conservation District and County Extension services develop avenues to distribute educational materials to appropriate citizens and groups.

D. County government include monitoring for erosion problems in the Surface Water Management Plan.

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Water, The Yearbook of Agriculture, The United States Department of Agriculture, 1955. page 126, How Rainfall and Runoff Erode Soil, Valleys and Hills, Erosion and Sedimentation.

Washington State Water Quality Guide, Integrating Water Quality and Quality into Conservation Planning.

Soil Survey of Kitsap County Area, Washington, 1877.

Human Resources:

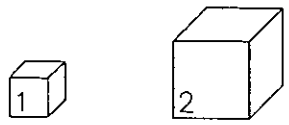
Dixion Dave, Kitsap County Public Works Dept, Personal contact 3/93

Drecksel Ken, Soil Conservation Service, Kitsap County Conservation District. Personal contact 3/93.

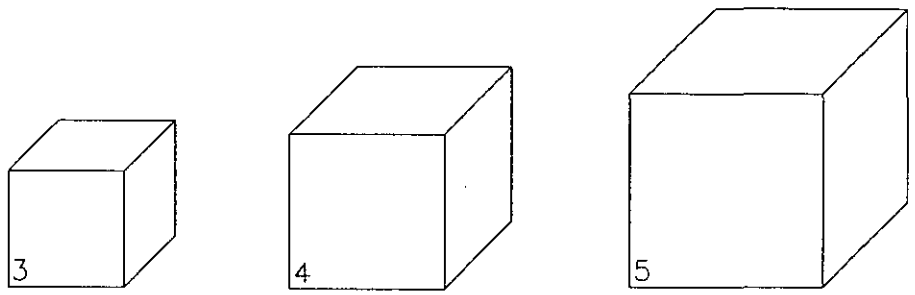
Veseth, Dr. Roger, Department of Soil Science, University of Idaho, Moscow Idaho. Personal contact 3/93.

EROSION

ESTIMATED SOIL LOSS PER SQUARE MILE SEDIMENT/VOLUME–TON/SQ MILE/YEAR		TONS PER ACRE	LOSS THICKNESS PER SQUARE ACRE
1. WOODLAND	100	.156 TONS	.0008
2. MIXED RURAL	300	.469 TONS	.002
3. FARM LAND	500	.781 TONS	.004
4. LIGHT DEVELOPMENT	10,000	15.625 TONS	.081
5. HEAVY DEVELOPMENT	100,000	156.250 TONS	.81



INCHES PER ACRE = .0008" .002"



INCHES PER ACRE = .004" .081" .810"

1 ACRE = 43,560 SQUARE FEET

1 ACRE FEET OF TOP SOIL = 1,613 CUBIC YARDS

1 CUBIC YARD OF TOP SOIL = 1.43 TONS

1 CUBIC YARD OF TOP SOIL = .0074" THICK LAYER SPREAD OVER ONE ACRE

NOTE:

DATA TAKEN FROM WATER RESOURCES PROTECTION TECHNOLOGY, A HANDBOOK OF MEASURES TO PROTECT WATER RESOURCES IN LAND DEVELOPMENT BY J. TOBY AND RICHARD WESMACOTT, THE URBAN LAND INSTITUTE 1981.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: HYDRAULIC CONTINUITY

February 15, 1994

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines **Hydraulic Continuity** - "the interconnection between ground water (aquifers) and surface water sources. An aquifer is in hydraulic continuity with wetlands, lakes, streams, rivers or other surface water bodies whenever it is discharging to these water bodies. It is also in continuity if it is being recharged by surface water. Hydraulically connected ground water and surface water cannot be considered as independent resources. A withdrawal from one will have some effect on the other" (Draft Hydraulic Continuity Policy Paper, The Water Resources Forum). Under RCW 90.44, hydraulic continuity is described as any underground water that is "part of or tributary to the source of any stream or lake." Any activities that impact the recharge (infiltration, precipitation, or runoff) to ground water, may have an impact on hydrologically connected surface water.

The Hydraulic Continuity policy developed by the Water Resources Forum states, "Since ground water is assumed to be in hydraulic connection with surface water bodies, this policy has statewide application. Case-by-case evaluations will be used to distinguish exceptions, i.e. those instances where ground water is truly confined. Ecology regional offices shall refer to this policy in making permit evaluations and decisions" (Draft Hydraulic Continuity Policy Paper, The Water Resources Forum). In Kitsap County the flow of ground water directly to seawater is the more common exception and that form of hydraulic continuity results in different considerations.

Ground water and surface water within most areas of the State are in some form of natural interrelationship or hydraulic continuity. The more pressing issue is determining the degree of impact or the significance of the relationship one has on the other by withdrawal or alteration of other factors . Given the highly variable geologic conditions in Kitsap County, hydraulic continuity evaluations need to be aquifer specific.

Population growth and past permitting practices are placing pressure on Kitsap County's known water resources. Decisions on applications submitted to Ecology are becoming increasingly difficult to make as most surface water bodies have become,

by regulation, fully appropriated. In addition, the decline of fisheries resources has raised concerns about water allocation decisions due to low instream flows. Impairment could result from ground water withdrawals adversely affecting surface water or vice versa. Where surface water is fully appropriated or reserved for minimum flow, it is either not available for further appropriation, or available only when existing rights and minimum flows are being satisfied. Past hydraulic continuity evaluations may have been inadequate because cumulative impacts were not addressed and existing rights and instream base flows may not have been adequately protected. Water resource management decisions today need to take hydraulic continuity into account in order to meet the challenge of fully managing and protecting the waters of the county for the public's benefit.

The Washington Administrative Code (WAC 173-515-10 through 173-515-100), regulates lakes and streams on the Kitsap peninsula to maintain safe levels and assure continuation of existing beneficial uses. In this WAC, the Washington State Department of Ecology (Ecology) has closed or partially closed most streams and lakes in the county to surface water withdrawal for domestic use.

Specifically, on the Kitsap peninsula, Ecology has ordered two lake closures, 20 stream and river closures, and 16 partial closures of creeks, rivers and streams. Thirty-two of the closed streams and creeks, which have an estimated annual flow of 5 cfs or less, also have high instream values for anadromous fish, aesthetics, water quality and/or recreation. In total, Ecology has closed or placed restrictions on 70 surface water bodies on the Kitsap Peninsula. The number of fully closed surface water bodies is 62 (see WAC 173-515-020). Thirty-nine of these are in Kitsap county. The rest are in Pierce and Mason Counties.

Five of the closed rivers or creeks are jointly shared by both Kitsap and Mason Counties and two are shared by Kitsap and Pierce Counties. The five in Kitsap and Mason Counties are the Dewatto River, the Tahuya River, the Mission River, the Union River and Coulter Creek. The two shared by Pierce and Kitsap Counties are Rocky Creek and Minter Creek.

Ecology has placed the Island Lake aquifer under study and is not issuing water rights in the area. The Island Lake aquifer is defined as, all the ground water from the surface down to about 100 feet below sea level in an area roughly 2 1\2 miles in diameter which contains Island Lake. A monitoring study is underway and a report will be produced which may lead to official closure of the aquifer. Ecology has recommended to the Bremerton - Kitsap County Health District that well site approval be denied within the area for all wells, including single domestic wells. Ecology will allow wells into the deeper aquifer if they are more than 100 feet below sea level. The Island Lake aquifer will be studied because ground water level has declined and the aquifer appears to be over-appropriated. The aquifer decline was brought to attention when the lake level dropped. The lake is partially perched over

the aquifer, and the aquifer water level is above the bottom of the lake. The rate of leakage from the lake is dependent on the degree of vertical separation between the lake surface and the water level in the aquifer (i.e., the differential pressure across the aquitard at the bottom of the lake). This is a type of hydraulic continuity.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. Legal and Administrative Authority

The Department of Ecology has assumed broad authorities and responsibilities that address hydraulic continuity issues through interpretation of the following:

Water Code - Chapter 90.03 RCW

States the objectives of Washington water policy: to promote the use of public waters so as to obtain maximum net benefits arising from both diversionary uses and retention of water within streams and lakes in sufficient quality and quantity to protect established instream flows. Requires permits to be conditioned to protect established flows. Prohibits waste in utilizing water rights. Establishes principle of prior appropriation to govern water right decisions and beneficial use. Requires Ecology to make four findings before issuing a permit: (1) water availability, (2) intended use is beneficial, (3) existing rights will not be impaired, and (4) the use will not prove detrimental to the public welfare.

Regulation of Public Ground Waters - Chapter 90.44 RCW

Extends prior appropriation doctrine to ground water withdrawals. Withdrawals by appropriators shall be conditioned to maintain safe sustaining yield. Establishes that to the extent that ground water is tributary to surface water, senior surface water rights are superior to junior ground water rights. Requires a permit for ground water withdrawals in excess of 5,000 gallons per day (subject to some restrictions).

Water Resources Act of 1971 - Chapter 90.54 RCW

Establishes fundamentals of water resource policy to insure that waters of the State are protected and fully utilized for the greatest benefit to the people thereof. Uses of water for domestic, stock watering, industry, hydroelectric power production, mining, fish and wildlife maintenance and enhancement, recreational, and thermal power production purposes, and preservation of environmental and aesthetic values, and all other uses compatible with enjoyment of the public waters of the state, are declared to be beneficial. The quality of the natural environment shall be protected and, where possible, enhanced. Withdrawals of water which would conflict therewith shall be

authorized only in those situations where it is clear that overriding considerations of the public interest will be served. Emphasizes wise water resource management to meet increasing demands.

Water Well Construction Act - Chapter 18.104 RCW

Provides Ecology with authority to establish and enforce well construction and maintenance standards, license well drillers, require reporting of well construction, and restrict well drilling in sensitive areas to protect the ground water resource. See also: Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160 WAC.

Construction Projects in State Waters - Chapter 75.20 RCW

Describes flow policy for the State regarding fisheries. Requires Ecology to notify the Departments of Fisheries and Wildlife of applications for water diversions or storage. The application for use may be denied if the agencies believe such a use will lower the flows necessary to adequately support food and game fisheries.

Federal treaty, statutory, and court ordered fisheries resource protection requirements must also be accounted for.

The Washington State Supreme Court in the recent "Sinking Creek" decision has introduced a different interpretation of Ecology's authorities regarding making determinations involving conflicts between two certificated appropriators, and in making certificated decisions where existing certificated rights exist.

The relationship of this decision to hydraulic continuity concerns is still being assessed. There are a variety of interpretations being offered and a legislative correction is necessary.

B. Hydraulic Continuity Decision Process

Water resource decisions related to hydraulic continuity in the future will likely occur within the following settings: planning, permitting, and regulation of existing rights. Regional/Basin planning could be the preferred approach if legally defensible, as it offers the opportunity to take a comprehensive look at the problem. Kitsap County is part of Water Resource Inventory Area (WRIA) 15 which is viewed as a basin and includes the greater Kitsap Peninsula and Vashon Island. Pre-scoping for possible regional planning including WRIA 15 has started. While this process proceeds, and given the likelihood that it may take five to ten years to complete, interim approaches to making incremental water allocations will be necessary to comply with the Growth Management Act (see Appendix A - Interim Solutions). The Water Resources Forum has developed the following as a process where hydraulic continuity between

ground and surface waters exist (Draft Hydraulic Continuity Policy Paper, The Water Resources Forum):

A. Identification of Basin Concerns

The first step in the process will be identification of basin concerns, i.e. those issues which have a bearing on the decision to issue a permit for additional appropriations of ground water.

- Has the basin been closed to further appropriations?
- Are there seasonal restrictions in effect?
- Are existing water rights being met?
- Have there been complaints by senior water right holders?
- Has the area been adjudicated, or is an adjudication underway?
- Have instream flows been established, and are they adequate?
- What instream values are in need of protection?
- What are the Tribal interests?
- What is the history of enforcement and compliance?
- What are the local/regional interests?
- Are ground water recharge areas impaired?

Water use in the basin will be evaluated, and rights which may be impaired will be identified. Cumulative effects from exempt wells and existing rights will be examined.

B. Assessment of Basin Hydrogeology

In cooperation with affected Indian tribes, local governments, other state and federal agencies and interested parties, Ecology shall conduct an assessment of basin hydrogeology in order to build a conceptual understanding of the ground and surface water interrelationship. Existing studies, data and well logs will be reviewed. Aquifer characteristics which are indicative of hydraulic continuity conditions will be studied and summarized, including: aquifer type (unconfined/confined), degree of correlation between static water levels and stream flow, transmissivity, topography, distance from surface water bodies, storativity, geologic materials, opportunities for capture and reuse, opportunities for conjunctive use, cumulative effects (from a technical standpoint), and water quality.

C. Review of Permit Applications

In addition to the assessment of basin hydrology, specific applications for permits for appropriation of ground water will be reviewed and evaluated to estimate the likely effects of ground water pumping on surface water. A number of technical and operational aspects of the proposed withdrawal will be studied, including:

- geology, topography and soils in the immediate proximity of the project
- aquifer test data
- cumulative effects, if more than one well is proposed and with existing wells
- percent consumptive/non-consumptive use
- timing of withdrawal
- timing and location (sub-basin/reach) of effect
- system management
- efficiency of current water use if the applicant has other water rights
- instantaneous and annual quantities of water requested
- protests filed
- comments provided by state and local governments and tribes
- comments provided by others, including responses to public notices

D. Classification of Impairment Risk

Based upon the research and analysis conducted above, Ecology will classify and document the risk of impairment to existing water rights, instream flows, and instream values. The risk factors will require some interpretation and subjective evaluation - not all factors may be present and some may weigh more heavily, depending upon the situation. Accordingly, one criteria may be in the high risk category, while another may require classification of a lower risk category. The standard measures in every case however, will be risk of impairment to existing water rights, instream flows, instream values, and the protection of the public interest. Given the variability of conditions, risks may be specific to a sub-basin or reach of stream.

Ecology will share this information with the applicant and interested parties and provide an opportunity for consultation.

The following table provides guidance to Ecology's staff for classifying risk of impairment; factors are listed but other relevant factors may be considered if appropriate.

Risk Category	Risk Factors
Low	- surface water is available above existing rights and base flow requirements - basin concerns minimal - aquifer confined - no history of closures - pumping rate low - percent consumptive use small - condition of the fish resource

Medium	- possible correlation between static water level and stream flow - surface water availability is seasonally dependent - timing of withdrawal and associated effects on surface water bodies likely to conflict with water level or flow restrictions (as indicated by an aquifer test or computer model analysis and consideration of consumptive use) - existence of suspected ground water contamination sources - condition of the fish resource - instream flows not established or inadequate, hydrologic data lacking or of poor quality, area lacks previous regulatory or permitting activity
High	- surface water bodies are fully appropriated - rate or quantity of proposed withdrawal will result in over appropriation (as indicated by an aquifer test or computer model analysis, verification, and consideration of consumptive use - existence of known ground water contamination sources - water sources in the area do not generally yield quantities proposed for appropriation - potential for ground water decline below safe yield - strong correlation between static water levels and stream flow - existing and potential cumulative impacts of permitted and non-permitted wells - history of well interference - condition of the fish resource

C. Policy Actions

Ecology anticipates linking hydraulic continuity with instream flow rule development, risk analysis, mitigation goals, and water right administration options at the outset. The goals of this process are expected to: 1) be a more comprehensive approach; 2) enable local review groups to make more informed decisions about whether to pursue critical situation planning or regional planning; and 3) make the consequences of going to rule with instream flows more apparent (once the level of hydraulic

continuity risk was determined and made known). Instream flow priority lists would also serve to establish priorities for hydraulic continuity risk analyses. The risk analysis will be used to determine which applications to place on hold per the instream flow policy, primarily those applications for ground water in medium or high risk categories.

Mitigation was seen as a key part of hydraulic continuity policy (at least until Sinking Creek). Ecology has determined that a guidance manual is needed to advise applicants about what mitigation plans should include and how Ecology will evaluate them.

III. GAPS AND PROBLEMS

A. Kitsap Geology and Hydrology

Approximately twenty-eight principle aquifer systems have been identified throughout the county. These systems range from relatively near ground surface and above sea level to a thousand feet below sea level in five glacial units. A few aquifer zones exist in non-glacial units, but typically with low yields. The extent and character of each of the stratigraphic layers are generally well defined in areas of high concentration of well data - normally the highly populated areas - and more poorly defined in areas lacking data. From the data generated to date, Kitsap geology is a complex glacial hodgepodge. Additional aquifer capacity is being discovered as new wells are drilled.

Precipitation varies considerably throughout the County, ranging from approximately 20 inches per year in the northern end to 80 inches per year in the south western portions of the County. Stream flows are precipitation and ground water discharge dependent. There is no snow pack for water reserves. Ground water is precipitation dependent.

B. Adequacy of Data

The data necessary to accurately assess the hydraulic relationship frequently does not exist - and can be very expensive to acquire. A long term data collection program involving collection of precipitation, surface water and ground water data needs to be in place (see the Data Collection and Management Issue Paper). This needs to be done in the most cost-effective manner possible, particularly since a single test well data point can cost in excess of $100,000 to generate.

C. Ability to Determine Risk Level

Current technology and data available do not allow for readily cost-effective and timely determinations of risk regarding the hydraulic relationship between surface water and ground water. This is particularly true for the deeper and more complex systems that exist in the county. Beyond the recognition that continuity exists, the concern must not be about the risk of impacts, but about the risk of negative impacts and their significance.

D. Significance of Impact

While hydraulic continuity exists between surface and ground waters, a no impact policy is unattainable and in fact meaningless. What needs to be determined is what the impact is, how much of an effect it will have on the impacted surface or ground water, what is the timing of the impact, and whether senior water rights are involved.

For example, a verifiable hydraulic relationship may be found between a stream and a well. The impact on the stream from pumping the well to meet peak month demand could reduce flows to below regulated minimums if inadequate recharge precipitation - occurs. The well's impact is evaluated by computer modeled to have a measurable impact six months after peak month demand. Peak month demand occurs in August and the measurable impact is projected to occur in February. Historically, significant precipitation events have occurred and surface waters are now discharging through recharge to ground waters.

In this case the significance of the impact of hydraulic continuity is minimal. Conversely, this could obviously change in unexpected long term drought conditions and curtailment practices would be necessary, or in situations where measurable impact occurs in a much briefer period and stream flows are still dependent upon ground water discharge.

E. Priorities Among Beneficial Uses

To make resource allocation decisions in general and particularly in situations where there is an identified significant hydraulic relationship between surface and ground water, policy guidance has to be given regarding what beneficial use has priority. This determination must be made by the legislature as it sets State policy.

IV. RECOMMENDATIONS AND STRATEGIES

A. Integrated Resource Planning and Total Water Management

State, regional and local agencies face increasing frustrations as they attempt to plan for future needs, and implement water supply, water quality, and water resource management responsibilities. Economic conditions, environmental concerns, multiple laws and conflicting agencies jurisdictions, scarce resources, and increasingly fractionalized citizen support for or against alternatives, makes efforts increasingly difficult. Integrated Resource Planning (IRP) is a comprehensive approach to evaluating demand-side and supply-side resource alternatives with respect to explicitly defined and often conflicting objectives. IRP encompasses least-cost planning, but is broader in its emphasis on an open and participatory decision-making process, the use of planning scenarios that incorporate uncertainties, externalities, long term community needs, and consideration of the multiple institutions concerned with water resources and the competing policy goals among them. The Chelan process is an example of participatory action by various interest groups that may lend itself to IRP. County and city governments and other applicable organizations should support the Chelan process.

B. Complex Hydrogeology and Data Adequacy

This topic is addressed in other issue papers , primarily the Ground Water Recharge Area Protection paper, the Data Collection and Management paper, and the various water quantity issue papers.

C. Risk Level and Significance of Impact Determinations

Studies specific to Kitsap County need to be done in order to determine the nature of the risk and impact of utilizing various aquifer zones on surface water bodies. While prohibitively expensive if starting from scratch, existing data, data protocols, and mechanisms are in place to begin looking at what is necessary to do site specific evaluations. The GWAC should develop a priority list for site specific studies.

D. Public Determination of Priority Among Beneficial Uses

As the demand for water resources continues to grow and impacts from conditions such as hydraulic continuity are evaluated in order to make good policy and management decisions, priorities should be established among beneficial uses. This needs to be done in the public arena by the legislature.

County and city governments and public water system purveyors should support a legislative ordering of priorities which begins with and includes the following rationale: A safe and adequate amount of water supply is essential to meet basic public health and societal needs. Consequently, drinking water should be identified as the highest and best use of available water resources to meet existing and projected community needs. Source development strategy would be based on aggressive water conservation and environmental protection as a minimum and enhancement where possible. Developing new sources of drinking water supplies is "water dependent" and, consequently, water utilities are forced to confront agencies and interest groups organized to restrict new supply development to meet basic public health and societal needs. Public health protection and basic community water needs are elements of the most basic principles of human environmental protection. All laws should be clarified to recognize this need and set priorities for source of supply development accordingly. It should be recognized that federal water rights (i.e., tribes, national parks, military bases) are separate rights and not subject to state water rights priority setting (See the Water Rights Issue Paper).

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DRAFT DRAFT

KITSAP COUNTY
GROUND WATER MANAGEMENT PLAN
ISSUE PAPER ON: WATER CONSERVATION

September 15, 1993

I INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the potential ~~for enhancing~~ for more efficient and effective use of water resources in Kitsap County through conservation. Traditionally, water conservation programs have been viewed as temporary measures to be implemented during emergencies such as drought or system supply interruptions. This is no longer the case. The need to install/retrofit water conservation devices and ~~to~~ educate the public to routinely utilize available water resources efficiently ~~through conservation measures~~, is based on the need to extend limited water resources.

As a preface to this discussion, it is important to note that ~~there are no clear definitions in the~~ current water resource laws promote conservation and water use efficiency, but do not mandate specific implementation activities. It should be understood that drought response activities usually include a combination of conservation and curtailment measures. Curtailment is characterized by sacrifice, by doing without, and is generally required by order (i.e. no lawn watering). It represents a mandated change in life style and reduction in an individual's quality of life preferences; but it is at times mandatory where supply is insufficient to meet normal demands in water short years. Conservation, as used in this paper is the application of prudent and cost effective supply and demand management strategies to increase water use efficiency, decrease or eliminate waste, and to protect the ground water resources from over-use so that it will be available for future generations.

B. Reasons for Conservation

As the population of the County expands, the water necessary to support growth will come from two sources:

I. Development of new resources.
II. Conservation measures.

Water resources saved through an effective conservation plan can be utilized to reduce the impact of withdrawal from hydrologic systems, to help maintain base flows in streams, and delay the development of more costly water sources.

Conservation of water is a basic tenet of Washington water law. Local water and land use plans must incorporate conservation as part of their agenda. Conservation efforts, provided for in the law, are directed at both suppliers and consumers of water.

Eighty percent of Kitsap County's potable water is derived from ground water sources and is dependent on the amount of local precipitation we receive each year. Rainfall can vary from year to year. Evaluations conducted in conjunction with the Ground Water Management Plan ~~estimate~~ project currently identified ground water resources are adequate to meet ~~projected~~ estimated water demand until 2010. Because growth projections are uncertain and aquifer data is incomplete, the sufficiency of actual water sources beyond 2010 is unknown. In any case, localized shortages have already occurred, especially in the dry summer months and where shallow ground water sources are relied ~~on~~ upon.

C. Ground water resources

The ground water resource of Kitsap County is complex. No single, large underground aquifer is available on which everyone is dependent. Twenty seven separate aquifers have been identified throughout the county (Exhibit II-8, Vol 1, Grant 1). ~~Based on the high rainfall in the western and southern parts of the county and in spite of the lack of information in some areas and for certain depths, additional aquifers, such as the Seabeck aquifer discovered in 1992, are likely to be found. Additional deep wells will also help to identify the extent of known aquifers.~~ Five aquifer levels have been identified. Two exist in ~~ragged~~ irregular patterns above sea level (Qg1/1a and Qg2). A third one (QG3)is more extensive. It runs from just above sea level to several hundred feet below in some locations. Two deep aquifers (Qg4 and Qg5) have been identified in many locations between 100 feet below sea level and the top of the under lying bedrock at about 800 ft.

Most of the more than ten thousand wells in the County are shallow, (ie., less than 100 feet). Because of a lack of deep wells, particularly in the south and west parts of the county, information about deep aquifers is incomplete. Based on the high rain fall and similar geology to the rest of the peninsula, the prospects for finding additional deep aquifers is good.

Through the Test Well Program deep wells (ie., greater than 1000 feet) will help identify new aquifers and better define the extent of existing ones. The Seabeck Aquifer was identified in 1992 by drilling test wells. Conservation, in conjunction with developing new ground water sources, can extend the County's ability to meet water demands well into the future with local resources.

Some aquifers are ~~currently~~ more susceptible to overdraft than others primarily because of nearby population densities that depend on well water. ~~Some aquifers have been used more than others.~~ The greatest ~~use occurs~~ extraction has occurred on the east side of the county in ~~the~~ high density growth areas. Of the 27 known major aquifers, 8 have been identified as needing investigation to determine if problem trends are now occurring or will emerge in the near future. As a section of the county shifts from rural to semi-urban to urban, there is a corresponding lowering of the recharge rates and ~~consequently~~ the amount of ground water available (Table II-13 Vol 1, Grant, also page II-39 recharge discussion).

D. Population trends and demographic distribution

Kitsap County is one of the fastest growing counties in the state. It had a population growth of 2.8 percent a year from 1980 to 1990 and the projected growth rate for 1990 to 2000 is 3.7 percent (Kitsap County Dept. of Community Development data obtained from Puget Sound Council Of Governments (PSCOG)). The unincorporated areas are growing at a much faster rate than are the urban centers. Unincorporated areas account for 73% of the total population as compared to King County where 41% live in unincorporated areas (Office of Fiscal Management 1989 Data). Growth Management plans may try to shift more of the growth to ~~the~~ designated urban centers. Kitsap county has the second highest population density in the state next to King County. King County has a population density of 679.5 persons per square mile compared to Kitsap's 461.8. The majority of the population resides on the east side of Kitsap County. The trend in Kitsap County towards populating unincorporated areas has created a proliferation of small water systems and individual wells which will put a stress on shallow aquifers. Small water systems will need assistance in carrying out conservation efforts. ~~The concentration of growth on the east side will strain the aquifers located there.~~

E. Water systems

The data available on Kitsap County water systems is incomplete but statistically significant. At the present time the county has over 1000 water systems, approximately 9% of the states water systems. In 1978 there were 450 systems, in 1982: 742 systems, and in 1986: 803 systems. This increase is due primarily to the proliferation of Group B (formerly class 4) systems. Over 700 of these systems are in operation in Kitsap County. Each Group B system has under 15 connections.

Of the 255 Group A systems (which serve 15 or more connections), 8 have more than 1,000 connections and 4 have more than 3,000 connections. As of the end of 1992 Bremerton has over 15,000 connections; North Perry Avenue has 5,200

connections and Annapolis has 4,200 connections and Silverdale has more than 3,800 connections. These 4 serve approximately 40% of the counties population. The top 8 Group A systems serve 56% of the County's population. All Group A systems serve 60 to 70% of the counties population and most use computers to assist monitoring efforts. An estimated 95% of Group A systems use meters at the point of service and approximately 80% have master source meters.

Private wells (individual and small Group B systems) serve approximately 20% of the county's population. ~~is served by individual water systems, mostly private wells.~~ Some individual and small systems draw water from surface sources. Almost all are located in rural and semi rural areas.

F. Consumptive Water Use ~~Water Users and Competing Interests~~

Water user categories can be broken down into the following consumer groups:

WATER USERS		ESTIMATED % USE IN KITSAP COUNTY
Municipal: Local government and minor business.	}	
Domestic: Includes single and multi-family housing.	}	70.47%
Commercial/ Industrial: Includes all Naval Base use. ----------	}	8.00%
Irrigation and non-stock Farming: ---------	}	6.40%
Fish Farms: ----------	}	15.10%
Stock Watering: ----------	}	0.03%

Note: the percentages given are based on estimates of water currently being used from Vol I of the GWMP.

G. Instream Flows

Debate on the amount of stream flow needed to assure recreation benefits and maintain fisheries is extensive yet little site specific information is available. All of Kitsap County's streams are fed by rain water run-off and ground water discharge. The discharge of ground water to streams constitutes hydraulic continuity of

ground water with surface water. Instream flow minimum requirements will most likely limit the amount of ground water that can be withdrawn from aquifers in certain areas. State Law (Chapter 90.22 RCW) and Administrative Codes (Chapter 173-515 WAC) provides for minimum flow and water levels for certain streams and lakes (See Current Laws and Practices Below for details). Ecology has authority to maintain stream and surface water levels and may ~~will~~ take actions such as a moratorium on drilling new wells or reducing well production if water withdrawal is ~~evaluated believed~~ established to be causing the unacceptable loss of instream base flow. Conservation measures can be important in maintaining adequate instream flows. To date, 36 streams in Kitsap County have had closures or partial closures placed on them. Two lakes have been closed. The drainage basins impacted by closures covers approximately 60% of the County's land surface.

H. Conservation Savings Potential

The degree of savings through conservation measures are dependent on the level of effort, public education, public acceptance, planning, and implementation. The City of Leavenworth, Washington reduced their consumption by 56% by installing meters at the point of use. The peak day demand dropped from 3.7 million gallons to 1.8 million.

The Seattle Water Department conducted a small, indoor, conservation retrofit program. Results indicate the amount of water saved in one year would pay for the devices. ~~With little effort or changes in life styles 10% savings can be realized. 30 % savings can be accomplished with additional measures which will not greatly impact quality of life. Under emergency conditions, 50 % and greater savings can be accomplished but the additional measures will result in significant sacrifices. <REFERENCE>~~
Based on the level of effort, a range of sustained savings between 10%-30% may reasonably be expected. Short-term curtailment savings or increased sustained savings in excess of 30% will likely be contingent upon life style changes and more stringent curtailment measures.

~~Increased water use efficiency can be viewed as a potential source of water.~~
Conserved water can be used as a new water source. Reduction in existing demand through water conservation techniques can provide a portion of the water that will be necessary to meet future increases in demand and help extend the use of ground water resources.

J. Conservation devices and practices

Homes and businesses can be completely furnished with low flow fixtures and appliances. A new water efficient home, which completely incorporates low flow

fixtures and appliances, can reduce indoor consumption by as much as 35 percent over a non-conserving home, with no appreciable impact on lifestyle (Kim and McCuen, 1984). Similar water saving devices and appliances can be installed in businesses.

Major reductions in residential outdoor water is also possible with modifications in landscaping practices. Approximately thirty percent of domestic water use is for lawns and gardens. Typically, between 20 and 50 percent of water applied to landscaping either evaporates or runs off (Maddaus, 1987). More efficient irrigation practices, use of more drought tolerant plant species, better turf preparation, and alternative landscaping designs (xeriscape) that reduce high water consumption turf areas are all strategies that can be employed to lower outdoor demand. Efforts in California to work with nurseries on conservation measures such as customer education, low use irrigation devices, and low water use plants has been helpful.

II. CURRENT LAWS PRACTICES AND PROCEDURES

A. Existing Laws and Procedures

RCW 19.27.170 **Substitute House bill (SHB) Number 1397** (an act relating to water use efficiency and conservation) passed by the Washington State Legislature directed the State Building Code Council to modify the Uniform Plumbing Code to require use of water saving plumbing fixtures for new construction or remodeling that involves replacement of plumbing fixtures. RCW 19.27.170 implements ~~of the requirements of SHB 1397 has begun~~ the bill. New toilets will be limited to 3.5 gallons per flush and urinals will be limited to 3.0 gallons per flush. Showerheads, kitchen faucets, bathroom faucets, and replacement aerators will be limited to a flow of 3.0 gallons per minute.

Under provisions of ~~SHB 1397~~ the RCW, even more stringent requirements for water saving devices will be implemented July 1, 1993. The more stringent requirements ~~would~~ limit new toilets to 1.6 gallons per flush and urinals to 1.0 gallons per flush. Continuous flow toilets or urinals will be prohibited. Showerheads, kitchen faucets, bathroom faucets, and replacement aerators would be limited to a flow of 2.5 gallons per minute. Other automatic shut-off requirements for public facilities are included in the 1993 requirements.

~~**Chapter 90.22 RCW** which sets minimum water flows and levels, provides the authority for Ecology to manage water flows and levels for the purpose of protecting fish, game, birds or other wild life resources, or maintaining aesthetic values whenever it appears to be in the public interest to do so. Both Fisheries and Wildlife Departments can advise Ecology on stream flows and levels.~~

~~Chapter 90.54 RCW~~ ~~provides that base flows shall be maintained in the perennial rivers and streams in sufficient quantities to provide for the preservation of various instream values (e.g. fish, scenic, recreation, etc.)~~

~~Chapter 173-500 WAC~~ ~~provides the administrative guidance to Ecology concerning stream flows and lake levels. Chapter 173-515 WAC sets minimum levels for 39 streams and 2 lakes. In Kitsap Co., these measures impact 60% of the land surface and the shallow aquifers which are in hydraulic continuity with surface waters.~~

B. Statutory ~~Mandated~~ Conservation Guidance.

Chapters 90.03, 90.44, 90.54 RCW, and RCW 43.20.230 ~~(the water use efficiency act)~~

The laws of the state for both surface and ground water require efficient use. The laws of the State for both surface and ground water preclude wasteful practices and strongly promote cost-effective conservation and /or efficiency measures (see particularly RCW 90.03.005, RCW 90.54.180, and RCW 43.20.230). Ground Water Management Programs are required to include "Alternative management programs to meet future needs and existing conditions, including water conservation plans ; ...(emphasis added) (see RCW 90.44.410 (1) (l). ~~These RCWs require conservation planning by all state registered water systems as a prerequisite for them to maintain water rights. Every 5 years, public water systems must reapply for water rights. Individual wells which withdraw less than 5000 gal. a day are exempt from state mandated conservation planning — All Ground Water Management Plans, must contain conservation recommendations.~~

The County Coordinated Water System Plan (CWSP) recommends implementation of a joint utility based regional water conservation program with Public Utility District # 1 of Kitsap County (KPUD) taking the lead in coordinating the program. Components of the CWSP recommendation include education, water saving device distribution, supply and demand management conservation techniques, and monitoring to evaluate water use trends and effectiveness of conservation measures. The Water Conservation Coalition of Puget Sound is cited as an appropriate resource for developing the Conservation Program. KPUD is developing a regional water conservation program to meet the intent of the interim guidelines for public water systems regarding water use, reporting, demand, forecasting, methodology, and conservation programs (Interim Guidelines) prepared jointly by ~~conjunction~~ with the Washington State Department of Ecology, Department of Health, and the Washington Water Utility Council. This water conservation program is intended to provide an example that ~~other~~ county utilities can use in developing conservation programs.

The conservation program should include conservation objectives, demand forecasting methods, program activities and level of effort, budget estimates, savings estimates, evaluation and monitoring criteria, and implementation schedule. Program activities should include education, system improvements, incentives, and research and development.

Types of conservation plans.
~~Under the Water Use Efficiency Act~~ ~~Relating to SHB No. 1397 and in conjunction with~~ The State Departments of Health(DOH) and Ecology (Ecology) ~~regulations,~~ have developed a Water Conservation Planning Handbook for public water systems. ~~has been developed. This hand book was the joint effort of both Ecology and DOH~~. Recommendations in the Handbook are related to the size of the Public Water System and its ability to finance conservation efforts. (See the Water Conservation Planning Handbook, of November 91, No 91-39, for details.)

The handbook lists three levels of conservation programs, basic, moderate and full. Basic programs are minimal and will not require much in the way of expense, manpower or time. They are largely voluntary and educational. Moderate programs are more detailed, requiring that technical and administrative activities be carried out. Full programs ~~on the other hand~~ are detailed, with components ~~recommendations including aspects~~ such as rate structure incentives, internal delivery and customer system monitoring, leak detection, use of native plants to reduce out door watering, and research activities.

Education is a required element for all Conservation programs. A regional approach is recommended in the Interim Guidelines and in the handbook so that customers of all utilities can participate, ~~in~~ regardless of system size.(See PP. 8 to 30 of The Handbook for details.)

C. Evaluation of Conservation program effectiveness

All conservation efforts must be evaluated to determine the amount of water saved. The Interim Guidelines recommend a Conservation Program Performance Audit to evaluate the effectiveness of the program.

III. PROBLEMS AND GAPS

A. Recreational water use

Data on water usage for recreational purposes (e.g., stream flow, irrigation) in Kitsap County is lacking. Little is known for example about the extent of water consumption by parks, athletic fields, and golf courses throughout Kitsap County. As noted in Vol. 1 Grant 1 page IV-10 Resource Management Issues, a need

exists for additional site specific data ~~and~~ on current and projected water demand ~~information~~. Each significant, recreational use of ground water needs to be documented. A detailed account of water use is necessary to develop a comprehensive conservation plan.

B. Water Rates

Recognizing the real value of water is an important step in implementing water conservation. Charges for water by many systems in Kitsap County is so low that encouraging conservation through ~~higher rates~~ a revised rate structures could be effective. Higher rates could provide ~~finance~~ capital for system conservation measures such as leak detection and correction. Block rates which increase commodity charges incrementally as consumption increases, have been successfully adopted in many areas in the west. Some systems do not have meters installed or do not use existing meters to set water charges. Conservation benefits and costs must be taken into account, including impact on hard to quantify benefits such as enhanced stream flow. ~~Traditionally, water conservation programs were viewed as temporary measures to be implemented during emergencies created by droughts or water supply system interruptions. Conservation has been seen only as a stopgap measure rather than a long-term solution to water supply inadequacies.~~ Defining the true cost of water use would be helpful in identifying wasteful practices and in designing programs and incentives to foster more efficient water use.

C. Data Limitations ~~**Water System Condition**~~

Inadequate information is available on the condition and age of the many water systems. Data on the number of connections and approximation population served by Group A systems is reliable. Few water systems have an organizational and financial base large enough to develop and carry out a comprehensive ~~effective~~ conservation plan. The rest of the water systems, most likely, will need both financial and technical assistance to carry out effective conservation efforts.

D.Financial Impact of Implementation

1. Water System Cash Flow Problems

As the cost of doing business continues to increase for utilities, implementing a conservation plan affects cash flow in two ways. The first is the cost of implementing the program and the second is reduction in revenues from reduced water consumption. Utility providers need to account for both factors when implementing a conservation plan.

2. Cost-of-service Based Water Rates

A method of addressing conservation through rates is by implementing an increasing block structure. The more water one uses the higher the rates. Experience shows that raising the cost of water has an immediate effect on people, but they will return to their normal water use once they are accustomed to the higher rates.

3. UTC Regulations governing "for profit water systems"

The "for profit water systems" are governed by the Utilities Trades Commission(UTC). The UTC looks at the utility from a financial point of view and may not agree that the cost of conservation is the most economical for the customers on the system. Another perspective is that share holders of "for profit water systems" may not feel that the cost of conserving out weighs the benefit to their investments.

E. Evaluating Conservation Measures

Conservation of ~~municipal~~ water supplies is essential to the proper management of Kitsap County ground water resources. ~~The PUD #1 of Kitsap County is compiling a variety of conservation measures and plans. Associated educational material specific to the region is also being collected.~~ A uniform standard of efficiency or minimum acceptable practices to be achieved by all water purveyors and users has not been established. To ensure creditability, it will be necessary to develop standards for evaluating the costs and benefits of potential conservation measures. When possible, assessments should be based on field studies.

IV. RECOMMENDATIONS

1. ~~Urge State and Kitsap~~ County government ~~Commissioners to~~ should adopt a policy which supports ~~encourages requires that~~ group A water utilities as they pursue ongoing conservation programs. These programs should include both supply and demand management measures within their service areas. ~~system conservation measures such as leak detection and control as well as efforts to encourage customer conservation within their service areas. It should require strict enforcement of water system design and construction standards, proper design and bedding of pipes, installation of corrosion control equipment, meter maintenance, and valve exercising.~~

2. ~~Reduce consumption in both existing and new homes.~~ The Kitsap County WUCC should evaluate and establish a county wide program to retrofit existing homes with toilet ~~displacement devices~~ flush limiters, low-flow showerheads, restricted flow replacement aerators, and other appropriate ~~measures~~ devices. ~~Establish new water conservation building codes.~~

3. Ensure that County and City governments enact and enforce building codes which promote water conservation and are consistent with state and federal water conservation legislation. When new, cost effective, water saving devices and measures become available, modify building codes accordingly.

4. The Kitsap County WUCC should establish public education efforts which emphasize; water resource information, behavior modification, and point of use leak detection. Educate homeowners, business owners, and industrial plant operators about methods to identify and repair leaks.

5. ~~Through easily accessible outlets,~~ Members of the Kitsap County WUCC should provide conservation devices and literature ~~such as inexpensive dye pills for detecting leaks in toilets.~~ for water users to obtain at various locations throughout the county.

6. ~~Encourage and facilitate~~ Water utilities should ~~to~~ initiate and/or continue leak detection programs which identify problems in distribution systems such as ~~Programs should include~~ inspection and repair of valves, meters, and other components, and reline or replace older pipes. The Kitsap County Water Utility Coordinating Committee (WUCC) ~~will~~ should evaluate a regional approach to leakage analysis efforts.

7. ~~The Ground water Management Program should encourage the broadest level of participation possible in water conservation efforts.~~ ~~Kitsap~~ County ~~Commissioners should issue~~ government should adopt a policy ~~statement~~ which strongly encourages citizens throughout the County ~~and water purveyors~~ to practice water conservation. ~~Incorporate a water conservation program into Kitsap County policy~~ and which, ~~institutionalizes~~ emphasizes water conservation as a county-wide goal. ~~efforts~~.

8. ~~Based on the fact that only a few~~ If water systems do not have the capability to carry out an independent conservation effort, the Interim Guidelines (Appendix II) should be used ~~by water systems that would have difficulty~~ to administer a conservation program.

9. The Kitsap County WUCC should gather data on county water systems to determine their condition and level of efficiency.

10. ~~Gather data on the capacity of the aquifers in the county to~~ Individual water systems should determine short and long term conservation goals and implement a ~~for their~~ water conservation plan.

11. The Kitsap County WUCC should develop and maintain a comprehensive, model, water conservation program for small utility's. The conservation program

~~should include~~ should include conservation objectives, demand forecasting methods, program activities and level of effort, budget estimates, savings estimates, evaluation and monitoring criteria, and implementation schedule. Program activities should include education, system monitoring and improvements, incentives for customers, water production monitoring, and other appropriate supply and demand management measures.

12. The Kitsap County WUCC should establish information programs on topics such as water efficient landscape design and watering practices.

13. In conjunction with the Kitsap County WUCC, ~~Establish~~ County Government should evaluate, develop, and implement building codes which incorporate appropriate low water use landscaping principles.

14. ~~Encourage Require~~ State government should require Group A systems to install meters on all water service connections and use conservation-based rates which charge for all water consumed.

~~15. Encourage Require all group A systems to institute water rate structures that are conducive to conservation.~~

15. ~~Carry out organizational activities with the~~ Kitsap County WUCC should sponsor periodic training for purveyors which offers technical and administrative assistance on conservation measures. ~~as directed by the Coordinated Water System Plan~~.

16. The Kitsap County WUCC should conduct joint conservation efforts with Pierce and Mason counties.

17. All water systems and the Kitsap County WUCC should gather data ~~for~~ to establish a baseline on water use and track water use to evaluate conservation measure effectiveness.

18. The WUCC should coordinate drought response conservation measures for small systems and assist in obtaining state aid when needed.

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DRAFT DRAFT

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: WATER REUSE

February 8, 1994

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines water reuse. Even in the rainy Pacific Northwest, conserving and reusing as much water as possible is important to assure adequate water supplies for future generations. ~~Ineffective use of water in Kitsap County will eventually require obtaining water from new sources which could be very costly.~~ Reuse or reclaimed water can help ensure future adequacy of domestic water supplies.

Water reuse is defined by the State as "use of reclaimed water, in compliance with Washington Department of Health and Ecology regulations, for a direct beneficial use". Reclaimed water is effluent from a wastewater treatment system that is adequately treated for a direct beneficial use.

B. Background

Kitsap County's water supplies, both surface and ground water, are dependent solely on rain for replenishment. County water supplies are a limited but renewable resource. More than 70% of the potable water being used in the county comes from ground water. That percentage will increase in the future because new surface water sources are limited.~~available to be developed. (Note the surface water closures listed below.)~~

~~Several studies conducted by the U.S. Geological Survey (USGS) in the 1960's and 1970's on available ground water in Kitsap County indicate depletion could start to occur between 2000 and 2025. The USGS studies were based on the assumption water used is consumed; that is, once used it was no longer available for reuse. This assumption was not altogether true at that time and is becoming even less true as new methods for conservation and water reuse emerge.~~

The use of reclaimed water is becoming more accepted throughout the country as water resource managers and the public are made aware of the advantages. In its "Interim Solutions to Public Water Supply needs," the state has identified water reuse as one of the strategies to meet future water requirements.

Recent evaluations by Economic and Engineering Services (EES) ~~extended the time period~~

~~that known sources would supply the projected population until 2025 to 2050~~ estimate the County's current water resources could supply the needs for its growing population to the year 2050. The EES estimates were based on a water savings goal of 10% ~~savings of water~~ through conservation efforts. ~~which were not considered by USGS. Population trends used, however, have been running behind actual growth.~~

~~**C. Current Problems**~~

~~The above estimates of the time period in which depletion would occur were based on known water sources on the Kitsap peninsula. Site specific investigations based on a review of historical well reports associated with currently identified aquifers has revealed the need to monitor eight aquifers to determine if depletion problems are occurring now or could occur in the near term. These aquifers are located in developed and developing areas of the county. (Note Volume I and II Grant 1, data collection and analysis for specific details.)~~

~~In addition to the eight aquifers under investigation, 39 surface water bodies in Kitsap County have been closed or have had partial closures placed on them by Ecology. The affected drainage area is approximately 58% of the County's land surface. Shallow aquifers within these drainage areas supply the base flow to the closed rivers and creeks. Maintaining water levels in the associated shallow aquifers is important if base flows are to be maintained. Most closures are established to protect fisheries, aesthetics, and other beneficial considerations.~~

Millions of gallons of secondary treated wastewater effluent and fish farm discharge flow to the sea from Kitsap County every day. Other than providing grounds irrigation at the treatment plants, no large-scale reuse projects are currently in place in the County. One project is proposed on Bainbridge Island. A potential exists to reused water in the County in applications which do not require drinking water standards.

Reclaimed water has not been processed for potable uses in the County but local projects have effectively used reclaimed water in applications such as crop irrigation, golf course watering, industrial processes, and even ground water recharge. Reuse is not conservation and does not involve a cutback in water use.

C. Water Reuse

The most significant problems with recycling waste water are psychological barriers to certain types of reuse, cost of infrastructure, and removal of contaminants. Contamination characteristics depend on the origin of the water to be processed for reuse. Depending on the extent of contamination, processing water for reuse can be very expensive. Costs ~~are of course~~ can be offset by resale. ~~The attitude of individuals involved with the reuse are a major and potentially controlling factor. In the course of developing this paper, no example in the U.S. of using treated sewer water as a direct supply for potable water was found.~~

How much of the demand for new water sources can be accommodated by reuse is dependent upon the effectiveness of efforts to educate citizens, the acceptability of proposed reuse projects and the financial feasibility of programs and facilities. The problem with applying recycled or reclaimed water to either surface or ground water is that it must be of high quality for State approval. Cleaning up water and delivering it to appropriate locations for reuse can be very expensive, however, it may be more cost efficient than developing new water sources ~~outside of the county~~ Reuse can effectively be an additional water resource as illustrated by these examples:

1. **Surface applications**
Reused water can be applied to golf courses, used in farming, or diverted to irrigate forests. An additional advantage to these applications is additional recharge. Partly treated wastewater can be further processed through a bio-filtration process for additional cleaning and collection for reuse. Industrial and commercial activities which do not require drinking water standards are also potential users of reclaimed water.

2. **Ground water recharge**
Reclaimed water can be applied to aquifer recharge areas where it can percolate into the soil, or be placed in retention ponds that are designed for recharge. Injection wells can be used to add high quality ~~(tertiary treated)~~ water to aquifers directly in accordance with State ground water standards. ~~Kitsap County's geology is not promising for costly aquifer injection projects due to the proximity to sea water. (Note information on pending legislation on the use of recycled waters. SHB 2833).~~

3. **Industrial applications**

Reclaimed water has been used effectively for process cooling in applications such as waste-to-energy plants.

4. **Wastewater Reclamation Examples**

The state of Florida has many water reclamation projects. Project Apricot was designed to provide reclaimed water for every non-potable use on every developed property in the Altamonte Springs, Florida, service area(Water, Environment, and Technology, February 1993).

Metro, in Seattle, King County, has a project under construction to pipe reused water to a large industrial facility where it will be used for cooling (phone conversation, J. Apperson, DOH January 1994).

~~Waste water reclamation is being used in **Santa Rosa, California** (data on the scope of use or technical details is not available). Waste water, treated to state standards,~~

~~is being stored behind newly constructed dams.~~

In **Malibu, California** a regional waste water project is being designed which will collect and process waste water in a reclamation plant. The design will incorporate a combination of a gravity collection system and a Septic Tank Effluent Pumping (STEP) system. The plant will be designed to handle over 1.30 mgd. The proposed uses of the reclaimed water will include a pilot wetlands project and water use by Pepperdine University and Hughes Research center for irrigation. Excess water will be used to augment creek flows, recharge ground water, and agriculture irrigation. The proposed project is expected be an emotional issue that will raise many sensitivities and be fairly costly. Tertiary treatment is planned. (Data taken from Water Resources Planning and Management and Urban Water Resources. American Society of Civil Engineers 5/91, Proceedings of the 18th Annual Conference and Symposium).

California's Orange County Comprehensive Water Resources Management Plan uses reclaimed water extensively to off set dependency on imported water. Storm water in particular is channeled for reuse. Program water savings are directly related to waste water availability and the incentives to finance projects, the costs of which are high (Water Resources Planning and Management and Urban Water Resources, American Society of Civil Engineers, May 1991.)

Cost of Reclaimed Water

The costs can vary considerably depending on the source of raw water, the degree of processing required, cost of constructing facilities needed, the distance raw and treated water must be transported, and maintenance and operating costs.

Waste water that is cleaned to acceptable levels for surface spreading, where it can be filtered and cleaned by plants and soils, is less expensive than processing to drinking water standards. Even in this case costs vary because the degree of cleaning before the water can be applied to the ground's surface will vary significantly depending on the waste water source.

Municipal Waste Water

A 10 year, 134 million dollar study conducted for the Denver Colorado Water Department was completed in 1993 (Denver's Water Direct Potable Water Reuse Demonstration Project). The project used a reverse osmoses split stream and ultra filtration process with some air striping. Costs were estimated to range between $1.64 per 1000 gallon to $1.73 per 1000 gallon. Actual reuse demonstration operation costs ranged between $1.64 to $2.34 per 1000 gallon.

Desalination (De-salting sea water)

Desalination cost can range between $3.40 to $4.03 per 1000 gallon. These are estimates for reverse osmosis low and high pressure processes. (Data obtained by personal contact AWWA 1/94)

Aquifer Storage and Recovery (ASR)

This process involves extracting water from a source such as a stream or river when flows are high and storing it in an aquifer which has been over drafted. Some estimates indicate that costs of such projects are one half of typical new sources projects that expand existing facilities. No costs estimates related to specific quantities of water were found.

Data above was obtained from a CH2M Hill report, New Directions in Water Policies, "Innovation and Diversification - The Key to our Future Water Supply" and "The High Plains Demonstration Projects; An investigation into cost and feasibility of ASR in 20 projects in the Rocky Mountains and Western United States".

The data gathered to date on alternative water supply costs is insufficient to be statistically valid. It does, however indicate ballpark values.

D. Water Reuse Potential in Kitsap County:

The following is an assessment of the amount of waste water generated in Kitsap County. Data on where water is being used gives an indication of were conservation and reuse efforts could be focused.

Water usage in Kitsap County (1992 data):

Category	**Million Gallons per Day (MGD/D)**	**Percentage**
Municipal/Domestic	17.06	51%
Commercial	5.07	15%
Industrial	3.52	11%
Irrigation	2.21	7%
Fish Farming	5.20	16%
Stock Watering	.02	0.06%
Total	33.08	

NOTES: Data extrapolated from grant I, Vol I, 1990 data, Table II-9)
Industrial includes Puget Sound Naval Ship Yard.
Irrigation relates only to farming practices.
Stock watering is live stock of all categories.

Not all of the water currently being used in the county is available for reuse. Water discharged to septic fields would not be available for processing but is effectively recycled by nature. See appendix A for an estimate of water loss, water recharging ground water, and waste water generated.

~~The sewer systems in the county receive some storm water which can be considerable during a storm. Sewer systems leak a percentage of the water they carry. The exact amount of the leak loss is difficult to measure but most ends up as recharge. These gains and losses were not considered in this paper.~~

E. Sewage Treatment Plants

Eight ~~sewage~~ secondary wastewater treatment plants are in operation in Kitsap County. They discharge as follows: ~~See Appendix A, Graph of water use and waste water generation and the Table A explanation of water loss, water recharge, and waste water generated for additional information.~~

Plant	Operator	Design Average Discharge Million gallons per day*
City of Bremerton	City of Bremerton	10.0
Central Kitsap Plant	Kitsap County	4.8
Annapolis	Sewer District #5	2.8
Manchester	Kitsap County	0.2
Winslow	City of Bainbridge Is.	1.0
Suquamish	Kitsap County	0.2
Kingston	Kitsap County	0.2
Industrial Park	Port of Bremerton	0.001

*Maximum monthly flow permitted by the State. Actual average flows will be less.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. The State Department of ~~Health~~ Ecology (Ecology) ~~has~~ sets standards for wastewater discharge under the federal National Pollutant Discharge Elimination System permits. A discharge must meet the standards before a permit is issued. The standards set

limits for chemical content, biological contamination, and temperature levels. Wastewater that meets discharge permit standards is not necessarily suitable for direct contact with humans or for reuse. In many cases, further treatment may be necessary. Note Chapter 90.48 RCW(Water Pollution Control).

Reclaimed Water Act:
SHB 2833, a new law passed in April 1992 is intended to encourage ~~recycling~~ reusing treated ~~sewerage~~ wastewater. Wastewater treated to standards beyond ~~normal~~ ~~sewer~~ wastewater effluent discharge levels ~~(i.e., tertiary vice secondary treatment)~~ can be used in some irrigation, industrial and commercial applications. Processed wastewater that could come in direct contact with humans must receive more than normal treatment before it can be used. Treated ~~sewer~~ wastewater applied in forest practices need not be decontaminated to the same level required for a golf course, for example. Reuse can be economically feasible, if storage and transmission costs are not too high.

Water Reclamation and Reuse Interim Standards were published by the Washington State Departments of Health (DOH) and Ecology in February, 1993. The guidelines cover irrigation, impoundments, ground water recharge, commercial, industrial, and other uses of processed ~~sewer~~ wastewater. ~~Three~~ Different qualities of treated water are defined in several classes of reuse.

Permits to distribute or sell treated wastewater are available for government authorities who currently have wastewater permits. In some circumstances application for water rights may be required.

III. GAPS AND PROBLEMS

Reuse:
As noted above, an estimated ~~46.73~~ 46% of the water now being used in the County is potentially available for reuse (~~12.58~~ 13% from fish farming and 34~~.15~~% from treated ~~sewer~~ wastewater. During the months when irrigation is needed, over 15~~.54~~ mgd could be generated for reuse.

Several factors must be considered when evaluating the practicality of reusing water:

The cost of further treating wastewater effluent to meet standards for specific reuse applications. ~~processing used water.~~

The availability and cost of water from other sources.

The expense of transferring water between water processing sites and reuse sites.

The volume of water available for reuse at a given location versus the demand for reused water in the vicinity.

Public acceptance of ~~treated sewer~~ reused water for the uses proposed.

Regulatory and policy barriers to reuse.

Quality control.

IV. RECOMMENDATIONS AND STRATEGIES

1. General purpose and special purpose governments support and facilitate water reuse projects in Kitsap County.

2. Discourage Ecology from requiring water rights for reclaimed water.

3. Support state government initiatives which encourage and facilitate water reuse.

4. Facilitate continuing coordination between DOH and Ecology for reuse project policy.

5. Encourage County wastewater dischargers to explore reuse opportunities rather than discharging to Puget Sound or Hood Canal.

6. Educate the public so that when reuse projects are proposed, citizens can evaluate them on an informed basis.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: INTERTIES

December 14, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the advisability and feasibility of developing a comprehensive system of interties between the major water systems in the county in order to better manage water resources.

B. Ground Water Resources

Over eighty percent of Kitsap County's population depends on ground water provided by over 1,000 water systems and thousands of private wells. Extraction of ground water occurs over a wide area of the county.

The glacial geology in the county is very complex, making assessments of groundwater capacity a difficult undertaking. The rain pattern in the county dramatically changes from about 20 inches per year in Hansville (North) to 80 inches per year at Holly (Southwest). Although data on ground water resources in the south and southwestern parts of the county is limited, high rainfall rates and the recent discovery of a significant aquifer near Seabeck may foreshadow those sections of the county becoming a major, future source of ground water. Kitsap is one of the fastest growing counties of the state. Increases in impervious surfaces due to development is reducing recharge. The county is essentially an island, surrounded by sea water, so the threat of sea water intrusion is always present.

All of these factors affect to different degrees, the numerous aquifers in the county on which people depend. In Kitsap County, sources of ground water currently are relatively near their point of use. As the factors listed above intensify, it may be necessary to reduce the amount of water being drawn from some aquifers and transport water from greater distances where the resource can support higher extraction rates.

C. Interties

A system of interties between the major purveyors in the county has a number of benefits such as providing water in case of an emergency to one of the intertied systems. From a resources stand point, it would also enable the major water purveyors to respond to

situations such as indications of aquifer over-drafting or sea water intrusion, by shifting ground water supplies as necessary. A comprehensive system of interties connected to future well fields which are located in aquifers with adequate capacity, would enable county planners and elected officials to make growth management decisions based on a variety of appropriate considerations without being constrained by water source availability in the vicinity of designated urban areas. It would also facilitate implementing ground water recharge protection measures without undue impact on high density residential, commercial, and industrial areas.

II. CURRENT LAWS, PRACTICES, AND PROCEDURES

A. **WAC 90.03.383** is the state law governing water system interties. The RCW recognizes "....the value of interties for improving the reliability of public water systems, enhancing their management, and more efficiently utilizing the increasingly limited resource". A 1991 modification to the statute established a coordinated process to review proposals for new interties. The new wording states, ".... exchange or delivery of water through interties commencing use after January 1, 1991, shall be permitted when the intertie improves overall system reliability, enhances the manageability of the systems, provides opportunities for conjunctive use, or delays or avoids the need to develop new water sources, and otherwise meets the requirements of this section...." Water quality characteristics may vary with different systems and may need to be addressed when blending occurs from interties.

B. **The Kitsap County Coordinated Water System Plan (CWSP)** in its Regional Supply System section analyzes the potential for water system interties in a county interior regional supply network, complete with regional storage facilities. A network like the one envisioned in the CWSP would substantially support the water resource management issues outlined above.

C. Existing Interties

Several of the larger water systems already have interties or are in close enough proximity to make interties inexpensive. Existing interties include:

1. Bremerton - Port Orchard
2. Port Orchard - Annapolis
3. Bremerton - North Perry

Factors other than the expense of constructing an intertie determine whether it will be built. Other considerations also play a factor.

III. GAPS AND PROBLEMS

A. A Plan for a System of Interties

Although the CWSP addresses eventual establishment of a system of interties, a comprehensive plan for developing the interties has not been started.

B. State Law

Current state law on interties may restrict their use as a water resource management tool. Water Right practices on point of use, as currently interpreted by the Department of Ecology (Ecology), could constrain or delay use of interties to respond to the water resource management problems similar to those enumerated above.

IV. RECOMMENDATIONS AND STRATEGIES

1. County, other local government entities, and the Water Utility Coordinating Committee, in conjunction with Growth Management Planning, should develop and implement plans for a system of interties for the County using the Coordinated Water System Plan process.

2. County and other local governments should urge the state to modify or interpret the RCWs to facilitate establishment of intertie systems within a Water Resource Inventory Area, which can be used to facilitate water resource management and combat problems such as aquifer over-drafting or sea water intrusion.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: WATER RIGHT PERMITTING PROCESS

June 15, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This Issue Paper examines the need for, impact from and effectiveness of State water right laws and associated policies on the management of ground water in Kitsap County. Identification of outdated, cumbersome, or inadequate laws and bureaucratic procedures are essential to the process of improving the water rights and reservations permitting system. Water rights laws and policies are key factors in developing an effective ground water management program and protecting the state's valuable water resource. These laws and policies determine who is entitled to appropriate water and the amount of water allotted for a specific use.

This paper includes:

* A **history** of water rights laws and allocation.
* A summary of **current water laws and procedures.**
* An examination of **problems** in modern water law that impact the Ground Water Management Program for Kitsap County.
* A discussion of potential **strategies** to resolve water law problems.

B. History

1. Riparian Doctrine

Water laws were and are important elements in the development of the American West. During the early 1800's, the Riparian Doctrine was the primary water law in Washington state. This doctrine gave land owners the right to appropriate surface water (lakes, streams, rivers) for any reasonable use, provided their land was adjacent to the source and did not adversely impact other riparian rights.

By the late 1800's, the heavy influx of settlers into Washington soon exceeded the locations adjacent to good supplies of surface water. Settlers then turned to another

accessible source of water, ground water. This was especially true in Kitsap County where ground water still provides the majority of water for municipal, industrial, and agricultural uses.

2. Prior Appropriation Doctrine

The 1891 State Legislature put in place a water allocation process which recognized, "First in time is first in right." Initially, anyone desiring to appropriate public water for beneficial use had to post a notice at the proposed point of diversion and record a copy of that notice with the local County auditor. Construction of the diversion which put the water to beneficial use, with due diligence, perfected the right in the amount of the beneficial use. Until such rights are confirmed by a court's general adjudication of water rights, they are generally referred to as "claims to vested right." In order to keep such a claimed right active, the claim had to be filed and registered with Ecology, or its predecessor, the Department of Water Resources, during the period from July 1, 1969 through June 30, 1974, pursuant to the claim registration requirements of RCW Chapter 90.14. The provisions of this law generally apply to ground water rights established prior to June 7, 1945, and all small wells, i.e., less than 5,000 gallons a day, that were put in use prior to July 1, 1974.

Under prior appropriation, the Washington State Legislature took action to replace the riparian doctrine regarding surface water diversions by giving a priority in "right" to water to a "diverter" who takes (or "diverts") the water from the stream and puts it to some form of beneficial use, regardless of whether the use is on land adjacent to the watercourse. In times of water scarcity, "senior appropriators," those whom first began using the water from a given source, have a higher priority to the water than "junior appropriators," those who more recently began diverting or using the water from the same source. If there is, at any time, an insufficient amount of water available to continue supplying all users, senior appropriators are entitled to continue to divert the full amount of water that they are putting to a beneficial use. The result may be a reduction in or total elimination of the water diversions of junior appropriators.

3. Surface Water Code of 1917

The 1917 legislation (RCW Chapter 90.03) codified the basic principles of water management in the State of Washington. It declared that water is a public resource of the state; that the diversion and beneficial use of water were to be regulated under a state-administered permit system; and that the basic principles of the prior appropriation doctrine constituted the fundamental principles of water allocation for the state. No withdrawals of surface water within the state were to be made without a permit from the State. The permit not only sets the amount of water to be taken,

but could also contain further conditions as to type of use, place of use, and other restrictions as necessary. The State Hydraulic Engineer (and now the Department of Ecology) was given the discretion to deny applications and was obligated to deny the application when there was no unappropriated water in the proposed source, when the proposed use conflicted with existing rights, or when the proposed use threatened to "prove detrimental to the public interest" after due regard was given to "the highest feasible development" of the use of the state's waters.

The priority date of a water right was set at the date of filing an application for a permit. The Code also set up a procedure for a general adjudication of all water rights on a particular stream or within a given basin, setting priorities and establishing the quantities of water attending them. The Code further established the right of any person to acquire by condemnation, any property rights necessary for the storage or use of water for a superior use, with a limitation on the right to condemn water being used on irrigated land.

In codifying this system, the Legislature took care to state that the legislation was not to be construed to "lessen, enlarge, or modify the existing rights" of any riparian owner or holder of a right by appropriation.

4. **Ground Water Code of 1945**

While surface water laws were developed and refined, ground water laws were not an issue throughout most of the American West; in Washington, ground water was not formally addressed until 1945. At that time, the State legislature extended the provisions of the 1917 Surface Water Code and applied them to ground water (see RCW Chapter 90.44).

A permit system, similar to that for surface water, was created based on the prior appropriation doctrine principle. The current Department of Ecology and its predecessors were given the authority to maintain a "safe sustaining yield" by limiting withdrawals, and the ability to designate ground water areas, sub-areas, or zones. As with surface water, the rights of pre-existing beneficial users of ground water were protected. The Legislature also specifically declared that the rights to ground water that were "tributary" to surface water were junior to prior rights of appropriators of the surface water. It also created exemptions from the permit requirement for certain uses of ground water, including stock watering, watering of a lawn, or a noncommercial garden not exceeding one-half acre in size, and domestic or industrial use not in excess of 5,000 gallons per day. Finally, the 1945 Code contained an abandonment provision that permitted the state to presume that the right had been abandoned if not used for a period of five years.

5. Water Rights Registration, Waiver, and Relinquishment Act of 1967

Declaring the necessity for maintaining proper records as part of the management of the state's water resources, the Legislature in 1967, required that those who claimed any right to the use of water for which they had not already received a state permit or certificate had to file a claim for such a right. The Legislature further declared that anyone claiming a right to use water, whether under authority of a certificate or not, who failed to put the water to beneficial use for a period of five years, relinquished that right, and it reverted to the state for further appropriation. Exceptions to the relinquishment requirement were made for certain designated categories of "sufficient cause." In 1969, the Legislature further declared that the failure to file such a claim would be conclusively deemed as a waiver and relinquishment of the right.

6. Federal Reserved and Indian Water Rights

Any appropriation of surface and ground water in Washington is subject to the federal reserved water rights on military and Indian reservations, and may be affected by Indian Tribe aboriginal water rights.

The doctrine of reserved water rights combines both the common law riparian water rights doctrine and prior appropriation discussed above. Under the doctrine of reserved water right, when a federal reserve (e.g. military, Indian) is created, there is an implied reservation of water to fulfill the purpose of the reservation. The priority date of the water right is the date the reservation is created. Use of water does not create and disuse does not destroy or suspend a federally reserved water right.

Another source of Indian water rights may be tribal aboriginal water rights. It is claimed that, when an Indian tribe has never moved from its aboriginal area, and its tribal title has never been extinguished, the tribe holds an unbroken and unfettered property right to the use and occupancy of the land and the water. The priority date for aboriginal water rights is considered to be "time immemorial" and like reserved water rights cannot be lost or destroyed by non-use. In Kitsap County, the Tribes claim Indian aboriginal water right include the right to an adequate water supply to maintain an Indian fishery.

Indian, aboriginal water rights may take priority over state-issued water rights. Federal reserve water rights may take priority over state-issued rights appropriated subsequent to the establishment of the federal facility or creation of an Indian reservation. These brief summaries of federally and treaty protected water rights are not intended to be exhaustive statements of federal and Indian water rights, but are presented in order to give a general overview of aboriginal and federal reserve water rights.

C. **Number of Ground and Surface Water Rights and Allocation Levels in Kitsap County**

Year	Permits of Number	Amount of Water Allocated in Gallons per Minute	Amount of Water Allocated in Acre ft./Year
Ground Water	(TO BE ADDED LATER)		
before 1950			
1950s			
1960s			
1970s			
1980s			
Total:			
	<DATA NOT AVAILABLE FROM ECOLOGY AT THIS TIME>		
Surface Water			
before 1950			
1950s			
1960s			
1970s			
1980s			

Source: Washington Department of Ecology

II. CURRENT LAWS AND PROCEDURES

A. Water Resources Act of 1971

In 1971, the Legislature added to the state's water law, a recitation of ten "fundamental" principles of "utilization and management of the waters of the state," including several important new principles. The Legislature declared that the proper utilization of water resources was necessary for achieving two fundamental goals: (1) promotion of the state's economic well-being, and (2) preservation of the state's natural resources and aesthetic values. These ten principles, which constitute the

basic legislative policy guiding water allocation and use decisions in the state today, are:

1. Beneficial uses of water include the traditional ones (domestic, stock watering, industrial, commercial, agricultural, etc.), but are significantly expanded to add fish and wildlife maintenance and enhancement, recreational, thermal power production, preservation of environmental and aesthetic values, and "all other uses compatible with the enjoyment of the public waters of the state"

2. Allocation of water is to be based generally on the principle of securing the "maximum net benefits of the people of the state"

3. The quality of the environment is to be preserved and, where possible, enhanced, by (a) establishing "base flows" in streams below which withdrawals of water would be allowed for "overriding considerations of the public interest," and (b) prohibiting the introduction of wastes and other substances into the state's waters that would reduce their quality

4. Adequate and safe supplies of potable water to satisfy human needs are to be preserved and protected

5. Multiple-use impoundments are given preference over single-purpose ones, and due protection to be accorded fisheries

6. Conservation is to be encouraged

7. Development of public water supply systems is to be encouraged over private systems

8. Recognition is to be given in allocation and use decisions to the relationship between surface and ground water

9. Expressions of public interest are to be sought at all stages of planning and allocation

10. Water management programs - including water quality, flood control, drainage, erosion control and storm run-off are deemed to be in the public interest

As part of the 1971 Act, the Legislature directed the Department of Ecology to develop a "comprehensive state water resources program" by the adoption of rules that would ensure that future water resource allocation and use would be consistent with the new policies. It was under this authority that Ecology filed **WAC 173-515**, Instream Resources Protection Program-Kitsap Water Resource Inventory Area

(WRIA) 15 on July 24, 1981. This administrative rule, particularly because of the hydraulic continuity issue, is very important to the future appropriation and management of ground water in Kitsap County.

B. Relevant Statutes

Several statutes provide guidance to Ecology in its ground water right and management determination. They include, among others, **RCW 75.20.050** (Review of permit applications...Water flow policy); **RCW 90.22** (Minimum Water Flows and Levels); **RCW 90.54** (Water Resources Act of 1971); and **RCW 43.21C** (State Environmental Policy Act of 1971). **RCW 18.014** (Water Well Construction) is also relevant but addressed in another issue paper. Because of the interrelationships of these laws and their overall complexity, they are not described in full, but their relationship to the GWMP is summarized.

Hydraulic continuity between surface water and ground water was recognized when the Ground Water Code was enacted in 1945. Prior surface water rights were protected from interference caused by subsequent rights to ground water, according to **RCW 90.44.030**. The Water Resources Act of 1971, **RCW 90.54.020(8)**, reads in part: "Full recognition shall be given in the administration of water allocation and use programs to the natural interrelationships of surface and ground waters." Therefore, an understanding of the status of surface waters within the GWMA is a necessity for ground water management planning.

In addition to those water rights established under the Surface Water Code, protection for fishery and other instream resources has been provided by three statutes. The oldest, **RCW 75.20.050**, was first enacted in 1949. It enunciated the policy "that a flow of water sufficient to support game fish and food fish populations be maintained at all times in the streams of this state." The policy was carried out by conditioning or rejecting applications for new water rights based on recommendations from the Directors of Fisheries or Game, now Wildlife.

The two other statutes are the Minimum Water Flows and Levels Act and the Water Resources Act referenced above. Both statutes establish a State policy that sufficient flows are to be retained in perennial rivers and streams to protect fish, game, wildlife, and other resources and values. **RCW 90.22** refers to "minimum flows" and **RCW 90.54** to "base flows." Ecology has attempted to overcome the definition problem by trying to establish "instream flows" through the process of adoption of State regulations. Once instream flows are established, all new permits are issued subservient to these flows. As a matter of law, a new appropriation cannot be exercised when instream flows are not being met. Water rights established prior to establishment of instream flows are not affected. Additionally, lake levels can be established under **RCW 90.22**. Further, **RCW 90.54** provides that "Lakes and ponds shall be retained substantially in their natural condition." The protection provided

by the above statutes is not absolute. There is a provision to withdraw waters in conflict with protected surface water levels "...where it is clear that overriding considerations of the public interest will be served."

There are two other provisions in the State Surface Water Code of additional relevance. **RCW 90.03.247** provides that "Whenever an application for a permit to make beneficial use of public waters is approved relating to a stream or other water body for which minimum flows or levels have been adopted and are in effect at the time of approval, the permit shall be conditioned to protect the levels or flows". This clause highlights that the impacts of surface water/ground water continuity may be unacceptable if ground water withdrawals deplete protected surface water. **RCW 90.03.345** also states "The establishment of reservations of water for agriculture, hydroelectric energy, municipal, industrial, and other beneficial uses under **RCW 90.54.050(1)** or minimum flows or levels under **RCW 90.22.010 or 90.54.040** shall constitute appropriations within the meaning of this chapter with priority dates as of the effective dates of their establishment..."

In addition to instream resource protection, the Water Resource Act of 1971 carries some important fundamental guidance for ground water management. The purpose of the Act, as stated in **RCW 90.54.010**, is "...to ensure that waters of the State are protected and fully utilized for the greatest benefits to the people of the State. Maximum net benefits shall constitute total benefits less cost including opportunities lost." **RCW 90.54.050(1)** provides the authorization to, "Reserve and set aside waters for beneficial utilization in the future."

The State Environmental Policy Act (SEPA) currently has limited impacts on the ground water quantity issue because appropriations of 2,250 gpm or less are exempted from the process through **WAC 197-11-800(4)(b)**.

C. Selected extracts from the Revised Code of Washington (RCW) concerning Water Rights

RCW 90.03.005 "It is the policy of the state to promote the use of the public waters in a fashion which provides for obtaining maximum net benefits arising from both diversionary uses of the state's public waters and the retention of waters within streams and lakes in sufficient quantity and quality to protect instream and natural values and rights."

RCW 90.14.160 "Any person entitled to divert or withdraw waters of the state who abandons the same, or who voluntarily fails, without sufficient cause, to beneficially use all or any part of said right to divert or withdraw for any period of five successive years after the effective date of this act, shall relinquish such right or portion thereof, and said right or portion thereof shall revert to the state, and the waters affected by said right shall become available for appropriation."

RCW 90.44.030 "The rights to appropriate the surface waters of the state and rights acquired by the appropriation and use of surface waters shall not be affected or impaired by any of the provisions of the supplementary chapter (on ground water) and to the extent that any underground water is part of or tributary to the source of any surface stream or lake, or that the withdrawal of ground water may affect the flow or any stream, watercourse, lake, or other body of surface water, the right of an appropriator and owner of surface water shall be superior to any subsequent right hereby authorized to be acquired in or to ground water."

RCW 90.44.050 "After June 6, 1945, no withdrawal of public ground waters of the state shall be begun, nor shall any well or other works for such withdrawal be constructed, unless an application to appropriate such waters has been made to the department (Ecology) and a permit has been granted by it as herein provided: Except, however That any withdrawal of public ground waters for stock- watering purposes, or for the watering of a lawn or non-commercial garden not exceeding one-half acre in area, or for single or group domestic uses in an amount not exceeding five thousand gallons a day, or for an industrial purpose in an amount not exceeding five thousand gallons a day, is and shall be exempt from the provisions of this section, but, to the extent that it is regularly used beneficially, shall be entitled to a right equal to that established by a permit issued under the provisions of this chapter"

RCW 90.44.070 "No permit shall be granted for the development or withdrawal of public ground waters beyond the capacity of the underground bed of formation in the given basin, district, or locality to yield such water within a reasonable or feasible pumping lift in case of pumping developments, or within a reasonable or feasible reduction of pressure in the case of artisan developments. The department shall have the power to determine whether the granting of any permit will injure or damage any vested or existing right or rights under prior permits and may in addition to the records of the department, require further evidence, proof, and testimony before granting or denying any such permits."

RCW 90.44.180 ". . . the Department may hold a hearing on its own motion, and shall hold a hearing upon petition of at least fifty or one-fourth, whichever is the lesser number, of the holder of valid rights to withdraw public ground water from any designated ground water area, sub-area, or zone, to determine whether the water supply in such area, sub-area, or zone is adequate for the current needs of all such holders. If such hearing finds that the total available supply is inadequate for the current needs of all holders of valid rights to withdraw public ground waters from the particular ground water area, sub-area, or zone, the department shall order the aggregate withdrawal from such area, sub-area, or zone decreased so that it shall not exceed such available supply.

Growth Management Act(2929 & 1025)- Water related requirements:
Under planning goals- "Ensure that those public facilities and services necessary to

support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards."

Revision to RCW 19.27- "Each applicant for a building permit of a building necessitating potable water shall provide evidence of an adequate water supply for the intended use of the building. Evidence may be in the form of a water right permit from the department of ecology, a letter from an approved water purveyor stating the ability to provide water, or another form sufficient to verify the existence of an adequate water supply. In addition to other authorities, the county or city may impose conditions on building permits requiring connections to an existing public water system where the existing system is willing and able to provide safe and reliable potable water to the applicant with reasonable economy and efficiency. An application for a water right shall not be sufficient proof of an adequate supply."

D. Federal Reservations

The Supreme Court has ruled that when Congress sets aside land for a Federal Reservation (e.g., military base, indian reservation) it at the same time sets aside the resources of that land which may be required for the purposes of the reservation. Water is included in this category. In general, therefore, federal reservations are not required to obtain state Water Right Permits for the water consumed on the reservation for uses consistent with the designated purpose of the reservation.

E. Water Right Processing

The permit system for acquiring water rights involves a three step procedure:

(1) Application

An application must be submitted to the State (Department of Ecology), requesting permission to appropriate water for beneficial use. Following a process of publication of legal notice, evaluation or protest, field examination, and consulting other agencies, Ecology either approves, approves with modification, or denies the application. To approve an application, Ecology must find:

* The proposal is a "beneficial use" as defined in the Code
* Water is available for appropriation in the amount requested
* The proposed use will not impair existing rights
* The proposed use will not be detrimental to the public interest, having due regard to the highest feasible development of the use of the waters belonging to the public

(2) Permit

Assuming approval of the application, a permit is issued upon payment of permit fees. This permit is authorization to proceed with construction of facilities and use of water consistent with the time schedule and other provisions of the permit.

(3) Certificate

Once a project is completed and water fully utilized, the Certificate of Water Rights is issued. This document is recorded with the local County auditor and in Ecology records. The right embodied in a Certificate is perpetual, and not subject to renewal; but a right can be lost through abandonment or forfeiture related to non-use of the water. In addition, if a prior water right becomes adversely impacted, applicable junior rights may be curtailed by the State.

III. GAPS-PROBLEMS

A. Water Rights Management

1. The current Washington State water right permitting process is cumbersome, unresponsive, and does not take a comprehensive approach to water allocation. Water capacity estimates and current allocation for each source (e.g., aquifer or drainage basin) are not maintained. The process is not supported by a monitoring program which injects current, source status into the analysis of water availability. A process which tracks aquifer or basin status with a comprehensive monitoring and computer allocation program could provide a readily available answer to the basic water rights processing question, is water available to grant the water right without adverse impact on senior rights. Issuing water rights on the basis of a continuous, comprehensive monitoring program would be more accurate than the current case by case analysis, certainly could be more timely, but could be more expensive depending on the sophistication of the monitoring effort. Any attempt to predict aquifer status by modeling is subject to error, therefore monitoring of actual ground water parameters is essential. Information on currently exempted water rights (e.g., ground water (5,000 gpd) exemption), which are established with no analysis, would be included automatically if the process was based on monitoring.

2. ECOLOGY has not quantified or taken appropriate action on many abandoned or under used water rights.

3. ECOLOGY enforcement of laws against over-use or misuse of water is inadequate.

4. ECOLOGY dedicates considerable personnel resources to an exhaustive case by case analysis of each water right request. In view of the current 3 year delay caused

by the process and the detraction it causes from other important water rights actions, a more efficient process should be adopted. The water rights process provides a framework for establishing the "first in time" basis for allocating water. It does not guarantee water will be available for all uses to which a right has been granted nor does it assure an applicant that their water allocation will not be curtailed or suspended at some time in the future. The State needs a less time consuming, more efficient water rights management process so that Ecology can use its personnel in activities which produce more benefit.

B. The Ground Water 5000 GPD Exemption

In evaluating water allocation, most exempt wells do not withdraw the full 5,000 gpd. Single family residences, which represent the bulk of exempt wells, average approximate 300 gpd. Exempt wells need to be included in the water management process through utilization of numbers and assumptions that reflect reality. Removing the exemption could greatly exacerbate the existing, lengthy delays in processing water rights unless a revised process is implemented.

C. The current three year processing time for Water Rights

The average three years ECOLOGY requires for processing water right applications is primarily caused by the cumbersome, case by case analysis of application and secondarily by the confusing application format. The former, in particular, impacts the Growth Management Process has caused an increase in the proliferation of wells falling under the ground water exemption.

D. Junior Water Rights

Because of the "First in time, first in right" doctrine, the State can make closures or issue a stop pumping order to well owners who are the most recent to receive water rights (Junior water rights). Should ECOLOGY determine an aquifer is being over drafted, junior rights to divert water can be temporarily curtailed. Such actions are normally the result of a verified drop in the aquifer static water level to the extent that aquifer depletion or seawater intrusion is indicated. As the population of the county continues to grow, numerous conflicts can be anticipated which will require resolution. Policies and procedures which address disputes by employing the "highest beneficial use" criteria, need to be developed more fully. .

E. Hydraulic Continuity

The legal and technical problems associated with identifying the impact of hydraulic continuity between surface waters (streams and lakes) and aquifers, have not been resolved. The associated water rights regulation problems have the potential to bring water rights granting to a standstill for protracted periods of time.

F. Growth Management

The Growth Management Act has set forth comprehensive requirements for utility (water) planning, development, coordination, and management. Cities, special purpose districts and other providers are responsible for meeting the water supply requirements which are developed in the growth management process. The current water rights procedures frustrate water resource planning and development required by the growth management process. Better coordination between The Department of Ecology and sections of state government responsible for growth management needs to take place.

G. ECOLOGY Assessment

A December 1991 ECOLOGY report on water right administration clearly demonstrates the need for dramatic change. The following is an excerpt of Ecology's assessment of the implications of the water rights permitting crisis.

"The problem of pending water right applications is real and growing. Its effects are felt within the Department of Ecology and without. For permit writing staff working in the Department of Ecology, there is a feeling of pressure to increase productivity. Many regional staff express a feeling of being overwhelmed or demoralized by the situation. External pressures from applicants and elected representatives create havoc as priorities shift constantly to deal with the latest brush fire or proclaimed emergency. For Ecology as a public institution, credibility with the public and local government has suffered. Water right permit decision periods are inconsistent with the decision time frames which local government, businesses, and individuals must operate under. Consequently, some projects have been approved locally before the essential question of water availability has been answered. Growth management legislation will place additional demands upon the department."

"For the public, the implications are perhaps most significant. Frustration, loss of confidence in government, and increased project costs associated with unanticipated delays are evident. In some instances, developers have exploited the 5,000 gallon per day exemption so as to avoid the water right requirement altogether. This may result in cumulative impacts on senior water right holders and instream flows. Illegal water use has also been a consequence."

"Uncertainty of water availability may impact local governments' responsibilities under growth management. They can't plan effectively unless water availability is known."

IV. RECOMMENDATIONS AND STRATEGIES

1. Urge State government to make a more sweeping change to the water rights processing

procedure than has been considered. Rather than revising the existing process, develop a new approach from the ground up. Request changes to the RCWs as necessary. The new process should:

* Create a system which monitors actual aquifer, stream, and precipitation conditions. Abandon the time consuming and resource devouring, case by case analysis of water rights applications which depends more on theoretical analysis than existing conditions. Since water rights only establish a priority and do not guarantee water availability, use the water rights process primarily to set priority and evaluate beneficial use.

* Employ Area Wide Assessments, rather than analyzing the impact of individual new wells. To address the question of availability, establish comprehensive monitoring programs for each Water Resource Inventory Area (WRIA). Limit denials of water rights applications to areas where water availability problems actually exist or, based on trend analysis, are projected . By issuing permits based on a WRIA monitoring process, water right permits could be issued in a timely manner and water uses currently exempted from the process could be factored in more realistically.

* Tailor the extent of application evaluation to the size of the proposed withdrawal and the observed characteristics of the source.

* Initiate a cooperative management approach by incorporating the resources of other major players (e.g., Departments of Health, Fisheries and Wildlife, and Community Development; the Tribes; and local government).

* Develop and adopt policies which are 1) technically sound, 2) politically acceptable, and 3) economically feasible.

*Incorporate factors such as:

Highest beneficial use
Adverse measurable impact of hydraulic continuity
Seawater intrusion
Instream flow

* More closely monitor existing water rights in order to reclaim amounts that are not put to authorized beneficial use.

* Make the water rights process compatible with the requirements of the Growth Management Act.

2. Urge Ecology to change the water rights application form so that it is more user friendly and the water rights permit so that it is written in clearly understandable terms.

KITSAP COUNTY

GROUND WATER MANAGEMENT PLAN

ISSUE PAPER ON: The Ground Water (5000 GPD) Water Rights Exemption

March 16, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper examines the ground water (5,000 gpd) exemption to the Washington State water rights procedure.

> Goal: Provide background on exemptions to Washington State water rights permitting procedures. Recognize the appropriate role of exempted domestic wells, the importance of protecting the water resources of the county and measures required to safeguard public health. Provide appropriate recommendations if required.

B. Background

The small domestic well, which traditionally has served the water needs to a single household, is exempt from the water rights permit process, as long as the amount of water extracted from the well is less than 5000 gallons per day (gpd) and less than 1/2 acre of lawn and/or non-commercial garden is irrigated. The right to the use of "domestic supplies of water" is well founded in the state laws of Washington and is common to numerous other western states.

Recently, a great deal of concern has been raised regarding a proliferation of exempt wells which are often perceived to be unregulated and a loophole in the Department of Ecology (Ecology) water rights process. Currently Ecology takes several years to approve a water right for a well withdrawing more than 5000 gpd. Conversely, wells which fall under the ground water exemption require no permit from Ecology and have been deemed sufficient by the Bremerton-Kitsap County Health Department(BKCHD) to serve up to 6 residences. Some concern also exists within both state and county health departments that small systems represent an inherent public health threat as well as an unnecessary administrative burden.

II. WATER LAW

As the history of water law for the State of Washington is fully discussed in the issue paper on water rights, this paper will not repeat the development of basic water law. This paper will focus on the specific aspects of the law as it regards the ground water exemption.

In **RCW 90.44.050**, the explicit exception of domestic wells from the water right permitting process is defined:

> "... Except, however, that any withdrawal of public ground water for stock-watering purposes, or for the watering of a lawn or of a non-commercial garden not exceeding one-half acre, or for single or group domestic uses in an amount not exceeding five thousand gallons a day, or for an industrial purpose in an amount not exceeding five thousand gallons a day is and shall be exempt from the provisions of this section,...."

Ecology can control the proliferation of new exempt wells under existing statutory authorities where it is warranted by resource conditions (see chapter 173-548 WAC, Water Resources Program in the Methow River Basin, WRIA 48).

The ground water exemption is well founded in state law. Any recommendations for administration or regulation of these wells should carefully consider the long standing basis for the exemption.

Exempt wells can be regulated within the existing law when it is shown that their use will adversely impact a senior right holder.

Under RCW 19.27.097 (the Growth Management Act of 1990), as amended, the counties and/or cities have increased authority to control development based on water availability. They can impose conditions on building permits, requiring connection to an existing public water system, where appropriate. They can deny building permits in areas where there is not an adequate water supply available.

III. PURPOSE OF THE GROUND WATER EXEMPTION

The following points are critical considerations for exempting small wells from the permit process. They serve as the basis for developing the subsequent recommendations.

Rights of Ownership It can be argued that the GROUND WATER exemption can be derived from the tenet that a basic subsistence amount of water is implicit in the ownership of the land surface.

Impact on the Hydrologic System The amount of water actually extracted by exempt wells in Kitsap County represent, is a small portion of the ground water resource. Domestic wells are generally located in sparsely populated areas where public water supplies are presently not available. The extraction of small amounts of water over a broad area results in minimal impact upon the regional ground water system. The few exceptions can be handled on an individual basis without modifying or encumbering the basic language of the present law.

Although up to 5000 gpd can be put to beneficial use without a water right permit , far less water is actually used or needed by most exempt well owners. The following calculation is an estimate of the impact exempt wells have on ground water in Kitsap County. Water system purveyors in the county report 300 gpd is typical usage for single domestic services. There is no present evidence that typical domestic well owners either require or use, on an annual average, more than 300 gpd. Never the less, 400 gpd will be used for this estimate. Kitsap County has an estimated 10,000 exempt wells and approximately 1000 of these serve more than one unit (average 3). The corresponding 12,000 service connections require an estimated 4.8 million gallons per day (mgd). Exempt wells are spread over approximately 75% of the County (300 square miles), an area that has a recoverable recharge of 110 mgd (Kitsap County Ground Water Management Plan Vol.1). The use of approximately 4.8 mgd, which appears to be a large quantity, represents only about 4.4% of the resource available. This calculation ignores the contribution of on site recharge.

Permitting Exempt Wells The task of permitting exempt wells in Kitsap County would be a monumental administrative task, would be extremely costly, and would add little to regional ground water management. For a one year period ending November 15, 1992, Ecology received 75 applications from Kitsap County. The figure usually is 100 or less. State-wide, Ecology reports that ten wells are drilled for every one that requires a permit (J. Liszak, Ecology, phone conservation Feb. 17, 1993). In 1992, 359 wells were drilled in Kitsap County; 78% exempt from the application process. Water Right application processing time currently exceeds three years. Adding exempt wells to the permitting process would devastate a system that is already in grave trouble. As an alternative, a sample group of exempt wells could be monitored to statistically estimate the impact of all domestic wells on the hydrologic system.

IV. CONCLUSIONS

The time, expense and effort required to administer ground water withdrawal from currently exempted wells could be excessive and could detract from more worthwhile endeavors. It is also apparent that current water rights policy will cause the number of exempt wells to continue to accelerate. The ground water exemption has a basic, useful purpose. Elimination of the exemption would be detrimental to some individuals of the County and would adversely impact the ground water management process. The exemption from the Water Rights permitting process for domestic wells which produce less than 5000 gpd should be retained.

V. RECOMMENDATIONS

1) Public Utility District No. 1 of Kitsap County has set up an exempt well monitoring program. This program should be designed to collect the hydrogeologic and usage data necessary to provide the information required to generate statistically valid conclusions concerning the nature of and production from exempt wells in Kitsap County and to assess the effects they might have on the hydrologic system.

2) Should a problem area be identified, through either the domestic or public well monitoring networks, a program to evaluate the total hydrogeology of the impacted aquifer must be undertaken. If it becomes apparent that exempted wells are a significant component of the problem, then within the problem area, the program must identify the seniority of water rights for the large wells and the dates of drilling for the domestic wells, which are involved and evaluate the water balance for the aquifer. Under such circumstances, it is appropriate to bring the exempt withdrawals into the management process. Where feasible, appropriate local officials should initiate the above action.

3) Should an aquifer be determined to be in an overdraft condition, water use should be regulated in accordance with state law. An aquifer management plan which controls withdrawals must be developed for the affected ground water system. In the most severe conditions, the county should consider petitioning Ecology to close the area to additional withdrawal.

4) For over-drafted aquifers, an education program must be initiated to inform the public as to the rationale for water withdrawal reductions. Voluntary agreements for limited use could be solicited from individual domestic well owners. The drilling community must be informed by Ecology when an aquifer has been closed and completion of wells will no longer be allowed.

SMOOTH DRAFT SMOOTH DRAFT

KITSAP COUNTY
GROUND WATER MANAGEMENT PLAN
ISSUE PAPER ON: MONITORING AND LONG-TERM DATA COLLECTION

Feb. 16, 1993

I. INTRODUCTION AND BACKGROUND

A. Purpose and Scope

This issue paper outlines the existing ground water monitoring network in Kitsap County as implemented by the Kitsap County Ground Water Management Plan (GWMP) and presents recommendations for continued development and management of water resource data. As a preface to the discussion of the monitoring network, this paper presents a brief overview of existing data sources that may be of consequence to water resource studies.

B. Monitoring Network for long-term Data Collection

Long-term trend data are generally required to evaluate changes in the hydrogeologic system that may be related to ground water development, land use changes, and climatic patterns. A comprehensive program of monitoring includes the collection of water level, water use, precipitation, stream flow and water quality data. Changes in the hydrogeologic system are usually quite subtle; therefore extended periods of monitoring are generally required to evaluate trends.

II. CURRENT LAWS AND PROCEDURES

A. EXISTING DATA SOURCES

1. Drillers

Well drillers must submit a Well Construction Report for each water well and resource protection well they drill in the state, to the Washington Department of Ecology (Ecology). Ecology in turn submits copies of these reports to the Bremerton/Kitsap County Health Department (BKCHD). These reports supply original data about the well location, depth, water level, geologic material, construction details, etc. Well reports have been required by state law since 1971 for all wells, but the implementation regulations were not in place until 1973. Prior to that time (1945 to 1971) Well Construction Reports were only mandated only for

wells which required a water rights permit. Some records for other wells collected during water resource investigations by the predecessor agencies, have been retained. Consequently, the number of reports on file for wells constructed prior to about 1973 is quite limited and the quality of well information is generally quite poor.

In addition to Well Construction Reports, drillers are required to pump test a well and submit a water quality sample to a state certified laboratory for an inorganic analysis of drinking water parameters. A copy of the water quality analysis report is submitted directly to the BKCHD.

Pumping test data which is not included on the Well Construction Report may also be forwarded to the BKCHD. The pumping test data include time-drawdown measurements that were collected while the well was operated at a relatively constant rate. Data of this nature can be used to determine properties of the aquifer such as aquifer permeability.

2. United States Geological Survey

The United States Geological Survey (USGS) maintains several national database systems for water resource information. In addition, technical information and reports on ground water resources, aquifer depletion, seawater intrusion, and ground water and surface water quality have been developed. The two most commonly used database systems are the Water Data Storage/Retrieval System (WATSTORE) and the National Water Information System (NWIS). These databases include well inventory data as well as stream flow and water quality data.

The USGS collected a considerable amount of data within Kitsap County in the 1940's and 1950's in order to develop several publications that describe the areas water resources (1965).

More recently, the USGS completed studies of the Bainbridge Island area in order to evaluate seawater intrusion. In addition to characterizing the hydrogeologic framework for the island, the USGS conducted an extensive sampling effort. About 210 wells were visited in the spring and fall of 1985 to measure depth to water and to collect water samples for analyses of specific conductance and chloride concentrations. Forty-eight samples were also collected from sites and analyzed for major cations and anions, nitrate, iron, manganese, and coliform bacteria; nine of the 48 samples were also analyzed for trace metals. Water levels and (or) chloride concentrations were measured monthly in 24 selected monitoring wells to document seasonal variations of those parameters.

Currently, monitoring activity by the USGS is confined to the operation of a stream gaging station during low flow periods on the Big Beef Creek.

3. Tribes

The Suquamish and Port Gamble-S'Klallam tribes have historically collected surface water quality data and limited stream flow data as part of their Fisheries enhancement programs. Water quality data consist primarily of physical parameters such as temperature, pH, conductivity, dissolved oxygen, and turbidity. Miscellaneous stream flow measurements have been collected by the Suquamish tribe at a number of streams during the 1980's (e.g. Dogfish Creek, Blackjack Creek, etc.). The tribes are currently working cooperatively with KPUD in the collection of stream flow data.

4. Health Department

The Division of Drinking Water within the Washington State Department of Health (WDOH) regulates public water systems and requires a wide variety of monitoring to ensure the quality of these water supplies. For well supplies, this ongoing data collection targets coliform bacteria, inorganic and volatile organic chemicals, and pesticides. The monitoring requirements are based on the type and size of the system and on results from previous sampling. Generally however, for public drinking water supplies, bacteriological data is collected a minimum of once every 3 months and inorganic and volatile organic chemicals are sampled once every 3 years. New federal drinking water regulations requiring additional tests for synthetic organic chemicals and radionuclides will be implemented by WDOH in the near future which will provide an additional source of water quality data.

The BKCHD is the repository for water quality data for public systems. The BKCHD is the primary source of data for inorganic and bacteriological data for new wells as well as inorganic, bacteriological, and volatile organic compound testing data for regulated water systems. As mentioned above, the information on new wells is submitted to BKCHD by the drillers. All data obtained from the installation and testing of new wells (i.e. well log, pump test data, inorganic and bacterial analysis, and pump specification information) are forwarded to KPUD. KPUD visits each new well site to determine elevation and location. A Unique Well Identification Number, if not already assigned, is placed on the well at this time. This data is then entered into the data base and filed by geographic location. This provides a valuable summary of basic water resource data for use by hydrogeologists and other water planners.

5. Ecology

Well drillers are required to submit all Water Well Reports to the Washington State Department of Ecology. Ecology organizes these by Township/Range-Section and places them into Well Report files which are accessible to the public. In addition, Ecology has a computerized listing of water rights data and other environmental studies and reports.

6. Kitsap Public Utility District (KPUD)

KPUD has primary responsibility for gathering and maintaining water resource data for the County. KPUD is also assuming responsibility for data management and AutoCAD support activities at the local level to facilitate the orderly accumulation and management of accurate data. KPUD has established approximately 30 computerized data centers with local utilities, agencies, and others who will routinely report data within the County.

As part of the GWMA study, a database of hydrogeologic information was developed and made operational on KPUD computers. This database relied upon information provided by USGS for approximately 3,350 wells. Data for an additional 450 wells was added from reliable data obtained from records maintained by the hydrogeological consultant on the project. Geologic logs for approximately 700 wells were computerized and information on water rights and water quality was also entered in the database. The water resource information was entered in accordance with the Data Management Guidelines established by Ecology. New information is being collected and entered into the database on an ongoing basis.

KPUD is currently involved in a private well sampling program. The program provides free water quality testing services to owners of private wells. The program will provide the PUD with valuable information regarding private well drinking water quality as well as additional hydrogeologic data (well logs, water levels, etc) that can be used to better manage ground water resources. These efforts will eventually allow KPUD to analyze water quality trends and land use patterns to identify areas potentially at risk from activities that impact water quality.

7. Kitsap County

Kitsap County provides KPUD with current GIS data to assist in mapping and related activities.

8. Other

Efforts are currently underway to take advantage of data produced by various citizen monitoring groups and other volunteer organizations. KPUD staff is working with several volunteer groups to set up standard procedures for data collection and monitoring. Once developed, this area could provide a wealth of information.

There are many other sources of water resource data contained in numerous reports and files. Much of this information is referenced in the GWMA bibliography (GWMA, Vol. I, 1991). Additional data sources include consultant reports, water purveyor files, the National Oceanic and Atmospheric Administration (NOAA), the Soil Conservation Service (SCS), the Environmental Protection Agency (EPA), etc.

B. KITSAP COUNTY GROUND WATER MONITORING PROGRAM

The Ground Water Management Program established a comprehensive network of monitoring sites throughout the county. The network includes wells for monitoring water levels and water quality, stream gaging stations, and precipitation gages.

1. Water levels

Water level monitoring provides a basis for evaluating impacts on the groundwater system that may be associated with ground water development, land use changes, and precipitation patterns. Water level trend data can be used to establish baseline trends and seasonal variations, to evaluate the effects of pumping and climate, to identify areas where possible overdraft is occurring and to assess areas where seawater intrusion may be of concern.

A total of 84 wells have been identified within the county for water level monitoring (Table 1, Exhibit 1). The sites were selected to provide coverage within the 25 principal aquifer systems that were identified within the county as well as other areas where trend data was generally absent. The network was designed to include wells that are completed over a wide range of depths to assess trends in both shallow, intermediate and deep ground water flow systems.

In addition to the wells identified for water level monitoring by the GWMA program, other wells are being incorporated into the network on an on-going basis. Many of the water purveyors in the county are expanding their monitoring efforts to include new and existing wells. KPUD is assisting with coordinating these efforts and managing the data.

The responsibility for water level monitoring is shared between local purveyors and KPUD personnel. KPUD collects water level data from wells that they operate as well as other public and private wells that are a part of the network. The other local purveyors are responsible for monitoring water levels in their wells. Water levels are measured on a monthly basis using electric well sounders. Water level data are entered by the purveyors into a water level spreadsheet software package. The computer package has options for data entry, reporting, plotting, and transfer. Water purveyors routinely transfer their data to KPUD where it is uploaded to the database management system.

2. Water quality

A water quality monitoring network was also developed which acknowledges the impact of land use activities in relation to the hydrogeology of the area. The network was designed to provide background data and continuing water quality information for the aquifers throughout the county. Indicator water quality parameters were

recommended for monitoring based on potential land use impacts, health concerns, frequency of occurrence, and aesthetic qualities which help to assess the hydrogeologic characteristics of the aquifer. Specifically the parameters were sorted to reflect potential contamination from land uses associated with urbanization, industrial/commercial, or agricultural activities.

A summary of the water quality monitoring network for the GWMP is presented in Exhibit 1 and Table 1. This network was established and background water quality data was collected by KPUD over two sample rounds in 1990 and 1991. The first round of data collection occurred during the fall of 1990 and represented dry season conditions. The second round of monitoring occurred at the end of the wet season in the spring of 1991. This background monitoring provided comprehensive and consistent data from the network and serves as a baseline for future, long-term data collection. This water quality data is maintained on the KPUD database management system.

The parameters analyzed were divided into three major categories: Program A included bacteriological, physical, and inorganic parameters; Program B consisted of regulated and unregulated volatile organic chemicals; and Program C contained a variety of synthetic organic chemicals (SOC's), many of which will be regulated in the future. The first monitoring round consisted of Program A parameters only, and the second round consisted of Program A, B, and C parameters.

Water purveyors will continue to collect water quality samples from the monitoring network sites as part of regulatory compliance monitoring. Future efforts will be directed towards establishing procedures for forwarding compliance monitoring data from WDOH to KPUD for inclusion into the GWMA database system.

3. Stream Flow

Stream flow data is a critical element in evaluating water balance relationships within any given drainage basin. Stream flow data can also provide insight into possible hydrogeologic impacts related to ground water development. Prior to the initiation of the GWMA study, there was only one active stream gaging station within the county. The site is located on Big Beef Creek near Seabeck. However, in the 1940s and 1950s many other stations were operated within the county.

Additional stream gaging sites for long-term monitoring have been established at 11 sites (Exhibit 2). The active stream gaging sites in the county include:

	Gage Location	Gage Type
1)	Hansville Creek	V-Notch Weir/Staff Gage
2)	Grovers Creek	Staff Gage (Suquamish Tribe)
3)	Dogfish Creek	Data Logger/Staff Gage

4)	Barker Creek	Data Logger/Staff Gage
5)	Clear Creek	Data Logger/Staff Gage
6)	Strawberry Creek	Staff Gage
7)	Big Beef Creek	Data Logger/Staff Gage operated by USGS for summer base flows
8)	Chico Creek	Data Logger/Staff Gage
9)	Gorst Creek	Data Logger/Staff Gage
10)	Anderson Creek	Staff Gage
11)	Blackjack Creek	Data Logger/Staff Gage
12)	Burley Creek	Data Logger/Staff Gage

The criteria used to select new sites included:

* Proximity to major ground water pumping centers;
* Proximity to areas where historical stream flow data are available;
* Some sites were located within urbanized areas to evaluate effects of urbanization on runoff; and
* Accessibility, channel geometry, and other siting factors.

Data loggers and pressure transducer equipment were installed at most sites to allow for continuous monitoring of stream flow events. Data is digitally transferred from the data loggers to computers at KPUD's office. A stream flow module is available as part of the database management system for manipulation of the data and preparation of summary reports and plots. Stream flow surveys are performed every month or two at most sites. The stream survey data is used to maintain stage-discharge relationships for each site and to convert the stage data to flow rates.

4. Precipitation

Precipitation information is a major component in water balance calculations. Accurate and extensive data can help to refine recharge/discharge relationships and provide a more detailed assessment of ground water resources.

Precipitation rates vary widely throughout the county from as little as 20 inches/year in the Hansville area to as much as 80 inches/year in the western portion of the county. Prior to the initiation of the GWMA study, there was little precipitation monitoring occurring within the county. Long-term records have been established within the Bremerton area by the city and the National Weather Service. Short-term records were also generated at the Bangor facility. Recognizing the need to delineate the distribution of precipitation patterns, KPUD established a number of new monitoring stations for the GWMA program. Currently there are 17 active precipitation monitoring stations within the county (Exhibit 2). These stations include:

Gage Location

1) KPUD Office (Poulsbo)
2) Hansville Water Department Office
3) Grovers Creek Hatchery
4) Bloedel Reserve Shop
5) Silverdale Water-Wixon Site
6) Dawn Park, Shadow Glen
7) Casad Dam-McKenna Falls
8) Lake Symington
9) Bremerton Water Department Office
10) Utility Forestry Office - Gorst Creek (Domsea)
11) Holly Beach Club
12) Bremerton Fire Station #2
13) Bangor Delta Pier
14) Lofall Ferry Dock
15) Fish Pro-Burley Hatchery
16) Scenic Beach-Seabeck
17) Frank Munroe Residence-Seabeck

Measurements are collected at most sites on a daily basis by volunteers and water purveyors. Data are transferred on a regular basis to KPUD offices where it is entered into the database management system. A precipitation module of the database management system is used to prepare summary reports and data plots.

5. Water use

Water use data are of critical importance in evaluating water resource issues associated with potential overdraft of aquifer systems, seawater intrusions, sustainable ground water yield, and water balance relationships. Most water purveyors within the county collect water production data from metering systems that are installed at the wellhead. The frequency of data collection and methods of reporting the data vary widely depending upon the individual requirements of the water system.

Recognizing the need to facilitate and standardize the reporting of water use data, the Kitsap GWMP developed a computerized software package for entering and managing data. The water use package has been distributed to the purveyors along with PC computer systems and spreadsheet software. The computer package has options for data entry, reporting, plotting and transfer. Water purveyors routinely transfer the data to KPUD offices where it is uploaded to the database management system.

C. DATABASE MANAGEMENT AND INFORMATION MAPPING

There are several computer networks being created in Kitsap County to manage the development and exchange of water resource information.

A water resource database management system and a project database were developed for the GWMP by the project consultants and KPUD. The database management system is a customized program that allows the user to conveniently manipulate data. The system was developed to assist the county and other water resource planners in future data management.

The project database includes a wide variety of information such as well construction data, location, elevation, geologic logs, water level data, owner and water rights information and water quality data. The database provides the basic information necessary to assess hydrostratigraphy, ground water flow systems, water quality conditions, and quantity and quality trends.

The computerized database management system incorporates the following features:

* Operates on a standard desktop PC computer system
* Compatible with Ecology data management requirements as well as U.S. Geological Survey and EPA database
* Provides a user friendly menu interface that allows water resource planners access to information without having to understand complicated programming commands
* Accepts both site-based and time series data
* Provides an optional graphics interface which allows presentation of data within an AutoCAD mapping environment

A second program involves KPUD providing 30 PC's to local water purveyors. The PC's contain standardized database programs for water use and water level data collection. The purveyors are able to produce automated water use and water level data that can be easily collected and compiled by KPUD.

Kitsap County has acquired GIS ARC/INFO to produce and manage geographic information for database maps. KPUD and cities will be linked to the GIS system on PC's via quarterly data transfers. KPUD will be able to transfer tabular water data to the GIS system where the tabular data can be linked to the data base maps.

Exhibit 3 shows a flowchart of the computer network for Kitsap County.

III. PROBLEMS AND GAPS

A. EXISTING DATA SOURCES

1. Drillers

Information obtained through the construction of new wells represents one of the more important sources of information for water resource management. To be of optimum benefit; however, several refinements must be made to procedures for filling out this document. These changes should include:

* Addition of vicinity map to well site.
* New procedure for accurate determination of well elevation.
* Improved accuracy and consistency in recording geologic logs.

2. Other Agencies

Lacking standard operating procedures for data collection, the accuracy of all imported information must be assessed prior to use. Increased communications between agencies will assist in establishing standard methodology while reducing the risk of duplicate efforts.

B. KITSAP COUNTY GROUND WATER MONITORING PROGRAM

Efforts must be made to take advantage of all available sources of water resource information. The monitoring program can be greatly enhanced by the participation of citizen monitoring groups; however agencies must first establish standardized collection and reporting procedures for these groups to follow.

C. DATABASE MANAGEMENT AND INFORMATION MAPPING

Relevant water resource data comes from a wide range of sources to cover a broad array of subjects. This diverse data must be maintained, transmitted amongst participating entities and, perhaps hardest of all, made to relate within an integrated database.

Management of such a complex database requires development of a data dictionary to define characteristics of all included data. This may include: reporting agency, method of collection, date of collection, etc. This dictionary will enable users to determine whether a particular database will meet their needs.

IV. RECOMMENDATIONS AND STRATEGIES

LONG-TERM DATA DEVELOPMENT AND MANAGEMENT

1. Establish Improved Coordination of Data Collection Activities

Currently there are numerous agencies that gather water resource information in the county. Coordination of this activity could result in more efficient data development. Data collection responsibilities need to be clearly identified and protocols established to facilitate data exchange.

Planning projects that need to be incorporated and organized include the Watershed Action Plans, Ground Water Management Plan, and the Coordinated Water System Plan. The database development and maintenance aspects of each of these plans should be linked to a distributed information system. Within a distributed system, local and state agencies share the responsibility of collecting and maintaining water resource data. Local agencies should collect data at a detailed level. This would be aggregated and transferred to state agencies. These state agencies should have the responsibility for integrating multiple local and regional databases.

2. Establish Improved Protocol for Transfer of Data

Intensive data standardization programs are the key to successful data transfer programs. Without standardized data collection, data exchange or transfer between neighboring systems is inefficient if not impossible. Data transfer is important for regional planning and resource management.

A universal data dictionary should be adopted. Data dictionaries, or common data terms, are crucial for data transfer. All agencies need to use the same data dictionary and standardized compatible data collection formats. At a minimum, data dictionaries must be developed for each data collection program. Such basic information will enable agencies to determine if specific databases are useful to them.

3. Identify Responsible Party for Computerization of Water Resource Data

Water quality test results should be computerized by the testing laboratories. The laboratories generally have the automated facilities to produce computerized data. A pilot program is under development by the WDOH, KPUD, and the BKCHD that will require laboratories to provide computerized data when conducting tests for local purveyors.

Kitsap PUD is currently involved in a program providing 30 PC's to the local water purveyors. The PC's contain standardized database programs for water use and water level data collection. The purveyors are then able to produce automated water use and water level data that can be easily collected and compiled by the PUD.

4. Periodic Data Reporting

It is recommended that a basic data report be prepared every five years. This report would include the presentation of all monitoring data in formats such as water quality tables, and water level, water use, precipitation, and stream flow hydrographs, etc. Within the report a limited analysis of the data should be provided. This five-year report of the monitoring network would be instrumental in assessing the adequacy of the current monitoring system; identifying potential water resource problems (overdraft, seawater intrusion, etc.) that may need to be addressed in greater detail; and to identify additions or changes in the data collection program.

5. Uniform Well Identification Number (UWIN) System

Inconsistency in well identification is one of the primary obstacles to sharing data in Kitsap County. The Water Resources Data Management Task Force (WRDMTF) is currently studying this problem.

A UWIN pilot program was started in 1989 by the WRDMTF in cooperation with Kitsap County and KPUD. Some 1000+ wells in the study area were tagged with a six digit ID number. Several drillers within the County have volunteered to tag wells as part of new construction. Furthermore, KPUD has begun an effort to tag all existing wells on a prioritized schedule.

6. Coordinate Water Quality Data Collection

The GWMA water quality monitoring network consists entirely of public water supply wells which are subject to regulatory sampling requirements by the WDOH. The potential exists for coordination of this sampling with the long-term data collection requirements of the Ground Water Management Program.

Ideally all water quality data collected by the various water purveyors could be forwarded to both the WDOH to fulfill compliance requirements and to KPUD for incorporation into the GWMA database. In addition, all water quality data collected by well drillers (new wells or existing wells where wells/pumps are serviced) should be submitted to both the BKCHD and KPUD for inclusion into the GWMA database. A procedure and protocol should be established to facilitate computerized transfer of the water quality data.

KPUD could complement the public water system compliance monitoring and the water quality testing provided by the drillers through selective long-term monitoring of private water supplies. The existing network of wells (Table 1) could be expanded to include a representative set of wells in coastal areas to document possible seawater intrusion. An additional representative set could be established in urban and agricultural areas to identify possible land use impacts.

7. Coordinate Data Collection with Well Drillers

A public education program should be considered which works with local drilling contractors to ensure complete, accurate, and consistent information on Well Construction Reports. The program should stress geologic soils classification schemes and well location procedures and conventions. Methods and procedures used to tag wells with Unique Well Identification Numbers should also be reviewed.

8. Establish Long-Term Funding Program for Data Collection and Management

To be considered effective, monitoring networks must be established and maintained over long periods of time. The costs for maintaining a network include:

* personnel
* equipment
* services (analytical, equipment repair, etc.)

Currently there exists no long-term funding mechanism to support the monitoring program that has been established for the GWMA program. Funding for long-term monitoring should be secured through local and state sources where possible. Because state funding sources can be quite unreliable, and the benefits to be realized from monitoring are primarily of a local nature, local funding sources will likely be the most important source for funds.

V. REFERENCES

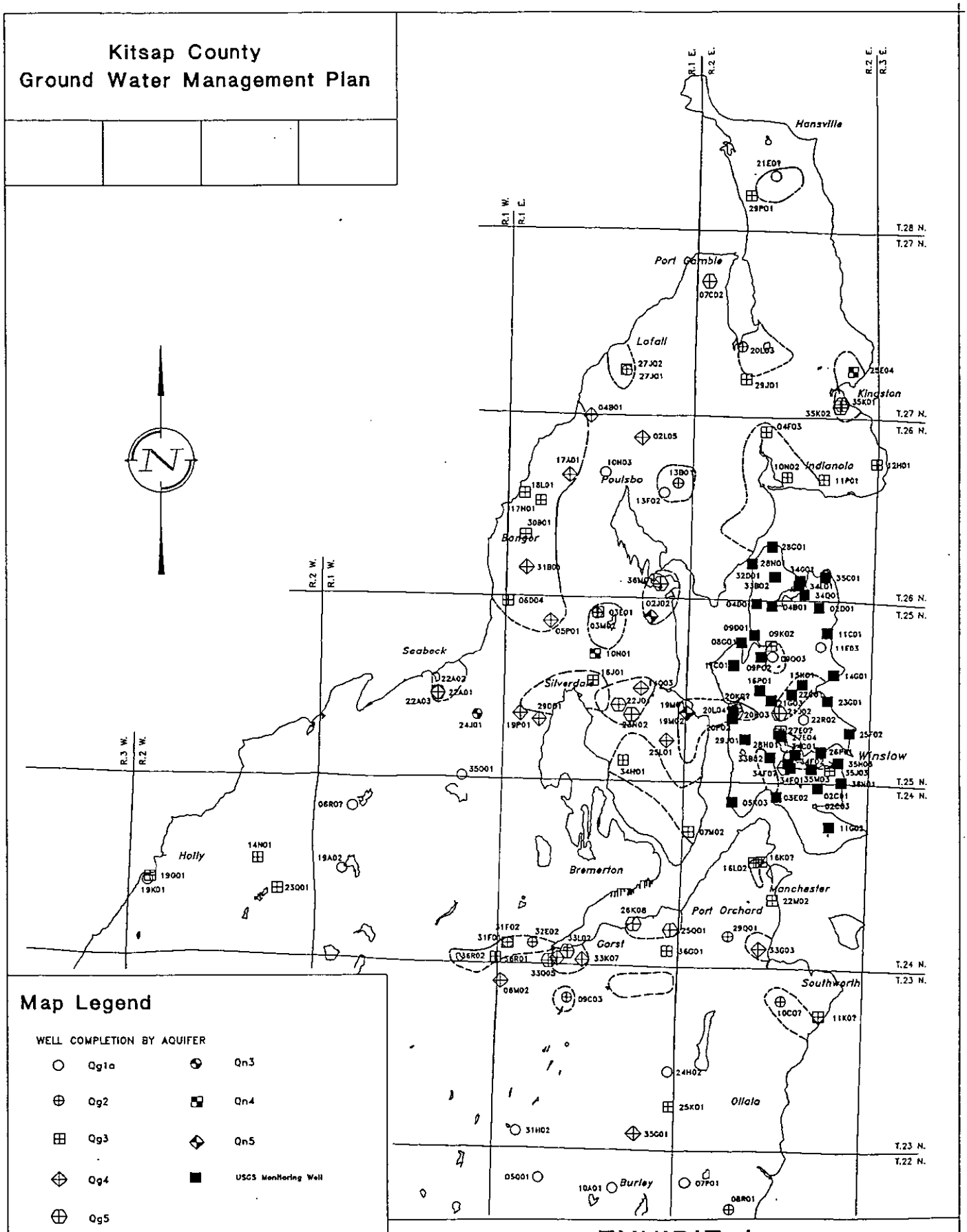
EES, 1992, Kitsap County Water Data Management Plan.

GWAC, 1991, Kitsap County Ground Water Management Plan, Background Data Collection and Management Issues, Volumes I and II.

USGS, 1987, Preliminary Evaluation of the Groundwater Resources of Bainbridge Island, Report #87-4237.

Washington Department of Ecology, 1990, Water Resources Data Management Program, Preliminary Findings and Recommendations of the Water Resource Data Management Task Force.

Kitsap County
Ground Water Management Plan



Map Legend

WELL COMPLETION BY AQUIFER

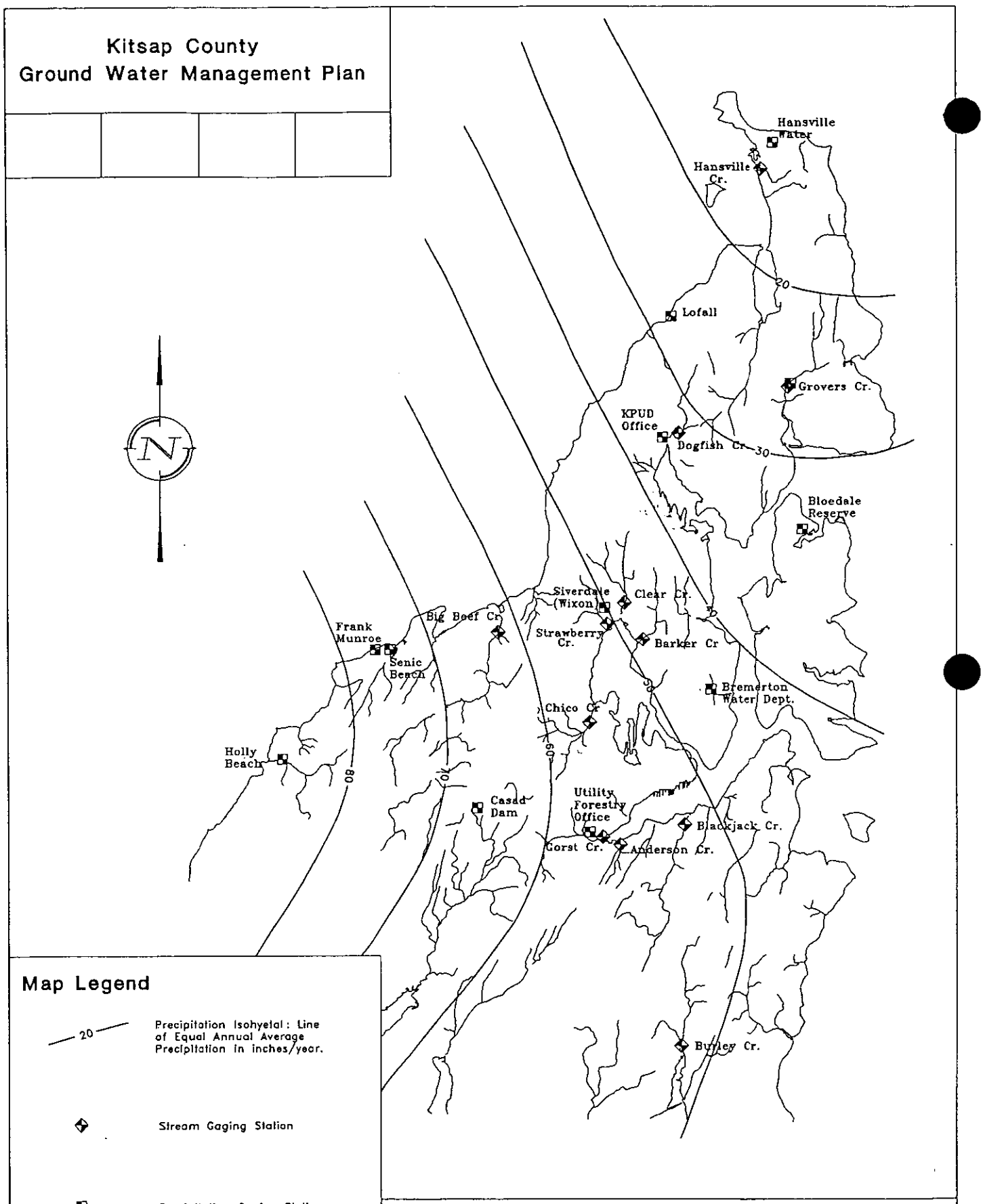
○	Qg1a	◔	Qn3
⊕	Qg2	◪	Qn4
⊞	Qg3	◆	Qn5
⊕	Qg4	■	USGS Monitoring Well
⊕	Qg5		

◯ Approximate location of principal aquifer system.

Scale in Miles
0 1 2 4

EXHIBIT 1
Location of GWMA Monitoring Well Sites

Kitsap County
Ground Water Management Plan



Map Legend

20 — Precipitation Isohyetal: Line of Equal Annual Average Precipitation in inches/year.

Stream Gaging Station

Precipitation Gaging Station

Scale in Miles
0 1 2 4

EXHIBIT 2
Precipitation and Stream Gaging Stations

June 24, 1992

EXHIBIT 2
COMPUTER PLATFORMS FOR INTEGRATED WATER DATABASES

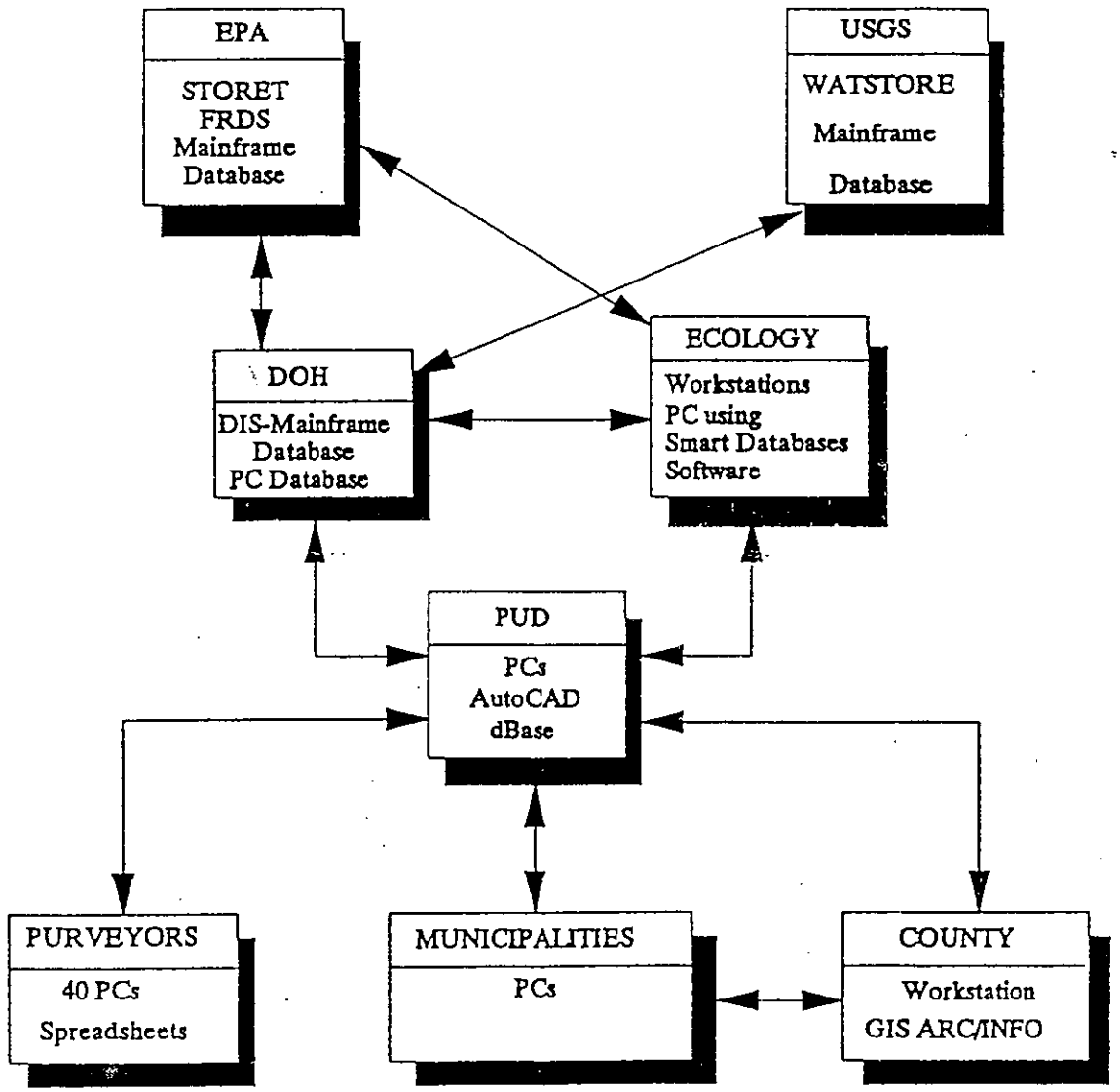


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Table 1 – Summary of GW[redacted] Monitoring Wells

Kitsap County Ground Water Management Program

Local Well Number	Site ID Number	Well Owner	Site/Mailing Address	Phone Number	Principal Aquifer	Site Elevation (ft–MSL)	Well Depth (ft)	Water Level Depth (ft)	Water Level Date	Well Diameter (inches)	Top of Screen (feet–bgs)	Bottom of Screen (feet–bgs)	General Monitoring	Monitoring Activity: Water Levels	Program A W.Q.	Program B W.Q.	Program C W.Q.	Remarks	Responsible Party
25N/01E–05P01	474057122420801	BANGOR TH–8	Naval Submarine Base	369–4192	Qg4	252	415	166.6	1975/06/06	8	225	395	WL	X				2 piezos	B
25N/01E–06D04	474130122435801	BANGOR TH–17	Building 1101, Code 8312, Silverdale 98315	396–4192	Qg3	300	314	260.3	1978/03/17	10	270	314	WL	X					B
26N/01E–17A01	474506122412801	BANGOR TH–10	Naval Submarine Base, Bangor	396–4192	Qg4	404	576	348.8	1975/05/31	8	493	555	WL	X					B
26N/01E–17N01	474101122423901	BANGOR TH–4A	Building 1101, Code 8312, Silverdale 98315	396–4192	Qg3	363	665	303.0	1974/11/06	8	383	459	WL	X					B
26N/01E–18L01	474431122432501	BANGOR WELL 504	Building 1101, Code 8312, Silverdale 98315	396–4192	Qg3	211	341	157.0	1976/06/00	16	295	340	QW		X	X	X		B
26N/01E–30B01	474323122431701	BANGOR TH–12	Building 1101, Code 8312, Silverdale 98315	396–4192	Qg3	240	493	209.0	1990/05/31	1.25	218	493	WL	X				3 piezos	B
26N/01E–31B01	474227122431301	BANGOR TH–11	Building 1101, Code 8312, Silverdale 98315	396–4192	Qg4	350	810	275.0	1977/02/05	1.25	270	764	WL	X				3 piezos	B
24N/01E–31F01	473147122434001	BREMERTN ALDR 2A	3027 Olympic Dr., Bremerton 98310	478–5318	Qg3	120	227	–10.3	1988/04/12	12	168	214	WL	X					BR
24N/01E–31F02	473147122434002	BREMERTN ALDR 2B	3027 Olympic Dr., Bremerton 98310	478–5318	Qg2	120	55	5.4	1988/04/22	4	35	55	WL	X					BR
24N/01E–32E02	473142122424101	BREMERTN DOMSEA 2	3027 Olympic Dr., Bremerton 98310	478–5318	Qg2	124	135	16.0	1974/10/16	8	95	135	QWWL	X	X	X			BR
24N/01E–33K07	473126122405501	BREMERTN AC 2R	3027 Olympic Dr., Bremerton 98310	478–5318	Qg4	35	273	31.6	1990/04/27	16	185	265	QWWL	X	X				BR
24N/01E–33L02	473134122410802	BREMERTN AC 8	3027 Olympic Dr., Bremerton 98310	478–5318	Qg5	61	578	–18.5	1980/08/05	16	540	578	QWWL	X	X				BR
24N/01E–33Q04	473121122405702	BREMERTN AC N–2	3027 Olympic Dr., Bremerton 98310	478–5318	Qg5	100	876	34.1	1990/04/27	16	833	858	WL	X					BR
24N/01E–33Q05	473121122405701	BREMERTN AC N–1	3027 Olympic Dr., Bremerton 98310	478–5318	Qg4	99	335	63.6	1990/04/27	16	282	330	WL	X					BR
24N/01W–36R01	473126122442101	BREMERTN PISTOL15	3027 Olympic Dr., Bremerton 98310	478–5318	Qg3	200	294	–5.0	1981/09/14	12	268	294	WL	X				same zone #17	BR
24N/01W–36R02	473122122440501	BREMERTN PISTOL17	3027 Olympic Dr., Bremerton 98310	478–5318	Qg3	200	293	–5.3	1982/08/11	16	258	293	QWWL	X	X	X			BR
25N/01E–22J01	473828122391301	BREMERTN BRIDLE 9	3027 Olympic Dr., Bremerton 98310	478–5318	Qg5	202	882	150.0	1977/10/04	8	850	881	QW		X			airline only	BR
25N/01E–23N02	473813122384302	BREMERTN PKWD 10	3027 Olympic Dr., Bremerton 98310	478–5318	Qg5	240	840	204.0	1975/04/16	8	810	840	WL	X					BR
25N/01E–26L03	473732122382401	BREMERTN/SLVRDLE MOBIL WELL 227	3027 Olympic Dr., Bremerton 98310	478–5318		160	380	120.5	1989/07/26										BR
25N/01E–34H01	473700122385601	BREMERTN MCWLM 14	3027 Olympic Dr., Bremerton 98310	478–5318	Qg3	130	273	28.3	1980/10/23	12	249	273	QWWL	X	X				BR
28N/02E–21R01	473354122327701	HANSVLL SPRING 1	5789 Twin Spits Rd. NE, Hansville 98340	683–2501	Qg1a	180	0	0.0	/ /	0	180	180	QW		X	X	X		H
28N/02E–29P01	473307122340101	HANSVLL WELL 1	5789 Twin Spits Rd. NE, Hansville 98340	683–2501	Qg3	93	128.6	74.0	1989/01/27	8	109	129	QWWL	X	X	X			H
22N/01E–05Q01	472507122421001	HARB WTR GLNWD F2	P.O. Box 336, Gig Harbor 98335	851–4060	Qg1a	295	95	32.0	1986/01/16	8	90	95	QW		X			airline only	KPUD
22N/01E–10A01	472455122391601	HARB WTR SIRC RD2	P.O. Box 336, Gig Harbor 98335	851–4060	Qg2	320	288	150.0	1988/08/00	6	278	288	QWWL	X	X	X	X		KPUD
22N/02E–07P01	472503122360001	HARB WTR FCFC VNT	P.O. Box 336, Gig Harbor 98335	851–4060	Qg1a	245	138	82.0	1985/06/01	6	71	94	QWWL	X	X	X			KPUD
22N/02E–08R01	472418122340801	HARB WTR ALPNWD N	P.O. Box 336, Gig Harbor 98335	851–4060	Qg2	240	198	132.0	1987/09/28	8	188	198	QWWL	X	X				KPUD
23N/01E–06M02	473045122435301	SNNYSLP WELL 2	4401 Sunnyslope Rd., Port Orchard 98366	674–2469	Qg4	440	619	190.0	1966/07/00	8	595	619	QW		X			airline only	KPUD
23N/01E–24H02	472809122363401	HARB WTR HUZN W 4	P.O. Box 336, Gig Harbor 98335	851–4060	Qg1a	410	187	122.0	1986/08/25	6	177	187	QWWL	X	X	X			KPUD
23N/01E–25K01	472713122364401	HARB WTR HUZN W 1	P.O. Box 336, Gig Harbor 98335	851–4060	Qg3	420	321	266.0	1974/05/01	8	313	321	QWWL	X	X				KPUD
23N/01E–31H02	472627122433002	HARB WTR WCKS LN2	P.O. Box 336, Gig Harbor 98335	851–4060	Qg1a	425	187.5	124.0	1979/08/08	8	172	188	QWWL	X	X	X			KPUD
23N/01E–35G01	472626122381601	HARB WTR PREVW T4	P.O. Box 336, Gig Harbor 98335	851–4060	Qg4	215	539.5	67.0	1974/04/04	5	527	540	QWWL	X	X				KPUD
23N/02E–11K01	472945122304401	HARB WTR STMWRTH	P.O. Box 336, Gig Harbor 98335	851–4060	Qg3	100	223	17.0	1980/08/13	6	223	223	QWWL	X	X				KPUD
24N/01E–25Q01	473214122365003	ANNAPLIS WELL 1–B	1621 Lincoln Ave., Port Orchard 98335	876–2545	Qg5	116	1244	25.0	1966/02/10	20	1150	1240	QWWL	X	X				KPUD
24N/01E–26K08	473223122382201	P ORCHRD WELL 7	216 Prospect, Port Orchard 98366	876–8250	Qg5	20	804	–1.6	1962/04/21	20	769	804	WL	X					KPUD
24N/01E–36G01	473143122365801	ANNAPLIS KRCH S16	1621 Lincoln Ave., Port Orchard 98335	876–2545	Qg3	230	301	86.5	1979/02/22	16	261	301	QWWL	X	X				KPUD
24N/01W–06R02	473548122504201	LORA LEE CAP DVD1	3850 Kitsap Way, Suite 105, Bremerton 98310	377–1777	Qg1a	600	115	50.0	1977/05/24	8	110	115	WL	X					KPUD
24N/01W–19A02	473348122503901	TAHUYA L WELL 2	313 Kingsway NW, Bremerton 98312	830–4561	Qg1a	625	93	56.0	1966/08/23	6	64	86	QWWL	X	X	X	X		KPUD
24N/02E–16K02	473410122331101	NAVY WELL 5	Manchester Fuel Dept., Manchester 98353	476–3724	Qg3	15	130	15.9	1990/05/30	16	120	130	QWWL	X					KPUD
24N/02E–16L02	473410122332601	WTAUGA B WELL 2	5641 Watauga Beach Dr. E., Port Orchard 98366	871–0794	Qg3	55	141	48.6	1954/01/07	8	80	137	QWWL	X	X	X	X		KPUD
24N/02W–14N01	473402122541301	HARB WTR SIVO	P.O. Box 336, Gig Harbor 98335	851–4060	Qg3	510	420	331.0	1982/07/08	6	415	420	QW		X				KPUD
24N/02W–19G01	473328122584701	HOLLY WELL 1	678 Alan King Rd. NW, Bremerton 98312	830–4391	Qg3	7	157	–0.1	1967/01/26	6	153	157	QWWL	X	X	X			KPUD
24N/02W–19K01	473321122584601	HOLLY WELL 2	678 Alan King Rd. NW, Bremerton 98312	830–4391	Qg1a	150	125.8	90.1	1988/10/10	6	126	136	QWWL	X	X	X	X		KPUD
24N/02W–23Q01	473312122532101	HARB WTR HNTZVLL1	P.O. Box 336, Gig Harbor 98335	851–4060	Qg3	520	353	302.0	1980/10/13	6	348	353	QW		X	X		airline only	KPUD
25N/01E–02J02	474125122374601	KPUD KYPORT 2	P.O. Box 1989, Poulsbo 98370	779–7656	Qn6	250	1070	190.8	1981/07/10	6	1020	1060	QWWL	X	X				KPUD
25N/01W–22A01	473850122465001	BIG BEEP PW–1	School of Fisheries, U of W, Seattle 98195	543–4270	Qg4	40	297	–5.8	1980/12/15	30	267	297	QWWL	X	X				KPUD
25N/01W–22A02	473850122469002	BIG BEEP TH–2	School of Fisheries, U of W, Seattle 98195	543–4270	Qg4	33.59	301	–13.4	1981/09/05	8	255	295	WL	X					KPUD
25N/01W–22A03	473850122465003	BIG BEEP TH–2	School of Fisheries, U of W, Seattle 98195	543–4270	Qg5	33.59	220	–11.0	1980/08/00	1.25	166	220	WL	X				2 piezos	KPUD
25N/01W–24J01	473825122440301	HARB WTR GRAYSTNE	P.O. Box 336, Gig Harbor 98335	851–4060	Qa3	395	278	252.0	1986/02/17	8	272	278	QWWL	X	X				KPUD
25N/01W–35Q01	473630122434501	HARB WTR TLEDS LN	P.O. Box 336, Gig Harbor 98335	851–4060	Qg1a	440	161	112.0	1986/10/30	6	156	161	QWWL	X	X	X			KPUD
25N/02E–20K03	473827122341801	KPUD FLETCHER PW	P.O. Box 1989, Poulsbo 98370	779–7656	Qg5	85	992	68.0	1978/04/24	24	937	983	QW		X				KPUD
25N/02E–20K04	473826122341601	KPUD FLCHR TW	P.O. Box 1989, Poulsbo 98370	779–7656	Qg5	97	1030	57.5	1978/04/24	4	930	1014	WL	X					KPUD
25N/02E–21Q03	473849122325801	KPUD ENDCTR	P.O. Box 1989, Poulsbo 98370	779–7656	Qg3	300	398.5	198.0	1974/04/25	8	383	399	WL	X					KPUD
25N/02E–34E01	473659122320601	ISLND UT MON WLL	500 Union, Suite 830, Seattle 98101	624–5810	Qg3	130	149.4	93.4	1987/11/23	12	126	136	WL	X					KPUD

Table 1 Summary of GWMA Monitoring Wells
Kitsap County Ground Water Management Program

Local Well Number	Site ID Number	Well Owner	Site/Mailing Address	Phone Number	Principal Aquifer	Site Elevation (ft-MSL)	Well Depth (ft)	Water Level Depth (ft)	Water Level Date	Well Diameter (inches)	Top of Screen (feet-bgs)	Bottom of Screen (feet-bgs)	General Monitoring	Monitoring Activity: Water Levels	Program A W.Q.	Program B W.Q.	Program C W.Q.	Remarks	Responsible Party
25N/02E-34F03	473658122320701	ISLND UT WELL 1	500 Union, Suite 830, Seattle 98101	624-5810	Qg5	130	958	106.5	1988/04/21	6	878	933	QWWL	X	X				KPUD
25N/02E-35J03	473649122301101	BILL PT WELL 3	8915 NE Day Rd., Bainbridge Is. 98110	842-2275	Qg3	160	167	131.3	1990/05/30	8	162	165	WL	X					KPUD
26N/01E-04B01	474648122403701	KPUD VNLND V2	P.O. Box 1989, Poulsbo 98370	779-7656	Qg4	320	687	288.7	1985/04/08	12	652	685	QWWL	X	X				KPUD
26N/01E-36M01	474205122373301	KPUD KYPORT 1	P.O. Box 1989, Poulsbo 98370	779-7656	Qg5	8	746	-29.9	1975/07/14	20	702	741	QWWL	X	X				KPUD
26N/02E-04F03	474625122331701	SQMISH WELL 3	P.O. Box 498, Suquamish 98329	598-3142	Qg3	20	269.6	-16.0	1988/09/20	12	175	261	QWWL	X	X	X		needs gage	KPUD
26N/02E-10N02	474508122322501	KPUD INDLA 6	P.O. Box 1989, Poulsbo 98370	779-7656	Qg3	180	338.9	153.1	1983/08/30	12	308	338	QWWL	X	X				KPUD
26N/02E-11P01	474505122305201	KPUD INDLA 5	P.O. Box 1989, Poulsbo 98370	779-7656	Qg3	240	340	152.8	1982/03/15	16	305	325	WL	X					KPUD
26N/02E-12H01	474533122283701	JEFF BCH WELL 2	P.O. Box 88, Kingston 98346	297-3002	Qg3	190	244	186.5	1967/08/16	6	234	244	QWWL	X	X				KPUD
26N/02E-33B02	474218122324901	BLOEDL R FARM WEL	7571 NE Dolphin Dr.,Bainbridge Is. 98110	842-7631	Qg1a	150	42	14.3	1986/08/15	10	42	42	QWWL	X	X	X	X	needs tap	KPUD
27N/01E-27J01	474806122390901	KPUD EDGWR 3B	P.O. Box 1989, Poulsbo 98370	779-7656	Qg1a	290	185	98.2	1987/10/16	16	162	180	QW		X	X	X	airline only	KPUD
27N/01E-27J02	474807122391101	KPUD EDGWTR 3	P.O. Box 1989, Poulsbo 98370	779-7656	Qg3	290	466	183.0	1979/03/05	6	402	457	QWWL	X	X				KPUD
27N/02E-07C02	475110122354201	POPE/TALBPORT GAMBLE	Pope & Talbot, Port Gamble	297-3341	Qg5	160	448	152.5	1990/04/23	12	438	448	QWWL	X				new well	KPUD
27N/02E-20L03	474849122342301	KPUD GMELWD 1	P.O. Box 1989, Poulsbo 98370	779-7656	Qg2	78	129	8.0	1967/07/17	8	110	129	QWWL	X	X	X			KPUD
27N/02E-25E04	474811122293801	KPUD KNGSTN 3	P.O. Box 1989, Poulsbo 98370	779-7656	Qa4	190	488	183.5	1980/03/18	12	476	488	QW		X			airline only	KPUD
27N/02E-29J01	474806122335501	KPUD RTR LN	P.O. Box 1989, Poulsbo 98370	779-7656	Qg3	160	329.5	98.4	1990/02/27	12	265	321	QWWL	X	X				KPUD
27N/02E-35K01	474715122301201	KPUD KNSTN T1	P.O. Box 1989, Poulsbo 98370	779-7656	Qg5	120	859	97.0	1988/09/23	10	725	845	WL	X				recorder	KPUD
27N/02E-35K02	474715122301202	KPUD KNGSTN 5	P.O. Box 1989, Poulsbo 98370	779-7656	Qg5	120	806	98.4	1990/04/20	16	744	805	QWWL	X	X				KPUD
23N/02E-10C04	473016122321901	MNCHSTR WELL 9	P.O. Box 98, Manchester 98353	870-0500	Qg2	350	310	150.6	1987/11/30	16	273	303	QWWL	X	X	X			M
24N/02E-21B05	473336122331601	MNCHSTR WELL 11	P.O. Box 98, Manchester 98353	871-0500		220	272.3	122.4	1989/05/25										M
24N/02E-22M02	473308122323801	MNCHSTR WELL 1	P.O. Box 98, Manchester 98353	871-0500	Qg3	80	100	11.0	1946/00/00	10	114	130	QWWL	X	X				M
24N/02E-29Q01	473204122342602	MNCHSTR WELL 4	P.O. Box 98, Manchester 98353	871-0500	Qg2	220	257	56.8	1973/04/06	18	191	250	QWWL	X	X	X			M
24N/02E-33G03	473143122330901	MNCHSTR WELL 7	P.O. Box 98, Manchester 98353	871-0500	Qg4	185	495.5	137.7	1983/10/13	8	476	494	QWWL	X	X				M
23N/01E-09C03	473017122410101	MCRMCK W WELL 3	5155 McCormick Way Dr. SW, Port Orchard 98366	895-0144	Qg2	420	188	133.2	1989/07/06	12	173	183	QWWL	X	X	X	X		MW
25N/02E-09K02	474021122325401	NBWC WELL 6	P.O. Box 4766,Bainbridge Is. 98110	842-3082	Qg3	117	102	22.1	1979/07/00	8	103	118	QWWL	X	X	X			NB
25N/02E-09Q03	474018122325101	NBWC WELL 1	P.O. Box 4766,Bainbridge Is. 98110	842-3082	Qg1a	150	63.5	30.0			58	63	WL	X					NB
25N/02E-11E03	474025122310901	NBWC WELL 8	P.O. Box 4766,Bainbridge Is. 98110	842-3082	Qg1a	340	203	140.0	1985/02/22	8	180	200	QWWL	X	X	X	X		NB
24N/02E-07M02	473501122361101	NPWD CNTR ST2	P.O. Box 2183, Bremerton 98310	373-9508	Qg3	123	311.8	60.2	1984/10/25	12	209	280	QWWL	X	X	X			NP
25N/01E-14Q03	473904122381601	NPWD BCKLN HL	P.O. Box 2183, Bremerton 98310	373-9508	Qg4	79	560	34.4	1980/06/11	16	500	550	QWWL	X	X				NP
25N/01E-25L01	473735122371001	NPWD MDWDLE 1	P.O. Box 2183, Bremerton 98310	373-9508	Qg4	340	750	260.0	1964/01/01	12	725	745	QWWL	X	X				NP
23N/02E-19M01	473823122362001	NPWD GLBRTN 1	P.O. Box 2183, Bremerton 98310	373-9508	Qa6	136	781	104.0	1969/05/01	24	719	770	QWWL	X	X				NP
25N/02E-19M02	473824122362101	NPWD GLBRTN 2	P.O. Box 2183, Bremerton 98310	373-9508	Qg4	136	490	97.0	1977/06/02	12	455	480	QWWL	X	X				NP
26N/01E-02L05	474612122382805	POULSBO BG VLLY	P.O. Box 2275, Poulsbo 98370	779-4078	Qg4	85	312	19.6	1990/06/07	8	302	312	QWWL	X	X				P
26N/01E-10N03	474512122395601	POULSBO NIKE	P.O. Box 2275, Poulsbo 98370	779-4078	Qg1a	260	107	-32.0	1959/07/00	12	103	107	QWWL	X	X	X		needs gage	P
26N/01E-13B01	474505122364401	POULSBO LINCOLN	P.O. Box 2275, Poulsbo 98370	779-4078	Qg2	320	313	115.0	1967/05/00	8	298	313	QW		X			airline only	P
26N/01E-13F02	473936122372101	POULSBO PUGH RD	P.O. Box 2275, Poulsbo 98370	779-4078	Qg1a	403	310	155.3	1988/11'08	10	280	310	QWWL	X	X	X	X		P
25N/01E-03B01	474113122400701	SLVRDLE SPRTRG4	9191 Bayshore Dr., Silverdale 98315	692-2604	Qg3	371	336	163.9	1985/05/22	16	290	331	QWWL	X	X				S
25N/01E-03M02	474111122401002	SLVRDLE SPRTRG1	9191 Bayshore Dr., Silverdale 98315	692-2604	Qg2	330	185	148.0	1973/10/00	8	170	185	WL	X					S
25N/01E-10N01	474002122401201	SLVRDLE BCHLN RG	9191 Bayshore Dr., Silverdale 98315	692-2604	Qa4	315	483	213.7	1976/01/20	10	469	480	QW		X			airline only	S
25N/01E-16J01	473917122374401	SLVRDLE CHENA 2	9191 Bayshore Dr., Silverdale 98315	692-2604	Qg3	210	279.9	110.3	1985/05/16	12	251	270	QWWL	X	X	X	X		S
25N/01E-19P01	474333122432501	SLVRDLE DICKEY RD.	9191 Bayshore Dr., Silverdale 98315	692-2604	Qg4	540	988	481.2	1990/02/19	8	835	970	QWWL	X				new well	S
25N/01E-29D01	473808122423201	SLVRDLE HESS	9191 Bayshore Dr., Silverdale 98315	692-2604	Qg4	170	706	110.0	1979/05/04	8	520	630	QWWL	X	X	X			S
25N/02E-21J02	473825122323102	WINSLOW SNDS RD1	625 Winslow Way E, Winslow 98110	842-1212	Qg5	163	335	114.0	1988/10/04	10	899	1015	QWWL	X	X			new well	W
25N/02E-22R02	473815122313001	BI HIGH HIGH SCH	8485 Madison Ave. E, Bainbridge Is., 98110	842-4117	Qg1a	250	264	127.7	1980/08/08	12	191	250	WL	X					W
25N/02E-27E10	473744122322501	WINSLOW BYHEADIA	625 Winslow Way E, Winslow 98110	842-1212	Qg3	20	136.9	-6.8	1990/05/02	12	122	132	QWWL	X				needs new gag	W
25N/02E-28H01	473748122321901	WINSLOW BAYHEAD5	625 Winslow Way E, Winslow 98110	842-1212	Qg3	60	138.4	-20.0	1983/05/26	8	125	135	QWWL	X	X	X		needs new gag	W

Responsible Parties Include:

KPUD - Kitsap PUD No. 1
M - Manchester
BR - Bremerton
S - Silverdale
NP - North Perry
NB - North Bainbridge Water
W - Winslow
P - Poulsbo
H - Hansville
B - Bangor